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TRANSMITTAL OF INTEGRATED ENVIRONMENTAL MONITORING PLAN (IEMP)

07/31/96

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INTEGRATED ENVIRONMENTAL MONITORING PLAN

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

AUGUST 1996

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

2505-WP-0022

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Department of Energy

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DOE-1187-96

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Region V - SRF-5J
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Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF INTEGRATED ENVIRONMENTAL MONITORING PLAN (IEMP)

Enclosed for your review and approval is the Integrated Environmental Monitoring Plan (IEMP). The plan is the result of a comprehensive evaluation of all DOE-FEMP environmental media sampling programs, and the tailoring of those programs to most effectively support remedial action activities. The IEMP presents a site wide environmental monitoring strategy which addresses all media including groundwater, surface water, sediment, air and biota. The plan has been prepared to address all applicable, relevant and appropriate state, federal and DOE monitoring requirements, and to fulfill an Operable Unit 5 (OU5) Remedial Design Work Plan (RDWP) obligation.

The DOE-FEMP looks forward to working with the U.S. Environmental Protection Agency (U.S. EPA) and Ohio Environmental Protection Agency (OEPA) in the successful implementation of this comprehensive plan.

If you have any questions regarding the IEMP, please contact Robert Janke at (513) 648-3124, or Kathi Nickel (513) 648-3166.

Sincerely,

Susan M. Peter

for Johnny W. Reising
Fernald Remedial Action
Project Manager

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AUGUST 1996

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

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LIST OF ACRONYMS

ALARA	as low as reasonably achievable
ALS	Analytical Laboratory Services
ARAR	applicable or relevant and appropriate requirement
ASL	analytical support level
AWWT	advanced wastewater treatment facility
BTVs	benchmark toxicity values
CAWQC	chronic ambient water quality criteria
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	constituent of concern
CPC	constituent of potential concern
CRARE	comprehensive response action risk evaluation
CT	central tendency
D&D	decontamination and dismantlement
DFO	Director's Findings and Orders
DMEPP	Design, Monitoring, and Evaluation Program Plan
DOE	U.S. Department of Energy
EDMP	Environmental Data Management Plan
EMP	Fernald Site Environmental Monitoring Plan
EPA	U.S. Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FRL	final remediation level
FRVP	Fernald Residues Vitrification Plant
FS	feasibility study
FY	fiscal year
GMA	Great Miami Aquifer
GMR	Great Miami River
gpm	gallons per minute
GPMPP	Groundwater Protection Management Program Plan
HI	hazard index
HQ	hazard quotient
IEMP	Integrated Environmental Monitoring Plan
ILCR	incremental lifetime cancer risk
IRDP	integrated remedial design package
LDR	land disposal restriction
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MTR	minimum technology requirements
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	National Emissions Standards Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission

LIST OF ACRONYMS
(Continued)

NRIMP	National Resource Impact Monitoring Plan
NTS	Nevada Test Site
O&M	operations and maintenance
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
OSDF	on-site disposal facility
OSHA	Occupational Safety and Health Act
OU	operable unit
PAH	polynuclear aromatic hydrocarbons
ppb	parts per billion
PPE	personal protection equipment
PRRS	Paddys Run Road Site
PSP	project-specific plan
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RD/RA	remedial design/remedial action
RfD	reference dose
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	resonable maximum exposure
ROD	record of decision
RWP	Radiation Worker Permit
SSOD	storm sewer outfall ditch
SWPPP	Storm Water Pollution Prevention Program
TBC	to be considered
TCLP	toxicity characteristic leaching procedure
TLD	thermoluminescent dosimeter
TSS	total suspended solids
TU	temporary unit
UMTRCA	Uranium Mill Tailing Radiation Control Act
V/FCN	Variance/Field Change Notice
VITPP	Vitrification Pilot Plant
WAC	Waste Acceptance Criteria

1.0 INTRODUCTION

1.1 BACKGROUND

The Department of Energy's (DOE's) Fernald Environmental Management Project (FEMP) is nearing completion of its sitewide Remedial Investigation/Feasibility Study (RI/FS) obligations, and final records of decision (Records of Decision) for all five of the FEMP's operable units are expected to be in place by November 1996. With the pending conclusion of the FEMP's RI/FS and remedy selection process, focus is now being directed to the safe and efficient implementation of site remediation activities and facility decontamination and dismantlement (D&D) operations. In recognition of this shift in emphasis toward remedy implementation, the FEMP's existing site Environmental Monitoring Plan (EMP) is being revised and tailored accordingly to accommodate the sitewide remediation monitoring needs brought into play by the FEMP's final remedy decision documents.

This plan presents the revisions to the FEMP's existing sitewide monitoring program that are tailored to the remediation activities planned for the FEMP. The revised plan has been designated as the Integrated Environmental Monitoring Plan (IEMP) and is the successor to the existing Fernald site EMP. The EMP historically has provided comprehensive on-property and off-property environmental surveillance capabilities that specifically addressed the monitoring and reporting needs associated with active uranium production at the facility. The IEMP will provide a remediation-specific focus by redirecting existing environmental monitoring program elements toward sitewide remediation activities and by incorporating any new regulatory requirements for sitewide monitoring, reporting, and remedy performance tracking that have been activated by the formal Applicable or Relevant and Appropriate Requirements (ARARs) that are part of the FEMP's remedy selection documents. Ultimately, the IEMP also will serve as the reporting link for the project-specific emission control monitoring activities that will accompany the individual remediation and D&D projects as needed over the life of the FEMP remediation program.

A key element in directing the focus of the IEMP is the depth of understanding of site environmental conditions that have been gained from nearly 10 years of detailed site characterization efforts at the

site. These detailed environmental evaluations recently culminated in a final remedy decision for the FEMP's environmental media, with the issuance of the final Operable Unit 5 Record of Decision in February 1996. Operable Unit 5 represents all of the FEMP's environmental media, contaminant transport pathways, and environmental receptors (soil, groundwater, surface water, sediment, air, and biota) that have been affected by past uranium production operations at the site. The selected remedy for Operable Unit 5 designates the FEMP's final sitewide cleanup levels and establishes the geographic extent of on-property and off-property actions necessary to provide permanent solutions to environmental concerns posed by the site. As a result of the cleanup decisions reached for Operable Unit 5 and the site characterization activities conducted over the past 10 years, the FEMP now has a much more clearly defined picture of the scope and intensity of the sitewide environmental monitoring activities that are necessary to accommodate remediation activities planned for the site.

The IEMP is a formal remedial design deliverable required to fulfill Task 9 of the Operable Unit 5 Remedial Design Work Plan (DOE 1996b). Following approval, the IEMP will replace the June 1995 (current) version of the EMP as the FEMP's sitewide monitoring plan.

1.2 PROGRAM OBJECTIVES AND SCOPE

As the various remediation projects move beyond the engineering design phase and are implemented or operated concurrently, the need for accurate, accessible, and manageable environmental monitoring information will increase substantially. The IEMP has been formulated to meet this need and will serve several comprehensive functions for the site:

- Maintain the FEMP's continued commitment to an effective remediation-focused environmental surveillance monitoring program that is consistent with DOE Orders 5400.1, and 5400.5 (while not formal ARARs, both orders are listed as "to be considered" [TBC] criteria in each of the FEMP's signed Records of Decision).
- Fulfill any additional sitewide monitoring and reporting requirements that are activated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) ARARs for the FEMP's signed Records of Decision.
- Provide the mechanism for assessing the performance of the Great Miami Aquifer groundwater remedy, including the determination of when restoration activities are complete.

- Provide a consolidated reporting mechanism for the FEMP's individual environmental regulatory compliance monitoring activities (e.g., Resource Conservation and Recovery Act [RCRA] property-boundary and on-site disposal facility groundwater monitoring; Federal Facilities Consent Agreement [FFCA] and National Pollutant Discharge Elimination System [NPDES] discharge reporting; and the total dose and air-pathway-specific dose estimates required under National Emissions Standards for Hazardous Air Pollutants [NESHAP] Subparts H and Q) with the environmental reporting for DOE Order 5400.1.

- Provide a reporting interface for the project-specific emissions control and monitoring activities that are implemented for the FEMP's major remediation projects.

In concept, the IEMP is responsible for maintaining a baseline of environmental conditions at the FEMP and for documenting that contaminant releases attributable to the implementation of the FEMP's sitewide remedial actions remain within established thresholds. (As projected by the short-term risk assessments accompanying each of the FEMP's remedy decision documents, the contaminant releases attributable to remediation are expected to be inconsequential.) To fulfill its documentation responsibility, the IEMP brings together the ingredients necessary to provide an independent appraisal of the collective effectiveness of the administrative and engineering emission controls accompanying the individual remediation projects.

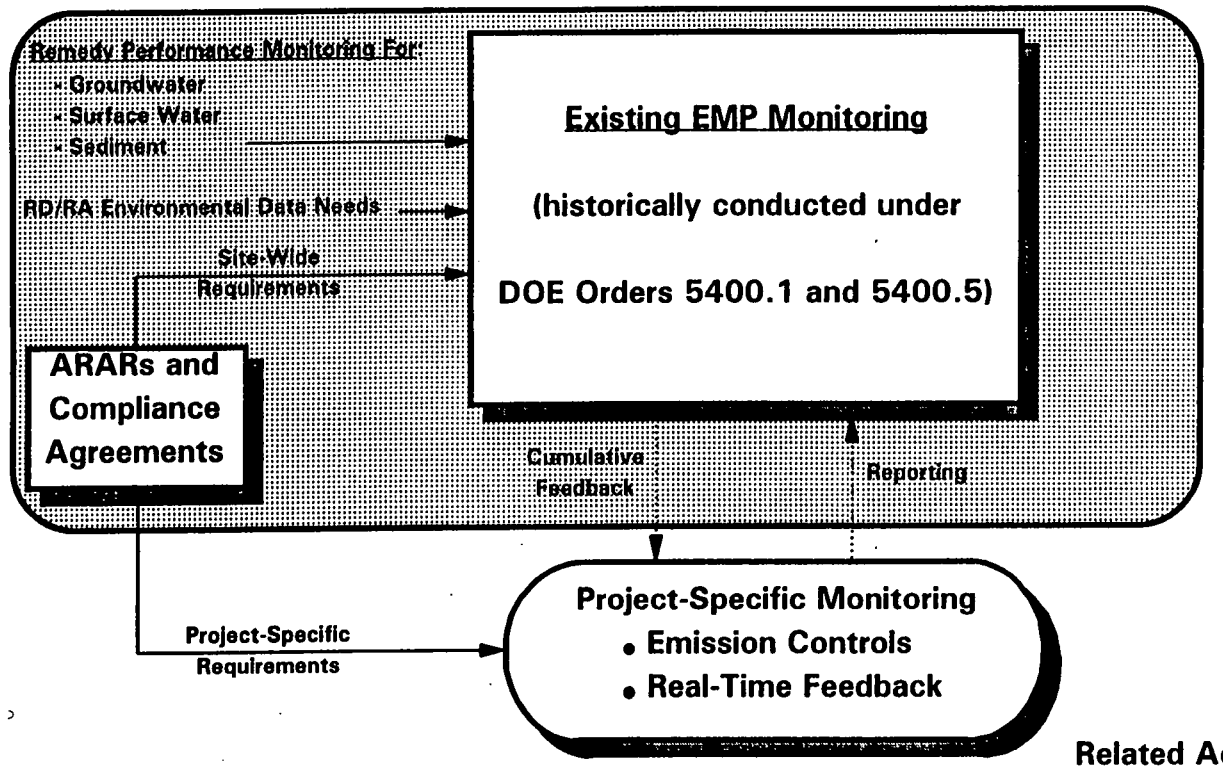
Figure 1-1 summarizes the overall scope of the IEMP and the major program elements assembled under its umbrella. As stated previously and as shown in the figure, the FEMP's current EMP program (that has historically provided sitewide monitoring under DOE Orders 5400.1 and 5400.5) was used as the primary conceptual model for development of the IEMP. The figure also shows a planned interface with project-specific monitoring that will occur throughout the life of FEMP remediation.

It is important to recognize that several remediation-based environmental activities fall outside the scope of the IEMP. These activities are:

- Project-specific emission-control monitoring for both point and area sources as identified in subsequent sections.

- The soil remediation precertification and certification sampling program which will be conducted as part of the work scope of the Soil Characterization and Excavation Project

Figure 1-1
Development of IEMP Scope



Shading Denotes IEMP Scope

Related Activities Conducted Outside IEMP:

- Soil Certification Sampling
- Occupational Health Sampling
- Natural Resource Impact Monitoring Plan
- Emergency Spill Release Reporting

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- Ecological impacts: A Natural Resource Impact Monitoring Plan (NRIMP) will also be prepared independent of the IEMP. This plan will provide the strategy for the monitoring of ecological impacts to wetlands, threatened and endangered species, and terrestrial and aquatic habitats. The NRIMP will identify the drivers and strategies for monitoring each resource. The results of the monitoring effort will be integrated with the quarterly and annual IEMP reporting. The NRIMP will also outline additional provisions for reporting these monitoring results to FEMP Natural Resource Trustees. Additionally, the NRIMP will identify the relationship of this monitoring effort with other relevant documents, such as the Natural Resource Impact Assessment and the Sloan's Crayfish Management Plan. The NRIMP will be submitted to the U.S. EPA and OEPA in fall 1996

- The ambient air sampling and direct radiation measurements conducted for worker health and safety purposes as part of the FEMP's occupational monitoring program

- The FEMP's spill and chemical release reporting required under SARA Title III.

Each of these efforts will continue to be conducted outside the IEMP under stand-alone work planning, execution, and reporting processes.

1.3 RELATIONSHIP TO PROJECT-SPECIFIC REMEDIAL PROGRAMS

As shown in Figure 1-1, the IEMP will provide a summary reporting link (to assist with sitewide interpretations) and a cumulative feedback function for the project-specific monitoring that is to be conducted by the individual remediation projects. Each remediation project will continue to be responsible for the design and execution of its own monitoring activities (under their own remedial action work plans outside of the IEMP) to demonstrate compliance with its respective project-specific emission-control ARARs and to obtain the necessary immediate feedback required to track the effectiveness of these controls.

To define the boundaries of the IEMP and the interface with the individual remediation projects, an evaluation of the ARARs that are contained in each of the FEMP's Records of Decision was conducted to identify the subset of ARARs that possess specific monitoring requirements. As part of the ARARs analysis, an evaluation was made to determine whether the monitoring requirements had sitewide implications (and therefore fall under the purview of the IEMP) or whether they pertained to project-specific monitoring as part of the project emission controls to be implemented by the

individual remediation projects. The results of these evaluations are presented in detail for each of the individual environmental media in Sections 3.0 through 7.0. Although the OU3 Record of Decision is not yet final, ARARs within the draft OU3 Record of Decision were considered. Any ARAR changes in the final OU3 Record of Decision from the draft OU3 Record of Decision will be evaluated for impacts to the IEMP, and the monitoring program will be revised immediately, if necessary.

1.4 PLAN ORGANIZATION

The IEMP is comprised of seven sections and four appendices. The remaining sections and their contents are as follows:

Section 2.0 Summary of the FEMP Remedial Strategy: provides a description of the individual remediation projects for each of the FEMP's five operable units, a status summary of the project-specific monitoring that is planned for each project, and a 2-year (fiscal years 1997 and 1998) forecast of the remediation activities planned for each major project.

Section 3.0 Groundwater Monitoring Program: provides a description of the monitoring activities necessary to track the progress of the restoration of the Great Miami Aquifer and ultimately to determine when restoration activities are complete. Also discusses the groundwater monitoring activities necessary to maintain compliance with RCRA requirements at the FEMP property boundary; and the groundwater monitoring program for the on-site disposal facility.

Section 4.0 Surface Water Monitoring Program: provides a description of the routine sitewide surface water monitoring to be performed during active remediation of the FEMP and to maintain compliance with treated-effluent surface water discharge requirements.

Section 5.0 Sediment Monitoring Program: provides a description of the routine sitewide sediment monitoring activities to independently verify the overall effectiveness of the sediment controls accompanying the FEMP's remedial construction and excavation activities.

Section 6.0	Air Monitoring Program: provides a description of the sitewide air monitoring to be conducted during active remediation of the FEMP. Includes a description of the plan for particulate, radon, and direct radiation measurements for specific locations and the continuation of the FEMP's Meteorological Monitoring Program.
Section 7.0	Biota Monitoring Program: identifies the scope of monitoring activities that will be maintained during remediation to verify the continued protection of local produce grown in proximity to the FEMP.
Section 8.0	Program Summary and Reporting: summarizes the program design, scope of each media monitoring program, and provides a phased plan to consolidate the FEMP's individual compliance reporting activities into a single reporting strategy.
Appendix A	Detailed Explanation of Parameter Selection for the Groundwater Monitoring Program.
Appendix B	Groundwater Monitoring Strategy of the FEMP's on-site disposal facility.
Appendix C	Surface Water FRL and BTV Exceedances
Appendix D	Dose Assessment: summarizes the IEMP's responsibility for preparing the FEMP's annual dose assessment related to remediation activities to comply with NESHAPs Subparts H and Q requirements and the intention of DOE Order 5400.5.

As this format indicates, the IEMP is organized according to the principal environmental media and contaminant migration pathways to be routinely examined under the program. For each of the media comprising the program, evaluations of the regulatory drivers and pertinent DOE policies that govern environmental monitoring for that media were conducted. Findings were made regarding those drivers that have sitewide implications and those that are project-specific in scope (and, therefore, fall outside the domain of the IEMP). This evaluation was used to define, for each media, the individual administrative or geographic boundaries that separate the project-specific emission control monitoring activities from those sitewide environmental monitoring activities that are the responsibility of the IEMP. The results of these responsibility- and boundary-definition evaluations are presented in detail for each respective media in Sections 3.0 through 7.0.

Following the review of the regulatory drivers, the scope of the monitoring activities conducted under the existing environmental monitoring program were evaluated against the remediation work scope contemplated under the FEMP's sitewide accelerated remediation schedule. Any reductions or alterations in existing scope that were deemed appropriate were made based on the knowledge of environmental conditions gained through the RI/FS process, the many years of sitewide monitoring conducted under the EMP during and after full-scale uranium production operations, and the expectations of stakeholders for continued surveillance monitoring. The existing scope of the environmental monitoring program was also evaluated to determine whether any existing effluent monitoring elements are project specific in intent and are, therefore, best accommodated by the individual remediation projects. The results of these evaluations, coupled with the evaluation of the regulatory drivers and pertinent DOE policies, were used to define the initial scope of the IEMP for each of the individual media. Finally, a detailed project-specific plan (PSP) was prepared for each media to define detailed execution and reporting requirements. The details and results of this process are presented in the media-specific sections of the plan (Sections 3.0 through 7.0).

1.5 PROGRAM MODIFICATIONS AND REVISIONS

Following approval, the IEMP will remain in place throughout the duration of the FEMP's remediation activities, under the accelerated remediation schedule. Accordingly, the IEMP will function as a living document with periodic revisions as necessary to accommodate the initiation of new projects and the completion of others. As part of this living document concept, the initial IEMP focuses primarily on the remedial activities forecasted for the forthcoming two years (beginning with fiscal year 1997 activities) and will undergo yearly reviews for appropriateness of scope and formal revisions every two years. This two-year revision cycle will provide for any change in program emphasis or allow for the scale back of monitoring activities deemed no longer appropriate based on project needs, accumulated results, or stakeholder concerns. If necessary, immediate, specific modifications to the IEMP will be made as data are reviewed.

The two-year revision cycle for the IEMP will also fulfill the formal commitment for revision of the FEMP's sitewide environmental monitoring program at least every three years as intended by DOE Order 5400.1. As discussed in Section 8.0, an annual report will be prepared each year to summarize

the previous year's monitoring activity and to provide recommendations for immediate program modifications or adjustments that will supplement the formal two-year revision cycle.

2.0 SUMMARY OF FEMP REMEDIAL STRATEGY

This section presents a summary of the FEMP remedial strategy, including descriptions of the FEMP's five operable units, the newly organized remediation projects, and similar large-scale remediation activities; and a two-year (fiscal years 1997 and 1998) forecast of the remediation activities planned for each major project.

The discussion will span the entire accelerated remediation case but will focus on the first two-year timeframe. The information provided in this section will assist in developing a collective understanding of the remediation activities, schedule, and project responsibilities that were used as the framework for developing the integrated environmental monitoring approach.

2.1 FEMP REMEDIATION STRATEGY

The FEMP remedial strategy reflects the culmination of nearly 10 years of CERCLA activities at the site, including extensive site characterization activities to determine the nature and extent of contamination, baseline risk assessments, and detailed evaluation and screening of remedial alternatives leading to a final remedy selection as documented in the record of decision for each operable unit. As a management approach to streamlining the remedial investigation/feasibility study decision-making process under CERCLA and expediting implementation of cleanup activities, the site was divided into five operable units. The definitions of the operable units were established considering factors such as geographic location, similarity in waste forms, and the availability of data on discrete waste units or areas.

As the remedy selection process is nearly complete, the FEMP has developed an integrated remediation strategy focusing on accelerated remedial design and action. At the heart of this strategy is integrated project planning which consolidates cleanup activities and schedules across the projects to accelerate remediation (referred to as the accelerated remediation case). Successful implementation of the accelerated remediation case is dependent upon the close coordination and sequencing of remediation activities, such as on-site disposal facility preparation, facilities D&D, and final soil and groundwater remediation, among all project organizations throughout the remedial design/remedial action process. The FEMP accelerated remediation strategy is reflected in the site

master schedule, which is summarized in Figure 2-1.

While the operable unit management approach was successful for completing the remedial investigation/feasibility study process, it does not represent the most effective organization of site responsibility to complete remedial design/remedial action. In order to align sitewide responsibilities and regulatory obligations across the five operable units to most efficiently complete remedial design/remedial action, the site has established fully integrated project organizations. Each operable unit remedy identified requirements for addressing contaminants in specific operable unit media, so it is logical that the FEMP should organize projects around these commonalities during remediation. Project organizations are focusing on planning and implementing remedial activities for discrete segments of the total remediation project scope, based on the similarity and sequencing of remediation activities. Realignment into project organizations reflects the actual work processes and operations to be performed during remediation, and does not alter the requirements of the FEMP's Record of Decisions. Table 2-1 provides the crosswalk between each operable unit remedy and the FEMP project organizations' responsibilities for implementing each remedy. The project organizations with primary responsibilities for CERCLA remediation are as follows:

- Waste Pits Remedial Action Project: Completion of remedial actions for the excavation, drying (as required), loading, and rail transport of contents of waste pits 1-6, the burn pit, and the clearwell to an off-site disposal facility, and responsibility for the off-site disposal of contaminated soil and debris that exceed the waste acceptance criteria for the on-site disposal facility.

- Soil Characterization and Excavation Project: Completion of remedial actions to address contaminated soil at the FEMP and miscellaneous waste units including the south field, flyash piles, lime sludge ponds, and the solid waste landfill; also excavation/removal of building foundations, roadways, underground utilities and piping systems, and sitewide restoration activities and management of perched water encountered during remediation.

- Facilities D&D Project: This work scope includes the completion of the D&D of the above-grade portion of the former uranium processing facilities and all remedial action facilities.

- Fernald Residues Vitrification Plant (FRVP): Completion of remedial actions for the contents of Silos 1-3, including the removal, vitrification, and transport of the inventoried residues for off-site disposal; includes the Vitrification Pilot Plant (VITPP) and the full-scale FRVP.

Figure 2-1

FEMP Accelerated Remediation Case Master Schedule

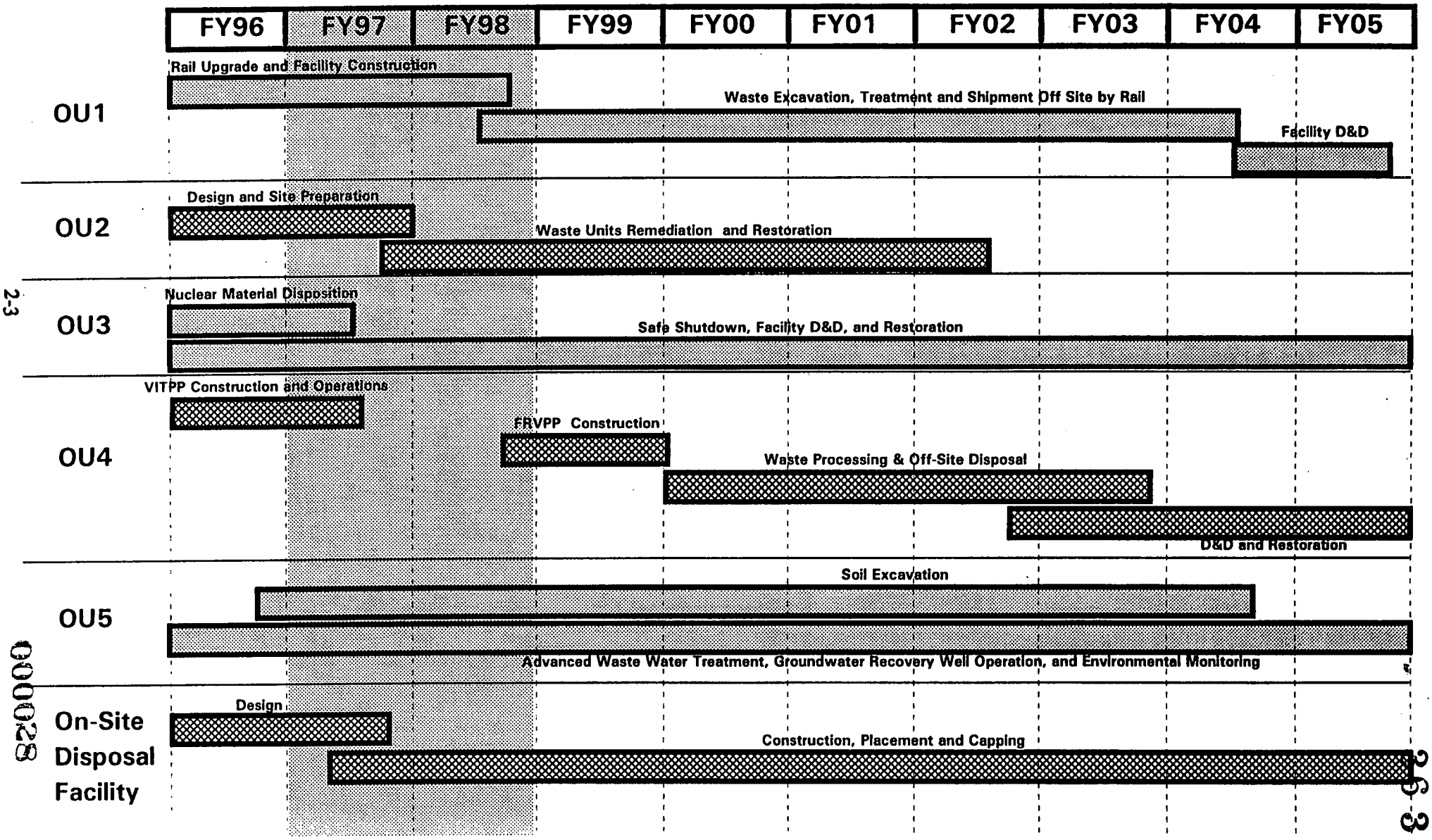

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TABLE 2-1

FEMP OPERABLE UNIT REMEDIES AND ASSOCIATED PROJECT RESPONSIBILITIES[b]

Operable Unit	Description	Remedy Overview[a]	Project Organization/Responsibilities
OU1	• Waste pits 1 - 6 • Clearwell • Burn pit • Berms, liners, caps and a limited amount of soil within the OU boundary	ROD Approved: March 1995 Excavation of materials with COCs above FRLs, waste processing and treatment by thermal drying (as necessary), off-site disposal at a permitted facility, and site restoration.	Primary Project: Waste Pits Remedial Action Project responsible for rail upgrade, excavation of OU1 waste units, waste processing and drying, loading, rail transport, and off-site disposal of contaminated soil and debris that exceed the waste acceptance criteria for the on-site disposal facility. (Note: This project will be performed by the Alternative Remedial Action Subcontracting Apprach subcontractor.) Related Projects: Soil Characterization and Excavation Project responsible for verification sampling, excavation, and disposition of contaminated soil beneath the waste pits. AWWT and Wastewater Project responsible for treating contaminated runoff and perched water collected during waste pit excavation; each project is responsible for containing and transporting remediation wastewater to the AWWT facility for treatment. Facilities D&D Project responsible for D&D of all OU1 remediation facilities.
OU2	• Solid waste landfill • Inactive flyash pile • Active flyash pile (now inactive) • North and south lime sludge ponds • Other south field disposal areas • Berms, liners and soil within the OU boundary	ROD Approved: May 1995 Excavation of all materials with COCs above FRLs, treatment for size reduction and moisture control as required, on site disposal in the OSDF, off-site disposal of a small fraction of excavated material that exceeds the WAC for the OSDF, and site restoration.	Primary Project: Soil Characterization and Excavation Project responsible for excavation and disposition of waste from all OU2 subunits. Related Projects: On-Site Disposal Facility Design Project responsible for design, installation, and closure of the on-site disposal facility that will contain OU2 subunit wastes; OU5 soils, and OU3 debris; responsible for monitoring leachate within the on-site disposal facility and perched groundwater in the till beneath the on-site disposal facility. AWWT and Wastewater Project responsible for treating contaminated runoff and perched water collected during excavation of OU2 subunit wastes; each project is responsible for containing and transporting remediation wastewater to the AWWT facility for treatment.

TABLE 2-1
(Continued)

Operable Unit	Description	Remedy Overview[a]	Project Organization/Responsibilities
OU3	Production area and associated facilities and equipment (includes all above- and below-grade improvements) including, but not limited to: • All structures, equipment, utilities, effluent lines, K-65 transfer line • Wastewater treatment facilities • Fire training facilities • Coal pile • Scrap metals piles • Drums, tanks, solid waste, waste, product, feedstocks, thorium	Interim ROD Approved: June 1994 Projected Final ROD: Fall 1996 Removal of gross surface contamination from material in facilities, dismantlement of facilities, a combination of interim storage for the majority of resulting remediation material/wastes and limited off-site disposal for non-recoverable or non-recyclable remediation wastes until a decision concerning waste disposition is made in the final ROD for OU3, and site restoration.	Primary Project: Facilities D&D Project responsible for D&D of all above-grade buildings and facilities at the FEMP. Related Projects: Soil Characterization and Excavation Project responsible for verification sampling of soil below demolished buildings and for removal of below-grade structures. AWWT and Wastewater Project responsible for treating decontamination and other wastewaters during D&D activities; each project is responsible for containing and transporting remediation wastewater to the AWWT facility for treatment. On-Site Disposal Facility Design Project responsible for design, installation, and closure of the on-site disposal facility that will contain OU3 debris; OU2 subunit wastes; and OU5 soils.
OU4	• Silos 1 and 2 (containing K-65 residues) • Silo 3 (containing cold metal oxides) • Silo 4 (empty and never used) • Decant tank system • Berms and soil within the OU boundary	ROD Approved: December 1994 Removal of silo residues and decant sump tank sludges with on site vitrification of residues and sludges followed by off-site disposal; demolition and decontamination, to the extent possible, of silos and vitrification facilities; excavation of contaminated soil above the FRLs with on site disposal for contaminated soils and debris that meet the OSDF WAC; and site restoration. Contaminated soil and debris that exceed the OSDF WAC will be disposed of off-site.	Primary Project: FRVPP responsible for silo content removal, treatment, and transport off-site. Related Projects: Soil Characterization and Excavation Project responsible for verification sampling, excavation and disposition of contaminated soil beneath the silos and for removal of subsurface structures (i.e., sub-grade silo decant system). AWWT and Wastewater Project responsible for treating decontamination and other wastewaters during D&D activities; each project is responsible for capturing and transporting remediation wastewater to the AWWT facility for treatment. Facilities D&D Project responsible for D&D of all OU4 remediation facilities.

TABLE 2-1
(Continued)

Operable Unit	Description	Remedy Overview[a]	Project Organization/Responsibilities
OU5	• Groundwater • Surface water and sediments • Soil not included in the definitions of OUs 1 - 4 • Flora and fauna	ROD Approved: January 1996 Extraction of contaminated groundwater from the Great Miami Aquifer to meet FRLs at all affected areas of the aquifer. Treatment of contaminated groundwater, storm water, and wastewater to attain mass-based discharge limits and FRLs in the Great Miami River. Excavation of contaminated soil and sediment to meet FRLs. Excavation of contaminated soil containing perched water that presents an unacceptable threat, through contaminant migration, to the underlying aquifer. On site disposal of contaminated soils and sediment that meet the on-site disposal facility WAC. Soil and sediment that exceed the WAC for the OSDF will be treated, where possible, to meet the OSDF WAC or will be disposed of at an off-site facility.	Primary Projects: Aquifer Restoration Project responsible for designing, installing, and operating the pumping systems for the Great Miami Aquifer groundwater restoration; responsible for groundwater monitoring in the Great Miami Aquifer, including the groundwater monitoring program for the on-site disposal facility. AWWT and Wastewater Project responsible for designing, constructing, and operating all treated effluent discharge systems, and for treating and discharging contaminated groundwater, storm water, runoff water, and remedial action wastewaters at the FEMP. Soil Characterization and Excavation Project responsible for verification sampling of sitewide soil; excavation and disposition of contaminated soil, sediment, perched groundwater and below-grade structures; and final site restoration. Related Project: Facilities D&D Project responsible for D&D of all OU5 remediation facilities. On-Site Disposal Facility Design Project responsible for design, installation, and closure of the on-site disposal facility that will contain OU3 debris; OU2 subunit wastes; and OU5 soils.

[a] Each remedy includes institutional controls.
[b] Source of information is from each operable unit's ROD and remedial design work plan.

- Aquifer Restoration Project: Completion of activities necessary to restore the water quality in the affected portions of the Great Miami Aquifer including the pumping, treating, reinjecting, and discharging of extracted groundwater. This project will continue to maintain responsibility for all sitewide fate-and-transport modeling, and groundwater monitoring.

- Advanced Waste Water Treatment (AWWT) and Wastewater Project: Design, construction, and operation of all wastewater, storm water, and drinking water holding, conveyance, treatment, and discharge systems at the FEMP. (Note that each project is responsible for containing and transporting remediation wastewater to the AWWT facility for treatment.)

- On-Site Disposal Facility Design Project: Design, installation, and closure of the on-site disposal facility; and monitoring leachate within the on-site disposal facility and perched groundwater in the till beneath the on-site disposal facility.

The realignment of the implementing organizations into an integrated project structure concentrated on remedy design and implementation is a critical step in positioning the site to accelerate final cleanup as reflected in the FEMP remediation strategy. While this realignment will facilitate efficient implementation of the FEMP remedial strategy, it will not affect cleanup levels that the DOE is required to meet. All final remediation levels (FRLs) identified in each operable unit Record of Decision will be addressed for all media.

2.2 REMEDIATION ACTIVITIES

As indicated in Table 2-1, there are several similar large-scale activities that will occur during each remediation project. These activities include site preparation, excavation, construction, remedial facility operation, wastewater management and treatment, transportation of waste materials, D&D, and site restoration. Each activity is explained in detail below:

- Site Preparation: Prior to full-scale remedial activities, there will be extensive site preparation activities, such as construction of haul roads to facilitate movement of waste, construction, and demolition materials; excavation of borrow areas; construction of parking lots and access roads; development of laydown areas and soil stockpile areas; as well as project-specific preparations for construction of remedial facilities.

- Waste and Soil Excavation: Excavation will be performed to remove all constituents of concern (COCs) above FRLs. The movement of waste and soil will create dust throughout remediation. The following locations will be excavated: in Operable Unit 1, each of the waste pits, the clearwell, and the burn pit; in Operable Unit 2, the solid waste landfill, inactive and active flyash piles, lime sludge ponds, the south field, and all Operable Unit 2 associated berms, and liners; and in Operable Unit 5, all affected contaminated soil on the FEMP property.

- Construction of Remedial Facilities: Construction will involve large-scale movement of materials, generation of dust, and development of project-specific controls such as collection of surface water runoff. Remedial facilities will be constructed to support three remedies: a waste processing and treatment facility to dry and segregate waste pit waste will be constructed in the waste storage area; two vitrification plants, one a pilot plant and one a full-scale plant, will be built near the K-65 silos; and the AWWT facility will be expanded to handle increased capacities of water generated during site remediation.

- Operation of Remedial Facilities: The remediation facilities that will be constructed will operate during most of the remediation project life. They will require controls and monitoring for point-source air emissions and surface water. The facility that will handle waste pit materials will include the capability to sort, crush, size, and shred the waste, as well as treatment by thermal drying. The VITPP will treat silo 1 and 2 contents and decant sludges by glassifying the silo residues and sludges in a super-heating process.

- Wastewater Management: Wastewater generated during remediation must be collected, monitored, discharged, and if necessary, transported to the AWWT. Wastewaters include pumped groundwater, decontamination water, storm water, and other wastewaters.

- Transportation of Treated and Untreated Waste to On- and Off-Property Disposal Facilities: All materials and soils with COCs above FRLs on the FEMP property will be transported following excavation, treatment, or both, to on- or off-property disposal facilities. This activity will generate dust throughout the life of the remediation.

- Decontamination and Dismantlement (D&D): Along with all facilities in the former production area, all facilities constructed to implement remedies will undergo D&D. D&D, which is already in process within the former production area, will continue throughout the life of the remediation.

- Site Restoration: Once all facilities have undergone D&D, the 1,050-acre FEMP site will be restored. This activity will involve movement and grading of soil, planting and seeding, erection of fences, and related activities.

2.3 TWO-YEAR PROJECTION

The extensive environmental characterization performed during the past 10 years, in conjunction with the scope of the current sitewide environmental monitoring program, has been used as the technical foundation for aligning the integrated environmental monitoring approach with the site accelerated remediation strategy. The two-year IEMP focus and revision schedule limits the uncertainties associated with long-range project planning and provides flexibility to customize monitoring programs to align with the current mix of remediation activities and actively incorporate stakeholder input. Table 2-2 identifies remediation activities for this two-year period (design activities, such as submittal of required design documents, are not included). As Table 2-2 indicates, in fiscal year 1997

TABLE 2-2

FEMP INTEGRATED REMEDIATION ACTIVITIES[a] FY97-FY98

Remediation Project	FY97	FY98
Waste Pits Remedial Action Project	Continue existing rail upgrade and remediation facility construction	Complete construction of remediation facility Begin pit excavation, treatment, shipment, and off-site disposal by rail
On-Site Disposal Facility Project	Start construction of on-site disposal facility - Phase 1 Completion of site preparation	Waste placement and capping begins Begin Phase 2 roads
Soils Characterization and Excavation Project		Remediate Area 1, Phase II, and Area 2, Phase I
Facilities D&D Project	Continue utility relocations Safe Shutdown Complete Plant 5 complex Continue Plant 2/3 complex Begin Plant 6 complex and Plant 8 complex D&D Complete Plant 1 complex, Phase I Begin tank farm complex, boiler and water plant complex, and thorium/Plant 9 complex	Continue utility relocations Safe Shutdown Complete Plant 2/3 complex Continue Plant 6 complex and Plant 8 complex D&D Complete tank farm complex Continue boiler and water plant complex, and thorium/Plant 9 complex Begin/complete sewage treatment plant complex Begin Plant 3 complex, maintenance complex, and Plant 5 complex
Fernald Residues VIT Plant (FRVP)	Completion of VITPP operations	Build silo superstructures Silo 4 demonstration construction Initiate construction of FRVP

TABLE 2-2
(Continued)

Remediation Project	FY97	FY98
Aquifer Restoration Project	Sitewide environmental monitoring	Sitewide environmental monitoring
	AWWT operations continue; AWWT expansion - construction and start-up	AWWT expansion - operations continue
	Sludge removal system construction	Sludge removal system operations
	Continue South Plume recovery well operations	Continue South Plume recovery well operations
	South Field extraction system construction	South Field extraction system start-up
	Begin pit-area design, construction, and operations for Waste Storage Area Extraction Module	Continue pit-area design, construction, and operations for Waste Storage Area Extraction Module
	Begin Plant 6 Recovery Wells design, construction, and operations	Plant 6 Recovery Wells design, construction, and operations

[a]All remediation activities are from each operable unit's ROD and remedial design work plan. Schedule information is from the site master schedule.

concurrent activities include site preparation, excavation, construction, safe shutdown and D&D, treatment facility operation, and recovery well operations. In fiscal year 1998, concurrent activities include continued site preparation, construction and operation of remediation facilities, continued excavation, continued safe shutdown and D&D, and continued recovery well operations. This two-year focus on remediation activities provides the basis to estimate monitoring needs, both on a project-specific and sitewide basis. A detailed description of remedial activities scheduled for fiscal years 1997 and 1998 is provided in Table 2-2. The scope of the activities detailed above was a fundamental consideration in developing the IEMP monitoring approach and media specific sampling programs.

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3.0 GROUNDWATER MONITORING PROGRAM

Section 3.0 presents the monitoring strategy for tracking the progress of the restoration of the Great Miami Aquifer; the IEMP's integration strategy for satisfying the FEMP's site-specific agreements related to groundwater monitoring; and the monitoring activities necessary to satisfy regulatory requirements for monitoring the performance of the FEMP's on-site disposal facility. A project-specific plan (PSP) for conducting all groundwater monitoring activities is provided, along with a phased plan to integrate the FEMP's several groundwater-related regulatory compliance reports into a single IEMP-sponsored report. Program expectations for 1997-1998 are outlined in Section 3.4 and the program design for 1997-1998 is presented in Section 3.5.

3.1 INTEGRATION OBJECTIVES FOR GROUNDWATER

As discussed in Section 1.2, the IEMP has been designated as the primary vehicle for tracking the performance of the full-scale Great Miami Aquifer groundwater restoration remedy to be implemented under Operable Unit 5. This performance monitoring will be an expansion of the existing Design, Monitoring, Evaluation Program Plan (DMEPP) (DOE 1993c) concept that is currently in place for the South Plume Removal Action Recovery System. In effect, the DMEPP strategy and technical approach will be expanded to encompass each of the new groundwater extraction and reinjection modules that are scheduled to be brought on line over the life of the remedy. Aquifer restoration modules include:

- The South Plume/South Plume Optimization Module
- The Injection Demonstration Module
- The South Field Extraction System Module
- The Waste Storage Area Module
- The Plant 6 Area Module.

An overview of each of these modules is provided in Section 3.4.

The initial focus of the monitoring program will be to address remedy performance tracking responsibilities for fiscal years 1997 and 1998. Ultimately, the IEMP will be used to document the approach for determining when the various modules can be removed from service, once remedial action objectives for the Great Miami Aquifer (provided in the Operable Unit 5 Record of Decision) are achieved.

Along with this performance-based responsibility, the IEMP also will serve to integrate several other compliance-based groundwater monitoring or protection programs currently in existence (or planned) for the FEMP:

- Performance monitoring for the on-site disposal facility (new activity)
- RCRA property boundary groundwater monitoring (current activity)
- KC-2 warehouse well sampling (current activity)
- Homeowner well sampling (current activity)
- Groundwater Protection Management Program Plan (current activity).

As discussed in Section 3.7, these multiple programs are intended to be brought together under a single reporting structure to facilitate regulatory agency review of the progressive success of the Operable Unit 5 remedy and the long-term protection strategy for the Great Miami Aquifer.

3.2 SUMMARY OF REGULATORY DRIVERS, DOE POLICIES, AND OTHER FEMP-SPECIFIC AGREEMENTS

This section presents a summary evaluation of the regulatory-based requirements and policies governing monitoring of the Great Miami Aquifer. The intent of the section is to identify the pertinent regulatory drivers, including ARAR and TBC-based requirements for the scope and design of the Great Miami Aquifer groundwater monitoring system. These requirements will be used to confirm that the design specifications: 1) satisfy the regulatory obligations for monitoring that have been activated by the Operable Unit 5 Record of Decision; and 2) will achieve the intentions of other pertinent criteria (such as DOE Orders and the FEMP's existing agreements, as appropriate) that have a bearing on the scope of groundwater monitoring.

The results of the analysis also will be used to define, as appropriate for this media, the administrative boundaries between the IEMP and the project-specific emissions control monitoring or certification monitoring conducted by other FEMP organizations.

3.2.1 Approach

The analysis of the regulatory drivers and policies for groundwater monitoring was conducted by examining the suite of ARARs and TBC requirements in the FEMP's approved CERCLA operable unit Record of Decisions to identify the subset with specific groundwater monitoring requirements. Although the Operable Unit 3 Record of Decision is not yet final, ARARs within the draft Operable Unit 3 Record of Decision were considered. Any ARAR changes in the final Operable Unit 3 Record

of Decision from the draft Operable Unit 3 Record of Decision will be evaluated for impacts to the IEMP, and the monitoring program will be revised immediately, if necessary. The FEMP's existing compliance agreements issued outside the CERCLA process, such as the September 10, 1993, OEPA Director's Findings and Orders, were also reviewed.

3.2.2 Results

The following summary of regulatory drivers, compliance agreements, and DOE policies were found to govern the monitoring scope and reporting requirements for remedy performance monitoring and general surveillance of the protectiveness of the Great Miami Aquifer groundwater remedy:

- The CERCLA Record of Decision for Remedial Actions at Operable Unit 5 (DOE 1996), which requires the extraction and treatment of Great Miami Aquifer groundwater above FRLs until the full beneficial use potential of the aquifer is achieved; this use includes use as a drinking water source. The FRLs are established by considering chemical-specific ARARs, hazard indices, background, and detection limits for each contaminant. Many Great Miami Aquifer FRLs are based on established or proposed Safe Drinking Water Act maximum contaminant levels (MCLs), which are pertinent ARARs for groundwater remediation. For those FEMP-related contaminants that do not have an established MCL under the Safe Drinking Water Act, a concentration equivalent to an incremental lifetime cancer risk (ILCR) of 10^{-5} for carcinogens or a hazard index (HI) = 1 for noncarcinogens will be used as the final remediation level (FRL), unless background concentrations or detection limits are such that health based limits cannot be attained (in these cases the background or detection limit becomes the FRL). The FRLs will be tracked throughout all affected areas of the aquifer and will be the basis for determining when the Great Miami Aquifer restoration objectives have been met. By definition, the record of decision incorporates the requirements of the FEMP's existing CERCLA South Plume Removal Action (which is the regulatory driver for the FEMP's DMEPP groundwater monitoring and reporting program) and the Abandonment and Plugging of the KC-2 Warehouse/Well No. 67 Groundwater Sampling Work Plan Addendum that is the regulatory driver for the sampling of the KC-2 warehouse well.

- The September 10, 1993, Ohio EPA Director's Findings and Orders (OEPA 1993), which requires groundwater monitoring at the FEMP's property boundary to satisfy RCRA facility groundwater monitoring requirements. This compliance agreement currently requires the issuance of a report each March summarizing the previous year's monitoring results. The agreement requires the sampling of 33 property boundary wells on a quarterly basis for a suite of prescribed parameters. Of note, the March 1996 annual report provided recommendations to update and align the monitoring parameters evaluated for the RCRA property boundary program with the FRLs for groundwater contained in the February 1996 Operable Unit 5 Record of Decision. The IEMP has adopted this recommendation in the selection of analytical parameters for the groundwater program.

- DOE Order 5400.1, General Environmental Protection Program, which establishes the requirement for a Groundwater Protection Management Program Plan (GPMPP) for DOE

facilities. The required informational elements of a GPMPP is fulfilled by the Operable Unit 5 Remedial Investigation and feasibility study documents; the groundwater monitoring program requirement will be fulfilled by the IEMP.

- DOE Order 5400.5, Radiation Protection of the Public and Environment, which establishes radiological dose limits and guidelines for the protection of the public and environment. Demonstration of compliance with these limits and guidelines for radiological dose are based generally on calculations that make use of information obtained from the site's monitoring and surveillance program. This program should be based on guidance in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, January 1991. The FEMP's current private well sampling program for the Great Miami Aquifer (that was previously in the EMP) is conducted to satisfy the intention of this order with respect to groundwater, and will be included in the IEMP.

The IEMP for the Great Miami Aquifer has been developed in full consideration of these regulatory drivers and responsibilities.

The IEMP also will be utilized as the mechanism for conducting groundwater monitoring within the Great Miami Aquifer of the performance of the on-site disposal facility. The ARARs and TBC criteria that have a bearing on the design and execution of a groundwater monitoring program for the disposal facility are listed below:

- Ohio Solid Waste Disposal Facility Groundwater Monitoring Rules, OAC 3745-27-10, which specify groundwater monitoring program requirements for sanitary landfills.

- RCRA/Ohio Hazardous Waste Groundwater Monitoring Requirements for Regulated Units, 40 CFR 264.90 through .99 (OAC 3745-54-90 through 99) and 40 CFR 265.90 through .94 (OAC 3745-65-90 through 94), which specify groundwater monitoring program requirements for surface impoundments, landfills, and land treatment units that manage hazardous wastes.

- Uranium Mill Tailings Reclamation and Control Act (UMTRCA) Regulations, 40 CFR 192.32(A)(2), which specify standards for uranium byproduct materials in piles or impoundments. This regulation requires conformance with the RCRA groundwater monitoring performance standard in 40 CFR 264.92. Compliance with RCRA/Ohio Hazardous Waste rules for groundwater monitoring will fulfill the substantive requirements for groundwater monitoring in the UMTRCA regulations.

- DOE Order 5820.2A Chapter III.3.k, Environmental Monitoring, which requires low-level radioactive waste disposal facilities to perform environmental monitoring for all media, including groundwater. Compliance with RCRA/Ohio Hazardous Waste and Ohio Solid Waste rules for groundwater monitoring will fulfill the requirement for groundwater monitoring in this order.

3.3 PROGRAMMATIC BOUNDARY FOR THE IEMP GROUNDWATER PROGRAM

This section identifies the programmatic boundary(s) that have been established between the IEMP and the project-specific activities to be conducted by others. The intent behind the boundary definition is to: 1) clearly delineate the scope and geographic extent of the IEMP's monitoring responsibility; and 2) establish a recognized interface between the sitewide focus of the IEMP and the predominant emission control focus of the project-specific monitoring.

The programmatic boundary for each of the FEMP's environmental media will be unique, and for certain media, time dependent. The media-specific boundary is defined by one or more of the following:

- Regulatory monitoring requirements for the media
- Physical boundaries (i.e., geologic, hydrogeologic, or surface boundaries imposed by the remediation projects)
- Media-specific monitoring requirements specifically assigned to the IEMP by administrative decision.

Because of these unique considerations, the boundary definitions are provided for each media to clearly convey the "line of responsibility" for that media under the IEMP.

For groundwater, three programmatic boundaries require definition for the IEMP:

- The responsibility boundary between the Great Miami Aquifer and the perched groundwater remediation efforts
- The administrative boundary between the FEMP and the Paddys Run Road Site (PRRS) contaminant plumes (Figure 3-1)
- The responsibility boundary between the On-Site Disposal Cell Design Project and the Aquifer Restoration Project for performance monitoring of the on-site disposal facility.

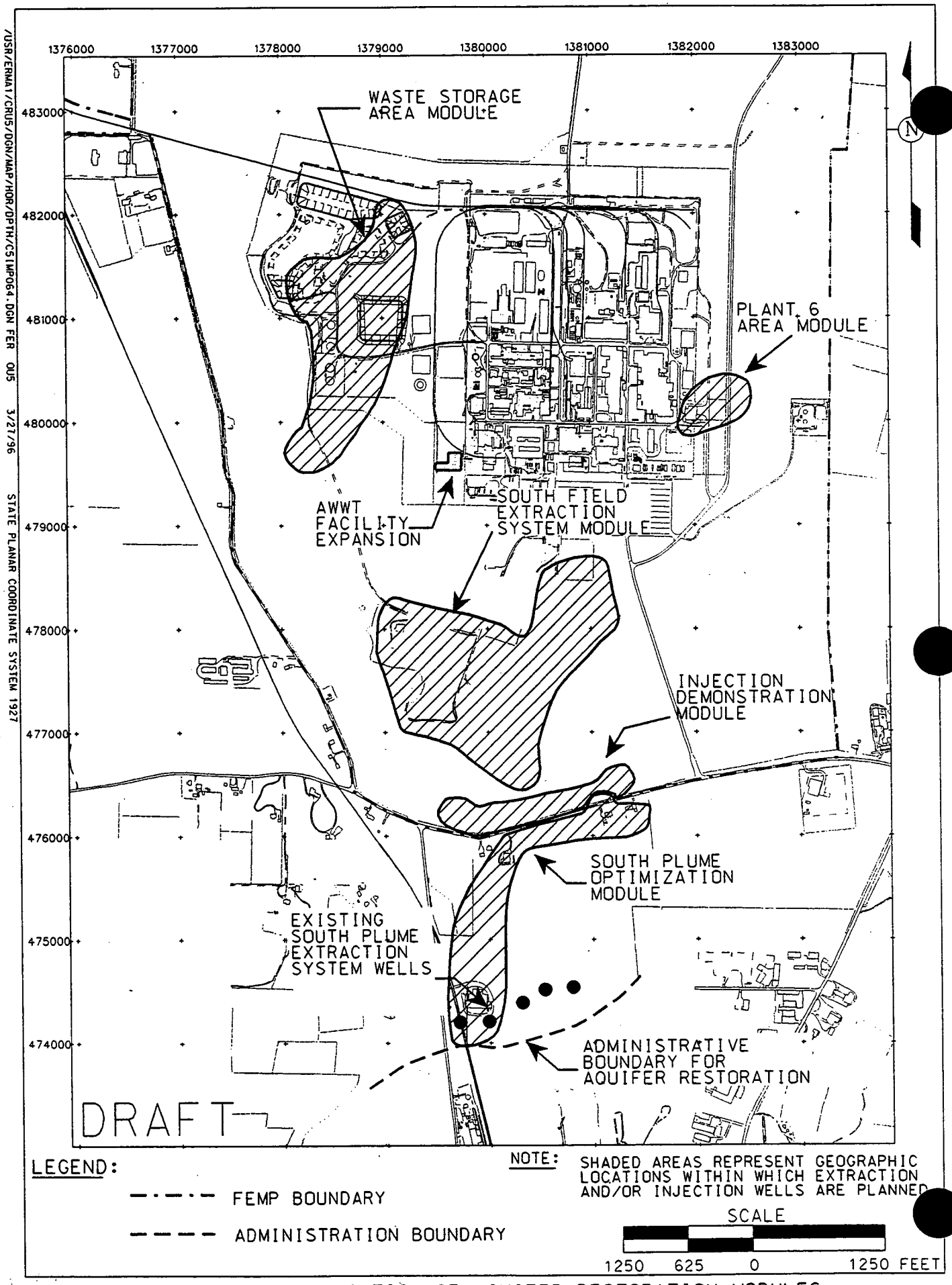

FIGURE 3-1. LOCATION OF AQUIFER RESTORATION MODULES

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For the FEMP's Great Miami Aquifer plume, all of the geographic areas that are to be restored under the Operable Unit 5 Record of Decision (or routinely monitored beyond the restoration area) reside within the scope of the Aquifer Restoration Project. For the perched groundwater remediation, all remedial responsibilities reside within the Soil Characterization and Excavation Project. The pre-certification and certification sampling activities that will accompany the excavation of affected perched groundwater zones (to demonstrate the attainment of cross-media based soil FRLs) will be performed by the Soil Characterization and Excavation Project.

As described in the Operable Unit 5 Remedial Investigation Report (Section 4.8.2), the Paddys Run Road Site consists of two facilities, Albright & Wilson Americas, Inc. and Ruetgers-Nease Chemical Company Inc. Albright and Wilson occupies the northern portion of the property and manufactures aromatic sulfonated compounds. The Paddys Run Road Site Remedial Investigation Report released in September 1992 documented releases to the Great Miami Aquifer of inorganics, volatile-organic compounds (VOCs), semivolatile organic compounds, and pesticides. In the Operable Unit 5 Proposed Plan (DOE 1995h), it was acknowledged that DOE's role and involvement in OEPA's ongoing assessment and/or cleanup of the Paddys Run Road Site plume, if any, would be defined separately as part of the Paddys Run Road Site response obligations and in accordance with the Paddys Run Road Site project schedule. Groundwater monitoring will continue south of the administrative boundary until such time as the need for action is established and implemented. This monitoring will assess the nature of the 20 μg/l uranium plume south of the administrative boundary and the impact that pumping of the South Plume extraction wells has on the Paddys Run Road Site plume. Monitoring is further discussed in Section 3.5.1.1.

Monitoring of the performance of the on-site disposal facility, with the exception of monitoring groundwater in the Great Miami Aquifer, is a project-specific responsibility of the On-Site Disposal Facility Design Project. Monitoring groundwater within the Great Miami Aquifer is a responsibility of the Aquifer Restoration Project. The interpretation of groundwater data, in relation to the performance of the on-site disposal facility is a joint responsibility of the On-Site Disposal Facility Design Project and the Aquifer Restoration Project. The On-Site Disposal Facility Design Project will collect leachate data from within the on-site disposal facility and groundwater data from perched groundwater in the glacial overburden. The IEMP annual report will be utilized to provide an annual summary of the data collection and interpretation effort.

3.4 PROGRAM EXPECTATIONS AND DESIGN CONSIDERATIONS

3.4.1 Program Expectations

The IEMP groundwater monitoring program for 1987 and 1988 is being designed to provide a comprehensive monitoring network that will fulfill a variety of expectations. These expectations are:

- Provide a groundwater monitoring network to monitor the Great Miami Aquifer Remedial Action.
- Provide a groundwater monitoring network that will continue to meet existing compliance-based groundwater monitoring obligations (e.g., RCRA property boundary monitoring)
- Provide a groundwater monitoring network that will begin to address groundwater monitoring of the on-site disposal facility.
- Provide groundwater data that is sufficient to verify groundwater model predictions of the remedy performance.
- Continue to fulfill DOE Order 5400.1 requirements to maintain an environmental monitoring plan for groundwater
- Continue to address concerns of the community regarding the progress of the aquifer restoration.

The following section provides the design considerations required to fulfill each of these expectations.

3.4.2 Design Considerations

3.4.2.1 The Modular Approach to Aquifer Restoration

The Great Miami Aquifer, which is the uppermost aquifer system beneath the FEMP, is contaminated with uranium and other constituents as reported in the Operable Unit 5 Remedial Investigation Report (DOE 1995f). One portion of the Great Miami Aquifer (i.e., the South Plume) has been undergoing pump-and-treat remediation since 1993. A groundwater remediation strategy which relies on pump-and-treat technology has been selected to cleanup of the Great Miami Aquifer (DOE 1996a). In an effort to improve upon the performance of this pump-and-treat remedy, a groundwater injection demonstration also is planned. If the injection demonstration is a success, injection will be used to accelerate the restoration. The restoration strategy focuses primarily on the removal of uranium, but has also been designed to control the further expansion of the plume, achieve removal of all targeted contaminants to concentrations below designated final remediation levels (FRLs), and prevent undesirable drawdown impacts beyond the FEMP property.

The distribution of uranium and other constituents in the Great Miami Aquifer has been extensively characterized in the Operable Unit 5 Remedial Investigation Report (DOE 1995f). The primary sources of contamination at the FEMP that contributed to the present geometry of the plume are: the waste pits, in the waste storage area, the inactive and active flyash piles in the south field area, deep soil contamination in the vicinity of Plant 6, and the previously uncontrolled surface water runoff from the former production area that had direct access to the aquifer through the storm sewer outfall ditch and Paddy's Run. Uranium is the principal constituent of concern in the Great Miami Aquifer and drives the overall extent and duration of the aquifer restoration program. Uranium contamination is most extensive and concentrated at the Type 2 well depths (Great Miami Aquifer water table) and generally less extensive and concentrated with depth below the water table. Figures 3-2 and 3-3 show the 1993 total uranium concentrations from unfiltered groundwater samples in Type 2 and Type 3 wells, respectively.

Restoration of the Great Miami Aquifer will be accomplished by using a series of area-specific groundwater restoration modules and a centralized water treatment facility (Figure 3-1). Area-specific modules include:

- The South Plume/South Plume Optimization Module
- The Injection Demonstration Module
- The South Field Extraction System Module
- The Waste Storage Area Module
- The Plant 6 Area Module.

Each area-specific module will be brought on line as scheduled during the life of the remedy and independently withdrawn from service once remedial objectives within an area are achieved. Table 3-1 presents the extraction/injection schedule for the accelerated remediation case, which begins in 1996. The installation sequence and operation of the modules will follow a coordinated schedule that is based on the remedial activities of other projects, and the modeling projections of the duration and intensity of restoration actions necessary to achieve desired site-wide cleanup time frames and satisfy discharge requirements to the Great Miami River, as described in the Operable Unit 5 Remedial Design Work Plan (DOE 1996b). A Baseline Remedial Strategy Report, detailing the pump-and-treat systems with predicted uranium concentrations over time, will be the first major groundwater design deliverable submitted under the Operable Unit 5 RD Work Plan. The groundwater monitoring program in this IEMP is designed around the modular remediation strategy

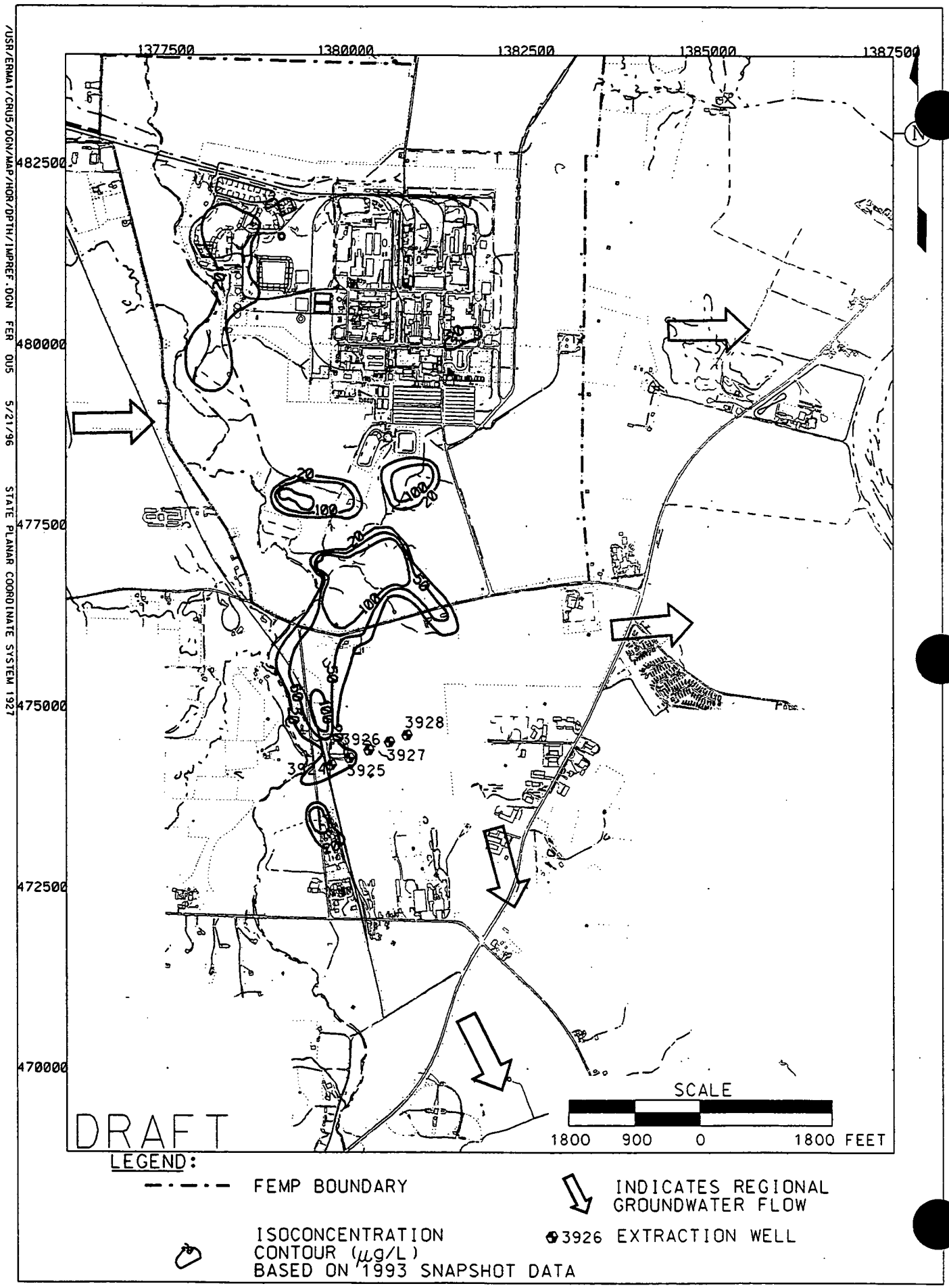

FIGURE 3-2. TOTAL URANIUM PLUME IN TYPE 2 WELLS

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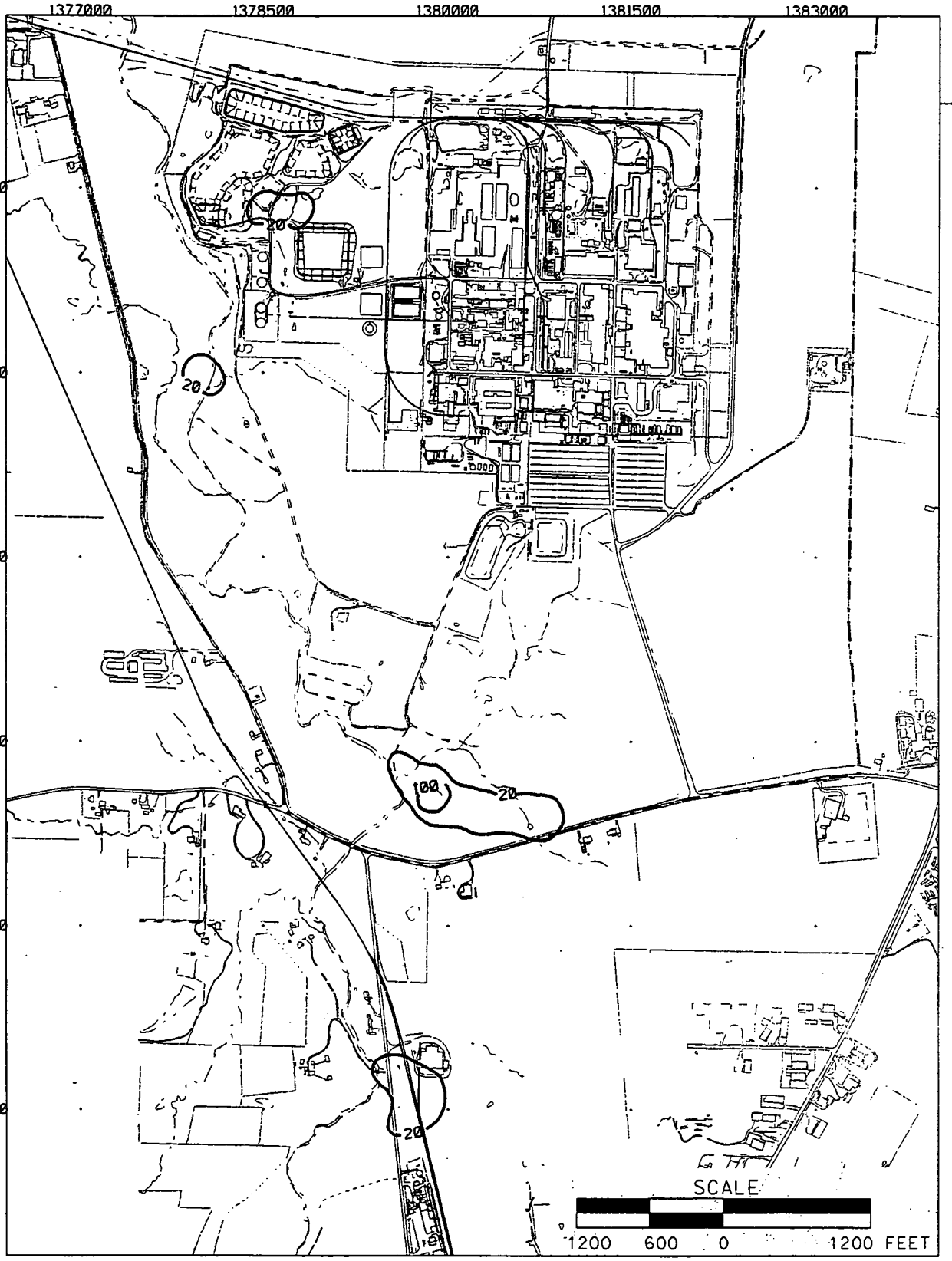
/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMP01O.DGN FER OU5 5/21/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

20 ISOCONCENTRATION CONTOUR (μg/L) BASED ON 1993 SNAPSHOT DATA

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FIGURE 3-3. TOTAL URANIUM PLUME IN TYPE 3 WELLS

TABLE 3-1

EXTRACTION/INJECTION SCHEDULE FOR THE ACCELERATED REMEDIATION CASE

		Flow Rates[a] (gpm)		
Module	Well ID[b]	Years 0 to 2 1996 - 1997	Years 3 to 7 1998 - 2002	Years 8 to 10 2003 - 2007
Waste Storage Area	1	0	0	100
Waste Storage Area	3	0	0	100
Waste Storage Area	4	0	0	100
Waste Storage Area	5	0	0	100
Waste Storage Area	6	0	0	100
Waste Storage Area	7	0	0	100
Waste Storage Area	55	0	0	100
Waste Storage Area	56	0	0	100
Waste Storage Area	57	0	0	100
Waste Storage Area	58	0	0	100
Totals		0	0	1000
Plant 6 Area	2	0	0	250
Plant 6 Area	23	0	0	250
Totals		0	0	500
Injection Demonstration	8	0	-200	-200
Injection Demonstration	9	0	-200	-200
Injection Demonstration	10	0	-200	-200
Injection Demonstration	11	0	-200	-200
Injection Demonstration	12	0	-200	-200
Totals		0	-1000	-1000
South Field	31565	0	200	-200
South Field	31564	0	200	-200
South Field	31556	0	200	100
South Field	31563	0	200	-200
South Field	31557	0	100	100
South Field	31550	0	100	0
South Field	31560	0	100	200
South Field	31561	0	100	200
South Field	31562	0	100	200
South Field	38	0	0	300
South Field	41	0	0	300
South Field	53	0	0	300
South Field	54	0	0	300
South Field	59	0	0	300
South Field	60	0	0	300
South Field	61	0	0	200
South Field	62	0	0	200
South Field	63	0	0	300
Totals		0	1300	2700
South Field Injection	42	0	0	-200
South Field Injection	43	0	0	-200
South Field Injection	44	0	0	-200
South Field Injection	49	0	0	-200
South Field Injection	51	0	0	-200

TABLE 3-1
(Continued)

Module	Well ID[b]	Flow Rates[a] (gpm) Years 0 to 2 1996 - 1997	Years 3 to 7 1998 - 2002	Years 8 to 10 2003 - 2007
Totals		0	0	-1000
South Plume/S.Plume Opt.	3924	300	300	300
South Plume/S.Plume Opt.	3925	300	300	300
South Plume	3926	400	0	0
South Plume	3927	400	0	0
South Plume Optimization	1	0	250	250
South Plume Optimization	2N	0	150	150
South Plume Optimization	3N	0	350	350
South Plume Optimization	KN	0	150	150
Totals		1400	1500	1500
Total pumped		1400	2800	6300
Total injected		0	-1000	-2600
Net aquifer extraction		1400	1800	3700

[a]Positive numbers indicate an extraction rate, negative numbers indicate an injection rate.
[b]If well exists, actual well number is used.

presented in the Operable Unit 5 Remedial Design Work Plan (DOE 1996b). If the Baseline Remedial Strategy Report, when final, indicates the need for altering the groundwater monitoring design, then the IEMP will be revised to incorporate the necessary design changes.

The South Plume Module, which was initiated as part of Removal Action 3, has been in operation since 1993. The existing four extraction wells currently in operation which comprise the South Plume Module were installed with the objectives to create a hydraulic barrier and prevent the further southern migration of the uranium plume (DOE 1992). According to the Operable Unit 5 Remedial Design Work Plan, the South Plume Module will be enhanced by installing additional extraction wells to supplement the existing wells. This enhancement, once installed, will incorporate and/or replace the South Plume Module, and is known as the South Plume Optimization Module.

During 1997, the four extraction wells comprising the South Plume Module will continue to be pumped at a combined rate of 1,400 gallons per minute (gpm). Figure 3-4 illustrates where these four wells are located. In 1998, three new restoration modules (the South Plume

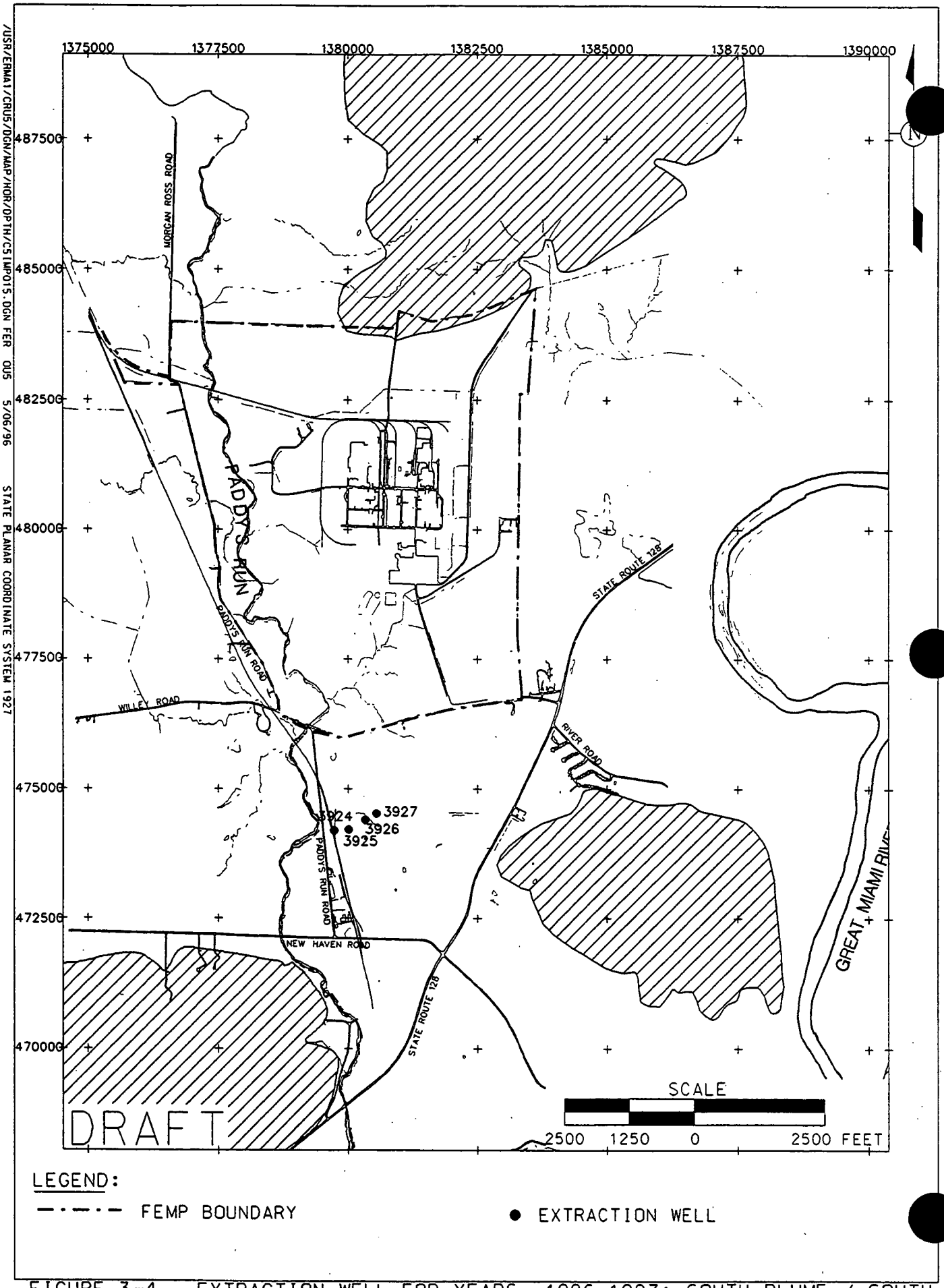

FIGURE 3-4. EXTRACTION WELL FOR YEARS 1996-1997: SOUTH PLUME / SOUTH PLUME OPTIMIZATION MODULE MONITORING / EXTRACTION WELLS - ACTIVITY 1

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Optimization Module, the Injection Demonstration Module, and the South Field Extraction System Module) are scheduled to become operational, and the remedy will include both extraction and an injection demonstration (Figure 3-5). In the South Plume Optimization Module, six extraction wells (two of the existing wells and four new wells) will be pumped at a combined rate of 1,500 gpm. In the South Field, nine extraction wells will be pumped at a combined rate of 1,300 gpm. In the Injection Demonstration area, treated water will be injected into five wells at a combined rate of 1,000 gpm. The net groundwater extraction rate during this time period will be 1,800 gpm. Table 3-1 provides a summary of the above information.

In year 2003, the final two modules (the Waste Storage Area Module and the Plant 6 Area Module) are scheduled to become operational. At that time, pumping will take place in the South Plume, South Field, Waste Storage Area, the Plant 6 Area, and the Injection Demonstration Area (Figure 3-6). In the South Plume, six extraction wells will be pumped for a combined rate of 1,500 gpm. In the South Field area, 14 extraction wells will be pumped for a combined rate of 3,300 gpm, and treated water will be injected into eight wells at a combined rate of 1,600 gpm. In the Waste Storage Area, 10 extraction wells will be pumped for a combined rate of 1,000 gpm. In the Plant 6 area, two extraction wells will be pumped for a combined rate of 500 gpm. In the Injection Demonstration Area, treated water will be injected into five wells at a combined rate of 1,000 gpm. The maximum pumping rate in the selected remedial alternative occurs in years eight to 10 at 6,300 gpm; however, the injection rate during this time is 2,600 gpm for a maximum net pumping rate of 3,700 gpm (Table 3-1).

3.4.2.2 Well Selection Criteria

Geologic and hydrogeologic properties, predicted groundwater flow (during remediation), and contaminant distribution within the Great Miami Aquifer, characterized in the Operable Unit 5 remedial investigation/feasibility study process, have served as input to the design of the IEMP groundwater monitoring program. Field measurements and computer simulations have been conducted to support the design efforts. All the available information was reviewed to select appropriate monitoring well locations. In general, the monitoring well locations for the IEMP were selected according to the following criteria:

- Monitor within the sitewide hydraulic capture zone unless a compliance-based monitoring obligation requires a monitoring location to be outside of the capture zone

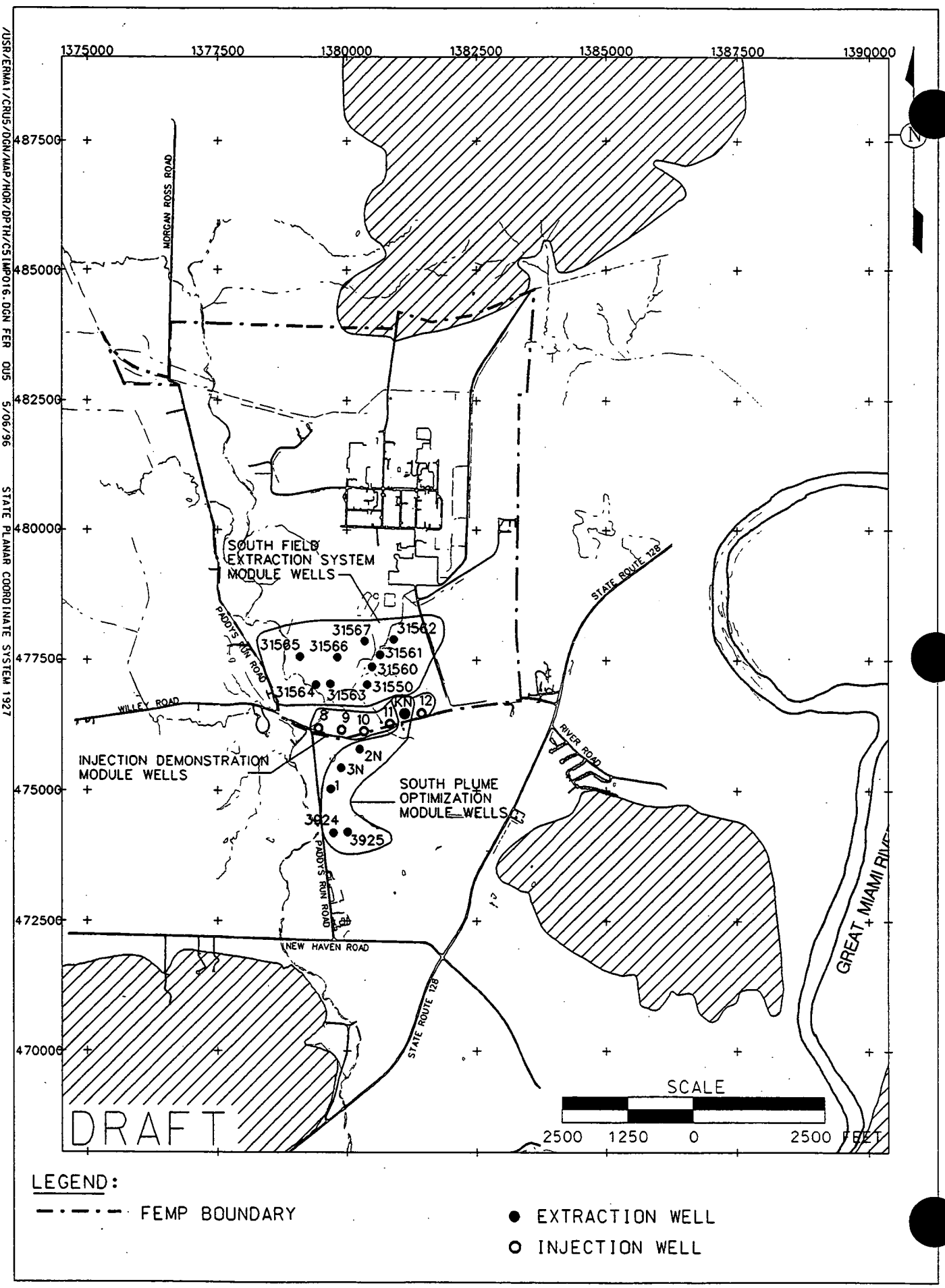
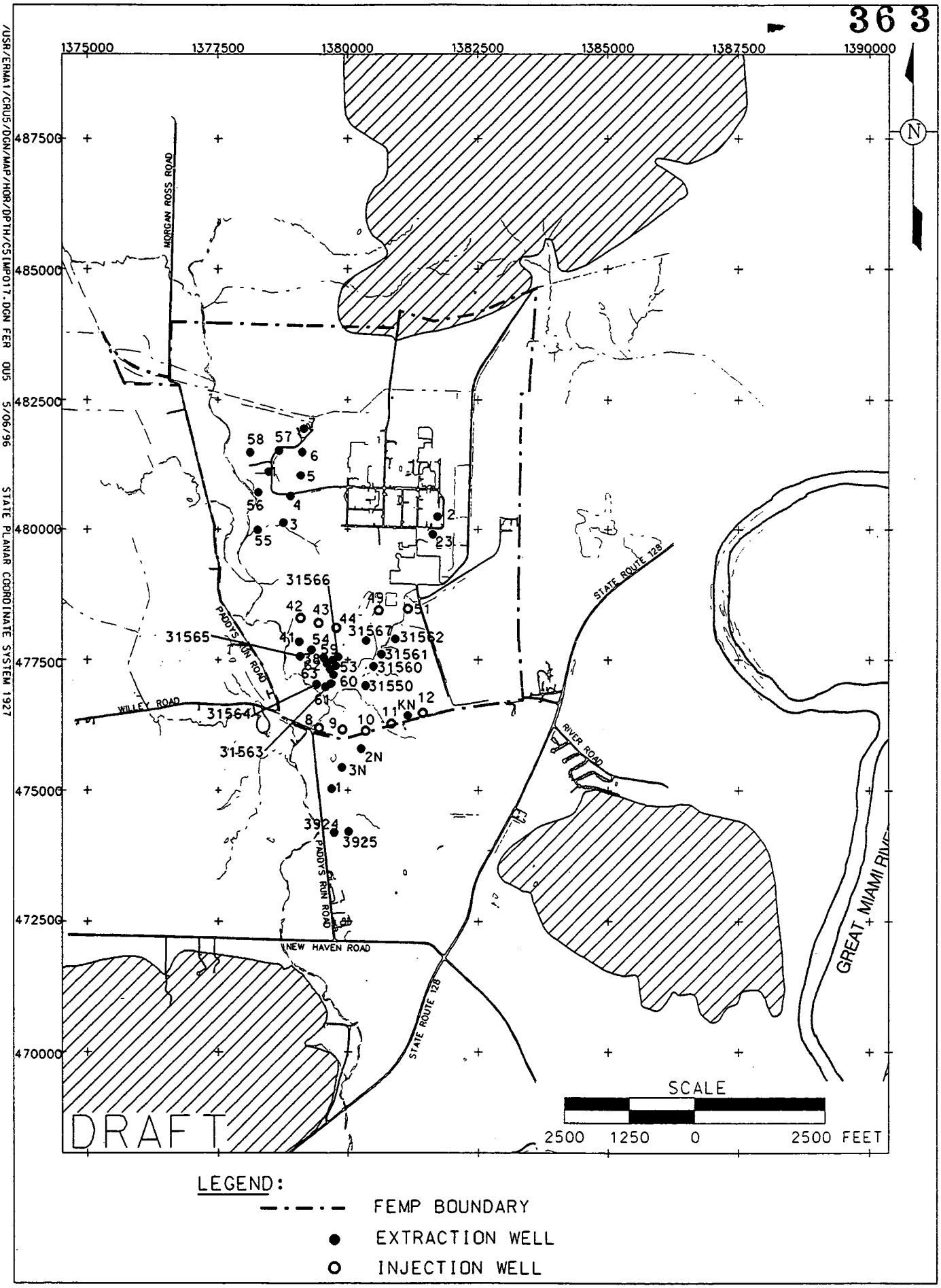


FIGURE 3-5. EXTRACTION AND INJECTION WELLS FOR YEARS 1998 - 2003



LEGEND:

- FEMP BOUNDARY
- ● EXTRACTION WELL
- ○ INJECTION WELL

FIGURE 3-6. EXTRACTION AND INJECTION WELLS FOR YEARS 2004 -2006

- Use existing monitoring wells and avoid installing new monitoring wells until remediation modules are operational and operational knowledge can be used to help select new locations
- Provide adequate areal coverage across each remediation module area
- Include monitoring wells which are needed to meet regulatory and other site specific monitoring commitments
- Avoid selecting monitoring well locations which would interfere with surface remediation activities such as soil excavations.

Using these criteria, it is proposed that 144 of 368 available wells be monitored during the first two years of the IEMP. Currently, 123 monitoring wells are monitored (DMEPP, RCRA, KC-2 Warehouse, and private wells). The IEMP program will remove 30 of the private wells and add 51 FEMP wells to the overall monitoring effort. The 30 private wells can be removed from the monitoring program because a public water supply is now available. Section 3.5.2.1 provides more information on the Private Well Monitoring Program.

The 51 wells added to the IEMP monitoring program are near the South Field, Waste Storage, and Plant-6 remediation module areas. These wells will document water quality changes that may be occurring in the aquifer that could impact the design or start-up of the restoration modules. Once a restoration module begins to operate in these areas, the wells will provide a preliminary monitoring network. It is anticipated that additional monitoring wells will be needed once systems become operational, but as stated earlier, new locations will not be selected until some operational experience has been obtained. Further discussion of the selection of specific monitoring locations for individual monitoring modules or programs is presented in Sections 3.5.1 to 3.5.2.

3.4.2.3 Parameter Selection Criteria

Restoration of the aquifer will be verified against FRLs. FRLs for the aquifer are presented in the Operable Unit 5 Record of Decision for 50 COCs. Groundwater monitoring will focus on these 50 FRL constituents to assess the progress of the aquifer remedy. These 50 FRL constituents either have concentrations that have been detected in the aquifer or have the potential to reach the aquifer within 1,000 years and pose an unacceptable risk to human health and/or the environment.

The groundwater monitoring program for the Great Miami Aquifer consists of 144 monitoring wells distributed over six restoration modules, along the FEMP's downgradient property boundary, and at

several private well locations. If all 144 of these wells were monitored quarterly for the full suite of the FEMP's groundwater FRL constituents (50 constituents, total), the analytical costs alone are estimated to exceed 18 million dollars over the life of the FEMP's groundwater restoration program. Clearly it would not be cost-effective to monitor the full suite of parameters at each successive monitoring interval at all available wells during the active restoration process.

For the IEMP, a representative list of FRL parameters was developed that can be used to track successfully the progress of the remedy, satisfy regulatory requirements, and ultimately determine when restoration activities are complete for each module. The FEMP recognizes its obligation to verify that all 50 FRL constituents are below their corresponding FRL values in order to deem the restoration activities as complete. During the active restoration process, the FEMP is proposing to track the progressive success of the remedy using a logical "short-list" of zone-specific indicator parameters (developed through the methodology described in Appendix A), and then verify the completion of the remedy (step-wise for each module, as appropriate) using the full suite of 50 FRL constituents identified in the Operable Unit 5 Record of Decision. The parameter list presented in this version of the IEMP focuses on monitoring for years 1997 and 1998. Subsequent versions of the IEMP are expected to focus on the monitoring activities and the parameters needed to support a collective decision on the part of DOE, EPA, and OEPA that restoration activities are complete for each module. Later versions will also define the FEMP's long-term groundwater monitoring activities (such as the long-term monitoring associated with the FEMP's on-site disposal facility) that may extend beyond completion of the restoration program.

For this version of the IEMP, the 50 FRL constituents were organized into four categories for the purpose of monitoring appropriately and cost effectively. Specific monitoring objectives were considered in subdividing the parameters into specific groups:

- Is the success of the groundwater remedy proceeding satisfactorily at the pace that is desired?
- Are engineering adjustments to the system (flow rates, well locations, etc.) needed?
- Are FRL constituents migrating beyond the hydraulic zone of capture created by the restoration system?

- Are new FRL constituents arriving in the aquifer as a result of migration through the glacial overburden or as a result of surface water infiltration?

- Is sufficient information being gathered to ultimately demonstrate that remedial objectives contained in the Operable Unit 5 Record of Decision have been obtained?

- Have all specific regulatory-based monitoring requirements for specific parameters ben satisfied in the selection process?

By categorizing the data, it was possible to identify a "short-list" of indicator parameters. This "short-list" of parameters will be monitored more frequently than the other FRL constituents. To select the short list and establish monitoring frequencies for the other FRL constituents, the following was determined:

- Presence in the aquifer, based on one or more validated FRL exceedance in the aquifer. The Operable Unit 5 remedial investigation/feasibility study data set and 1994 and 1995 groundwater data sets were evaluated.

- Presence in the glacial overburden, ability to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk to human health and the environment based on Operable Unit 5 Feasibility Study modeling results.

Constituents were then organized into specific monitoring parameter lists based upon the above noted monitoring objectives and the geographic locations of the monitoring module/program. The parameter selection strategy, approach, and results are presented in Appendix A. A summary of the results of the parameter selection process is presented in Table 3-2.

The following is a description of the information contained in Table 3-2, and how the information in the table was used to determine the most appropriate parameters for a particular module/program.

- Column 1, Constituents: This column represents the suite of constituents considered for monitoring in the groundwater modules/programs as a result of the remedial investigation/feasibility study process at the FEMP. It consists of the constituents for which a FRL was established in the Operable Unit 5 Record of Decision.

- Column 2, Groundwater FRLs: This column represents the human-health protective remediation levels for groundwater that were established in the Operable Unit 5 Record of Decision.

TABLE 3-2

CATEGORIZATION OF GROUNDWATER FRL CONSTITUENTS BASED ON EXCEEDANCES, MOBILITY, AND PERSISTENCE

Constituents	Groundwater FRL[a]	Zones with Groundwater Concentrations > FRL[b]	Mobility/Persistence Characteristic[c]	Characterization by Zone[d]				
				Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
General Chemistry	mg/L							
Fluoride	.89	0,1,2,3,4	MP	>MP	>MP	>MP	>MP	>MP
Nitrate[e]	11	0,1,2,4	MP	>MP	>MP	>MP	<MP	>MP
Inorganics	mg/L							
Antimony	.0060	0,1,2,3,4	N	>N	>N	>N	>N	>N
Arsenic	.050	0,1,2,3,4	N	>N	>N	>N	>N	>N
Barium	2.0	4	N	<N	<N	<N	<N	>N
Beryllium	.0040	1,3,4	N	<N	>N	<N	>N	>N
Boron	.33	-[f]	MP	>MP[f]	>MP[f]	>MP[f]	>MP[f]	>MP[f]
Cadmium	.014	0,1,2,3,4	N	>N	>N	>N	>N	>N
Chromium VI[g]	.022	-[h]	MP	>MP[h]	<MP	<MP	>MP[h]	<MP
Cobalt	.17	1,3,4	N	<N	>N	<N	>N	>N
Copper	1.3	-	N	<N	<N	<N	<N	<N
Lead	.0020	0,1,2,3,4	N	>N	>N	>N	>N	>N
Manganese	.90	0,1,2,3,4	N	>N	>N	>N	>N	>N
Mercury	.0020	0,1,2,3,4	MP	>MP	>MP	>MP	>MP	>MP
Molybdenum	.10	1,3	N	<N	>N	<N	>N	<N
Nickel	.10	0,1,2,3,4	N	>N	>N	>N	>N	>N
Selenium	.050	1,2,3,4	N	<N	>N	>N	>N	>N
Silver	.050	0,1,4	N	>N	>N	<N	<N	>N
Vanadium	.038	0,1,3,4	N	>N	>N	<N	>N	>N
Zinc	.021	0,1,2,3,4	N	>N	>N	>N	>N	>N
Radionuclides	pCi/L							
Neptunium-237	1.0	0,2,4	MP	>MP	<MP	>MP	<MP	>MP
Radium-226	20	4	N	<N	<N	<N	<N	>N
Radium-228	20	-	N	<N	<N	<N	<N	<N
Strontium-90	8.0	0,1,3,4	MP	>MP	>MP	<MP	>MP	>MP
Technetium-99	94.0	0,1	MP	>MP	>MP	<MP	<MP	<MP
Thorium-228	4.0	0,1,2,3,4	N	>N	>N	>N	>N	>N
Thorium-230	15	-	N	<N	<N	<N	<N	<N
Thorium-232	1.2	0,2,4	N	>N	<N	>N	<N	>N
	µg/L							
Total Uranium	20	0,1,2,3,4	MP	>MP	>MP	>MP	>MP	>MP
Organics	mg/L							
Alpha-chlordane	.0020	-	MP	<MP	<MP	<MP	<MP	<MP
Aroclor-1254	.00020	-[i]	N	<N	<N	<N	<N	<N
Benzene	.0050	0	N	>N	<N	<N	<N	<N
Bis(2-chloroisopropyl)ether	.0050	-[i]	N[j]	<N	<N	<N	<N	<N
Bis(2-ethylhexyl)phthalate[k]	.0060	-	N	<N	<N	<N	<N	<N

TABLE 3-2
(Continued)

Constituents	Groundwater FRL[a]	Zones with Groundwater Concentrations > FRL[b]	Mobility/Persistence Characteristic[c]	Characterization by Zone[d]				
				Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
Organics (Contd.)	mg/L							
Bromodichloromethane	.1	-	MP	<MP	<MP	<MP	<MP	<MP
Bromomethane	.0021	-	N	<N	<N	<N	<N	<N
Carbazole	.011	-	N[j]	<N	<N	<N	<N	<N
Carbon disulfide	.0055	1,2,3	N	<N	>N	>N	>N	<N
Chloroethane	.0010	-[i]	N[l]	<N	<N	<N	<N	<N
Chloroform	.10	-	N	<N	<N	<N	<N	<N
1,1-Dichloroethane	.28	-	N	<N	<N	<N	<N	<N
1,1-Dichloroethene	.0070	4	N	<N	<N	<N	<N	>N
1,2-Dichloroethane	.0050	4	MP	<MP	<MP	<MP	<MP	>MP
Methylene chloride	.0050	-	N	<N	<N	<N	<N	<N
4-Methylphenol	.029	-	N	<N	<N	<N	<N	<N
4-Nitrophenol	.32	-	N[l]	<N	<N	<N	<N	<N
Octachlorodibenzo-p-dioxin	.0000001	-[i,m]	N	<N	<N	<N[m]	<N	<N[m]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	.000010	-[m]	N[l]	<N	<N	<N[m]	<N	<N[m]
Trichloroethene	.0050	0,1,2,4	N	>N	>N	>N	<N	>N
Vinyl Chloride	.0020	-	MP	<MP	<MP	<MP	<MP	<MP

Shading indicates short list of indicator parameters.
[a]From Table 9-3 in OU5 ROD.
[b]0,1,2,3,4 indicate the zone(s) where constituent was detected in the aquifer above the FRL. From OU5 RI/FS data set and supplemented by 1994 and 1995 groundwater data.
- indicates that the constituent was not detected in the aquifer above the FRL.
[c]From OU5 FS Report Table F.2-2. A constituent that failed modeling (model screening predicted that it has the ability to migrate to the aquifer) is considered mobile and persistent, and is listed as MP. A constituent that passed modeling (model screening indicated that it could not reach the aquifer) is considered not mobile and persistent, and is listed as N.
[d]>MP = Has been detected in the aquifer at concentrations greater than the FRL, and has the ability to migrate to the aquifer.
>N = Has been detected in the aquifer at concentrations greater than the FRL, and does not have the ability to migrate to the aquifer.
<MP = Has not been detected in the aquifer at concentrations greater than the FRL, and has the ability to migrate to the aquifer.
<N = Has not been detected in the aquifer at concentrations greater than the FRL, and does not have the ability to migrate to the aquifer.
[e]Nitrate/Nitrite will be analyzed in future modules/programs.
[f]Not analyzed in Zones 0, 1, 2, 3 or 4, but categorized as having a valid FRL exceedance in these zones since it has been predicted to have the ability to migrate to the aquifer and create an unacceptable risk.
[g]Total chromium will be analyzed in future modules/programs.
[h]Not analyzed in Zones 0 or 3, but categorized as having a valid FRL exceedance in these zones since it has been predicted to have the ability to migrate to the aquifer and create an unacceptable risk.
[i]Analyses of constituent had method detection limit above FRL, but categorized as not having a valid FRL exceedance since model predictions indicate that it does not have the ability to migrate to the aquifer and create an unacceptable risk.
[j]Failed modeling in F.2-2. Constituent was since remodeled with updated information and passed modeling. It was therefore assigned an N.
[k]This constituent showed FRL exceedances in three samples (.015- mg/L, Well 3043 in Zone 1; .013- mg/L, Well 3016 in Zone 2, .007J mg/L, Well 2037 in Zone 3). Confirmatory sampling indicated that each exceedance was due to laboratory contamination.
[l]Not in Table F.2-2. Constituent assigned an N based on literature review which shows high degradation rates for chloroethane and 4-nitrophenol and low water solubility for 2,3,7,8 tetrachlorodibenzo-p-dioxin.
[m]Not analyzed in Zones 2 or 4, but categorized as not having a valid FRL exceedance in these zones since it does not have the ability to migrate to the aquifer and create an unacceptable risk.

- Column 3, Zones with Groundwater Concentrations > FRL: This column identifies, by zone, where constituents that have been detected in the aquifer at concentrations above their established FRL. In order to determine the location of FRL exceedances in the aquifer, the analytical data was sorted into the same four zones (Zones 1 through 4) used to model the aquifer remediation (described in Appendix F.7 of the Operable Unit Feasibility Study Report). A fifth zone (Zone 0) includes the area outside of Zones 1 through 4 (refer to Figure 3-8).

- Column 4, Mobility/Persistence Characteristic: This column identifies which constituents failed or passed the model screening (Operable Unit 5 Feasibility Study Report, Table F.2-2). FRL constituents predicted to have the ability to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk to human health and the environment are identified as letter MP.

- Columns 5-9, Characteristic by Zone: These columns present a combination of the information presented in Column 3 (FRL exceedance) and Column 4 (Mobility/Persistence characteristic). The constituents are categorized into four characteristics by zone. These four characteristics are:

- >MP The constituent has been detected in the aquifer at concentrations "greater than its established FRL" and is considered "Mobile and Persistent." It has been predicted to be able to migrate from the glacial overburden to the aquifer and has already caused a FRL exceedance in the aquifer.

- >N The constituent has been detected in the aquifer at concentrations "greater than its established FRL" but is "Not considered mobile and persistent." This constituent is not predicted to be able to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk. Background conditions and/or surface water infiltrations may be the cause of the isolated FRL exceedances noted in the historical record.

- <MP The constituent has "not been detected is the aquifer at concentrations greater than its established FRL," but is considered both "Mobile and Persistent." This constituent is predicted to be able to migrate through the glacial overburden to the aquifer (if no source actions are taken), but as yet has not caused exceedances of its established FRL.

- <N The constituent has "not been detected is the aquifer at concentrations greater than its established FRL" and is "Not considered mobile and persistent."

A zone-specific breakdown of the number of constituents in each of the four categories is presented below.

BREAKDOWN OF FRL CATEGORY CONSTITUENTS BY ZONE

Constituent Characteristic	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
>MP	9	7	6	6	8
>N	13	16	12	14	18
<MP	4	6	7	7	5
<N	24	21	25	23	19

The constituents that are in the >MP category in at least one zone are:

- Fluoride
- Nitrate
- Boron
- Chromium VI
- Mercury
- Neptunium-237
- Strontium-90
- Technetium-99
- Total Uranium
- 1,2-Dichloroethane.

These constituents are considered to be the master short-list of indicator parameters from which zone-specific short-lists will be developed. These short-list parameters will be monitored more frequently than the other constituents in order to track the overall success and progress of the remedy. These parameters have been detected in the aquifer at concentrations above their established FRL and they are both mobile and persistent.

Each of the four categories of constituents will be targeted for monitoring at the following frequency:

- **>MP** Are to be monitored quarterly in source areas and at the property boundaries because they have been detected in the Great Miami Aquifer above their established FRL and are considered mobile and persistent.

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- >N Are to be monitored annually in source areas and at the property boundaries because they have been detected in the Great Miami Aquifer above their established FRL and because they are not considered mobile and persistent.

- <MP Are to be monitored annually because they have not been detected in the Great Miami Aquifer above their established FRL and because they are considered mobile and persistent.

- <N Will be monitored every five years to verify that these lowest-priority FRL constituents remain below their established FRL.

Exception:

- The constituents with the >MP characteristic in the two areas where groundwater cleanup is not expected to begin in the next five years (Plant 6 and Waste Storage Area modules) will be monitored semi-annually instead of quarterly. The frequency will be increased to quarterly one year before the groundwater remediation begins in these areas.

Parameter lists for the monitoring modules/programs were developed using Columns 5 through 9 of Table 3-2. These module-/program-specific parameter lists can be found in Section 3.5.1 and 3.5.2 of the IEMP. Columns 5 through 9 indicate how constituents have been categorized for each aquifer zone. Specific monitoring modules and programs fall in one or more of these zones as follows:

- South Plume/South Plume Optimization Module is located in Zones 2 and 4
- South Field/Injection Demonstration Modules are located in Zone 2
- Waste Storage Area Module is located in Zone 1
- Plant 6 Area Module is located in Zone 3
- RCRA Boundary Monitoring Program monitors downgradient of Zones 0 through 3.

Exceptions:

- KC-2 Warehouse, private well monitoring, and on-site disposal facility monitoring programs and Paddys Run Road Site Activity of the South Plume/South Plume Optimization Module have established parameter lists that were put together to meet specific objectives.

3.4.2.4 Model Verification

Because the remedy design and expected performance are based on predictions made with the FEMP's groundwater model, the monitoring program will need to evaluate the predictive capabilities of the model through an ongoing model verification process. Field data will be collected and assessed to verify model predictions.

Groundwater modeling is used to predict water-table elevations and the behavior of contaminants in the aquifer under various future aquifer remediation scenarios. Assessing the performance of the model will be a relatively straightforward task of comparing field data with modeling predictions over the course of the restoration (Figure 3-7).

Modeling predictions of flow will be routinely verified by measuring water levels at various locations throughout the aquifer and comparing the results against predicted water levels. If the field values match the predicted values, capture and control of fluid movement is behaving as predicted by the model.

Predicted contaminant concentration profiles over time will be verified by using water quality data collected from designated monitoring wells. The modeling predictions of concentrations through time at various monitoring points will be compared to actual field conditions to determine if concentrations are being lowered as the model predicts. Field data will be used to determine when pumping adjustments need to be initiated. The groundwater model has been used initially to design pumping strategies and will be used to design system operational changes throughout the life of the remediation. If the field data shows a discrepancy with the model predictions, the model parameters will be adjusted with the additional information from the monitoring network and the model will be rerun. The results of the updated model and the monitoring data will be used then to determine if the system as a whole is meeting design objectives. If the system is not meeting design objectives, the updated model will be used to define the necessary changes that will be made to the remediation system and the accompanying monitoring program.

3.5 DESIGN OF THE IEMP GROUNDWATER MONITORING PROGRAM

Groundwater monitoring to assess performance of the aquifer remedy and to maintain an understanding of contaminant conditions in the aquifer where active remediation has not yet begun is organized around the individual restoration modules that will be used to implement the aquifer remedy:

- The South Plume/South Plume Optimization Module (Section 3.5.1.1)
- The South Field Extraction System Module (Section 3.5.1.2)
- The Injection Demonstration Module (Section 3.5.1.3)
- The Waste Storage Area Module (Section 3.5.1.4)
- The Plant-6 Area Module (Section 3.5.1.5).

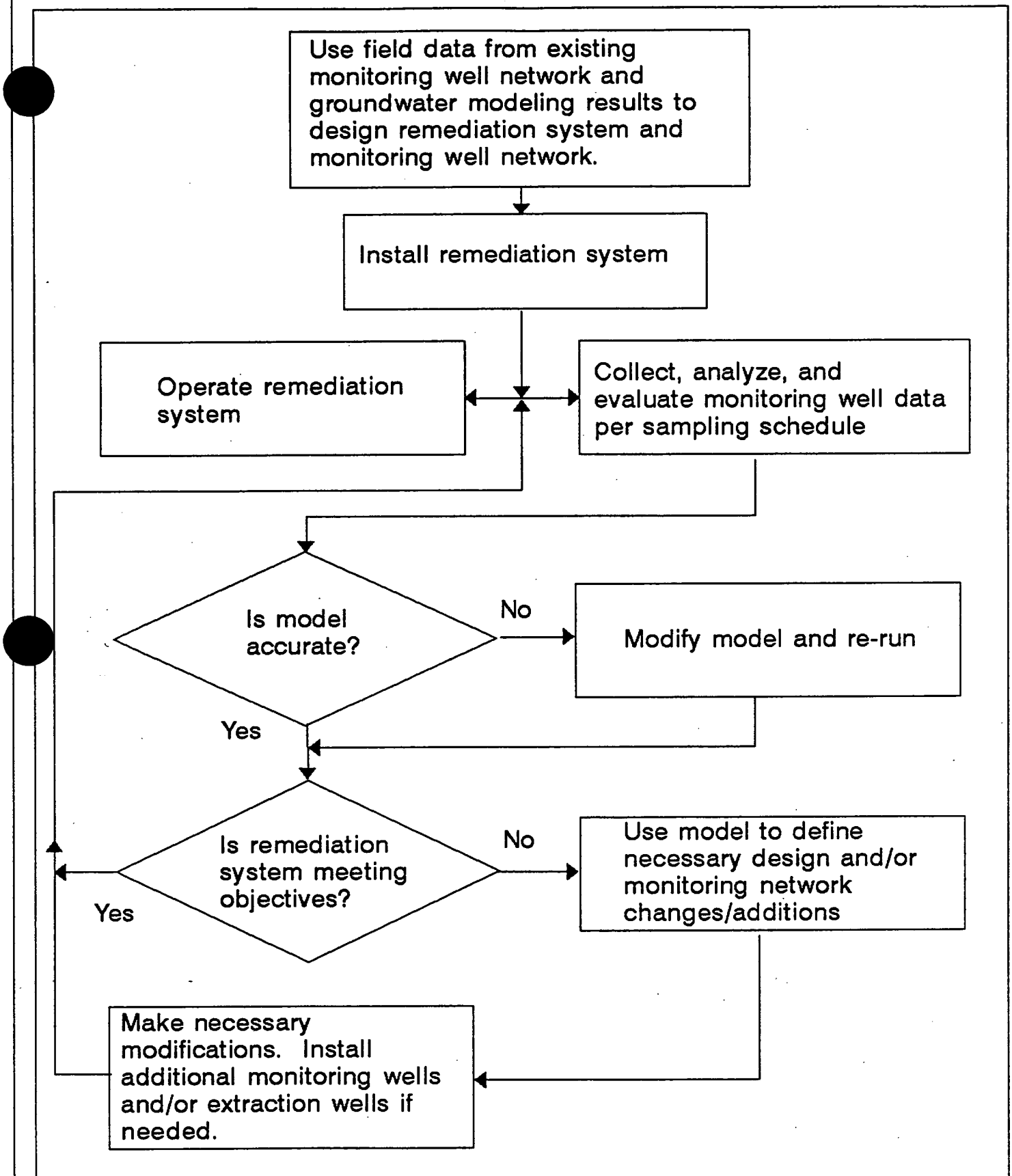


FIGURE 3-7. MODELING PERFORMANCE EVALUATION PROCESS

Performance monitoring will be conducted by monitoring each individual remediation module separately and by assessing the impact of individual modules on the total remediation system. Performance monitoring will be an expansion of the existing DMEPP (DOE 1993c) concept that is currently in place for the South Plume Module. In effect, the DMEPP strategy and technical approach will be expanded to encompass each of the new groundwater extraction and injection modules that will be brought on line over the life of the remedy.

A water-level monitoring program which encompasses all of the module areas (presented in Section 3.5.1.6) will be conducted to assess how the individual modules interact with one another to capture contaminants in the aquifer.

Groundwater monitoring to meet compliance-based monitoring obligations is organized into individual programs:

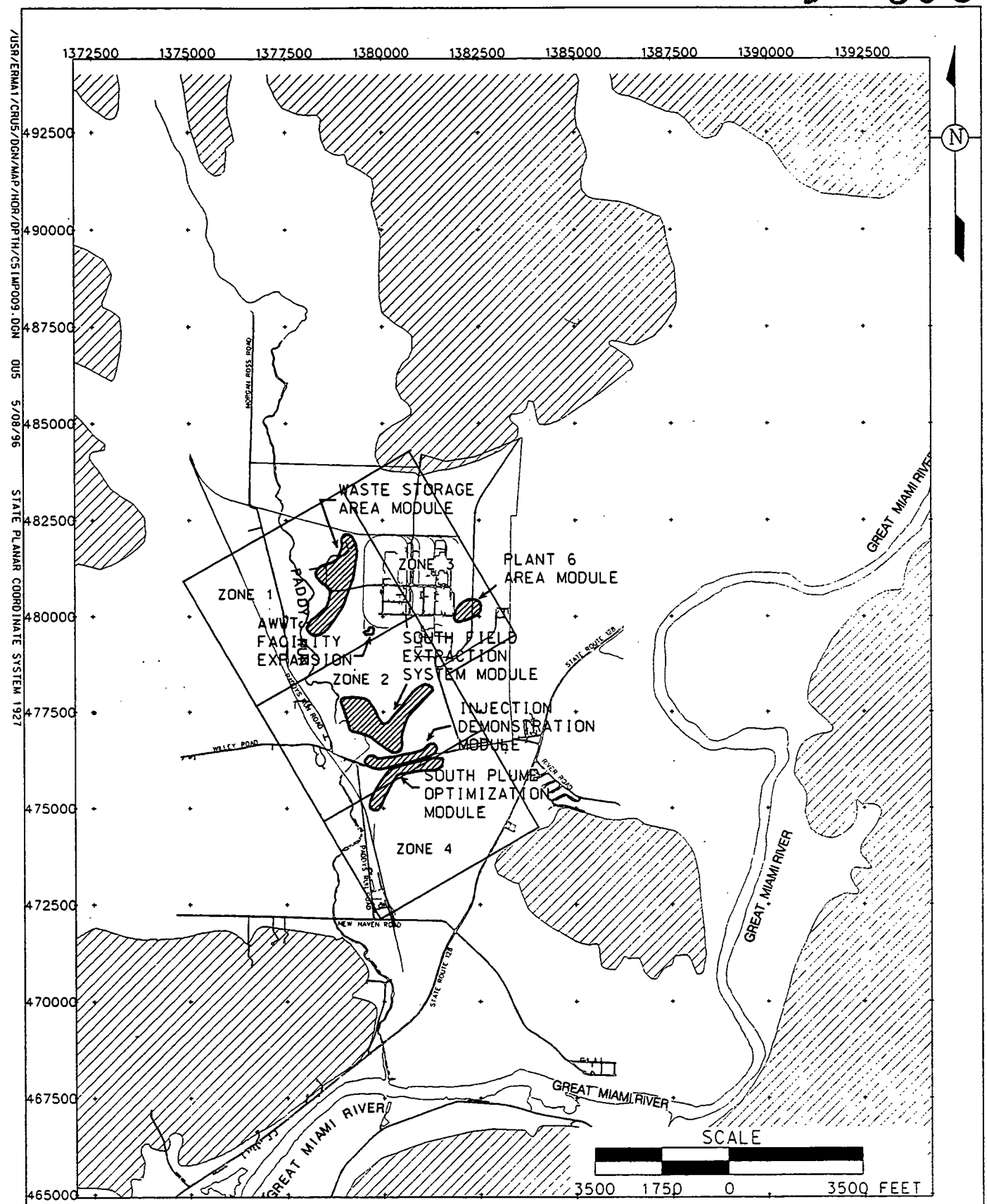
- The Private Well Monitoring Program, Section 3.5.2.1
- The RCRA Boundary Monitoring Program, Section 3.5..2.2
- The KC-2 Warehouse Monitoring Program, Section 3.5.2.3
- The On-Site Disposal Facility Monitoring Program, Section 3.5.2.4.

For modeling and monitoring purposes, the uranium groundwater plume was divided into five zones referred to as aquifer zones, Figure 3-8. These zones identify the geographic areas where each of the respective remediation modules will have the greatest impact. Four of the five zones (Zones 1 through 4) contain remediation modules. Zone 0 (the fifth zone) is the area outside the other four zones. The location of the restoration modules is as follows:

- The South Plume/South Plume Optimization Module is located in Zones 2 and 4
- The South Field Extraction and Injection Demonstration Modules are located in Zone 2
- The Waste Storage Area Module is located in Zone 1
- The Plant-6 area module is located in Zone 3.

3.5.1 Groundwater Restoration Module Monitoring for 1997 and 1998

During 1997, only the existing South Plume wells will be pumped. During 1998, the South Plume Optimization Wells, the South Field Extraction Wells, and the Injection Demonstration Wells will begin operation. Therefore, groundwater monitoring for remedy performance during fiscal years 1997 and 1998 will focus on tracking the progress of the South Field Extraction System



LEGEND:

— · — · — FEMP BOUNDARY

NOTE:
SHADED AREAS REPRESENT GEOGRAPHIC LOCATIONS WITHIN WHICH EXTRACTION AND/OR INJECTION WELLS ARE PLANNED
ZONE 0 CONSISTS OF ALL AREAS OUTSIDE ZONES 1, 2, 3, AND 4.

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FIGURE 3-8. GROUNDWATER MONITORING ZONES

Module, the Injection Demonstration Module, and South Plume area restoration Module. The performance monitoring will be based on the South Plume monitoring strategy which has evolved since system start up in August 1993 as a result of the operational experience with the South Plume extraction system.

3.5.1.1 South Plume and South Plume Optimization Modules

The South Plume and South Plume Optimization Modules are located in aquifer Zones 2 and 4 (Figure 3-8). Aquifer Zone 4 is located mostly south of FEMP property. Pumping from these modules will also effect the southern portion of aquifer Zone 2. The aquifer in this area is contaminated with a uranium plume that resulted from infiltration through Paddys Run where contaminants were carried southward and eastward into the aquifer (Figure 3-2). Remediating this off-property uranium plume and preventing it from mixing with a separate non-FEMP plume, located further to the south (Paddys Run Road Site Plume), is a high priority of the Aquifer Restoration Project. As explained in Section 3.3, an administrative boundary has been established between the FEMP and Paddys Run Road Site contaminant plumes. Groundwater monitoring to assess the area of uranium contamination (above 20 μg/l) south of the FEMP administrative boundary, and to determine the impact that pumping from the South Plume Extraction wells has on the Paddys Run Road Site Plume will continue until the need for action is established and implemented.

Four groundwater monitoring activities will be conducted during 1997 and 1998 in the South Plume/South Plume Optimization Module area to:

- Document the amount of uranium that is being removed from the aquifer through the extraction wells and determine the efficiency of the extraction wells in removing uranium from the aquifer (Activity 1)
- Document the effectiveness of the pumping in maintaining a hydraulic barrier that limits the further southern migration of the uranium plume and document the area of uranium contamination (above 20 μg/L) south of the administrative boundary (Activity 2)
- Begin to document how other FRL constituent concentrations within the uranium plume are being reduced by the pumping effort. Monitoring the concentration of other FRL constituents in the uranium plume north of the administrative boundary (defined in Section 3.3) currently is not performed in the DMEPP (Activity 3)
- Document the degree to which the Paddys Run Road Site Plume is being affected by the operation of the South Plume System (Activity 4).

Groundwater monitoring for the existing system is currently conducted according to the South Plume Groundwater Recovery System Design, Monitoring, and Evaluation Program Plan (DOE 1993c) as amended in subsequent south plume removal action design, monitoring, evaluation program plan system evaluation reports. This program plan has proven successful at the FEMP in monitoring the uranium plume so the monitoring strategies and data evaluation processes described in this plan will be expanded and used during the active aquifer restoration, not only for the South Plume but for the other restoration modules, as well.

During 1997 and 1998, 57 existing monitoring wells will continue to be monitored in the South Plume area. Data collected from many of the wells will be used to address more than one monitoring objective. The wells that will be monitored, frequency of sampling, and the corresponding activity for which the monitoring is being conducted are presented in Table 3-3. During 1997 and 1998, as is currently done in the DMEPP, uranium will continue to be monitored monthly in the four extraction wells (Activity 1, Table 3-3). Table 3-3 lists the 4 existing extraction wells. In 1998 the system will be optimized and additional extraction wells will also be monitored. The locations of the existing extraction wells are shown in Figure 3-9.

Currently water samples are collected quarterly from 57 monitoring wells and analyzed for total uranium. These same 57 wells will continue to be sampled in 1997 and 1998 for the IEMP. A list of the 57 wells that will be sampled is presented in Table 3-3 under Activity 2. The locations of the 57 monitoring wells are shown in Figure 3-9. Eight of these 57 monitoring wells (wells 2881, 3881, 2897, 3897, 2093, 3093, 2898, and 3898) north and east of the current extraction system historically have shown uranium concentrations, well below the uranium FRL, with no significant increasing trends. The IEMP proposes that these wells be sampled annually for uranium instead of quarterly.

Beginning in 1997 with the start of the IEMP, an additional monitoring activity will begin that will document how the concentration of other FRL constituents within the uranium plume are being reduced by the restoration effort. Groundwater samples will be collected from 26 of the 57 wells that are being sampled for uranium and analyzed for 31 constituents other than uranium. The wells that will be sampled are listed in Table 3-3 under Activity 3. The locations of the 26 wells are shown in Figure 3-10. The 31 constituents are those which have been categorized as >MP, <MP, or >N in

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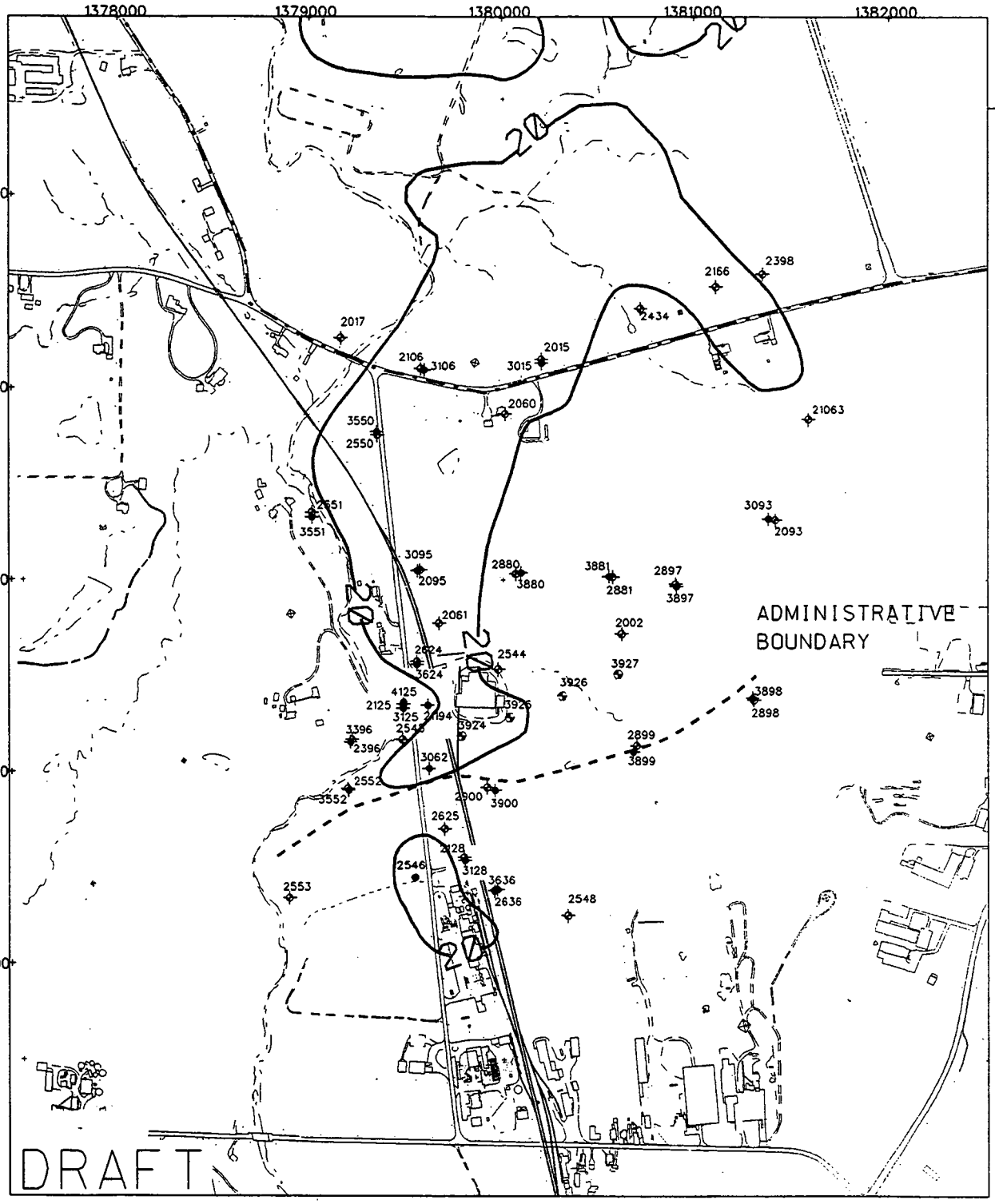

LEGEND:

- FEMP BOUNDARY
- 3900 — TYPE 3 MONITORING WELL
- 2900 — TYPE 2 MONITORING WELL
- 3926 — EXTRACTION WELL
- 20 — ISOCONCENTRATION CONTOUR (μg/L)

BASED ON 1993 SNAPSHOT DATA

SCALE: 800 400 0 800 FEET

FIGURE 3-9. SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULES PERFORMANCE MONITORING AND EXTRACTION WELLS, ACTIVITY 2

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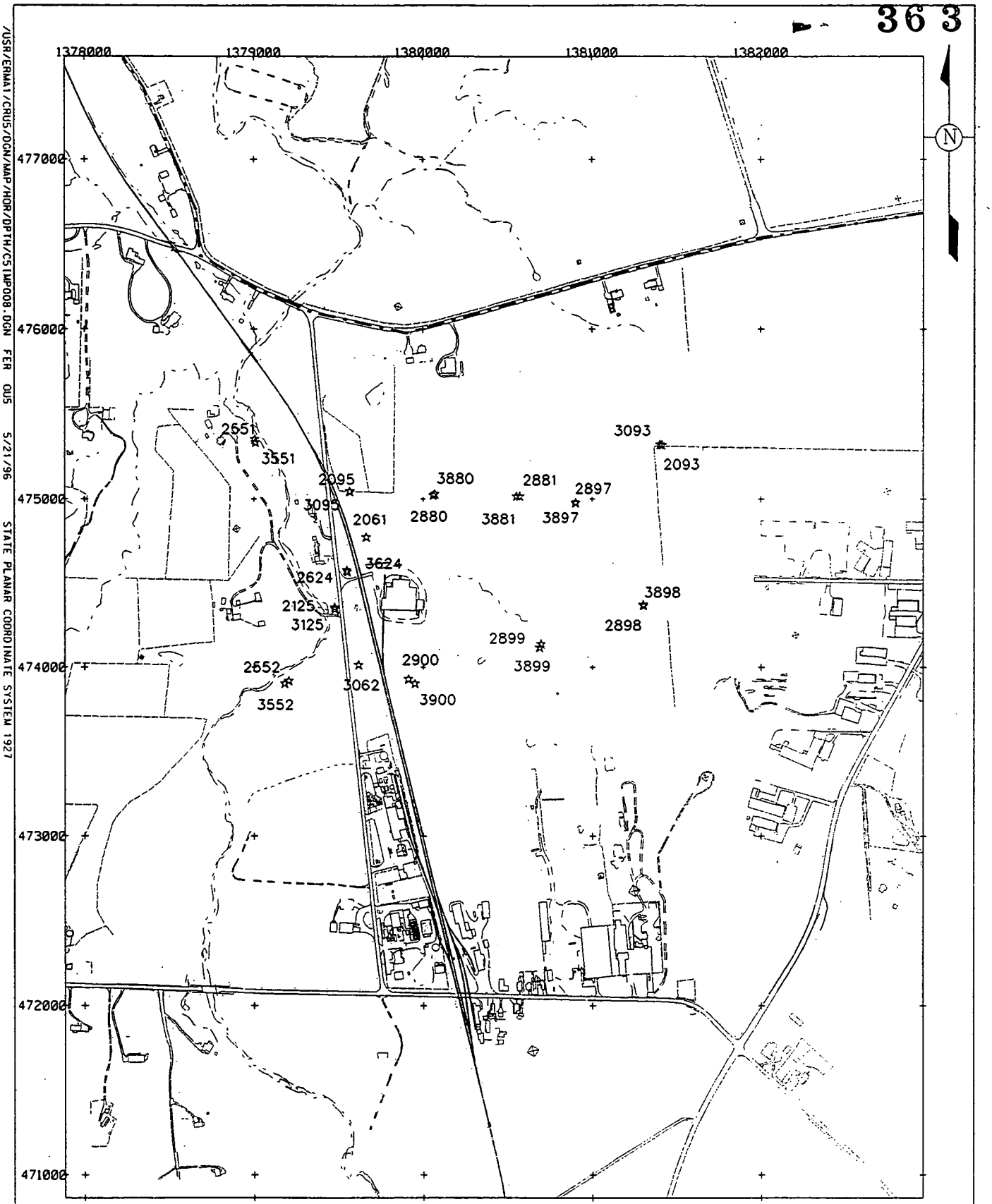

FIGURE 3-10. SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULE MONITORING WELLS, ACTIVITY 3

TABLE 3-3

SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULE

		Sampling Frequency			
		Monitor Uranium in Extraction Wells	Monitor Uranium Across Module Area	Monitor Other Target FRL Constituents Across Module Area	Monitor PRRS Constituents
Well No.	Well ID	Activity 1	Activity 2	Activity 3	Activity 4
1	2002		Quarterly		
2	2015		Quarterly		
3	2017		Quarterly		
4	2060		Quarterly		
5	2061		Quarterly	Quarterly	
6	2093		Annually	Quarterly	
7	2095		Quarterly	Quarterly	
8	2106[a]		Quarterly		
9	2125		Quarterly	Quarterly	
10	2128		Quarterly		Quarterly
11	2166		Quarterly		
12	2396		Quarterly		
13	2398[a]		Quarterly		
14	2434[a]		Quarterly		
15	2544		Quarterly		
16	2545		Quarterly		
17	2546		Quarterly		
18	2548		Quarterly		Quarterly
19	2550		Quarterly		
20	2551		Quarterly	Quarterly	
21	2552		Quarterly	Quarterly	
22	2553		Quarterly		
23	2624		Quarterly	Quarterly	
24	2625		Quarterly		Quarterly
25	2636		Quarterly		Quarterly
26	2880		Quarterly	Quarterly	
27	2881		Annually	Quarterly	
28	2897		Annually	Quarterly	
29	2898		Annually	Quarterly	Quarterly
30	2899		Quarterly	Quarterly	Quarterly

TABLE 3-3
(Continued)

		Sampling Frequency			
		Monitor Uranium in Extraction Wells	Monitor Uranium Across Module Area	Monitor Other Target FRL Constituents Across Module Area	Monitor PRRS Constituents
31	2900		Quarterly	Quarterly	Quarterly
32	3015		Quarterly		
33	3062		Quarterly	Quarterly	
34	3093		Annually	Quarterly	
35	3095		Quarterly	Quarterly	
36	3106[a]		Quarterly		
37	3125		Quarterly	Quarterly	
38	3128		Quarterly		Quarterly
39	3396		Quarterly		
40	3550		Quarterly		
41	3551		Quarterly	Quarterly	
42	3552		Quarterly	Quarterly	
43	3624		Quarterly	Quarterly	
44	3636		Quarterly		Quarterly
45	3880		Quarterly	Quarterly	
46	3881		Annually	Quarterly	
47	3897		Annually	Quarterly	
48	3898		Annually	Quarterly	Quarterly
49	3899		Quarterly	Quarterly	Quarterly
50	3900		Quarterly	Quarterly	Quarterly
51	3924	Monthly	Quarterly		
52	3925	Monthly	Quarterly		
53	3926	Monthly	Quarterly		
54	3927	Monthly	Quarterly		
55	4125		Quarterly		
56	21063		Quarterly		
57	21194		Quarterly		

[a]These wells are sampled under the RCRA Boundary Monitoring Program. The data are also used for the South Plume/South Plume Optimization Module.

Zones 2 and 4. The 31 constituents are listed below. Section 3.4.2.3 and Appendix A provide additional information on the parameter selection process. The 7 >MP constituents will be analyzed quarterly and the 19 >N, and 5 <MP constituents will be analyzed annually.

LIST OF CONSTITUENTS THAT WILL BE ANALYZED IN THE SOUTH PLUME MONITORING WELLS FOR ACTIVITY 3

Constituents Categorized as >MP Shown in **Bold** are Analyzed Quarterly
Other Constituents are Analyzed Annually

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony	**Neptunium-237**	Alpha-Chlordane
Nitrate/Nitrite	Arsenic	Radium-226	Bromodichloromethane
	Barium	**Strontium-90**	Carbon Disulfide
	Beryllium	Technetium-99	1,1-Dichloroethene
	Boron	Thorium-228	**1,2-Dichloroethane**
	Cadmium	Thorium-232	Trichloroethene
	Total Chromium		Vinyl Chloride
	Cobalt		
	Lead		
	Manganese		
	Mercury		
	Nickel		
	Selenium		
	Silver		
	Vanadium		
	Zinc		

The well locations shown in Figure 3-10 were selected to provide good areal coverage around the existing South Plume extraction wells. These locations provide a line of monitoring wells north and south of the existing South Plume extraction wells. The intent of this monitoring is to determine the effect the pumping is having on these constituents, and to define better which of the constituents need to be monitored for the duration of the aquifer restoration.

As discussed in Appendix A, Groundwater Monitoring Parameter Selection, several of these constituents have been categorized as having FRL exceedances in the aquifer. Some of the FRLs were based on aquifer background values which could be overly conservative. A formal Operable Unit 5 activity identified in the Operable Unit 5 Remedial Design Work Plan, the Restoration Verification Sampling (DOE 1996b), will be conducted to define better how these FRL exceedances

fit into the aquifer restoration effort. After this evaluation is completed, a determination will be made as to whether or not this sampling effort needs to be modified.

The South Plume and South Plume Optimization Modules will continue to pump groundwater from the aquifer immediately north of the Paddys Run Road Site, and it remains important to document the influence that the pumping is having on the Paddys Run Road Site plume. Groundwater samples are currently collected quarterly from 12 monitoring wells and analyzed for Paddys Run Road Site constituents as part of the DMEPP. Groundwater samples are also currently collected weekly from seven wells (2128, 2548, 2625, 2636, 2900, 3924 and 3925) and analyzed for arsenic. Arsenic sampling was increased to weekly after it was determined that changes to the flow rates in wells 3924 and 3925 effected the arsenic concentrations. Enough data has been collected to determine that as long as wells 3924 and 3925 are pumped at 300 gpm each or less, arsenic concentrations are relatively stable. It is recommended that starting in 1997 sampling for arsenic be returned to a quarterly frequency. Therefore, the current monitoring to analyze for Paddys Run Road Site constituents quarterly will continue during 1997 and 1998. The 12 wells which are being sampled quarterly in 1996 are listed in Table 3-3 under Activity 4. The locations of the monitoring wells are shown in Figure 3-11. The Paddys Run Road Site constituent list used in 1996 will be carried over into 1997 and 1998. The constituent list presented below represents Paddys Run Road Site constituents to be monitored for.

LIST OF PADDYS RUN ROAD SITE CONSTITUENTS THAT WILL BE ANALYZED FOR ACTIVITY 4

All Constituents Analyzed Quarterly

General Chemistry	Inorganic	Radionuclide	Organic
Phosphorus	Arsenic		Benzene
	Potassium		Ethyl Benzene
	Sodium		Isopropyl Benzene
			Toluene
			Total Xylene

3.5.1.2 South Field Extraction System Monitoring Module

The South Field Extraction System is located in aquifer Zone 2 (Figure 3-8). The aquifer in this area is contaminated with a uranium plume which resulted from infiltration of contamination through the South Field Inactive Flyash Pile, Paddys Run and the Storm Sewer Outfall Ditch (Figure 3-2). The

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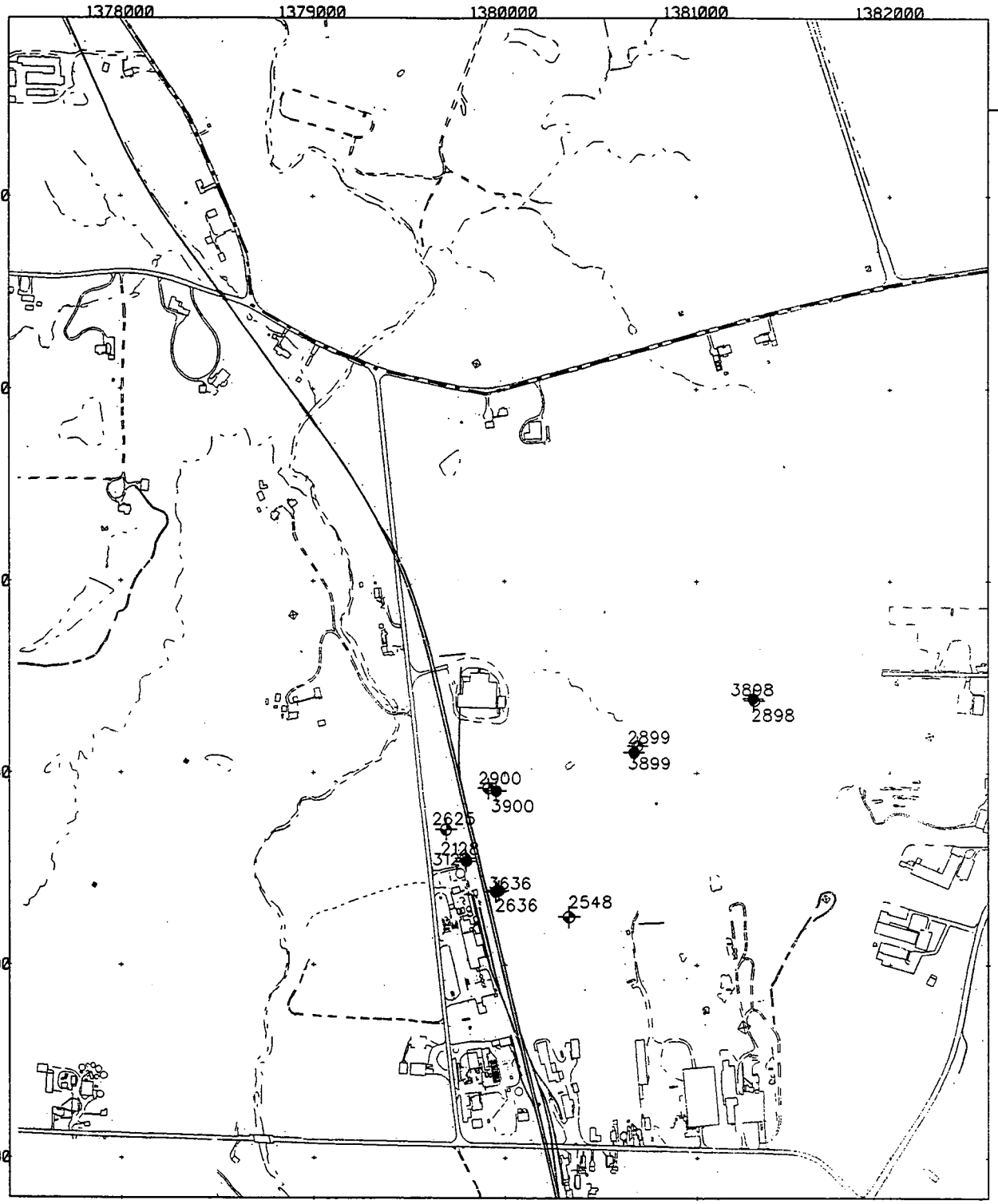

LEGEND:

- FEMP BOUNDARY
- 3900 TYPE 3 MONITORING WELL
- 2900 TYPE 2 MONITORING WELL
- 3926 EXTRACTION WELL

SCALE

800 400 0 800 FEET

DRAFT

FIGURE 3-11. SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULES MONITORING WELLS. ACTIVITY 4

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source of contamination in the glacial overburden and wastes within the southfield inactive and active flyash piles in this area will be remediated through the Soil Characterization and Excavation Program beginning in 1998. Unlike the South Plume Area, restoration of the aquifer in this area has not yet begun. It is scheduled to begin in 1998 when nine extraction wells will begin pumping around the planned excavation area and near the Storm Sewer Outfall Ditch (South Field Extraction System) (Figure 3-5).

Groundwater monitoring during 1997 and part of 1998, before pumping begins, will be conducted to:

- Document water quality changes that may be occurring in the aquifer that could impact the design or start-up of the South Field Extraction system
- Verify contamination conditions within the aquifer immediately before the start of pumping.

In 1998, after pumping has begun, groundwater monitoring will be conducted to:

- Document the amount of uranium that is being removed from the aquifer through the extraction wells
- Determine the efficiency of the pumping wells in removing uranium from the aquifer
- Document that contaminant concentrations in the area of the extraction wells are decreasing as planned.

Twenty existing monitoring wells were selected to monitor the South Field Extraction area in 1997 and 1998. The 20 wells are listed below and shown in Figure 3-12.

LIST OF SOUTH FIELD EXTRACTION SYSTEM MONITORING WELLS

2014	2045	2049	2068	2385	2386	2387	2390
2397	2402	3014	3045	3049	3068	3385	3387
3390	3397	3402	21033				

These existing monitoring wells are located along the storm sewer outfall ditch; a few of the wells are located along the northern edge of the excavation area. All 20 wells are located outside of the surface

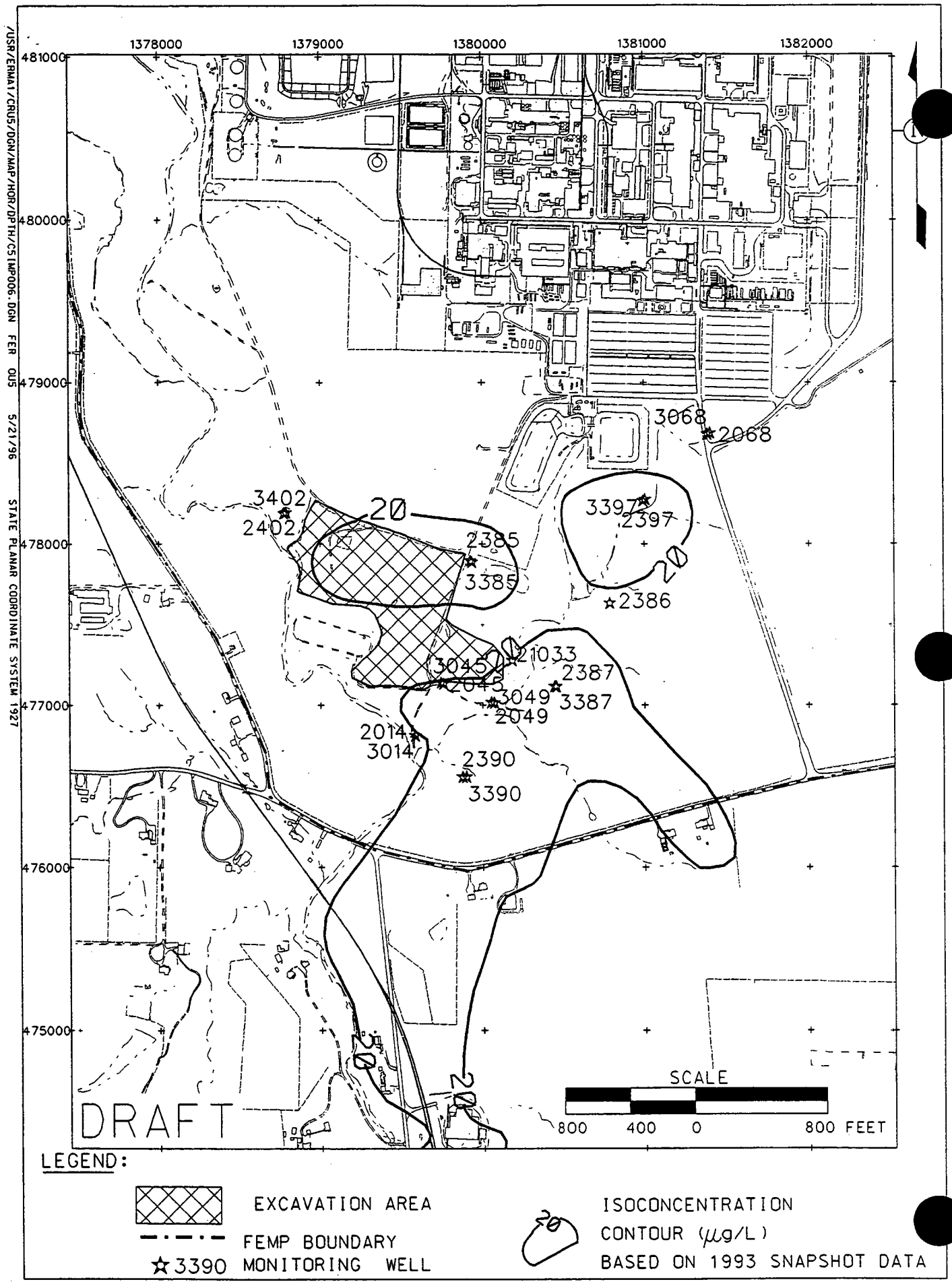

FIGURE 3-12. SOUTH FIELD/EXTRACTION MODULE MONITORING WELLS

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excavation area. Once the South Field Extraction module becomes operational and the Operable Unit 2 wastes are removed, it is anticipated that additional monitoring wells will need to be installed to help track the restoration. So that new monitoring wells can be installed in the most useful locations, the selection of new locations will be delayed until some operational experience has been obtained.

Surface excavation activities will be ongoing in 1997 and 1998, so existing monitoring wells located in the excavation areas cannot be used for groundwater monitoring. The excavation area is shown in Figure 3-12. Existing monitoring wells in the excavation areas will need to be plugged and abandoned to make way for excavation activities. Once excavation activities are completed, it is anticipated that new monitoring wells will be installed in the former excavation area and added to the monitoring program as needed to track the performance of the groundwater remedy.

Groundwater monitoring will focus on FRL constituents that have been detected in Zone 2 of the Great Miami Aquifer at concentrations that are above their established FRL, and FRL constituents that are predicted to migrate from the glacial overburden to the aquifer due to their mobility and persistence (Table 3-2). Section 3.4.2.3 and Appendix A provide additional information on the parameter selection process. Groundwater samples will be collected quarterly and analyzed for the six constituents categorized as >MP in Zone 2 (see Table 3-2). These constituents have been detected in the Great Miami Aquifer at concentrations above the FRL and are mobile and persistent. The six constituents are listed in bold type in the list presented below. 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 12 constituents categorized as >N and the seven constituents categorized as <MP in Zone 2. A yearly sampling frequency was selected for these constituents because they are less mobile (>N) or not currently present in the aquifer (<MP) above their FRL.

LIST OF CONSTITUENTS WHICH WILL BE ANALYZED IN THE SOUTH FIELD EXTRACTION SYSTEM MONITORING WELLS

Constituents Categorized as > MP Shown in **Bold** are Analyzed Quarterly
Other Constituents are Analyzed Annually

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

When the South Field Extraction wells begin operation, uranium samples will be collected from the nine extraction wells (Wells 31550, 31560, 31561, 31562, 31563, 31564, 31565, 31566, and 31567) to determine flow rates and to manage water treatment flow. An Operations and Maintenance Plan for the South Field Extraction System (to be submitted to the EPA in July 1997) will control sampling during the start-up phase of the pumping operation. Once the start-up phase has been completed, the extraction wells will be sampled monthly for total uranium to monitor system performance, as is currently done for the South Plume System.

3.5.1.3 Injection Demonstration Monitoring Module

The Injection Demonstration Module is located in aquifer Zone 2 (Figure 3-8). The aquifer in this area is contaminated with a uranium plume that resulted from infiltration of contamination through Paddys Run and the storm sewer outfall ditch (Figure 3-2). Restoration of the aquifer in this area has not yet begun. It is scheduled to begin in 1998 when five injection wells will begin injection along the Southern FEMP property boundary (Injection Demonstration Module) (Figure 3-5).

Groundwater monitoring during 1997 and part of 1998 (before injection begins), will be conducted to:

- Document water quality changes that may be occurring in the aquifer that could impact the design or start-up of the Injection Demonstration Module

- Document contamination conditions within the aquifer immediately before the start of injection.

In 1998, after injection has begun, groundwater monitoring will be conducted to determine if injection is causing undesirable spreading of the plume either laterally or vertically.

Nine of the RCRA boundary monitoring system wells (Wells 2106, 3106, 2434, 3069, 2398, 3398, 4398, 2070, and 3070) are located in the same area where the Injection Demonstration Module will be installed (Figure 3-17). These 9 RCRA boundary monitoring wells will be used to monitor the Injection Demonstration Module area in 1997 and 1998. The total uranium data collected quarterly from these RCRA boundary wells will be used to document pre-injection plume conditions in the Injection Demonstration area. Details on the RCRA boundary well monitoring program are presented in Section 3.5.2.2.

Once the Injection Demonstration Module becomes operational, it is anticipated that additional monitoring wells may need to be installed to help track the injection process. So that new monitoring wells can be installed in the most useful location, the selection of any new locations will be delayed until some operational experience has been obtained.

3.5.1.4 Waste Storage Area Monitoring Module

The Waste Storage Area is located in aquifer Zone 1 (Figure 3-8), which contains a uranium plume that has been targeted for restoration (Figure 3-13). The Waste Storage Area Module is not scheduled to be operational until year eight of the aquifer remediation. The installation of the system will begin after the source which rests above the aquifer have been remediated. Until pumping actually begins in this area, water quality conditions need to be monitored to document water quality changes that may be occurring in the aquifer which could impact the design and installation of the restoration module. In the waste storage area, groundwater samples will be collected from 12 locations along the downgradient edge of the waste pit excavation area and from the 20 μg/L total uranium plume. Monitoring locations are listed below and shown in Figure 3-13.

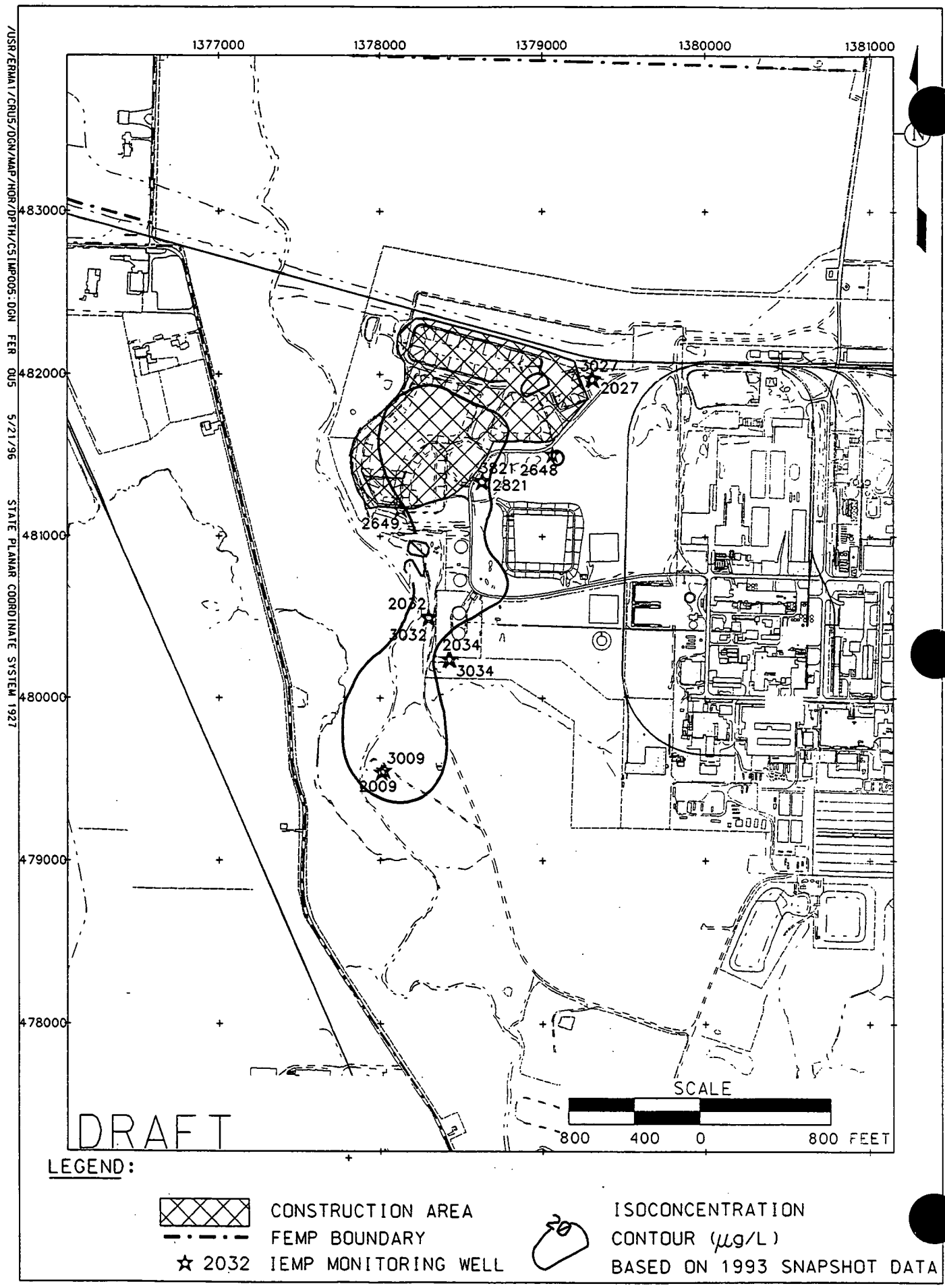

FIGURE 3-13. WASTE STORAGE AREA MODULE MONITORING WELLS

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LIST OF WASTE STORAGE AREA MONITORING WELLS

2009	2027	2032	2034	2821	2648
3009	3027	3032	3034	3821	2649

Wells 2027, 3027, 2648, 2821, 3821, and 2649 are positioned downgradient from various portions of the waste storage area. Wells 2032, 3032, 2034, and 3034 were selected for monitoring because they are close to the Operable Unit 4 area. If a release occurs during excavation of these silos, these wells are in a good position to detect it. Finally, wells 2009 and 3009 were selected because they are located in the southern tip of the >20 μg/L uranium plume that is present in the waste storage area.

Water samples will be collected semi-annually from the 12 locations and analyzed for the seven constituents which have been characterized as >MP in this area (Zone 1). In addition, samples will be collected annually from the 12 locations and analyzed for the 16 constituents characterized as >N and the six constituents categorized as <MP in Zone 1 (Table 3-2). Section 3.4.2.3 and Appendix A provide additional information on the parameter selection process. Since no active pumping will be taking place in the area and the restoration module will not be installed for several years, semi-annual monitoring should be adequate to monitor conditions. It is anticipated that a year or two before the Waste Storage Area Module becomes operational, the frequency of the seven >MP constituents will be increased to quarterly. The 29 constituents to be monitored in this area are listed below. The <N constituents will be sampled once every five years.

LIST OF CONSTITUENTS WHICH WILL BE ANALYZED IN THE WASTE STORAGE AREA MONITORING WELLS

Constituents Categorized as >MP Shown in **Bold** are Analyzed Semi-Annually
All Other Constituents are Analyzed Annually

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

3.5.1.5 Plant 6 Area Monitoring Module

The Plant 6 Area is located in Aquifer Zone 3 (Figure 3-8). This area contains a uranium plume that is targeted for restoration (Figure 3-14). The Plant 6 Area Module is not scheduled to be operational until year eight of the aquifer remediation. The installation of this system will begin after the source which rests above the aquifer has been remediated. Until pumping actually begins in this area, water quality conditions need to be monitored to document water quality changes that may be occurring in the aquifer which could impact the design and installation of the restoration module.

In the Plant 6 area, water samples will be collected in 1997 and 1998 annually from 4 locations which encircle the area where the Plant 6 extraction wells will be installed. Monitoring locations are listed below and shown in Figure 3-14.

LIST OF PLANT 6 AREA MONITORING WELLS

2054	2118	2389	3054

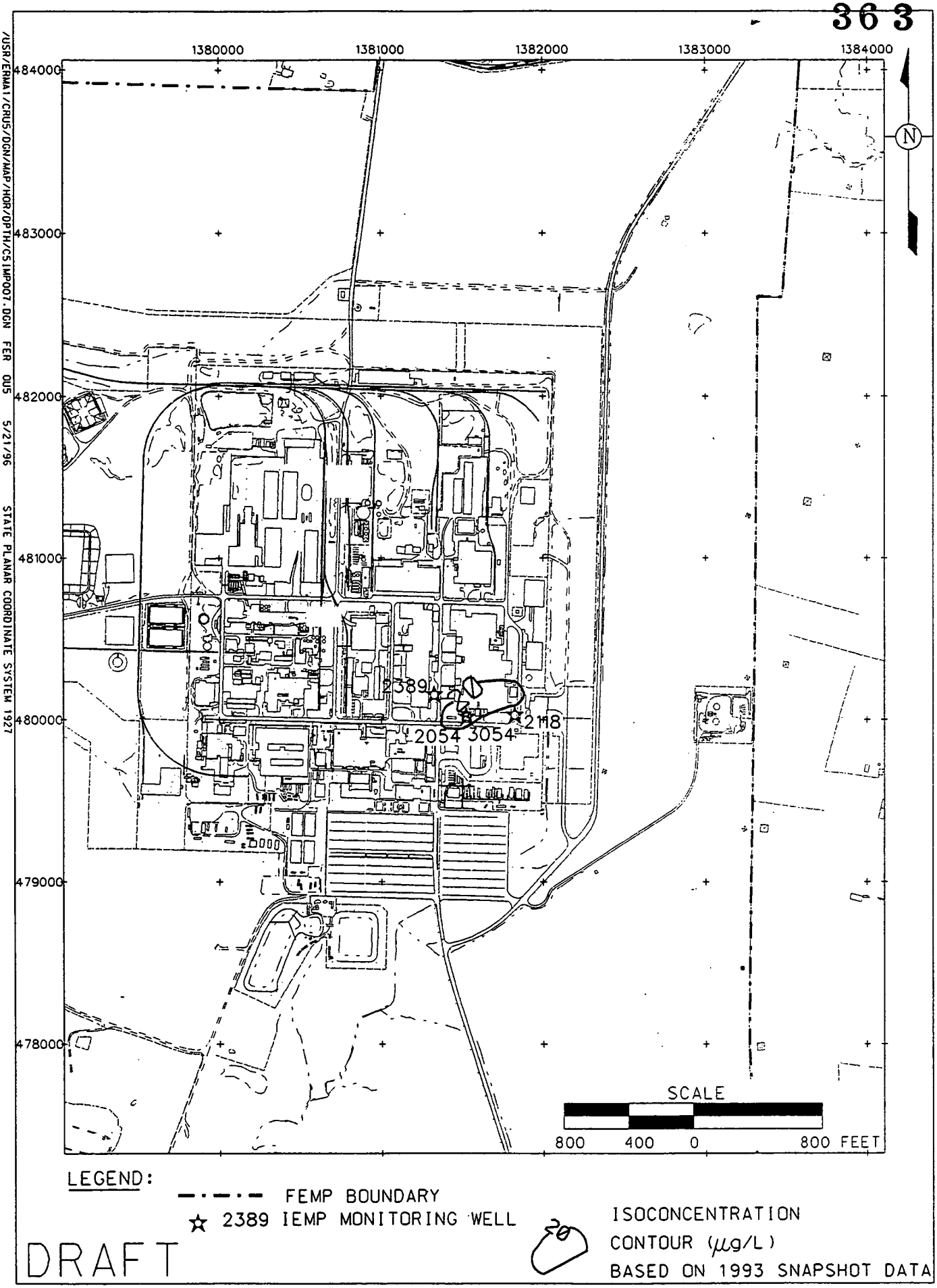


FIGURE 3-14. PLANT 6 AREA MODULE MONITORING WELLS

Water samples will be collected semi-annually from the 4 locations and analyzed for the six constituents which have been characterized as >MP in Zone 3. In addition, samples will be collected annually from the 4 locations and analyzed for the 14 constituents characterized as >N and the seven constituents categorized as <MP in Zone 3 (Table 3-2). Section 3.4.2.3 and Appendix A provide additional information on the parameter selection process. Since no active pumping will be taking place in the area and the restoration module will not be installed for several years, semi-annual monitoring should be adequate to monitor contamination conditions. It is anticipated that a year or two before the Plant 6 Area Module becomes operational, the frequency of the six >MP analyses will be increased to quarterly. The 27 constituents to be monitored in this area are listed below.

LIST OF CONSTITUENTS WHICH WILL BE SAMPLED IN THE PLANT 6 AREA MONITORING WELLS

Constituents Categorized as >MP Shown in **Bold** are Analyzed Semi-Annually
All Other Constituents Analyzed Annually

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

3.5.1.6 Routine Water-Level Monitoring Program

The location of the water-table in the Great Miami Aquifer and the water-table response to seasonal fluctuations has been well characterized in the Operable Unit 5 Remedial Investigation Report. Water-level data have been collected routinely for the FEMP since 1988. Water-level data are used

to determine groundwater flow and direction. This is accomplished by preparing hydrographs and maps of the water-level surface in the Great Miami Aquifer. During the remediation phase of the CERCLA process, water levels will be monitored across the site to assess the effects of extraction and injection operations on flow conditions within the Great Miami Aquifer.

The Great Miami Aquifer is an unconfined aquifer and responds rapidly to recharge events. Data collected at the FEMP and reported in the Operable Unit 5 Remedial Investigation Report documents that no strong vertical gradients exist in the area of the FEMP. Therefore, water level monitoring during the remediation will use wells that are screened at the water table surface (i.e., 2000 series wells).

The monitoring wells which were selected for water level monitoring in 1997 and 1998 are shown in Figure 3-15 and listed below.

LIST OF GROUNDWATER ELEVATION MONITORING WELLS

2002	2051	2107	2396	2436	2679
2009	2052	2108	2397	2439	2702
2011	2054	2118	2398	2446	2728
2014	2060	2119	2399	2543	2733
2015	2061	2120	2400	2544	2821
2016	2064	2125	2401	2545	2880
2017	2065	2126	2402	2546	2881
2020	2066	2128	2417	2548	2897
2027	2068	2166	2420	2549	2898
2032	2070	2171	2421	2550	2899
2033	2091	2383	2423	2551	2900
2034	2092	2384	2424	2552	2949
2043	2093	2385	2426	2553	21033
2044	2095	2386	2429	2624	21063
2045	2096	2387	2430	2625	21064
2047	2097	2389	2431	2636	21065
2048	2098	2390	2432	2648	21194
2049	2106	2394	2434	2649	

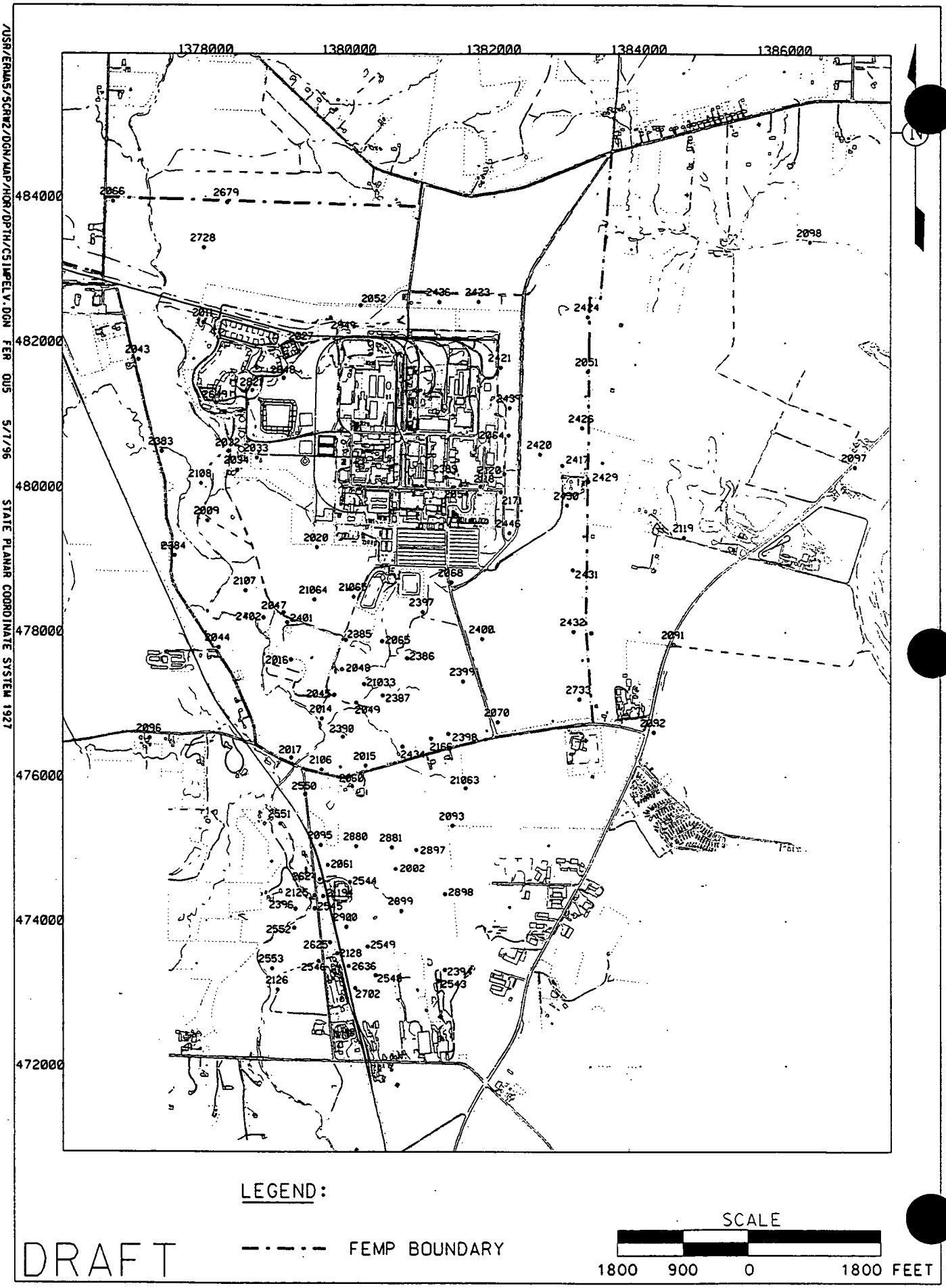


FIGURE 3-15. GROUNDWATER ELEVATION MONITORING WELLS

These locations were selected to provide areal coverage across all areas of the FEMP site with an increasing density of wells in areas surrounding active aquifer restoration modules. Groundwater elevations will be measured quarterly in these wells beginning in 1997 to provide data for construction of water table elevation maps. These maps will be used to determine the location of flow divides, capture zones, and stagnation zones created by the operation of remediation modules. Additional monitoring wells and more frequent measurement interval may be added near aquifer remediation modules as they become operational and as sensitive capture zone or stagnation zones are identified, or if unpredicted fluctuations in contaminant concentrations are observed.

Water table maps produced from the collected field data will be compared to modeled predictions to determine how well the groundwater model is predicting actual aquifer responses during remediation. The model will be used to predict the occurrence of capture zones, flow divides, and stagnation zones that will result from extraction and injection operations. A continuous model verification process is critical to ensure that model predictions are accurate and reliable (Figure 3-7).

3.5.2 Compliance Based Monitoring

3.5.2.1 Private Well Monitoring Program

The oldest monitoring effort (still ongoing) is the Radiological Environmental Monitoring (private well) Program. As explained below, the existing formal program is being modified after 1996. Future sampling at three private well locations will continue in 1997 and 1998 as part of the IEMP.

Sampling of private wells began on a routine basis in 1982, but the program was not formalized until 1984. In the past, at a property owner's request, any drinking water well near the site would be sampled for uranium. The one-time results were reported to the well owner. If any "special request" sample showed a questionable or significant total uranium concentration, or if the well was believed to be representative of an area based on its location, the property owner had the option to participate in the routine sampling program. This program grew to 33 wells in 1996. Wells were either sampled monthly or quarterly, depending upon the location. Sampling results were reported yearly in the Site Environmental Report.

When the program was initiated, a public water supply to the area did not exist. If the total uranium concentration of the water in the private well was above the upper limit of what was considered

background for uranium, the private well user was offered bottled drinking water to preclude the use of affected wells for a drinking water source. In 1996, with the arrival of the DOE-funded public water supply, the need for the affected wells and bottled water was eliminated, ending the need for the sampling program.

Continuing the historical database at a few private well locations is beneficial for facilitating discussions with area stakeholders on the progress of the aquifer restoration. Sampling will continue in 1997 and 1998 at three private well locations (Wells 12, 13, and 14) as part of the IEMP. These three locations are shown in Figure 3-16. The three locations are located immediately downgradient of the FEMP property boundary. Two of the wells are located within the 20 μg/L total uranium plume. The other well is used periodically for irrigation. One of three locations is also the location where the off-property uranium contamination problem in the Great Miami Aquifer was first detected in the early 1980s. These three wells will be sampled quarterly for total uranium.

3.5.2.2 RCRA Property Boundary Monitoring Program

The focus of the current RCRA groundwater monitoring program is to detect and assess potential changes in groundwater conditions at the Fernald property boundary. This is accomplished through quarterly sampling of 33 wells at three different depths (2000, 3000 and 4000 series wells) located along the downgradient property boundary for approximately 90 site-specific radiological and nonradiological constituents. An annual report of the results is issued in March of each year.

The RCRA groundwater monitoring program was first initiated near Waste Pit 4 in 1985 to comply with federal and state RCRA hazardous waste regulations to determine if the hazardous waste unit was impacting groundwater. By 1988, monitoring results from the program indicated that Waste Pit 4 was impacting the groundwater. In 1991, additional waste management units at the Fernald site were identified as requiring groundwater monitoring under RCRA regulations. It was necessary to develop a monitoring strategy to integrate CERCLA and RCRA monitoring activities in order to eliminate redundancies. For this reason, the DOE proposed an alternate monitoring approach which was accepted by the State of Ohio in September 1993. The alternate monitoring approach consisted of groundwater contaminant characterization under CERCLA, and groundwater monitoring at the downgradient facility boundary under RCRA to detect and assess potential changes in groundwater conditions at the Fernald property boundary while the CERCLA characterization efforts were

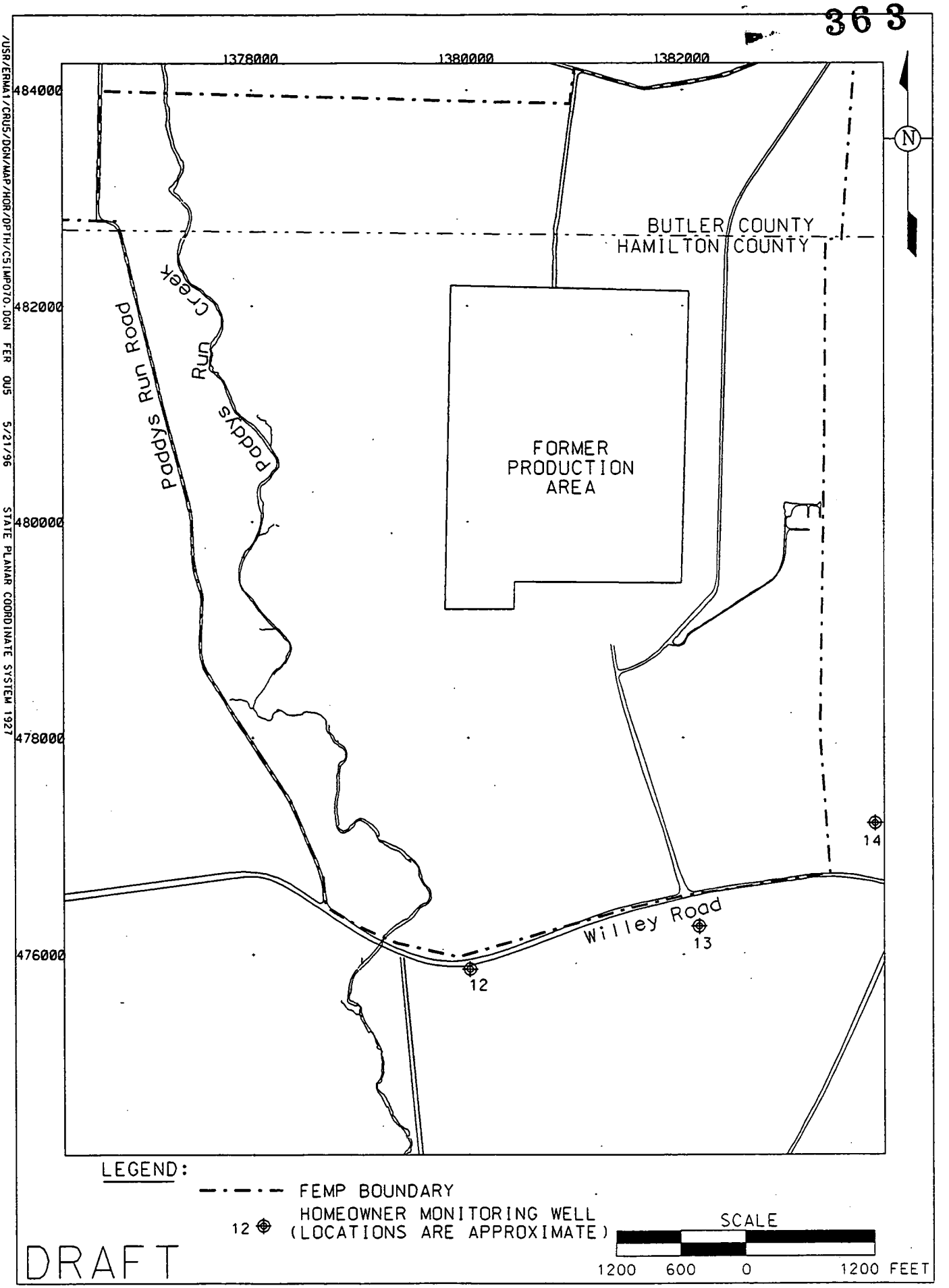


FIGURE 3-16. PRIVATE WELL MONITORING PROGRAM WELLS

underway. The list of 33 wells and analytical parameters currently analyzed under the program were specified in the FEMP's September 1993, OEPA Director's Findings and Orders compliance agreement and accompanying Project-Specific Plan for the Routine Groundwater Monitoring Program Along the Downgradient Boundary of the FEMP, Revision 1.

The 1995 results from the RCRA monitoring program continue to confirm that other than the contamination comprising the South Plume (currently addressed with the South Plume Removal Action Wells), there are no concentrations of contaminants detected through the program that trigger the need for action ahead of the final groundwater remedy. This finding is consistent with the findings for the previous years (1993 and 1994).

Monitoring at the downgradient property boundary during the initial two-year phase of the IEMP will document if any contamination greater than the remediation FRLs is leaving the property boundary and entering the public domain. The 33 property boundary monitoring wells which will be sampled in 1997 and 1998 are shown in Figure 3-17 and listed below.

LIST OF RCRA PROPERTY BOUNDARY MONITORING WELLS

2051	2070	2106	2398	2417	2424	2426
2429	2430	2431	2432	2434	2733	3067
3069	3070	3106	3398	3417	3424	3426
3429	3431	3432	3733	4067	4398	4424
4426	4432	31217	41217	OSDF-1		

The parameter list currently defined in the DFO will be modified beginning in 1997 to address final remediation level constituents. The proposed new constituent list for this monitoring activity is presented below. Section 3.4.2.3 and Appendix A provide additional information on the parameter selection process. Monitoring will focus on the FRL constituents that have had an FRL exceedance in the aquifer. Those constituents that have not yet caused an FRL exceedance will be monitored upgradient of the boundary wells. Should a new exceedance be documented, it will be added to the RCRA boundary program. Quarterly sampling will analyze for the nine constituents categorized as >MP in aquifer Zones 0, 1, 2, or 3. Annual sampling will analyze for the 18 constituents categorized as >N in aquifer Zones 0, 1, 2, or 3. No <MP constituents will be analyzed for at the property

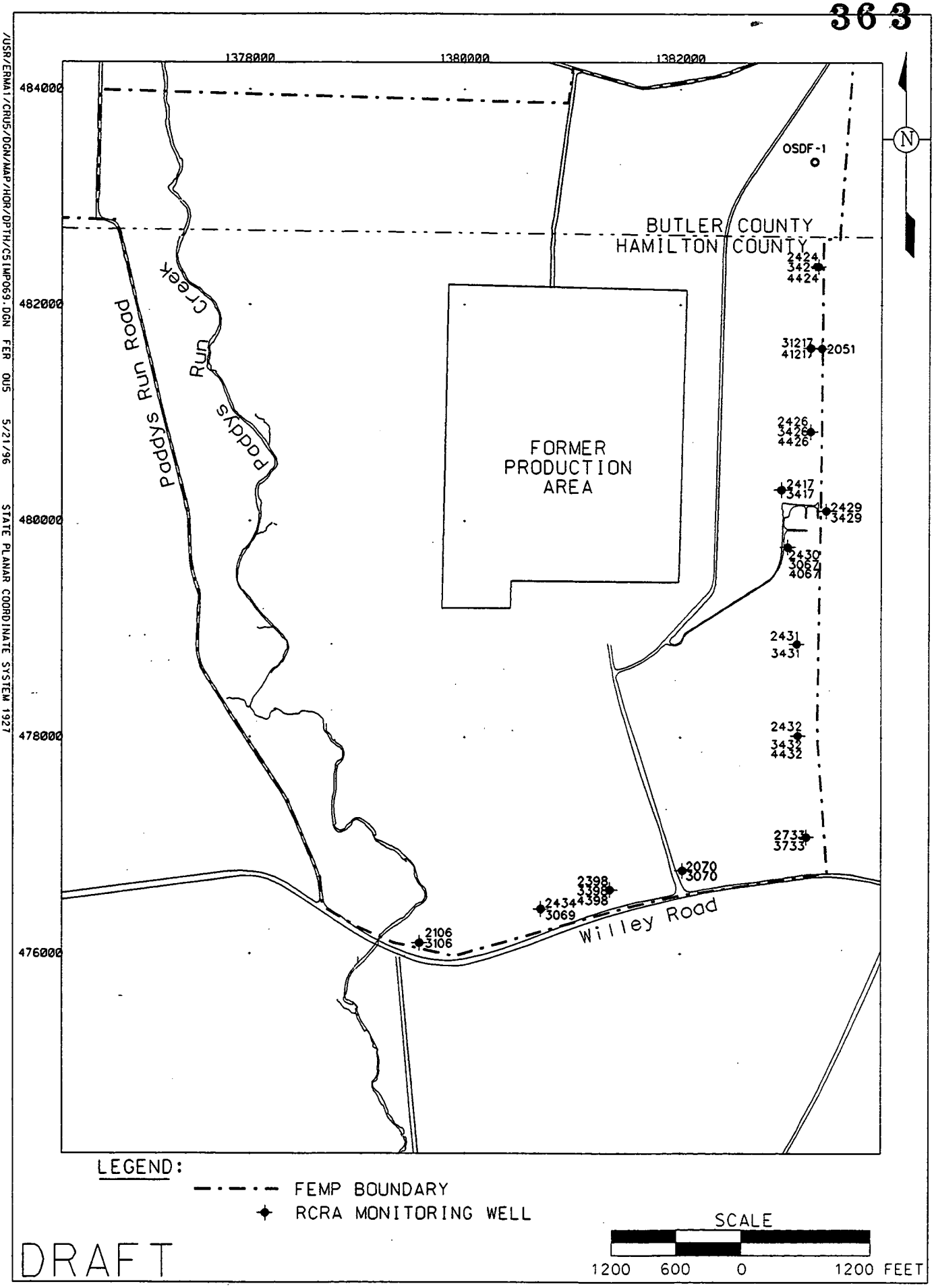


FIGURE 3-17. RCRA BOUNDARY MONITORING PROGRAM WELLS

boundary since they would be detected first in the individual monitoring modules on-property. Upon approval of the IEMP by the EPA and OEPA, the IEMP will replace the Project-Specific Plan for the Routine Groundwater Monitoring Program Along the Downgradient Boundary of the FEMP, Revision 1.

LIST OF CONSTITUENTS WHICH WILL BE ANALYZED IN THE RCRA BOUNDARY MONITORING WELLS

Constituents Categorized as > MP Shown in **Bold** are Analyzed Quarterly
Other Constituents Analyzed Annually

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony	**Neptunium-237**	Benzene
Nitrate/Nitrite	Arsenic	**Strontium-90**	Carbon Disulfide
	Beryllium	**Technetium-99**	Trichloroethene
	Boron	Thorium-228	
	Cadmium	Thorium-232	
	Total Chromium	**Total Uranium**	
	Cobalt		
	Lead		
	Manganese		
	Mercury		
	Molybdenum		
	Nickel		
	Selenium		
	Silver		
	Vanadium		
	Zinc		

Beginning in 1998, operation of the South Field Extraction System and the South Plume Optimization and Groundwater Injection demonstration module will alter groundwater flow conditions along the eastern FEMP property boundary. The boundary monitoring program will continue in 1998, for the purpose of verifying that the flow conditions have changed as predicted. It is anticipated that a recommendation may be made to alter the boundary monitoring strategy with the first revision of the IEMP in 1999.

3.5.2.3 KC-2 Warehouse Monitoring Program

The KC-2 Warehouse Monitoring Program was initiated in July of 1993 (DOE 1992). The controlling document was the Abandonment and Plugging of the KC-2 Warehouse/Well No. 67 Groundwater Sampling Work Plan Addendum. This monitoring program will continue as part of the IEMP up to the point in time that the KC-2 warehouse is decontaminated and demolished, and the well is plugged and abandoned. Figure 3-18 shows where this well is located.

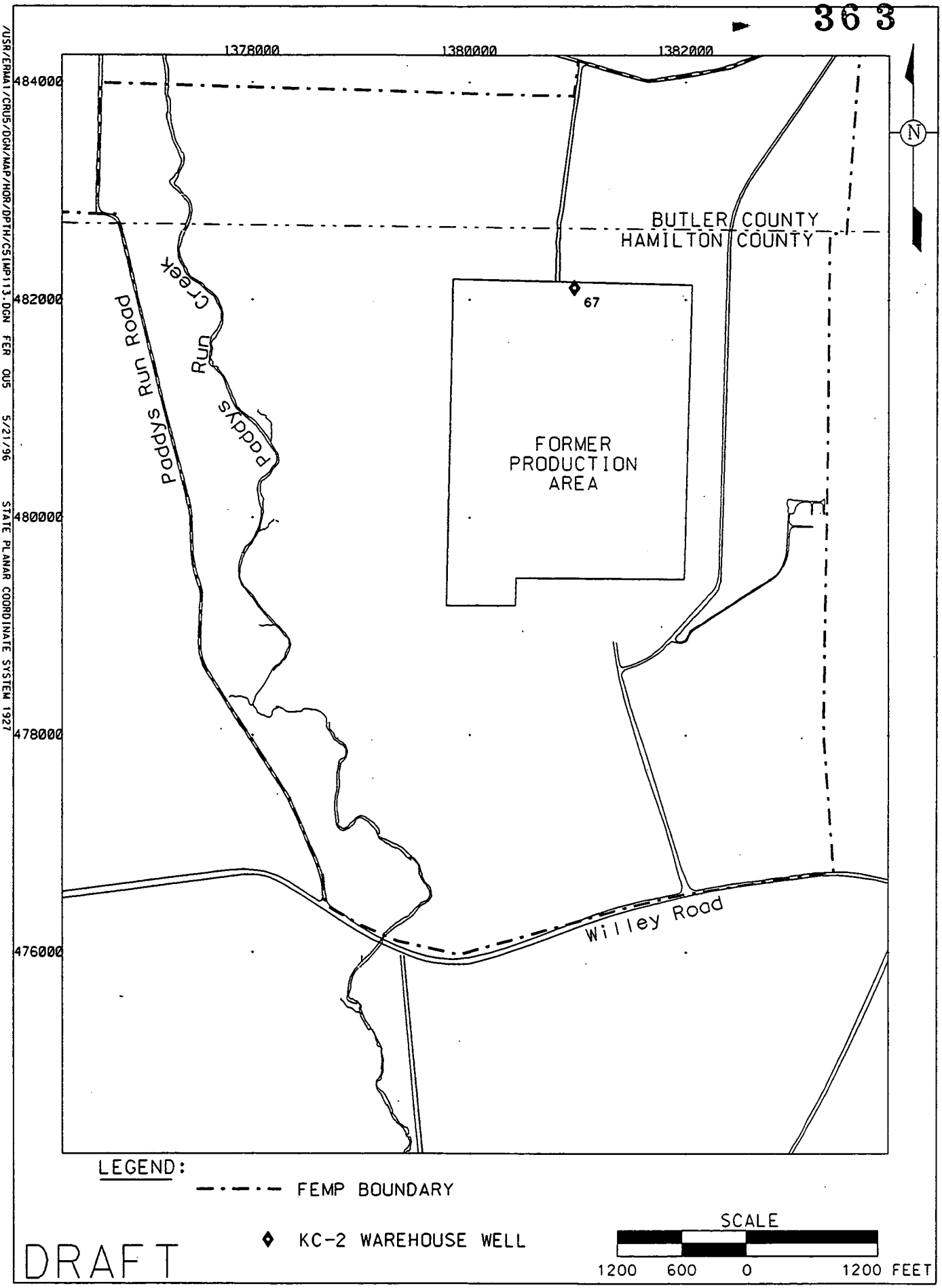


FIGURE 3-18. KC-2 WAREHOUSE MONITORING PROGRAM WELL

The original scope of the monitoring effort was to sample Well 67 on a semi-annual basis for uranium and HSL metals. Well 67 is an old well located in the KC-2 Warehouse. The bottom of the well contains contaminated sediment. Monitoring is conducted to document water quality conditions in the well until the well can be plugged and abandoned. Sampling of Well No. 67 is currently taking place annually. Rather than modifying the sampling list to reflect FRL constituents, the well will continue to be sampled annually in August of each year for uranium and the same metals that have been sampled for in the past. These are presented below.

LIST OF CONSTITUENTS WHICH WILL BE SAMPLED ANNUALLY IN THE KC-2 WAREHOUSE MONITORING WELL
Constituents Analyzed Annually

General Chemistry	Inorganics		Radionuclides
Cyanide	Antimony	Magnesium	Total Uranium
	Aluminum	Manganese	
	Arsenic	Mercury	
	Barium	Nickel	
	Beryllium	Potassium	
	Cadmium	Selenium	
	Calcium	Silver	
	Total Chromium	Sodium	
	Cobalt	Thallium	
	Copper	Vanadium	
	Iron	Zinc	
	Lead		

3.5.2.4 On-Site Disposal Facility Groundwater Monitoring Program

Groundwater monitoring is a recognized component of the On-Site Disposal Facility Monitoring Strategy and represents a new groundwater monitoring obligation for the FEMP. Groundwater monitoring of the on-site disposal facility in the Great Miami Aquifer will be addressed in the IEMP.

A PSP for the on-site disposal facility Groundwater Detection Monitoring Program was submitted to the EPAs in June 1996 as part of the 90 percent on-site disposal facility design submittal. An edited version of the 90 percent PSP is provided in Appendix B of this IEMP. The PSP presented in Appendix B has been edited from the 90 percent submittal to add clarity and to incorporate the conclusions of an independent evaluation of monitoring options for perched groundwater in the glacial overburden. The conclusion of the independent evaluation supported the monitoring option presented in the PSP of the glacial overburden.

The PSP for the on-site disposal facility Groundwater Detection Monitoring Program is contained in Appendix B because it provides both project specific and IEMP groundwater monitoring responsibilities, and having it in this format facilitates EPA review. Table 2-1, in Section 2 of the IEMP, outlines project responsibilities.

Groundwater monitoring in the Great Miami Aquifer around the on-site disposal facility in 1997 and 1998 for the IEMP will be conducted in the 11 existing monitoring wells listed below. The locations of the wells are shown in Figure 3-19.

LIST OF ON-SITE DISPOSAL FACILITY MONITORING WELLS

2051	2064	2120	2171	2421	2424	2426
2429	2430	2439	2446	OSDF-1	OSDF-2	OSDF-3
OSDF-4						

In addition to these 11 existing monitoring wells, four new 2000 series monitoring wells will be installed during the construction of the two northern most on-site disposal facility waste cells in 1997 and 1998. Several of the existing wells which have been selected for monitoring in 1997 and 1998 will eventually need to be plugged and abandoned to make way for the cell footprint. New monitoring wells will be installed during the construction of each individual cell to replace abandoned wells. When complete, the monitoring network of wells will encircle the on-site disposal facility on both the downgradient eastern and southern edge, and upgradient western edge.

The wells will not be sampled for FRL constituents; instead, they will be sampled for total uranium, Technetium-99, Total Organic Carbon and Total Organic Halogens in addition to the routine field parameters pH, dissolved oxygen, specific conductance, temperature, and turbidity. The parameter selection process is presented in detail in Appendix B. Uranium and Technetium-99 are target constituents for the on-site disposal facility.

3.6 PROJECT-SPECIFIC PLAN FOR GROUNDWATER MONITORING IN 1997 AND 1998

This section serves as the PSP for implementation of the sampling, analysis and data management activities associated with the sitewide environmental groundwater monitoring program. The design of the program is presented in Section 3.5. The sampling, analytical, and data management activities

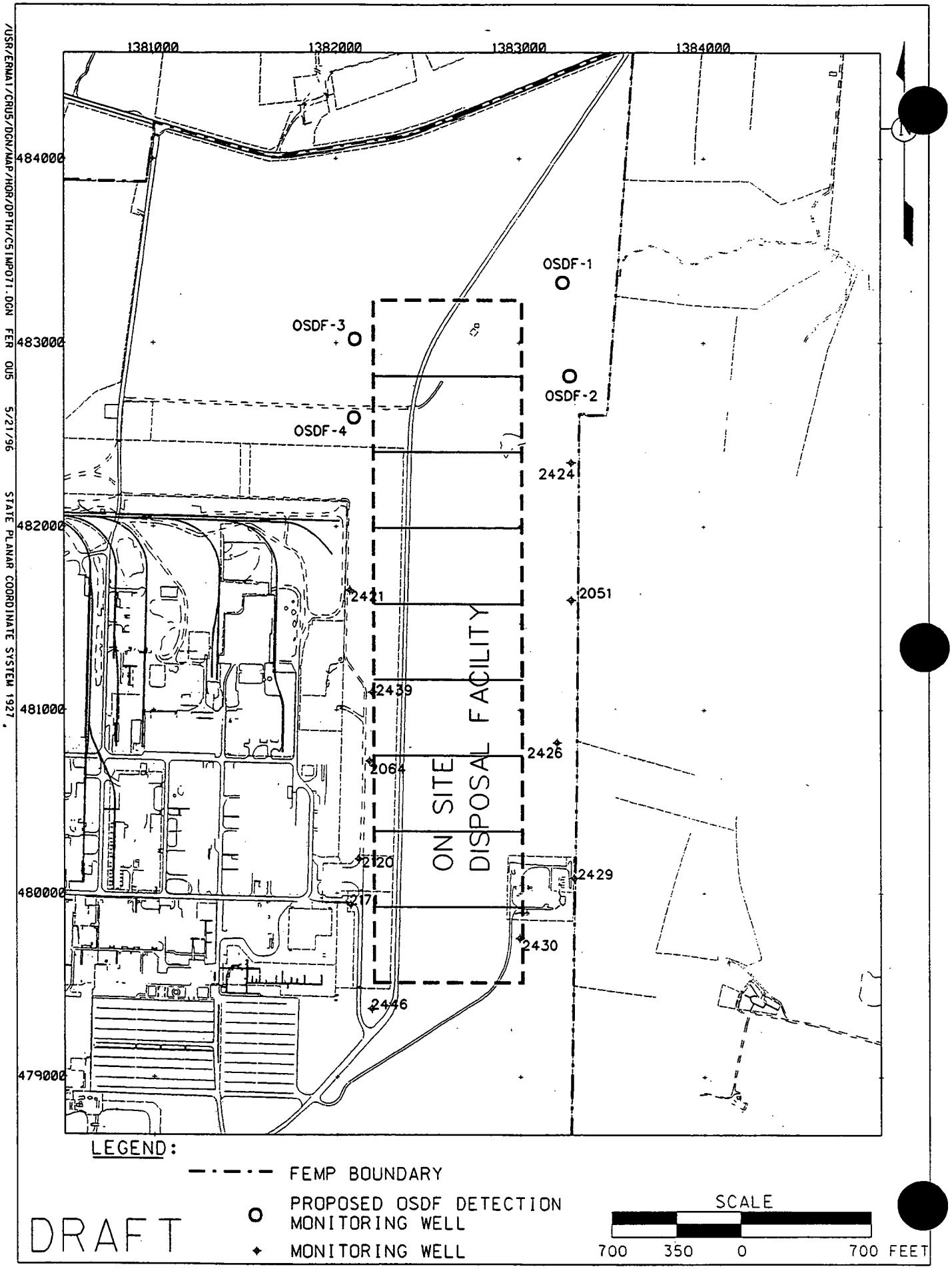


FIGURE 3-19. OSDF GROUNDWATER MONITORING PROGRAM WELLS

000095

described in this PSP have been designed to provide groundwater data of sufficient quality to meet the program expectations as defined in Section 3.1. To ensure that specific data quality objectives are met, all sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the FEMP Site-wide CERCLA Quality Assurance Project Plan (SCQ).

Subsequent sections of this PSP define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Health and safety
- Data management
- Project quality assurance.

3.6.1 Project Organization

A multidiscipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this PSP. The key positions and associated responsibilities required for successful implementation are described below.

The project team leader will have full responsibility and authority for the implementation of this PSP in compliance with all regulatory specifications and site-wide programmatic requirements defined by the Program Oversight and Integration Division. Integration and coordination of all PSP activities defined herein with other project organizations is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

Health and safety is the responsibility of all individuals working on this project scope. Qualified health and safety specialists shall participate on the project team to provide radiation protection and industrial hygiene support and assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance specialists will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the SCQ or other referenced standard and assist in evaluating and resolving all quality related concerns.

3.6.2 Sampling Program

The information derived from the field investigation should suffice to produce a clear understanding of groundwater quality in the Great Miami Aquifer. The groundwater sampling process will be controlled so that collected samples are representative of groundwater quality. All procedures for monitoring well development, sample collection, and shipment will be performed in accordance with directives established in the SCQ. The summary listing of the monitoring wells that comprise the overall sampling program (sorted numerically by well number) is provided in Table 3-4.

Figure 3-20 shows where all of the sampling points are located. Individual well lists and constituent lists are presented in Sections 3.5.1 though 3.5.2.

Groundwater samples will be collected and analyzed to:

- Track remedy performance of the South Plume/South Plume Optimization Module, and the South Field Extraction and Injection Demonstration Modules when they become operational in 1998
- Document that no water quality changes are occurring in the aquifer that could impact the design or start-up of the South Field Extraction or the Injection Demonstration Modules in 1998
- Document that no water quality changes are occurring in the aquifer that impact the design and start-up of the Waste Storage Area and Plant-6 Area Modules
- Monitor water levels across the entire aquifer restoration area
- Continue sampling at three private well locations
- Assess potential changes in groundwater conditions at the Fernald property boundary
- Monitor the water quality of well number 67 in the KC-2 Warehouse

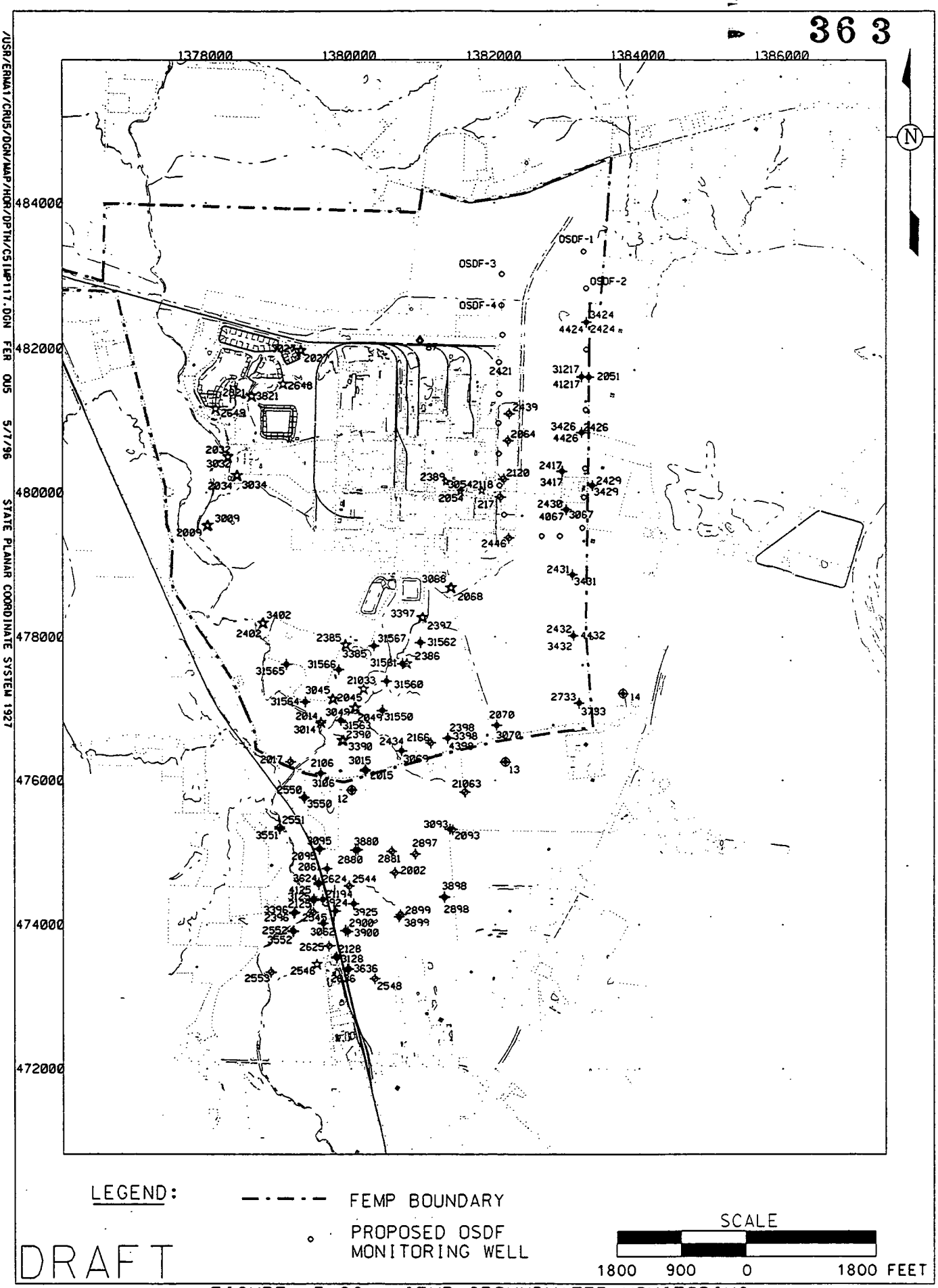


FIGURE 3-20. IEMP GROUNDWATER MONITORING WELLS FOR WATER QUALITY

000098

TABLE 3-4

LISTING OF IEMP GROUNDWATER MONITORING WELLS

Well No.	Well ID	Monitoring Module/Program[a]
1	12	Private Well Monitoring Program
2	13	Private Well Monitoring Program
3	14	Private Well Monitoring Program
4	67	KC-2 Warehouse
5	2002	South Plume/South Plume Optimization Modules
6	2009	Waste Storage Area Module
7	2014	South Field/Injection Demonstration Modules
8	2015	South Plume/South Plume Optimization Modules
9	2017	South Plume/South Plume Optimization Modules
10	2027	Waste Storage Area Module
11	2032	Waste Storage Area Module
12	2034	Waste Storage Area Module
13	2045	South Field/Injection Demonstration Modules
14	2049	South Field/Injection Demonstration Modules
15	2051	RCRA Boundary Monitoring Program OSDF Monitoring Program
16	2054	Plant-6 Area Module
17	2060	South Plume/South Plume Optimization Modules
18	2061	South Plume/South Plume Optimization Modules
19	2064	OSDF Monitoring Program
20	2068	South Field/Injection Demonstration Modules
21	2070	RCRA Boundary Monitoring Program
22	2093	South Plume/South Plume Optimization Modules
23	2095	South Plume/South Plume Optimization Modules
24	2106	South Plume/South Plume Optimization Modules RCRA Boundary Monitoring Program
25	2118	Plant-6 Area Module
26	2120	OSDF Monitoring Program
27	2125	South Plume/South Plume Optimization Modules
28	2128	South Plume/South Plume Optimization Modules
29	2166	South Plume/South Plume Optimization Modules
30	2171	OSDF Monitoring Program
31	2385	South Field/Injection Demonstration Modules
32	2386	South Field/Injection Demonstration Modules
33	2387	South Field/Injection Demonstration
34	2389	Plant-6 Area Module Modules
35	2390	South Field/Injection Demonstration Modules
36	2396	South Plume/South Plume Optimization Modules
37	2397	South Field/Injection Demonstration Modules

TABLE 3-4
(Continued)

Well No.	Well ID	Monitoring Module/Program[a]	
38	2398	South Plume/South Plume Optimization Modules	1
39	2402	South Field/Injection Demonstration Modules	2
40	2417	RCRA Boundary Monitoring Program	3
41	2421	OSDF Monitoring Program	4
42	2424	RCRA Boundary Monitoring Program	5
43	2426	RCRA Boundary Monitoring Program OSDF Monitoring Program	6
44	2429	RCRA Boundary Monitoring Program OSDF Monitoring Program	7
45	2430	RCRA Boundary Monitoring Program OSDF Monitoring Program	8
46	2431	RCRA Boundary Monitoring Program	9
47	2432	RCRA Boundary Monitoring Program	10
48	2434	South Plume/South Plume Optimization Modules	11
49	2439	OSDF Monitoring Program	12
50	2446	OSDF Monitoring Program	13
51	2544	South Plume/South Plume Optimization Modules	14
52	2545	South Plume/South Plume Optimization Modules	15
53	2546	South Plume/South Plume Optimization Modules	16
54	2548	South Plume/South Plume Optimization Modules	17
55	2550	South Plume/South Plume Optimization Modules	18
56	2551	South Plume/South Plume Optimization Modules	19
57	2552	South Plume/South Plume Optimization Modules	20
58	2553	South Plume/South Plume Optimization Modules	21
59	2624	South Plume/South Plume Optimization Modules	22
60	2625	South Plume/South Plume Optimization Modules	23
61	2636	South Plume/South Plume Optimization Modules	24
62	2648	Waste Storage Area Module	25
63	2649	Waste Storage Area Module	26
64	2733	RCRA Boundary Monitoring Program	27
65	2821	Waste Storage Area Module	28
66	2880	South Plume/South Plume Optimization Modules	29
67	2881	South Plume/South Plume Optimization Modules	30
68	2897	South Plume/South Plume Optimization Modules	31
69	2898	South Plume/South Plume Optimization Modules	32
70	2899	South Plume/South Plume Optimization Modules	33
71	2900	South Plume/South Plume Optimization Modules	34
72	3009	Waste Storage Area Module	35
73	3014	South Field/Injection Demonstration Modules	36
74	3015	South Plume/South Plume Optimization Modules	37
75	3027	Waste Storage Area Module	38
76	3032	Waste Storage Area Module	39

TABLE 3-4
(Continued)

Well No.	Well ID	Monitoring Module/Program[a]
77	3034	Waste Storage Area Module
78	3045	South Field/Injection Demonstration Modules
79	3049	South Field/Injection Demonstration Modules
80	3054	Plant-6 Area Module
81	3062	South Plume/South Plume Optimization Modules
82	3067	RCRA Boundary Monitoring Program
83	3068	South Field/Injection Demonstration Modules
84	3069	RCRA Boundary Monitoring Program
85	3070	RCRA Boundary Monitoring Program
86	3093	South Plume/South Plume Optimization Modules
87	3095	South Plume/South Plume Optimization Modules
88	3106	South Plume/South Plume Optimization Modules
89	3125	South Plume/South Plume Optimization Modules
90	3128	South Plume/South Plume Optimization Modules
91	3385	South Field/Injection Demonstration Modules
92	3387	South Field/Injection Demonstration Modules
93	3390	South Field/Injection Demonstration Modules
94	3396	South Plume/South Plume Optimization Modules
95	3397	South Field/Injection Demonstration Modules
96	3398	RCRA Boundary Monitoring Program
97	3402	South Field/Injection Demonstration Modules
98	3417	RCRA Boundary Monitoring Program
99	3424	RCRA Boundary Monitoring Program
100	3426	RCRA Boundary Monitoring Program
101	3429	RCRA Boundary Monitoring Program
102	3431	RCRA Boundary Monitoring Program
103	3432	RCRA Boundary Monitoring Program
104	3550	South Plume/South Plume Optimization Modules
105	3551	South Plume/South Plume Optimization Modules
106	3552	South Plume/South Plume Optimization Modules
107	3624	South Plume/South Plume Optimization Modules
108	3636	South Plume/South Plume Optimization Modules
109	3733	RCRA Boundary Monitoring Program
110	3821	Waste Storage Area Module
111	3880	South Plume/South Plume Optimization Modules
112	3881	South Plume/South Plume Optimization Modules
113	3897	South Plume/South Plume Optimization Modules
114	3898	South Plume/South Plume Optimization Modules
115	3899	South Plume/South Plume Optimization Modules
116	3900	South Plume/South Plume Optimization Modules
117	3924	South Plume/South Plume Optimization Modules

TABLE 3-4
(Continued)

Well No.	Well ID	Monitoring Module/Program[a]
118	3925	South Plume/South Plume Optimization Modules
119	3926	South Plume/South Plume Optimization Modules
120	3927	South Plume/South Plume Optimization Modules
121	4067	RCRA Boundary Monitoring Program
122	4125	South Plume/South Plume Optimization Modules
123	4398	RCRA Boundary Monitoring Program
124	4424	RCRA Boundary Monitoring Program
125	4426	RCRA Boundary Monitoring Program
126	4432	RCRA Boundary Monitoring Program
127	21033	South Field/Injection Demonstration Modules
128	21063	South Plume/South Plume Optimization Modules
129	21194	South Plume/South Plume Optimization Modules
130	31217	RCRA Boundary Monitoring Program
131	31550	South Field/Injection Demonstration Modules
132	31560	South Field/Injection Demonstration Modules
133	31561	South Field/Injection Demonstration Modules
134	31562	South Field/Injection Demonstration Modules
135	31563	South Field/Injection Demonstration Modules
136	31564	South Field/Injection Demonstration Modules
137	31565	South Field/Injection Demonstration Modules
138	31566	South Field/Injection Demonstration Modules
139	31567	South Field/Injection Demonstration Modules
140	41217	RCRA Boundary Monitoring Program
141	OSDF 1	RCRA Boundary Monitoring Program
142	OSDF 2	OSDF Monitoring Program
143	OSDF 3	OSDF Monitoring Program
144	OSDF 4	OSDF Monitoring Program

[a] Refer to Section 3.5 for details on monitoring modules and programs.

- Monitor the impact to groundwater in the Great Miami Aquifer resulting from the on-site disposal facility

3.6.2.1 Sample Collection

The laboratory analyses, collection frequency and sample integrity requirements for groundwater samples are summarized in Table 3-5.

All monitoring wells will be purged and sampled using procedures specified in SCQ Section 6.2. All analyses will be conducted by the appropriate FEMP or contracted laboratory using procedures which meet the standards for these analytical support levels as established in the SCQ. Sample collection procedures are identified in the SCQ and in specific detail in project procedures. The following project procedures and guidance sections of the SCQ are used to conduct groundwater monitoring:

Standard Operating Procedures

ADM-02	Field Project Prerequisites
SC-GWM-FO-201	Groundwater Sampling Activities
EP-GWM-202	Groundwater Sample Shipment

Sitewide CERCLA Quality (SCQ) Assurance Project Plan

Section 5	Field Activities
Section 6	Sampling Requirements
Section 7	Sample Custody
Section 9	Analytical Procedures
Appendix I	Field Calibration Requirements
Appendix J	Field Activity Methods
Appendix K	Sampling Methods

Once samples are taken, they will be sent to either an on-site or off-site laboratory. Due to the extensive sampling for the groundwater monitoring program, a significant number of FEMP samples are shipped off site for analysis by contract laboratories. Contract laboratories must be able to meet the standards identified in the SCQ prior to being used for sample analysis. The approved laboratories use EPA methods for chemical analyses and are required to meet analyte performance criteria for radiological analyses as specified in the SCQ.

TABLE 3-5

SAMPLING PROCEDURES FOR ALL CONSTITUENTS IN THE GROUNDWATER MONITORING PROGRAM

Constituent	Sample Type	ASL	Holding Time	Preservation	Container[a]
General Chemistry:					
Cyanide	Grab	B	14 days	Cool to 4°C, NaOH to pH > 12	Plastic or glass
Fluoride	Grab	B	28 days	None	Plastic
Nitrate/Nitrite	Grab	B	28 days	Cool to 4°C, H_2SO_4 to pH < 2	Plastic or glass
Phosphorus	Grab	B	28 days	Cool to 4°C, H_2SO_4 to pH < 2	Plastic or glass
Inorganics:					
Metals Excluding Mercury	Grab	B	6 months	HNO_3 to pH < 2	Plastic or glass
Mercury	Grab	B	28 days	HNO_3 to pH < 2	Plastic or glass
Radionuclides: (All Radiological)	Grab	B	Six months or 5 x half-life, whichever is less	HNO_3 to pH < 2	Plastic or glass
Volatile Organics:	Grab	B	7 days	Cool to 4°C	Glass vial with Teflon lined septum cap
	Grab	B	14 days	Cool to 4°C H_2SO_4, HCl, or solid $NaHSO_4$ to pH < 2	Glass vial with Teflon lined septum cap
Pesticides[b]:	Grab	B	7 days to extraction 40 days from extraction to analysis	Cool to 4°C	Amber glass bottle with teflon lined cap
Field Parameters[c]:	Grab	A	NA[d]	NA[d]	NA[d]

[a]Container size is left to the discretion of the individual laboratory
[b]The pesticide that will be analyzed is alpha-chlordane
[c]Field parameters include dissolved oxygen, pH, specific conductance, temperature and turbidity
[d]NA = Not applicable

3.6.2.2 QA Sampling Requirements

Field quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as decontamination or sampling technique, may be responsible for introducing bias in the project's analytical results. The following types of quality control samples will be collected: sampling equipment rinsates, trip blanks, field blanks and duplicate samples as outlined in Section 6 and Appendix K of the SCQ. Each QC sample is preserved using the same method for groundwater samples. The QC sample frequencies will be tracked for each groundwater area program (i.e., RCRA routine monitoring) to ensure the proper frequency requirements are met as follows:

- Trip Blanks: Prepared for each sampling team on each day of sampling when volatile organic compounds are included in the respective analytical program.
- Equipment Rinsates: Collect one rinsate sample for every 20 groundwater samples that are collected using reusable sampling equipment. If the specific sampling program (e.g., RCRA routine monitoring) consist of less than 20 groundwater samples, a rinsate sample is still required. Rinsates are not required when dedicated well equipment or disposable sampling equipment is utilized.
- Field Blanks: Collect one field blank for each day of groundwater sampling.
- Field Duplicates (blind): One duplicate sample will be collected for every 20 groundwater samples or fraction thereof if the specific sampling program consists of less than 20 samples.

The field samples associated with each QC sample also will be tracked to ensure traceability in the event that contaminants are detected in the QC samples.

3.6.2.3 Decontamination

Sampling equipment shall be decontaminated following sample collection from each well to prevent cross-contamination of samples. The decontamination of equipment shall be performed in accordance with the Level II method referenced in Appendix K.11 and described in Section 6.4.1 of the SCQ.

3.6.2.4 Waste Disposition

The following wastes will be generated during sampling activities:

- Purge water
- Contact wastes
- Equipment decontamination solutions.

The following subsections provide the proposed disposition methodology for each type of waste generated.

Purge Water and Decontamination Solutions

Groundwater purged from the wells and solutions used to decontaminate equipment used during sampling will be contained and transported to the FEMP for proper disposal. If historic data for a well indicate the purge water is potentially a RCRA waste, the purge water will be drummed at the well and moved to the FEMP's controlled holding area until analytical results are returned.

Contact Wastes

Contact wastes such as personal protective equipment (PPE), paper towels, and other solid, investigation-derived waste will be placed in plastic bags or 55-gallon drums and transported to the FEMP for appropriate disposition.

3.6.3 Change Control

Changes to the PSP will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or design shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the PSP must have approval by the designee and QA prior to implementation. PSP changes shall be documented on the Variance/Field Change Notice within 24 hours of verbal approval. The completed Variance/Field Change Notice must be received by QA within one week of verbal approval. The Variance/Field Change Notice form shall be controlled and included in the field data package and become part of the project record. Permanent PSP changes will incorporate applicable Variance/Field Change Notices in annual PSP revisions. Scope changes to the PSP or DQO will require respective document changes.

3.6.4 Health and Safety Considerations

The FERMCO Health and Safety Department is responsible for the development and implementation of health and safety requirements for this PSP. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified field work will be addressed.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the field work required by this PSP. Daily safety meetings will be conducted prior to beginning field work to address specific health and safety issues.

All FERMCO employees and subcontractor personnel who will be performing field work required by this PSP are required to have completed all site required training.

For areas subject to more restrictive radiological controls where the potential for exposure is greater, Radiation Work Permits (RWPs) are necessary and will be obtained prior to the field work being performed in those areas. A radiological control technician will be assigned to each field crew performing any activities in an area requiring an RWP.

3.6.5 Data Management

Field and analytical data will be managed to meet the IEMP data reporting and quality objectives. The field documentation and analytical data results shall be verified to ensure conformance to the appropriate SCQ sections and appendices. The process for management of the field and analytical data is described in the Environmental Data Management Plan (EDMP) (FERMCO, 1996).

Field documentation will be verified for accuracy and completeness by the sampling team followed by an independent field data validation in accordance with SCQ requirements for the corresponding ASL. The project team leader must have processes in place to verify that chemical and radiological data results meet all applicable quality requirements specified in the SCQ for the respective ASL (SCQ Section 11.0 and Appendix F). The quality of analytical data shall be evaluated by independent project personnel qualified to determine accuracy, completeness and applicable statistical data necessary to evaluate data useability and data quality required for environmental monitoring reporting.

Both the field and analytical data will be entered into a controlled database using a double key or equivalent method to ensure accuracy. The hard copy data will be managed in the project files in accordance with FEMP record keeping procedures and DOE orders.

3.6.6 Quality Assurance

Independent assessments of work processes shall be conducted to verify quality of performance. Such assessments may include audits, surveillances, inspections, tests, data verification and field validation, and peer reviews. Assessments shall include performance based evaluation of compliance to technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance to IEMP, SCQ, applicable DQOs, and FEMP Quality Assurance Program (RM-0012) requirements.

Independent assessment is the responsibility of designated project Quality Assurance personnel. The project team leader and QA will coordinate independent assessment oversight activities and comply with SCQ Section 12. Recommended quarterly QA surveillances shall be performed on some task specified in the PSP. The QA representative shall have "stop work" authority if significant adverse quality conditions are identified or work conditions are unsafe. In accordance with SCQ Section 3, QA shall review and have approval signature of plans, procedures, and final documents supporting IEMP programs.

Only laboratories on the Approved Laboratory List will be used for FEMP sample analyses in accordance with SCQ Section 12 and Appendix E.

3.7 IEMP Groundwater Monitoring Data Evaluation and Reporting

Groundwater data collected under the IEMP will be evaluated by graphical and trend analysis methods to track remediation system performance and to monitor the overall progress of the aquifer remedy. This evaluation will include concentration maps, water elevation maps with capture zones and flow divides, and individual well hydrographs as is currently done in the separate reports from the DMEPP, RCRA boundary, KC-2 warehouse, and private well programs.

Groundwater monitoring activities are currently reported in various documents on a semi-annual and an annual basis. Figure 3-21 identifies the current reporting schedule for these documents and identifies when IEMP reporting will assume responsibility for groundwater monitoring reporting. Current reports include:

- Performance monitoring of the South Plume Removal Action pumping system is reported semi-annually in the South Plume Removal Action System Evaluation Report which is required by the South Plume Design Monitoring Evaluation Program Plan.

- RCRA boundary monitoring program results and analyses are presented annually in the RCRA Annual Report as required by the DFO of September 1993 and the Project-Specific Plan for the Routine Groundwater Monitoring Program Along the Downgradient Boundary of the FEMP, issued in October 1993.

- The KC-2 Warehouse/Well 67 monitoring program is reported annually in a letter report to the OEPA and the U.S. EPA as required by the Abandonment and Plugging of the KC-2 Warehouse/Well No. 67 Groundwater Sampling Work Plan Addendum.

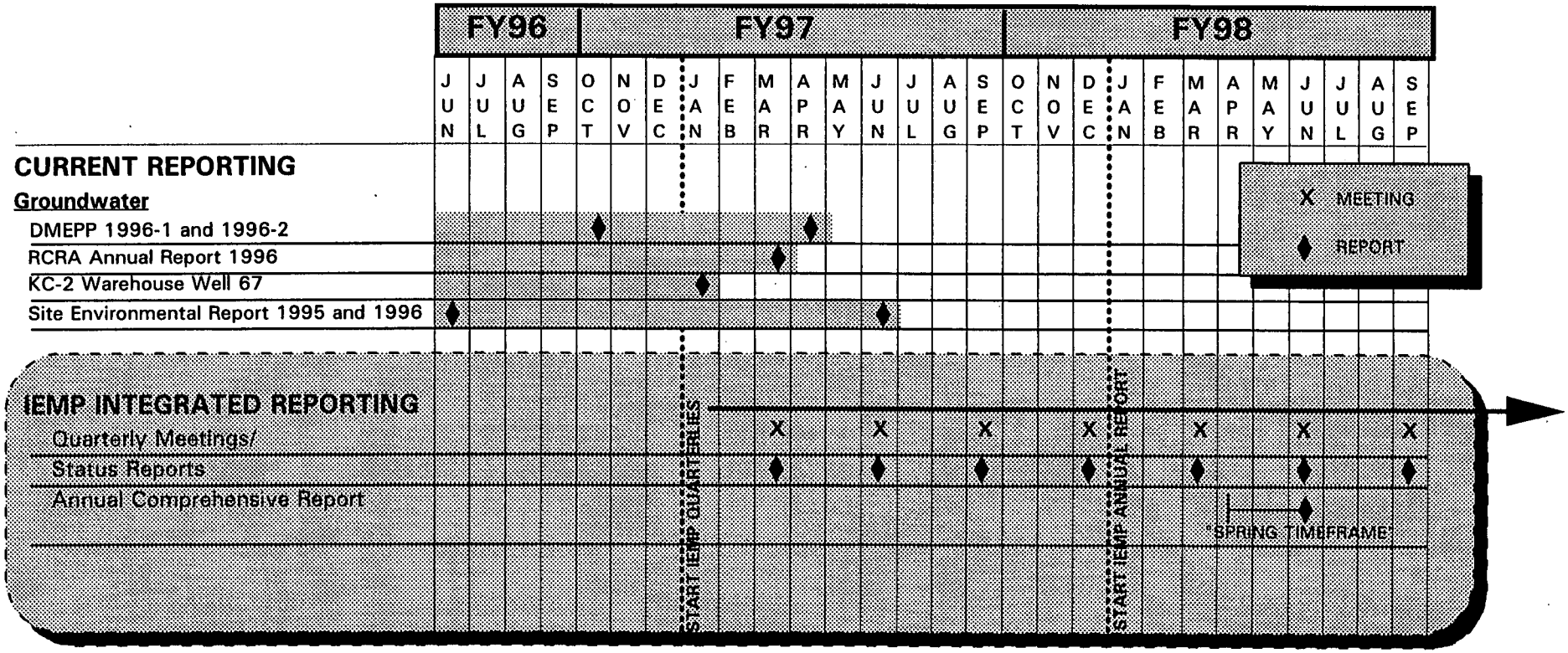
- The Site Environmental Monitoring program for groundwater reports private well sampling results on an annual basis in the Site Environmental Report, as required by DOE Order 5400.1.

With the approval of the IEMP groundwater sampling program, these groundwater sampling programs and reports will be incorporated into one annual IEMP groundwater report. It will document the various groundwater sampling activities presented in the groundwater section of the IEMP. Furthermore, the documents mentioned above which contain program and reporting requirements will be superseded by the IEMP which, upon approval, will become the groundwater sampling program document for the site.

Since these groundwater reports are prepared on different schedules with different due dates, a transition period during 1996 and 1997 will be used to phase out the distinct groundwater reports and move to the annual IEMP groundwater monitoring report. Specifically:

- The next two semi-annual South Plume Removal Action System Evaluation Reports for the periods of January 1 to June 30, 1996 and July 1 to December 31, 1996 will be prepared and submitted in October 1996 and April 1997, respectively, according to the existing schedule. The sampling and analysis results from January 1 to June 30, 1997, which would have been scheduled for release in October 1997, will be replaced by the first IEMP environmental monitoring report to be released during spring of 1998. It will present the sampling and analysis results for calendar year 1997.

FIGURE 3-21
IEMP GROUNDWATER REPORTING STRATEGY



- The next RCRA Annual Report scheduled for release March 1, 1997, for the 1996 calendar year will be prepared and submitted as scheduled. The RCRA Annual Report scheduled for release March 1, 1998, however, will be replaced by the first IEMP environmental monitoring report to be released during spring of 1998. It will present the sampling and analysis results for calendar year 1997.

- The next two Site Environmental Reports scheduled for release in June 1996 and June 1997 for sampling and analysis results during calendar years 1995 and 1996 will be prepared and submitted as scheduled. The Site Environmental Report covering sampling and analysis reporting for calendar year 1997 which was to be released in June 1998 will be replaced by the first IEMP environmental monitoring report to be released during spring of 1998.

- The next KC-2 Warehouse Removal Action/Well No. 67 Report scheduled for release in January 1997 will be prepared and released as scheduled. However, the following report scheduled for release in January 1998 will be replaced by the first IEMP environmental monitoring report to be released during the spring of 1998.

4.0 SURFACE WATER AND TREATED EFFLUENT MONITORING PROGRAM

Section 4.0 provides a description of the routine sitewide surface water and treated effluent monitoring to be performed during active remediation of the FEMP; a strategy for integrating the FEMP's numerous compliance-based monitoring and reporting obligations for surface water and treated effluent; and a PSP for conducting all surface water and treated effluent monitoring activities. The section concludes with a phased plan to integrate the FEMP's existing surface water and treated effluent compliance reports into a single IEMP-sponsored reporting structure.

4.1 INTEGRATION OBJECTIVES FOR SURFACE WATER/TREATED EFFLUENT

Unlike groundwater and soil, no direct restoration of the FEMP's surface water resources (i.e., Paddys Run and the Great Miami River) is required to achieve the surface water FRLs specified in the Operable Unit 5 Record of Decision (DOE 1996). However, because surface water represents both a contaminant transport pathway and an environmental receptor, routine monitoring of surface water is necessary to confirm that the FEMP's point and non-point discharges from other remedial operations to receiving waters fall within established thresholds. The monitoring activities for surface water will thus serve both a surveillance and a compliance function over the life of remediation at the FEMP. These measures will help document that the FEMP's remedial operations are protective of both groundwater (via the surface water cross-media pathway) and the intended use designations for surface water in the vicinity of the FEMP.

The IEMP is the designated vehicle for conducting the FEMP's sitewide surface water surveillance and compliance monitoring. The initial focus is intended to accommodate remedial construction and operation activities taking place in fiscal years 1997 and 1998. Ultimately, the IEMP will be used to verify and document that the conclusion of the FEMP's sitewide remedial actions result in a condition that no longer poses any long-term threat to human health and the environment through the surface water pathway. In this comprehensive role, the IEMP will serve to integrate several compliance-based monitoring and reporting programs currently in existence for the FEMP:

- The discharge monitoring and reporting program related to the site National Pollutant Discharge Elimination System (NPDES) permit and associated storm water pollution prevention plan
- The radiological monitoring of and reporting for the treated effluent mandated by the FFCA

- The existing Environmental Monitoring Program which has been ongoing at the FEMP since the 1950s and which is being updated in the IEMP to accommodate surface water monitoring needs during remediation.

As discussed in Section 4.6, these multiple programs are intended to be brought together under a single reporting structure to facilitate review of the performance of the FEMP's surface water protection actions and measures.

4.2 ANALYSIS OF REGULATORY DRIVERS, DOE ORDERS, AND OTHER FEMP-SPECIFIC AGREEMENTS

This section presents a summary evaluation of the regulatory drivers governing the monitoring of the FEMP's point and non-point discharges to Paddys Run and the Great Miami River. The intent of this section is to identify the pertinent regulatory requirements, including ARARs and TBC-based requirements for the scope and design of the surface water monitoring program. These requirements will be used to confirm that the program: 1) satisfies the regulatory obligations for monitoring that have been activated by the FEMP's Record of Decisions; and 2) will achieve the intentions of other pertinent criteria (such as DOE Orders and the FEMP's existing agreements, as appropriate) that have a bearing on the scope of surface water monitoring. Although the Operable Unit 3 Record of Decision is not yet final, ARARs within the draft Operable Unit 3 Record of Decision were considered. Any ARAR changes to the Operable Unit 3 Record of Decision after finalization will be evaluated for impacts to the IEMP, and the monitoring program will be revised immediately, if necessary.

The results of the analysis will also be used to define, as appropriate for this media, the administrative boundaries between the IEMP and the project-specific emission control and runoff monitoring conducted by other FEMP organizations.

4.2.1 Approach

The analysis of the regulatory drivers and policies for surface water and treated effluent was conducted by examining the suite of ARARs and TBC requirements in the Operable Unit 5 Record of Decision to identify the subset with specific environmental monitoring requirements. The FEMP's existing compliance agreements issued outside the CERCLA process (such as NPDES) permit requirements and the Federal Facilities Compliance Agreement [FFCA]) were also reviewed.

4.2.2 Results

The following summary of regulatory drivers, compliance agreements, and DOE Orders were found to govern the monitoring scope and reporting requirements for surface water and treated effluent:

- The CERCLA Record Of Decision For Remedial Actions at Operable Unit 5, which requires remediation of the site such that the surface water pathway is protective of the underlying Great Miami Aquifer and protective of the various surface water environmental receptors. The surface water FRLs provided in the Operable Unit 5 Record of Decision considered and incorporated all chemical-specific ARARs and TBCs for the protection of human health via the surface water pathway.

- The current NPDES permit for the FEMP, which triggers a variety of site-specific surface water and treated effluent sampling, analysis, and reporting requirements for non-radiological discharges. The NPDES permit became effective November 1, 1995, and expires March 31, 1998.

- The 1986 FFCA, which requires that the FEMP maintain a continuous sample collection program for radiological constituents at the FEMP's treated-effluent discharge point and report the results quarterly to the EPA, OEPA, and the Ohio Department of Health. The sampling program to address this requirement has been modified over the years and is currently governed by an agreement reached with EPA and OEPA in early 1996. This agreement became effective May 1, 1996.

- DOE Order 5400.1, General Environmental Protection Program Requirements, which requires DOE facilities that use, generate, release, or manage significant pollutants or hazardous materials to develop and implement an environmental monitoring plan. Each DOE site's environmental monitoring plan must contain the design criteria and rationale for the routine effluent monitoring and environmental surveillance activities of the facility. The FEMP's existing EMP provides the initial basis for the development of the IEMP strategy that is responsive to the changing site mission and associated remedial needs while still DOE Order compliant.

- DOE Order 5400.5, Radiation Protection of the Public and the Environment, which obligates the FEMP to perform surveillance monitoring of surface water to assess dose to the general public from releases of radioactivity. Under these requirements, the exposure to members of the public associated with activities at DOE facilities from all pathways must not exceed, in one year, an effective dose equivalent greater than 100 mrem. Studies in support of the Operable Unit 5 Feasibility Study (DOE 1995a) demonstrated for all media that combined exposure to FEMP radiological COCs at their respective FRLs falls well below the DOE dose requirement. Therefore, monitoring designed to track and document the CERCLA FRL-based remediation of the site meets the intent of DOE Order 5400.5.

The surface water and treated-effluent monitoring plan provided in this IEMP has been developed in full consideration of these regulatory drivers. The FEMP's current and long-range plan for complying with the reporting requirements invoked by these drivers is provided in Section 4.6.

4.3 PROGRAMMATIC BOUNDARIES FOR THE SURFACE WATER AND TREATED EFFLUENT MONITORING PROGRAM

This section identifies the programmatic boundaries established between the IEMP and the project-specific activities to be conducted by others. The intent behind the boundary definition is to: 1) clearly delineate the scope and geographic extent of the IEMP's monitoring responsibility; and 2) establish a recognized interface between the sitewide focus of the IEMP and the predominant emission-control focus of project-specific monitoring.

It is important to emphasize that the programmatic boundary for each of the FEMP's environmental media is unique and, for portions of surface water program, time dependent. The boundary is the combined result of:

- Regulatory monitoring requirements
- The physical configuration of the site, and planned remediation areas (which will change over time for soil excavation occurring in various areas of the site shown in Figure 4-1, and the associated project-specific controls/monitoring of surface water runoff)
- The media-specific responsibilities assigned to the IEMP.

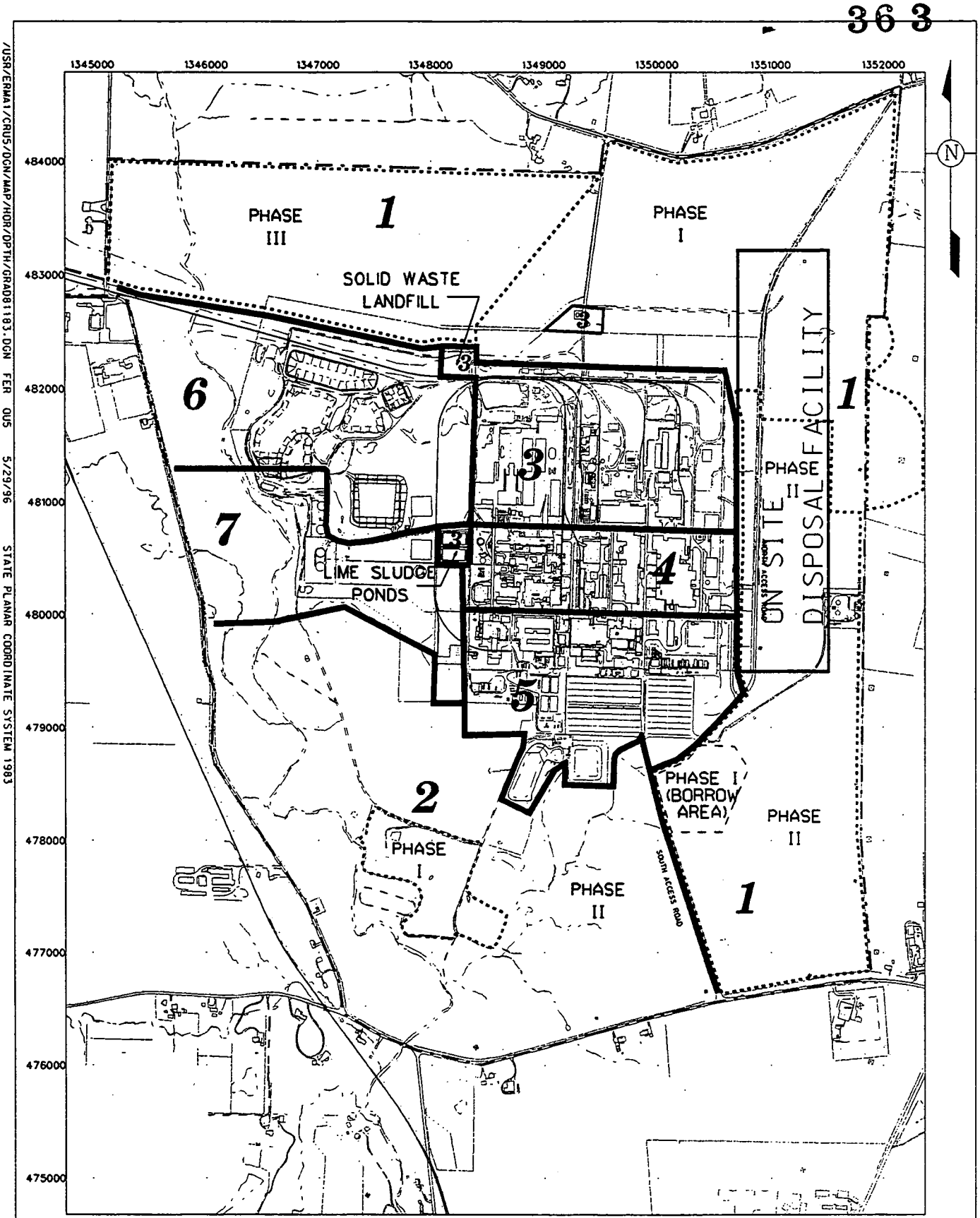
For surface water, the programmatic boundary requiring definition for purposes of the IEMP is the line of demarcation between the areas where surface water is currently controlled (former production area, Operable Unit 3; waste storage areas, Operable Units 1 and 4; and portions of the inactive flyash pile and the South Field in Operable Unit 2 shown in Figure 4-2), or will be controlled as a result of soil remedial activities and construction of the on-site disposal facility. As noted above, these boundaries will be transient during remediation as the soil remediation progresses across the site and as individual cells of the on-site disposal facility are developed. In essence, the IEMP will provide surveillance monitoring downstream from the areas where project-specific controls are in place. IEMP surface water and treated effluent monitoring also includes all FFCA and NPDES surface water and treated effluent sampling requirements.

4.4 PROGRAM EXPECTATIONS AND DESIGN CONSIDERATIONS

4.4.1 Program Expectations

The IEMP surface water and treated-effluent monitoring program is being designed to collect data sufficient to meet the following expectations for fiscal years 1997 and 1998:

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/GRAD81183.DGN FER OU5 5/29/96 STATE PLANAR COORDINATE SYSTEM 1983



LEGEND:

PHASE BOUNDARIES

FEMP BOUNDARY

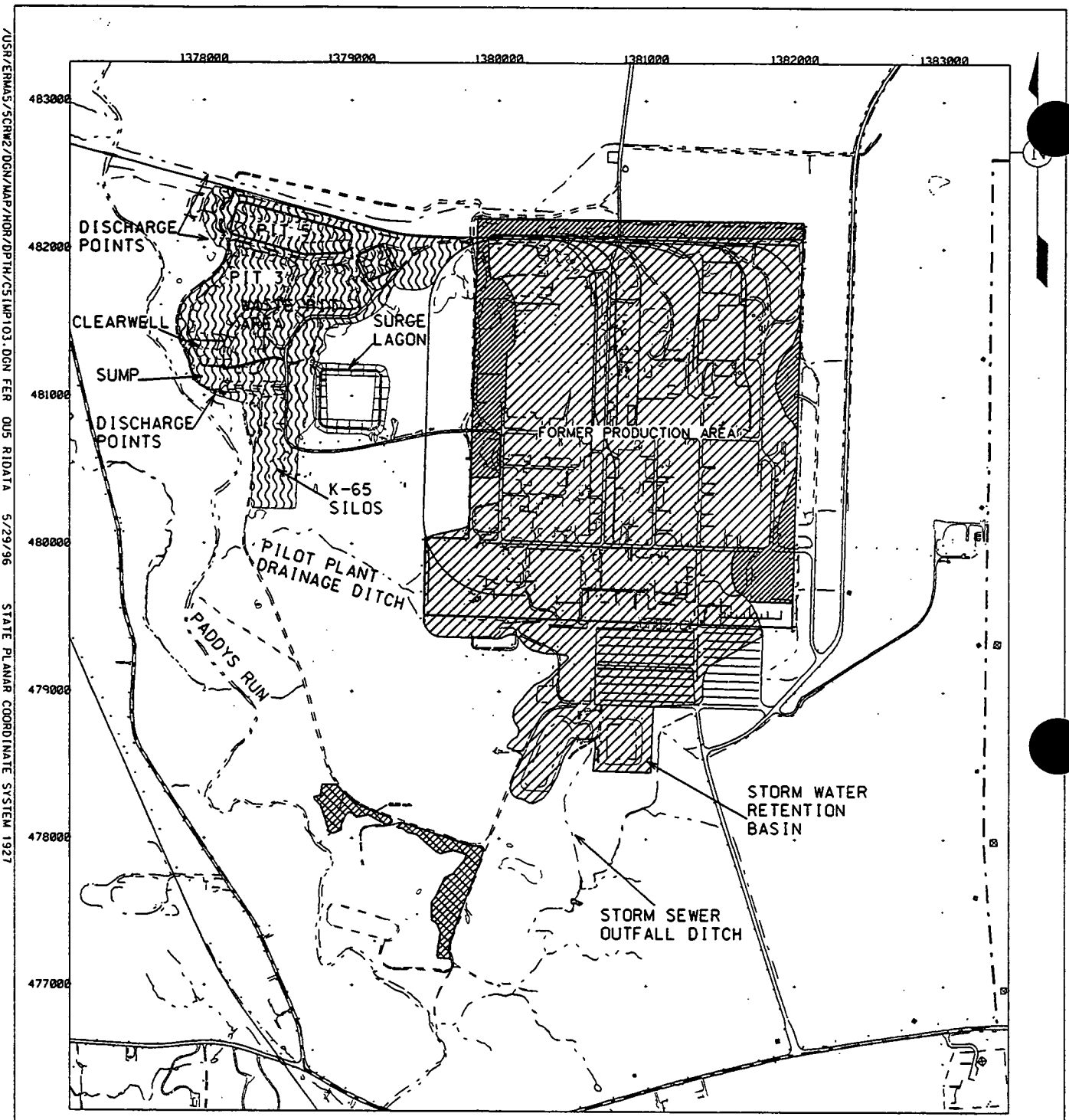
1 REMEDIATION AREA

SCALE

1200 600 0 1200 FEET

DRAFT FINAL

FIGURE 4-1. SITEWIDE REMEDIATION AREAS



LEGEND:

- FEMP BOUNDARY
- REMOVAL ACTION 16
- PRE-REMOVAL ACTION CONTROLLED AREA
- REMOVAL ACTION 2
- REMOVAL ACTION 30

NOTE:

DRAWING IS BASED ON 1992 AERIAL PHOTOGRAPHS.

SCALE

1000 555 0 1000 FEET

DRAFT

/USR/ERMA5/SCRW2/DGN/MAP/HOR/DPTH/C5IMP103.DGN FER OU5 RIDATA 5/29/96 STATE PLANAR COORDINATE SYSTEM 1927

FIGURE 4-2. CONTROLLED AREA SURFACE WATER RUNOFF

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- Provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer, at locations near the point where the protective glacial overburden has been breached by site drainages

- Document whether the sporadic exceedances of FRLs and benchmark toxicity values (BTVs) in various site drainages (noted in the Operable Unit 5 Feasibility Study) continue to occur at key on-property locations, at the property boundary on Paddys Run, and in the Great Miami River outside the mixing zone

- Provide an assessment of impacts to surface water due to uncontrolled runoff and implementation of site remedial activities

- Provide data to determine if certain constituents exceed the FRL. This is necessary for some constituents because 1) there is an insufficient number of historical analyses or 2) historical analyses had a detection limit which exceeded the FRL

- Provide additional data at background locations on Paddys Run and the Great Miami River to refine the FEMP's ability to distinguish site impacts from background as remediation progresses

- Continue to fulfill monitoring and reporting requirements associated with the site NPDES permit

- Continue to fulfill monitoring and reporting requirements associated with the FFCA

- Continue to fulfill DOE Order 5400.1 requirements to maintain an environmental monitoring plan for surface water

- Continue to address the concerns of the community regarding the magnitude of the FEMP's discharges to surface water (i.e., to Paddys Run and the Great Miami River).

The following section provides the design considerations required to fulfill each of these expectations.

4.4.2 Design Considerations

4.4.2.1 Parameter Selection Criteria

A comprehensive summary of site-specific information and data was assembled to determine the most appropriate site-specific indicator parameters for surface water and treated-effluent sampling under the IEMP. This information is presented in Table 4-1. The following is a description of each of the

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TABLE 4-1

SURFACE WATER PARAMETER SELECTION CRITERIA SUMMARY[a]

Constituent	No. of Analyses	Final Remediation Levels[b] (FRL)	FRL Basis[b]	No. of Analyses Above FRL[c]	Benchmark Toxicity Value (BTV)	No. of Analyses Above BTV[c]	No. of Areas Failed Modeling	95th Percentile Background Level in Surface Water[d]	
								Paddys Run	Great Miami River
Radionuclides (pCi/L)									
Cesium-137+1d	78	1.0×10^{1}	R	0	-	-	-	3.1	ND
Neptunium-237+1d	143	2.1×10^{2}	R	0	-	-	-	-	ND
Lead-210+2d	0	1.1×10^{1}	R	-	-	-	-	-	-
Plutonium-238	152	2.1×10^{2}	R	0	-	-	-	ND	ND
Plutonium-239/240	152	2.0×10^{2}	R	0	-	-	-	0.09	ND
Radium-226+8d	364	3.8×10^{1}	R	0	1.2×10^{3}	0	2	0.35	0.41
Radium-228+1d	368	4.7×10^{1}	R	1	-	-	-	2.1	2.2
Strontium-90+1d	183	4.1×10^{1}	R	0	-	-	10	0.96	ND
Technetium-99	185	1.5×10^{2}	R	1	-	-	14	ND	ND
Thorium-228+7d	228	8.3×10^{2}	R	0	1.9×10^{3}	0	-	ND	0.62
Thorium-230	229	3.5×10^{3}	R	0	2.2×10^{3}	0	-	ND	0.36
Thorium-232+10d	230	2.7×10^{2}	R	0	2.5×10^{3}	0	0	ND	ND
Uranium, total (mg/L)	340	5.3×10^{-1}	R	25	8.9×10^{-1}	18	10	0.001	0.001
Chemicals (mg/L)									
Alpha-chlordane	23	3.1×10^{-4}	R	0	-	0	-	-	-
Aluminum	95	-	-	-	8.7×10^{-2}	37	34	-	-
Ammonia	94	-	-	-	1×10^{0}	4	-	-	-
Antimony	88	1.9×10^{-1}	A	0	1.9×10^{-1}	0	-	ND	ND
Aroclor-1254	23	2.0×10^{-4}	D	0	-	-	-	-	-
Aroclor-1260	23	2.0×10^{-4}	D	0	-	-	-	-	-
Arsenic	145	4.9×10^{-2}	R	0	1.9×10^{-1}	0	-	ND	0.0036
Barium	145	1.0×10^{2}	R	0	1.45×10^{-1}	2	0	0.053	0.1
Benzene	48	2.8×10^{-1}	R	0	-	-	-	-	-
Benzo(a)anthracene	47	1.0×10^{-3}	D	U	-	-	-	-	-

TABLE 4-1
(Continued)

Constituent	No. of Analyses	Final Remediation Levels[b] (FRL)	FRL Basis[b]	No. of Analyses Above FRL[c]	Benchmark Toxicity Value (BTV)	No. of Analyses Above BTV[c]	No. of Areas Failed Modeling	95th Percentile Background Level in Surface Water[d]	
								Paddys Run	Great Miami River
Chemical (mg/L) - Contd.									
Benzo(a)pyrene	47	1.0×10^{-3}	D	U	-	-	-	-	-
Beryllium	86	1.2×10^{-3}	A	5	1.5×10^{-1}	0	-	ND	ND
Bis(2-chloroisopropyl)ether	47	2.8×10^{-1}	R	0	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	47	8.4×10^{-3}	A	9	8.4×10^{-3}	9	-	-	-
Bromodichloromethane	49	2.4×10^{-1}	R	0	-	-	-	-	-
Bromomethane	49	1.3×10^{0}	R	0	-	-	-	-	-
Cadmium	143	9.8×10^{-3}	B	1	3.5×10^{-3}	19	0	ND	0.01
Carbon disulfide	49	-	-	-	1.49×10^{0}	0	-	-	-
Chloroform	49	7.9×10^{-2}	A	0	-	-	-	-	-
Chromium VI[e]	145	1.0×10^{-2}	D	25	1.1×10^{-2}	25	-	ND	ND
Copper	143	1.2×10^{-2}	A	8	3.4×10^{-2}	0	-	ND	0.012
Cyanide	81	1.2×10^{-2}	A	4	1.2×10^{-2}	4	35	ND	0.005
Dibenzo(a,h)anthracene	47	1.0×10^{-3}	D	U	-	-	2	-	-
3,3-Dichlorobenzidene	47	7.7×10^{-3}	R	U	-	-	-	-	-
Di-n-butylphthalate	47	6.0×10^{0}	R	0	-	-	-	-	-
1,1-Dichloroethene	49	1.5×10^{-2}	R	0	-	-	-	-	-
1,2-Dichloroethene (total)	49	-	-	-	3.1×10^{-1}	0	-	-	-
Dieldrin	23	2.0×10^{-5}	D	0	-	-	-	-	-
Di-n-octylphthalate	6	5.0×10^{-3}	D	2	-	-	-	-	-
Fluoride	94	2.0×10^{0}	A	0	-	-	-	0.22	0.9
Lead	94	1.0×10^{-2}	B	13	3.0×10^{-2}	9	0	ND	0.010
Manganese	138	1.5×10^{0}	R	0	9.8×10^{-2}	19	-	0.035	0.08
Mercury	145	2.0×10^{-4}	D	12	2.0×10^{-4}	12	35	ND	ND
Methylene chloride	49	4.3×10^{-1}	A	0	4.3×10^{-1}	0	-	-	-

TABLE 4-1
(Continued)

Constituent	No. of Analyses	Final Remediation Levels[b] (FRL)	FRL Basis[b]	No. of Analyses Above FRL[c]	Benchmark Toxicity Value (BTV)	No. of Analyses Above BTV[c]	No. of Areas Failed Modeling	95th Percentile Background Level in Surface Water[d]	
								Paddys Run	Great Miami River
Chemical (mg/L) - Contd.									
4-Methylphenol	47	2.2×10^{0}	R	0	-	-	-	-	-
Molybdenum	143	1.5×10^{0}	R	0	7.0×10^{-1}	0	-	ND	0.02
Nickel	143	1.7×10^{-1}	A	0	4.7×10^{-1}	0	-	ND	0.023
Nitrate	64	2.4×10^{3}	R	0	-	-	-	1.7	6.6
4-Nitrophenol	44	7.4×10^{3}	R	0	-	-	-	-	-
Selenium	123	5.0×10^{-3}	A	1	5×10^{-3}	1	-	ND	ND
Silver	128	5.0×10^{-3}	D	15	1.3×10^{-3}	16	12	ND	ND
Tetrachloroethene	49	4.5×10^{-2}	R	1	7.3×10^{-2}	1	-	-	-
Thallium	85	-	-	-	1.6×10^{-2}	0	-	ND	ND
1,1,1-Tricholoroethane	49	1.0×10^{-3}	D	1	-	-	-	-	-
1,1,2-Tricholoroethane	49	2.3×10^{-1}	R	0	-	-	-	-	-
Trichloroethene	49	-	-	-	7.5×10^{-2}	0	-	-	-
Vanadium	103	3.1×10^{0}	R	0	4.1×10^{-2}	0	-	ND	ND
Zinc	84	1.1×10^{-1}	A	2	2.8×10^{-1}	1	1	ND	0.045

[a] = Shading indicates parameters selection for IEMP surface water target analytes and associated reason for selection
[b] = Derived from Operable Unit 5 Record of Decision Table 9-5
A = ARAR values
B = Background concentrations
D = Analytical detection limit
R = Human health risk
[c] = Additional information is provided in Appendix C
[d] = For small data sets (≤ 7 Samples), the maximum detected concentration is used as the 95th percentile
[e] = FRL and BTV are based on chromium VI; however, the analytical results are for total chromium
U = Number of analyses above FRL is unknown because method detection limits for all analyses were above the FRL
ND= Non-detect
- = Not applicable/not available

columns in Table 4-1 and how the information in the table was used to determine the most appropriate parameters for a particular location. Additional details regarding a particular portion of parameter selection criteria are provided in Appendix C as noted below.

- Column 1, Constituent: This column represents the suite of constituents considered for monitoring in the surface water pathway as a result of the remedial investigation/feasibility study process at the FEMP. It represents the summation of the constituents for which a BTV was documented in the Operable Unit 5 Feasibility Study and/or a FRL was established in the Operable Unit 5 Record of Decision.

- Column 2, Number of Analyses: This column depicts the number of analyses for a particular constituent available for evaluation. The analyses were compiled by combining surface water data from the Operable Unit 5 Remedial Investigation, EMP data from 1990 through 1995, and NPDES/FFCA data from November 1995 through April 1996. Constituents with no historical analyses or no analyses with method detection limits above the FRL were added to the list of constituents to be analyzed at property boundary sampling locations.

- Column 3, Final Remediation Levels: This column represents the human-health-protective remediation levels for surface water that were established in the Operable Unit 5 Record of Decision.

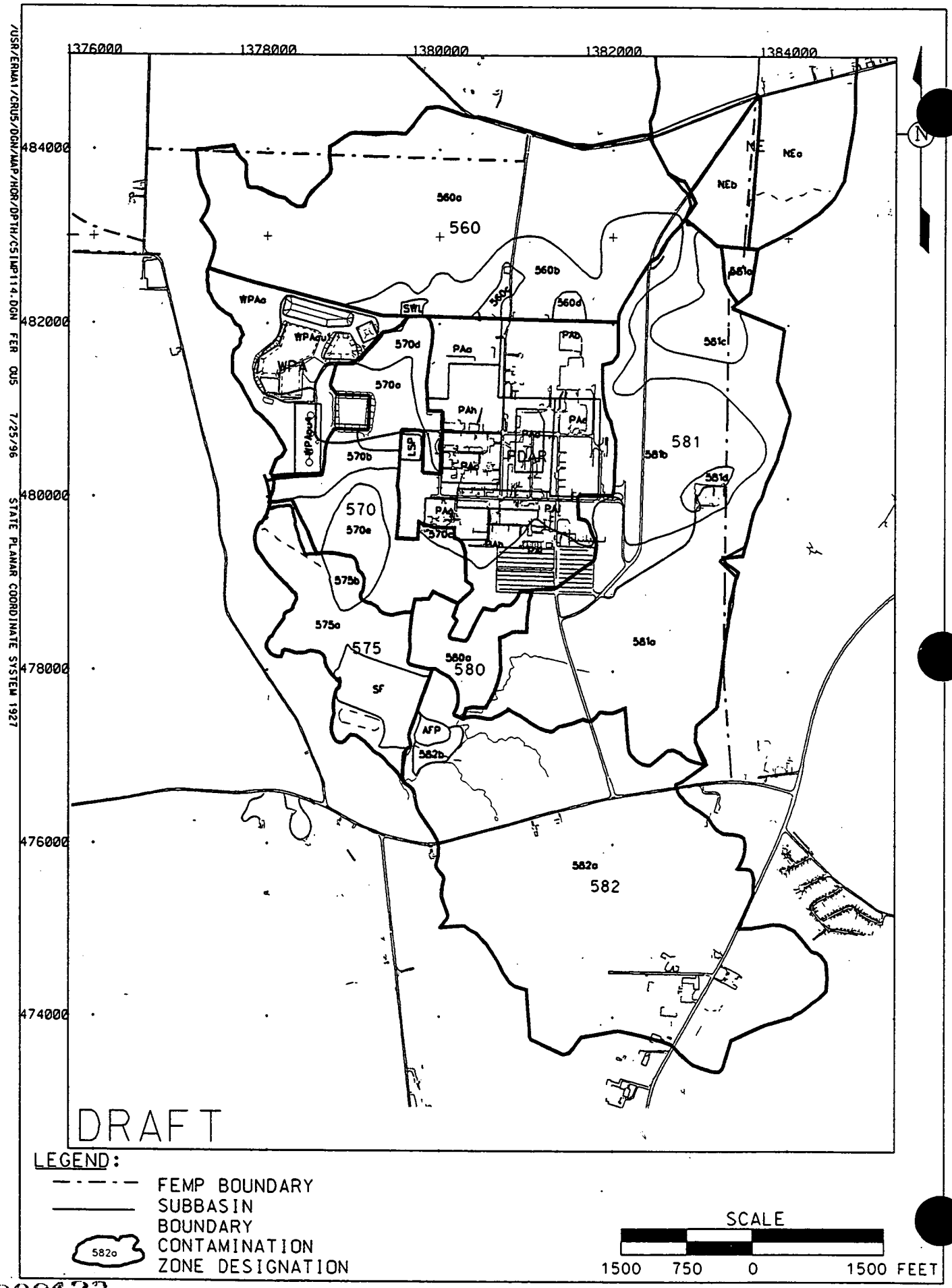
- Column 4, FRL Basis: This column is the basis for establishment of the FRL as defined in the Operable Unit 5 Feasibility Study.

- Column 5, Number of Analyses above FRL: This column identifies the number of analyses in Column 2 which exceeded the FRL. The location of each FRL exceedence was evaluated with respect to drainage basin and are shown in Appendix C. Constituents that exceeded the FRL were added to the parameter list at surface water sample locations downstream of the FRL exceedence location.

- Column 6, Benchmark Toxicity Value: This column represents the surface water BTVs from the Sitewide Ecological Risk Assessment (as documented in the Operable Unit 5 Feasibility Study). BTVs are used to predict the toxicity of chemicals to ecological receptors.

- Column 7, Number of Analyses above BTV: This column represents the number of analyses in Column 2 which exceeded the BTV. An analyte was added to the parameter list for all surface water sample locations downstream of the BTV exceedence. Additional detail is provided in Appendix C.

- Column 8, Number of Areas Failed Modeling: This column represents, by constituent, the total number of site drainage areas that failed modeling for cross-media impacts (35 specific drainage areas were evaluated, see Figure 4-3). Fate-and-transport modeling of soil contaminants was conducted on an area-by-area basis to determine what area-specific constituents in soil have the potential to affect a surface water receptor or could cause a cross-media impact to groundwater during remediation. Specifically, if a particular constituent was found to have the potential to exceed the surface water BTV or FRL for that constituent, it



000123 FIGURE 4-3. DRAINAGE SUB-BASINS WHICH COVER THE FEMP

failed the modeling. Also, if a constituent was found to have a potential to cause a cross-media impact to groundwater via the surface water pathway (i.e., cause an FRL exceedence in groundwater), it failed.

This information was used as part of the parameter selection process for each of the proposed IEMP surface water sampling locations. If a constituent failed the modeling in any drainage area "upstream" from a particular sampling location, then the respective "downstream" sampling location target analyte list includes the failed constituent.

- Column 9, 95th Percentile Background Level in Surface Water: This column represents the 95th percentile background level in surface water as presented in the Operable Unit 5 Remedial Investigation (DOE 1995f) for Paddys Run and the Great Miami River. This information is provided for comparison purposes.

4.4.2.2 Surface Water Cross-Media Impact

To assess the cross-media impact that contaminated surface water has on the underlying Great Miami Aquifer, the following design considerations are necessary:

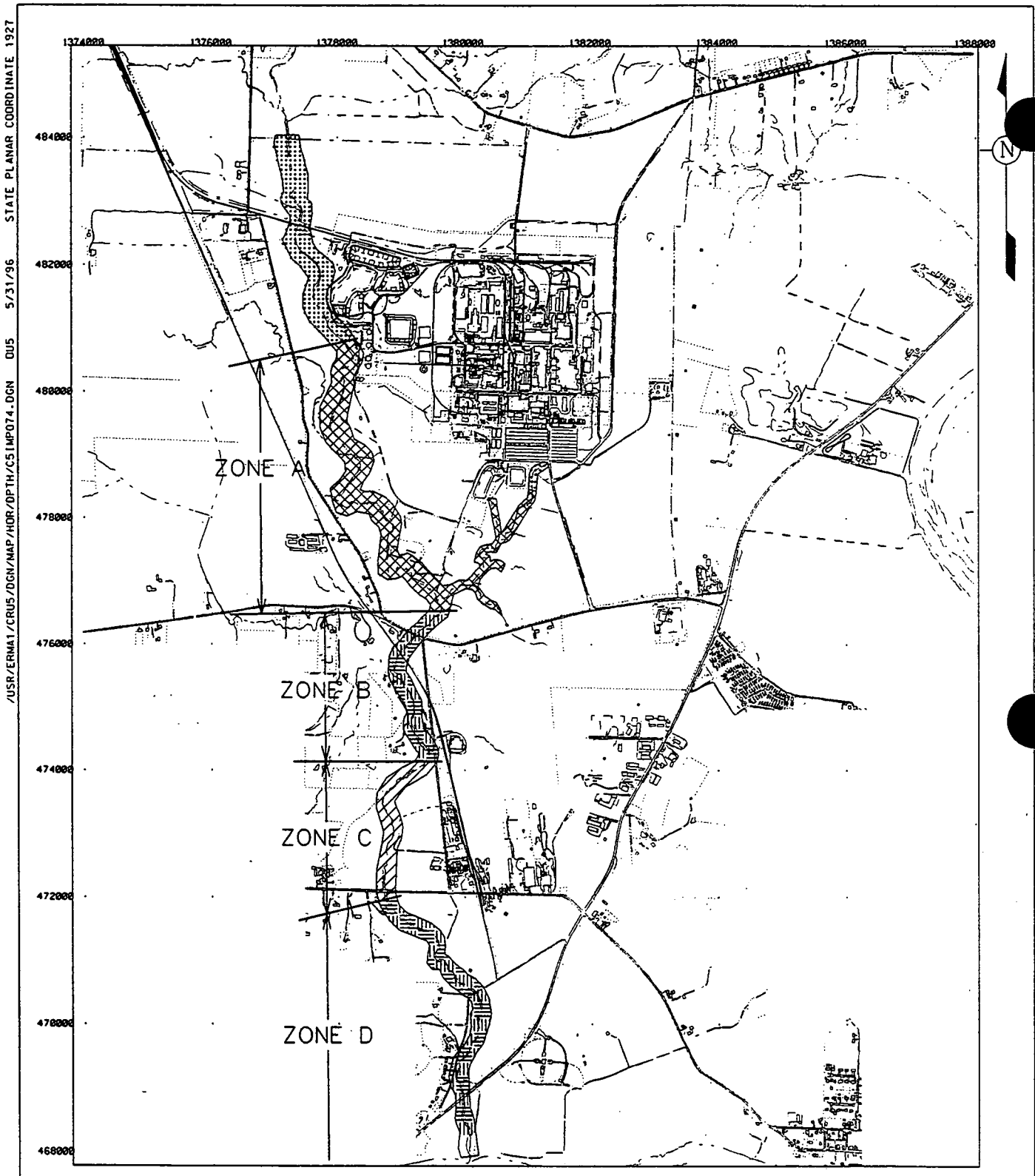
- Samples should be collected at those points near where the glacial overburden has been breached by site drainages. As described in the Operable Unit 5 Remedial Investigation, the majority of the FEMP is underlain by clay-rich glacial overburden, which, where present, provides a measure of protection to the underlying sand-and-gravel aquifer. Where the protective glacial overburden (Figure 4-4) has been eroded by site drainages (primarily in the lower reaches of Paddys Run and in the storm sewer outfall ditch), a direct pathway exists for surface water and associated contaminants to reach the underlying sand-and-gravel Great Miami Aquifer. In the Operable Unit 5 Remedial Investigation, contaminant migration via this pathway was determined to be responsible for the formation of the South Plume. Specifically, the South Plume was formed over the years when contaminated surface water runoff infiltrated through the streambeds of the storm sewer outfall ditch and Paddys Run.

- Parameters analyzed should represent those area-specific COCs identified in the Operable Unit 5 Feasibility Study (DOE 1995a) and subsequent fate-and-transport modeling as having the potential for cross-media impact to groundwater via the surface water pathway.

- Sampling frequency should be such that seasonal fluctuations in contaminant concentrations can be assessed.

4.4.2.3 Sporadic Exceedances of FRLs and BTVs

To assist in the development of the scope and focus of the IEMP surface water program, a review of the FEMP's existing sitewide surface water characterization database was conducted. This review identified a limited number of constituents that occasionally and sporadically exceed their respective FRL or BTV established through the Operable Unit 5 Remedial Investigation/Feasibility Study process. Maps detailing surface water locations with historical FRL or BTV exceedances and a table



NOTE:
ZONE AREAS ARE APPROXIMATE AND BASED ON AVERAGE WATER LEVELS

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LEGEND:

- ON GLACIAL OVERBURDEN MINIMUM INFILTRATION
- INFILTRATION ALWAYS OCCURS
- INFILTRATION DEPENDENT ON WATER TABLE ELEV.
- GROUNDWATER DISCHARGE IN ALL SEASONS
- FEMP PROPERTY BOUNDARY

SCALE

2250 1125 0 2250 FEET

FIGURE 4-4. SURFACE WATER INFILTRATION TO THE GREAT MIAMI AQUIFER ALONG PADDYS RUN AND THE STORM SEWER OUTFALL DITCH

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providing the number of FRL or BTV exceedances per location and analyte are provided in Appendix C. To comply with the requirements of the Operable Unit 5 Record of Decision, all surface water FRLs must be achieved and maintained at the completion of the FEMP's remedial actions (It was acknowledged in the Operable Unit 5 Feasibility Study that the BTVs were not a formal part of the FRL development process.). To address the BTVs, the Operable Unit 5 Feasibility Study provided a provision that if, following remediation of the site to achieve FRLs, the concentrations of constituents remained above BTVs for ecological receptors, further investigation and remediation may be warranted. The plan for accommodating the BTVs, as established in the Operable Unit 5 Feasibility Study, is therefore a necessary design consideration for development of the surface water monitoring plan under the IEMP.

During site remediation, those constituents that have occasionally exceeded FRLs and/or BTVs should be monitored to document whether the exceedances continue to occur, or, as expected, dissipate as remediation progresses. Because active remediation will be occurring in and near on-property drainages, it is appropriate to monitor for exceedances of the FRLs and BTVs downstream from the remedial areas and upstream from the off-property receptors. Therefore, sampling points should be located at: 1) on-property locations downstream of historical FRL or BTV exceedances; 2) the point where Paddys Run flows off the FEMP property; 3) the northeast drainage as it leaves the property; and 4) the treated-effluent water as it leaves the FEMP destined for the Great Miami River. To determine the concentration of the treated effluent constituents outside the mixing zone in the Great Miami River, a conservative calculation using the 10-year low-flow conditions will be necessary. To provide surveillance monitoring for FRL and BTV exceedances, samples should be collected monthly and analyzed for those constituents identified in Table 4-1 as having exceeded FRLs or BTVs within the respective drainage areas upstream of the sampling point.

4.4.2.4 Impacts to Surface Water due to Uncontrolled Runoff and Remedial Activities

As stated in Section 4.3, IEMP surface water monitoring will occur outside of and downstream from areas where surface water is controlled. As shown in Figure 4-2, the majority of highly contaminated surface water drainage from the site (i.e., from the former production area [Operable Unit 3], the waste storage area [Operable Units 1 and 4], and portions of Operable Unit 2 [inactive flyash pile/south field]) has been identified and controlled through contaminant abatement and formal removal actions from 1986 to 1995.

Figure 4-5 shows the dramatic effect contaminated runoff controls have had in lowering the concentrations of uranium, the principal site contaminant, in surface water leaving the FEMP via Paddys Run. EMP surface water sample locations are shown in Figure 4-6. Other important distinctions regarding uranium in surface water leaving the site to Paddys Run, based on the data in Figure 4-5, are that:

- Average concentrations have been far below the human-health-protective surface water FRL concentration of 530 μg/l in each year since 1979. (This includes nine years while the site was in production.)

- Average annual concentrations have been consistently below the human-health-protective groundwater FRL of 20 μg/l for each of the nine years since the storm water retention basin began collecting contaminated runoff in 1986.

It is anticipated that the controls currently in place will remain until remediation of the respective areas is complete. Therefore, it will not be necessary to monitor within these controlled areas for purposes of the IEMP. Stormwater runoff from these areas is collected and treated. Monitoring of the effluent is covered by the NPDES and FFCA programs discussed in Section 4.4.2.6.

Additional controls on surface water runoff are mandated by the site storm water pollution prevention plan for construction activities which includes areas where soil remedial excavations will occur and the area where the on-site disposal facility is being constructed. As noted in Section 4.3, responsibility for these controls and monitoring for the effectiveness of the controls is the responsibility of each individual project. The specifications of these controls and associated performance monitoring of the controls will be outlined in Operable Unit 5 soil remediation remedial action work plans and other project-specific remedial action documentation, as warranted.

Effective sampling points for this surveillance monitoring need to be:

- At points downstream of the controls and activities
- At the FEMP site boundary in Paddys Run
- In the treated effluent routed to the Great Miami River as it leaves the facility.

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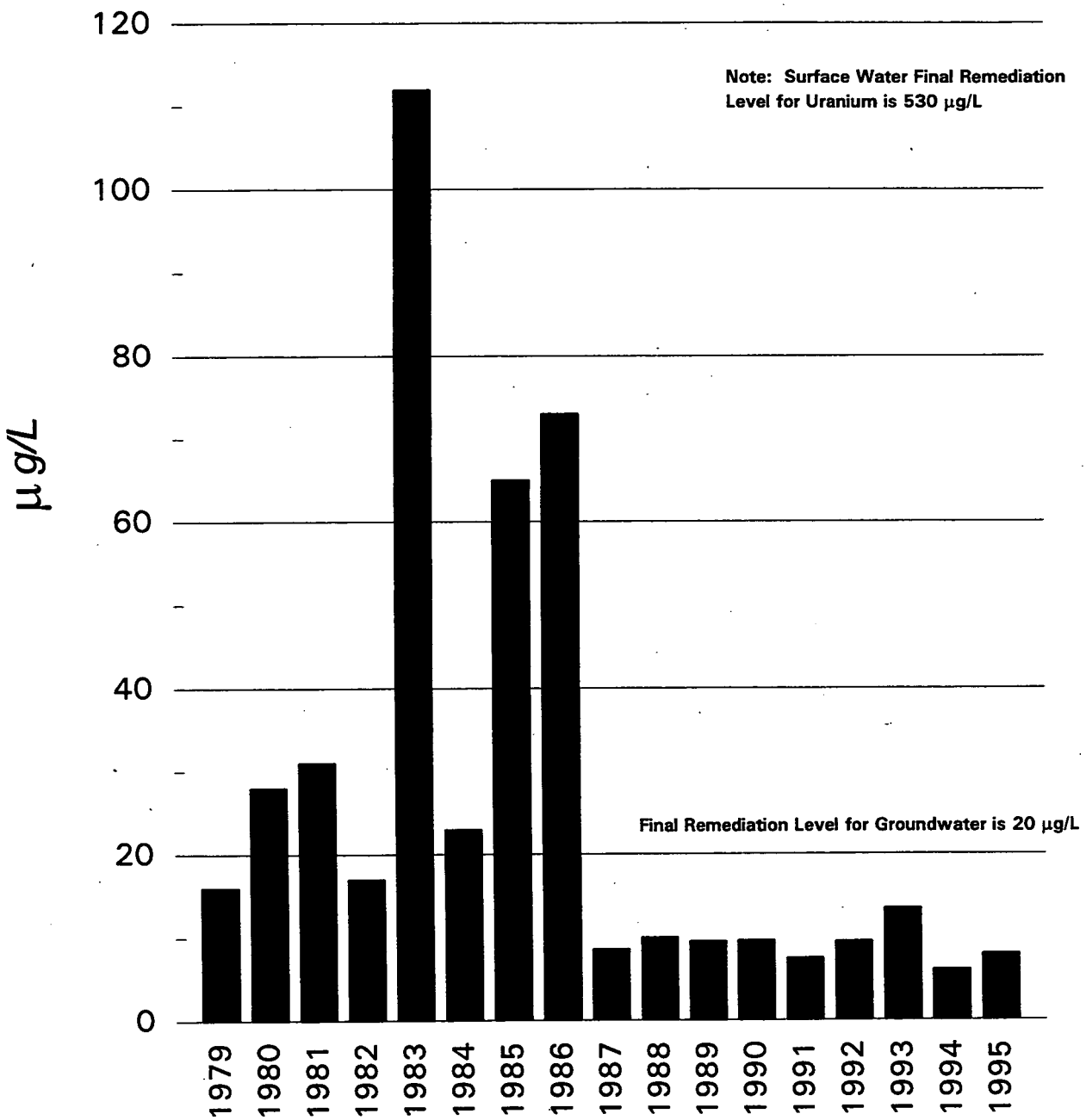
Figure 4-5

Comparison of Average Total Uranium Concentrations at Paddys Run at Willey Road



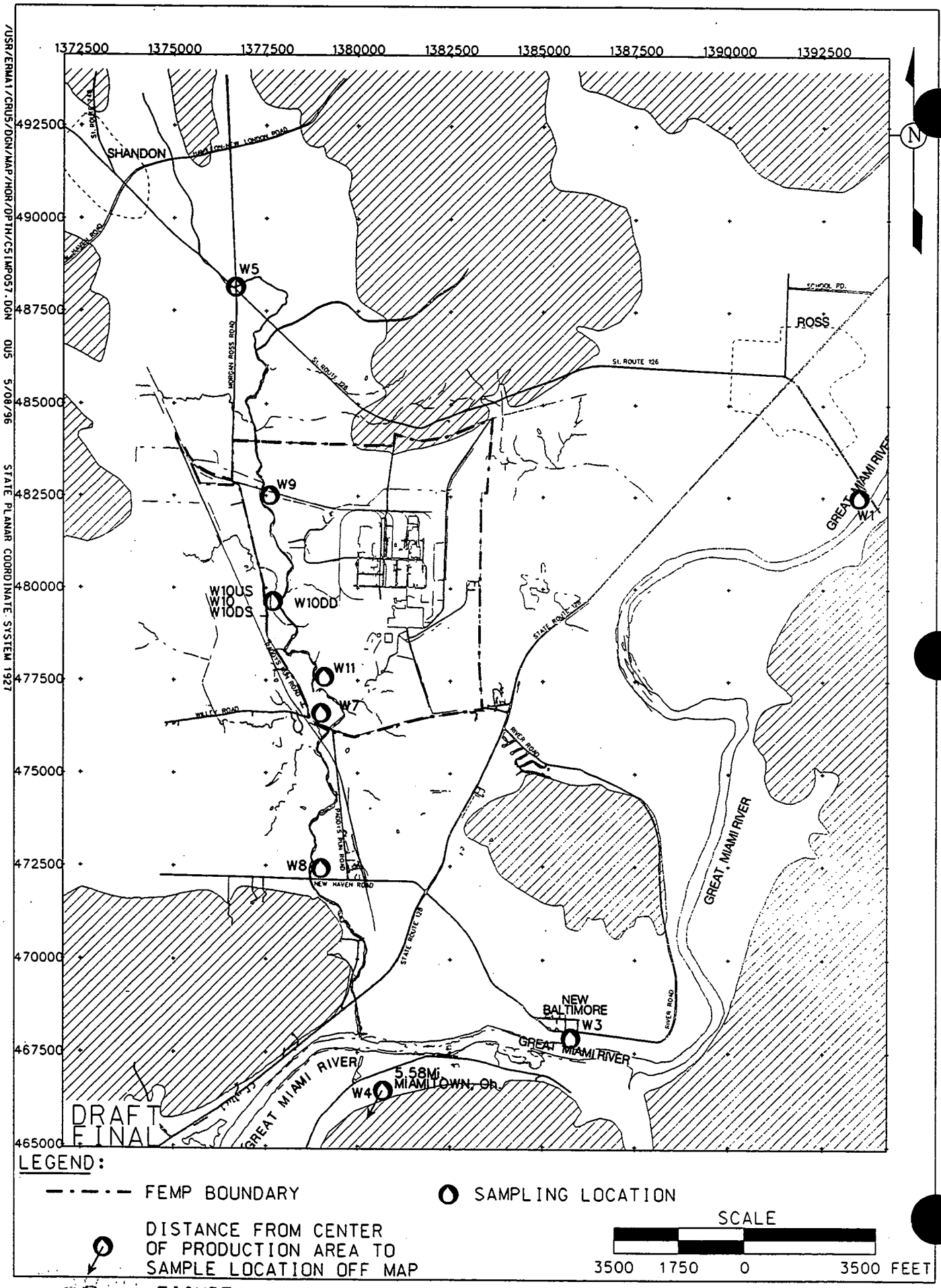


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FIGURE 4-6. EMP SURFACE WATER SAMPLING LOCATIONS

Parameters for this surveillance monitoring need to be those constituents that:

- Exceed surface water FRLs or BTVs upstream from the monitoring points and
- Present insufficient concentration upstream of the monitoring points and are mobile to the degree such that they have the potential for: 1) cross-media impact to groundwater; 2) affecting surface water to the degree that human-health-protective FRLs are exceeded; and 3) impact surface water above BTVs.

The frequency of sampling to fulfill this expectation should be such that seasonal variations in contaminant concentrations can be assessed.

Unlike the relatively low concentrations of uranium documented at the property boundary, uranium concentrations in the Pilot Plant drainage ditch have consistently exceeded the surface water FRL for uranium (Figure 4-7, Location W10DD). Additionally, a portion of Paddys Run in the vicinity of the waste storage area has consistently shown elevated levels of uranium. These surface water data were collected in support of the EMP and the Remedial Investigation/Feasibility Study. Figure 4-8 identifies the average annual uranium concentrations for the past 5 years at environmental monitoring points along Paddys Run.

In the spring of 1996, a sump was installed at the Pilot Plant drainage ditch to reroute contaminated surface water to treatment. Under the IEMP, surface water will be monitored monthly for a total uranium at two locations to determine the effectiveness of this control and to determine if an ongoing problem exists from runoff originating in the area between the waste storage area and the former production area.

4.4.2.5 Insufficient Number of Historical Analyses

Due to insufficient data for a limited number of constituents with FRLs (i.e., method detection limits for all analyses were above the FRL or there was an insufficient number of analyses), it cannot be adequately determined whether they exceed the FRLs and/or BTVs. These constituents are: benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, 3,3-dichlorobenzidine (identified with a U on Table 4-1) FRLs and BTVs were developed after sampling in support of the remedial investigation was completed. FRLs developed for several constituents were based on the lowest reasonable and achievable method detection limits. For several constituents, the resulting FRLs were below the method detection limits used for the samples collected during the remedial investigation.

Figure 4-7
Average Annual Total Uranium Concentrations
at Pilot Plant Drainage Ditch Sampling Location

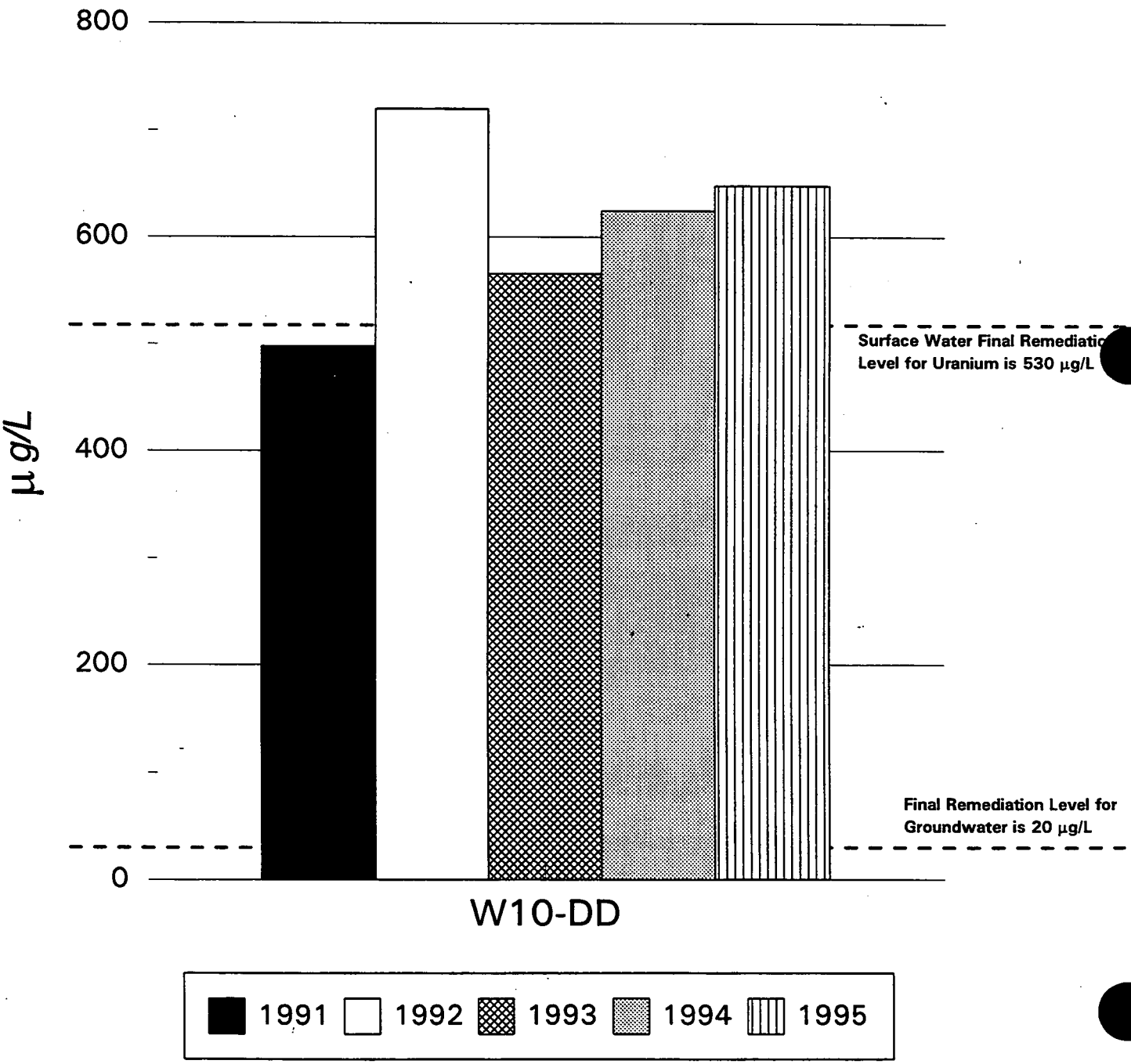

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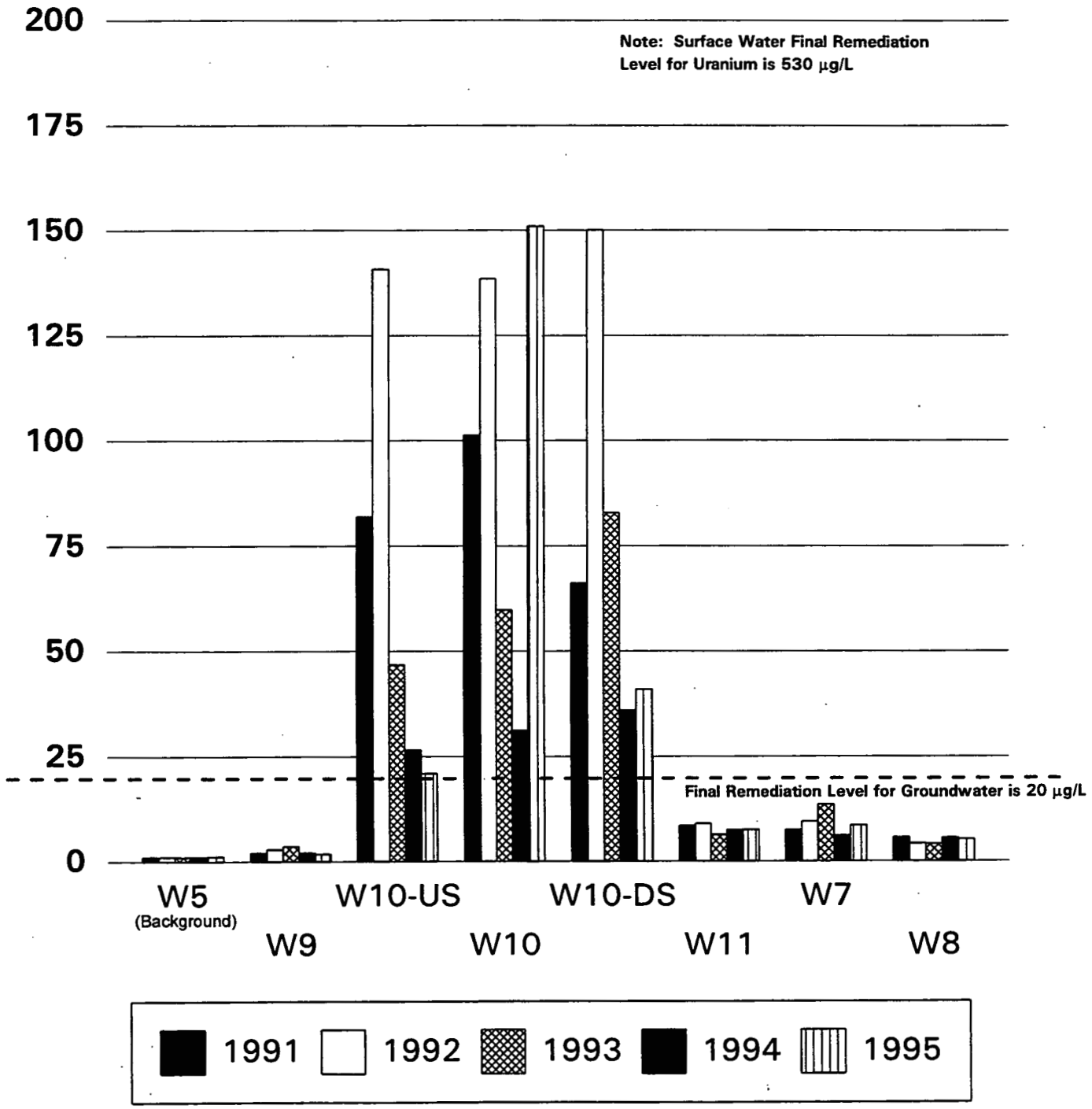
Figure 4-8
Average Annual Total Uranium Concentrations at Paddys Run Sampling Locations



Additionally, lead-210 has not historically been sampled in surface water at the FEMP.

Therefore, to adequately assess whether these parameters are a concern, effective sampling points need to be:

- At the FEMP site boundary in Paddys Run, and
- In the treated effluent routed to the Great Miami River as it leaves the facility.

The frequency of sampling to fulfill this expectation should be such that seasonal variations in contaminant concentrations can be assessed.

4.4.2.6 Ongoing Background Evaluation

As shown in the Operable Unit 5 Remedial Investigation, the remedial investigation/feasibility study background data set for Paddys Run and the Great Miami River surface water was limited both by the number of samples and temporal variability represented by the samples. In addition to this remedial investigation/feasibility study data limitation, background surface water quality is by nature transient (i.e., background surface water quality is subject to variations over time due to changes in activities and runoff conditions within the watershed). To address the limited background data for Paddys Run and the Great Miami River, the following considerations are recommended for the establishment of the IEMP surface water background sampling program for fiscal years 1997 and 1998:

- Sampling points should be consistent with those locations established for the existing environmental monitoring program and the remedial investigation/feasibility study
- Parameters analyzed should represent the parameters for which the Operable Unit 5 Record of Decision established surface water FRLs and those parameters for which the Sitewide Ecological Risk Assessment documented BTVs
- The sampling frequency should be such that seasonal variations are measured.

These considerations define the IEMP program for surface water sampling of background locations provided in the following program design section.

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4.4.2.7 Continue to Fulfill National Pollutant Discharge Elimination System Requirements

As noted in Section 4.2, wastewater and stormwater discharges from the FEMP are regulated under the state-administered NPDES program. The current permit (OEPA Permit 1I000004*ED) was issued on September 27, 1995, became effective November 1, 1995, and expires March 31, 1998. All surface water and treated-effluent sampling and analysis requirements as they are defined in the current permit will be carried forward and integrated in the IEMP shown in Section 4.4.3; however, it is anticipated that when the site NPDES permit is renewed in 1998, the permit requirements will be refined based on the progressive findings of the IEMP and ongoing remedial activities of the site.

To better assess the impacts of treated effluent on the surface water with respect to FRLs and BTVs, the IEMP recommends that lower detection limits be implemented for two constituents analyzed in the NPDES program. In the future, analytical methods 220.2 and 272.2 from Methods for Chemical Analysis of Water and Wastes (EPA 1983), will be used for the analysis of copper and silver, respectively. These methods are both approved for use in NPDES programs under 40 CFR 136.3 (Table 1B) and will provide sufficiently low detection limits.

4.4.2.8 Continue to Fulfill Federal Facilities Compliance Agreement Requirements

As noted in Section 4.2.2, the current FFCA sampling and reporting requirements became effective May 1, 1996. These requirements specify sampling at the following locations: 1) the Parshall Flume; 2) the Stormwater Retention Basin spillway; 3) the Stormwater Retention Basin bypass; 4) the South Plume recovery wells; and 5) the inactive fly ash pile. In addition to these sampling requirements, a calculation of the amount of uranium reaching Paddys Run via uncontrolled runoff is also performed. Based on the programmatic boundary definition described in Section 4.3, the IEMP would incorporate sampling at above-described locations 1 and 2, and would include the uranium calculation for the uncontrolled runoff, the Parshall Flume, and at the Stormwater Retention Basin spillway. Sampling at above-described locations 3, 4, and 5 are project-specific responsibilities and, therefore, outside the purview of IEMP sampling. However, as discussed in Section 8.0, monitoring data for each of the five FFCA monitoring locations and calculations of the amount of uranium reaching Paddys Run will be incorporated into a comprehensive IEMP reporting structure that will be phased in during fiscal years 1997 and 1998.

The sampling agreement implemented May 1, 1996, noted that, pending further evaluation, several radiological parameters may be deleted from the FFCA sampling of treated effluent. Further evaluation was performed in the comprehensive point-by-point parameter selection evaluation completed in support of this IEMP surface water and treated-effluent sampling program; the radiological parameters selected for the treated-effluent sampling point at the Parshall Flume IEMP are a composite of:

- Those radiological COCs that have been detected above their respective human-health-based surface water FRL or above the ecologically protective BTVs at any point upstream from the Parshall Flume

- Those radiological COCs that were found to be: 1) present in those areas where surface water is controlled and ultimately routed to the stormwater retention basin and/or Parshall Flume; and 2) mobile to a degree such that surface water may be impacted above FRLs or BTVs during remediation as indicated by fate-and-transport modeling

These parameters are listed in Section 4.4.3, Program Design; also listed are all other parameters deemed necessary to fulfill the program expectations outlined in Section 4.4.1, for the Parshall Flume treated-effluent sampling point as a result of the IEMP parameter-selection process.

4.4.2.9 Continue to Fulfill DOE Order 5400.1 Requirements

The design considerations provided above, which were based on information and conclusions derived from the existing DOE-compliant environmental monitoring program, as well as the comprehensive findings of the FEMP remedial investigation/feasibility study process, are sufficient to meet or exceed the requirements of DOE Order 5400.1, as summarized in Section 4.2.2.

4.4.2.10 Continue to Address Concerns of the Community

The monitoring derived from Section 4.4.2.4 (Impacts to Surface Water due to Uncontrolled Runoff and Remedial Activities) will be sufficient to address the concerns of the community. These concerns focus on limiting the amount of FEMP related contamination entering Paddys Run and the Great Miami River. This monitoring will provide a comprehensive monitoring program on Paddys Run at the facility boundary and in the treated effluent that is destined for the Great Miami River to document the reduction in FEMP related contamination entering these streams that is anticipated to occur as the remediation progresses.

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4.4.3 Program Design

This section provides the IEMP surface water and treated-effluent sampling program derived from the design considerations provided in Section 4.4.2. The IEMP surface water and treated effluent sampling locations are shown on Figures 4-9 and 4-10. Table 4-2 summarizes the program design by providing the sampling locations, the frequency, and the parameters to be sampled for at each location. This table also provides the basis for the locations, and parameters with respect to program expectations identified in Section 4.4.1.

In summary, the existing EMP has been restructured to assess the impact of site remedial activities on surface water. The nonradiological discharge monitoring and reporting related to the NPDES permit has been incorporated into the IEMP. The radiological discharge monitoring related to the FFCA has been incorporated into the IEMP with minor modifications to include all of the constituents that exceeded FRLs and BTVs in areas where stormwater runoff is controlled.

The analytical support level (ASL) for the data collected in this IEMP surface water and treated effluent program will be level B. The rationale for specifying ASL B for this program is that the data will be used for surveillance monitoring purposes. Validation of the analytical data will occur on an annual basis for one round of data from all sample locations.

All parameters from one of the monthly or quarterly samples at each location will be validated to fulfill this requirement. Near the completion of site remediation, sampling will occur to certify that the surface water pathway at the FEMP is meeting the obligations set forth in the Operable Unit 5 Record of Decision. Samples collected for this certification process will undergo a higher level of analytical scrutiny and validation than the current surveillance program.

4.5 PROJECT-SPECIFIC PLAN FOR SURFACE WATER SAMPLING

This section serves as the PSP for implementation of the sampling, analytical, and data management activities associated with the IEMP surface water sampling program. The sampling, analytical, and data management activities described in this PSP were designed to provide surface water data of sufficient quality to meet the program expectations as stated in Section 4.4.4. The program expectations in conjunction with the design considerations presented in Section 4.4.4 were used as the framework for developing the monitoring approach presented in this PSP. To ensure that the specific

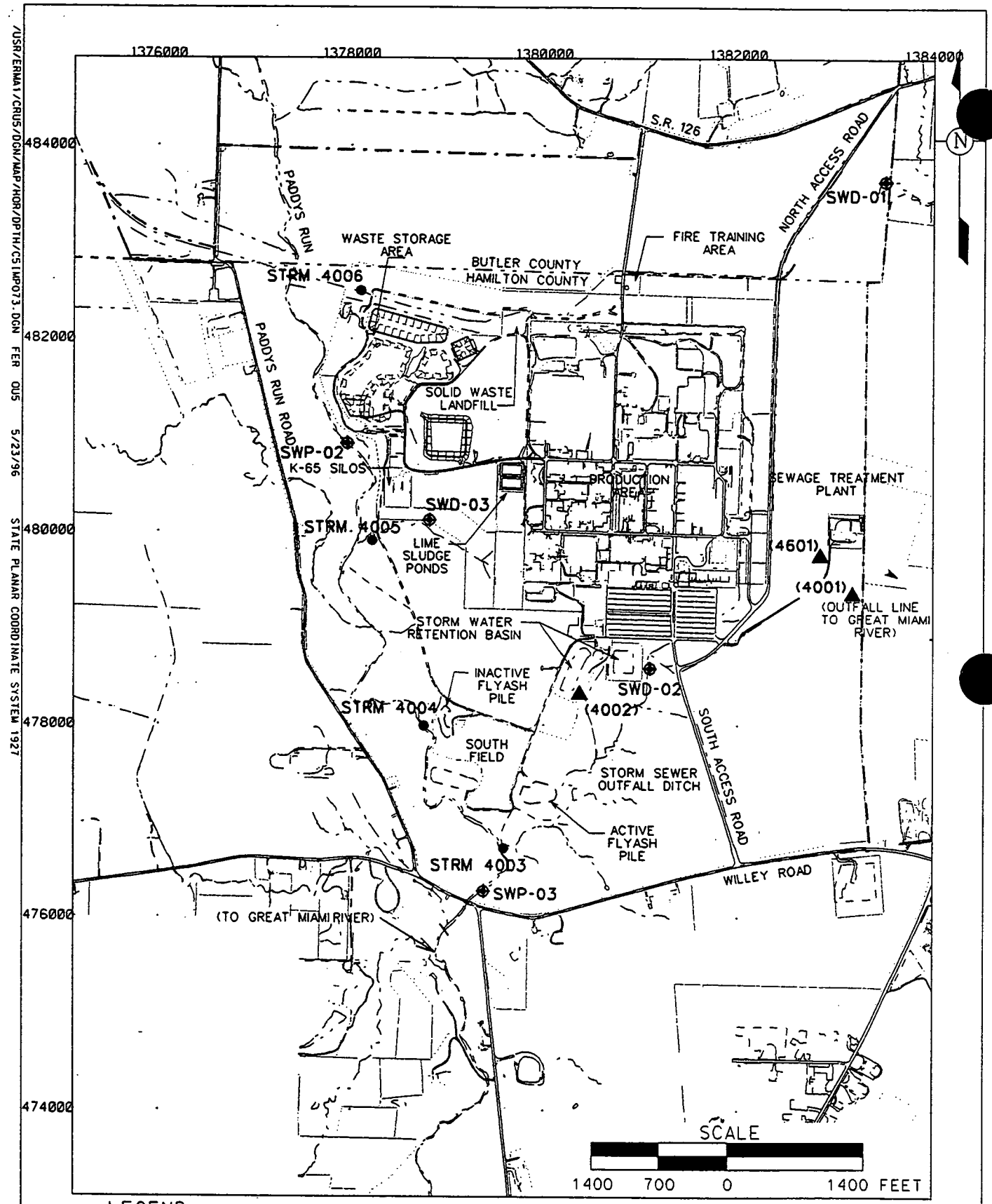

FIGURE 4-9. IEMP SURFACE WATER SAMPLE LOCATIONS

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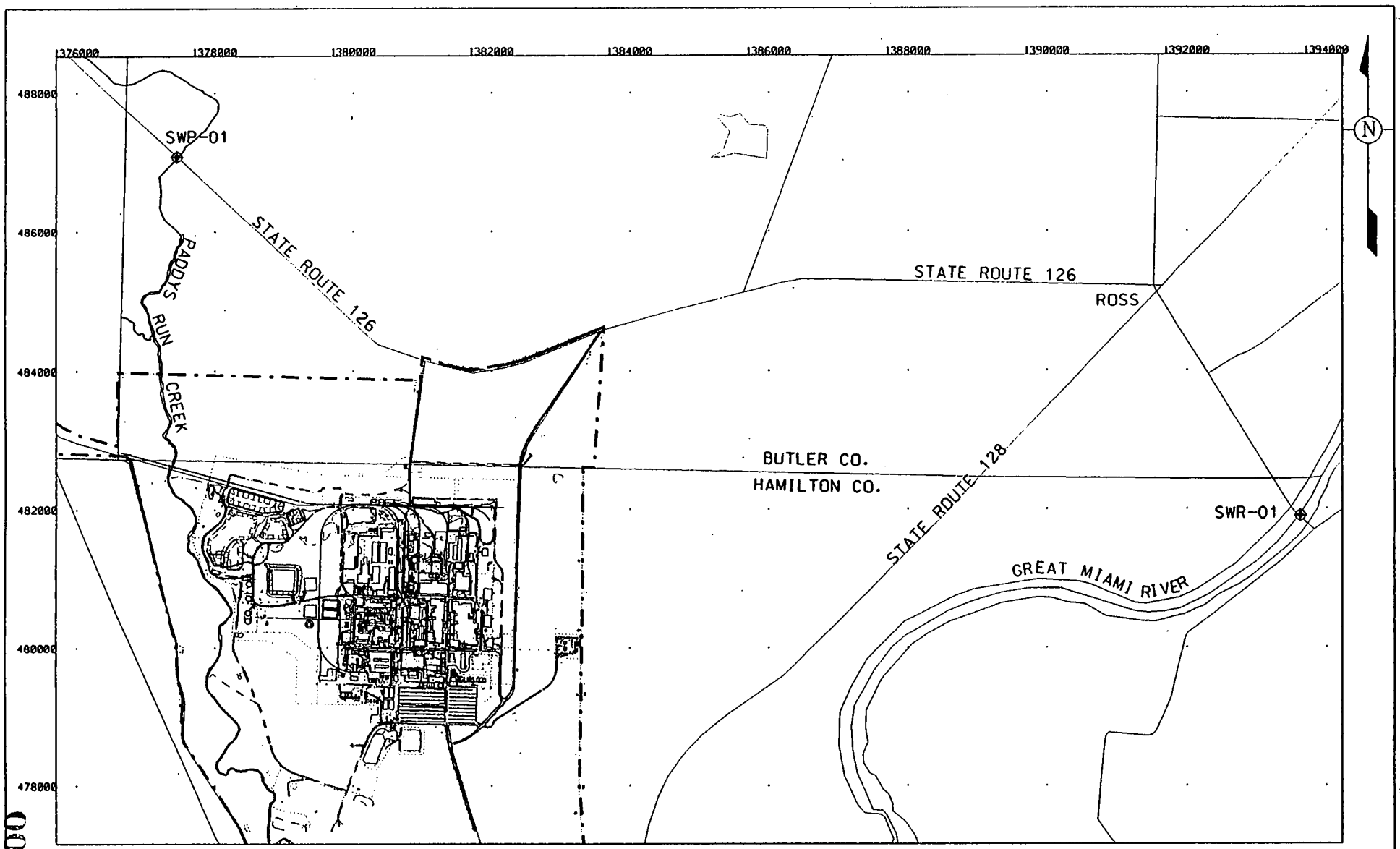

LEGEND:

— · — · — FEMP BOUNDARY

SWR-01 ◈ SAMPLE LOCATION

SCALE

2000 1000 0 2000 FEET

DRAFT

/USR/ERMA1/CRU5/DGN/MAP...C5IMPO72.DGN FER OU5 5/21/96
STATE PLANAR COORDINATE SYSTEM 1927

FIGURE 4-10. TEMP BACKGROUND SURFACE WATER SAMPLE LOCATIONS

TABLE 4-2

SUMMARY OF SURFACE WATER SAMPLING PROGRAMS

Location	Parameter	Basis for Parameter Selection: Potential Surface Water or Groundwater FRL or Surface Water BTV Exceedance Based on Modeling[a]	Sporadic Exceedances of FRLs and BTVs[b]	Insufficient Number of Historical Analyses[a]	Ongoing Background Evaluation[a]	Continue to Fulfill NPDES Requirements[c]	Continue to Fulfill FFCA Requirements[c]
SWP-01 (Paddys Run Background)	All parameters listed in Table 4-1				♦		
SWP-02 (Paddys Run)	Aluminum		♦				
	Beryllium		♦				
	Cadmium		♦				
	Chromium, Total		♦				
	Copper		♦				
	Manganese		♦				
	Mercury		♦				
	Technetium-99	♦	♦				
	Uranium, Total		♦				
SWP-03 (Paddys Run at Downstream Property Boundary)	Aluminum	●	♦				
	Barium		♦				
	Benzo(a)anthracene			♦			
	Benzo(a)pyrene			♦			
	Beryllium		♦				
	Bis(2-ethylhexyl)phthalate		♦				
	Cadmium		♦				
	Chromium, Total		♦				
	Copper		♦				
	Cyanide	♦					
	Dibenzo(a,h)anthracene			♦			
	3,3-Dichlorobenzidine			♦			
	Di-n-octylphthalate		♦				
	Lead		♦				
	Lead-210			♦			
	Manganese		♦				

000139

TABLE 4-2
(Continued)

Location	Parameter	Potential Surface Water or Groundwater FRL or Surface Water BTV Exceedance Based on Modeling[a]	Sporadic Exceedances of FRLs and BTVs[b]	Insufficient Number of Historical Analyses[a]	Ongoing Background Evaluation[a]	Continue to Fulfill NPDES Requirements[c]	Continue to Fulfill FFCA Requirements[c]
		Basis for Parameter Selection					
SWP-03 (Paddys Run at Downstream Property Boundary) - Contd.	Mercury	◆	◆				
	Selenium		◆				
	Silver	◆	◆				
	Strontium-90	◆					
	Technetium-99		◆				
	Tetrachloroethene		◆				
	1,1,1-Trichloroethane		◆				
	Uranium, Total	◆	◆				
	Zinc	◆					
SWD-01 (Northeast Drainage)	Aluminum	◆					
	Beryllium		◆				
	Cyanide	◆	◆				
	Lead		◆				
	Manganese		◆				
	Mercury	●					
	Zinc		◆				
SWD-02 (Storm Sewer Outfall Ditch)	Aluminum		◆				
	Bis(2-ethylhexyl)phthalate		◆				
	Cadmium		◆				
	Manganese		◆				
	Strontium-90	◆					
	Technetium-99	◆					
	Uranium, Total	◆	◆				
SWD-03 (Waste Storage Area)	Aluminum	◆					
	Barium		◆				
	Bis(2-ethylhexyl)phthalate		◆				
	Chromium, Total		◆				

TABLE 4-2
(Continued)

Location	Parameter	Basis for Parameter Selection: Potential Surface Water or Groundwater FRL or Surface Water BTV Exceedance Based on Modeling[a]	Sporadic Exceedances of FRLs and BTVs[b]	Insufficient Number of Historical Analyses[a]	Ongoing Background Evaluation[a]	Continue to Fulfill NPDES Requirements[c]	Continue to Fulfill FFCA Requirements[c]
SWD-03 (Waste Storage Area) - Contd.	Copper		♦				
	Cyanide	♦					
	Lead		♦				
	Manganese		♦				
	Mercury	♦					
	Silver	♦					
	Technetium-99	♦					
	Tetrachloroethene		♦				
	1,1,1-Trichloroethane		♦				
	Uranium, Total		♦				
	Zinc	♦					
SWR-01 (Great Miami River Background)	All parameters listed in Table 4-1				♦		
4001 (Parshall Flume - Treated Effluent)	Aluminum	♦	♦				
	Ammonia					♦	
	Benzo(a)anthracene			♦			
	Benzo(a)pyrene			♦			
	Beryllium		♦				
	Biochemical Oxygen Demand					♦	
	Cadmium		♦				
	Chromium, Hexavalent					♦	
	Chromium, Total		♦				
	Copper, Total		♦			♦	
	Cyanide	♦	♦				
	Dibenzo(a,h)anthracene			♦			
	Di-n-octylphthalate			♦			
	3,3-Dichlorobenzidine			♦			
	Flow Rate					♦	
	Fluoride					♦	

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TABLE 4-2
(Continued)

Location	Parameter	Basis for Parameter Selection: Potential Surface Water or Groundwater FRL or Surface Water BTV Exceedance Based on Modeling[a]	Sporadic Exceedances of FRLs and BTVs[b]	Insufficient Number of Historical Analyses[a]	Ongoing Background Evaluation[a]	Continue to Fulfill NPDES Requirements[c]	Continue to Fulfill FFCA Requirements[c]
4001 (Parshall Flume - Treated Effluent) - Contd.	Lead-210			◆			
	Manganese		◆				
	Mercury	◆	◆				
	Nitrogen, Nitrate					◆	
	Oil and grease					◆	
	Radium-226	●					
	Radium-228		●				●
	Silver	◆					
	Solids, Total Suspended					◆	
	Strontium-90	◆					
	Technetium-99	◆	●				◆
	Toxicity, Acute					◆	
	Trichloroethene	◆					
	Uranium, Total	◆	◆				●
4002 (Storm Water Retention Basin)	Ammonia					◆	
	Chlorine, Residual					◆	
	Chromium, Total					◆	
	Chromium, Hexavalent					◆	
	Copper					◆	
	Flow Rate					◆	
	Fluoride					◆	
	Nickel					◆	
	Nitrate					◆	
	Oil and grease					◆	
	Phosphorus					◆	
	Silver					◆	
	Solids, Total Suspended					◆	
	Uranium, Total						◆

TABLE 4-2
(Continued)

Location	Parameter	Basis for Parameter Selection: Potential Surface Water or Groundwater FRL or Surface Water BTV Exceedance Based on Modeling[a]	Sporadic Exceedances of FRLs and BTVs[b]	Insufficient Number of Historical Analyses[a]	Ongoing Background Evaluation[a]	Continue to Fulfill NPDES Requirements[c]	Continue to Fulfill FFCA Requirements[c]
STRM 4003, STRM 4004, STRM 4005, STRM 4006 (Drainages to Paddys Run)	Ammonia					◆	
	Chromium, Total					◆	
	Chromium, Hexavalent					◆	
	Copper					◆	
	Flow Rate					◆	
	Fluoride					◆	
	Lead					◆	
	Nickel					◆	
	Nitrite + Nitrate					◆	
	Oil and grease					◆	
	Phosphorus					◆	
	Silver					◆	
	Solids, Total Suspended					◆	
	Uranium, Total		◆[d]				
4601 (Sewage Treatment Plant Effluent)	Ammonia					◆	
	Cadmium					◆	
	Biochemical Oxygen Demand, Carb.					◆	
	Chromium, Total					◆	
	Chromium, Hexavalent					◆	
	Copper					◆	
	Fecal Coliform					◆	
	Flow Rate					◆	
	Lead					◆	
	Mercury					◆	
	Nickel					◆	
	Solids, Total Suspended					◆	
	Zinc					◆	

[a]Quarterly sampling frequency
[b]Monthly sampling frequency
[c]Refer to Tables 4-10 through 4-14 for frequencies.
[d]Total uranium is to be sampled only at location STRM 4005 to assess effectiveness of surface water control recently in emplaced within the Pilot Plant drainage ditch.

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data quality objectives are met for this program, all sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the FEMP SCQ.

Subsequent sections of this PSP define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Health and safety
- Data management
- Project quality assurance.

4.5.1 Project Organization

A multidiscipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this PSP. The key positions and associated responsibilities required for successful implementation are described below.

The project team leader will have full responsibility and authority for the implementation of this PSP in compliance with all regulatory specifications and sitewide programmatic requirements defined by the Oversight and Program Integration Division. Integration and coordination of all PSP activities defined herein with other project organizations is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

Health and safety is the responsibility of all individuals working on this project scope. Qualified health and safety specialists shall participate on the project team to provide radiation protection and industrial hygiene support and assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance specialists will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the SCQ or other referenced standard and assist in evaluating and resolving all quality related concerns.

4.5.2 Surface Water Sampling Program

As discussed in Section 4.1, the surface water sampling program integrates three existing programs required to document the progress of the FEMP's remedial actions effects on surface water. The three existing programs are:

- Environmental monitoring of surface water mandated by DOE Order 5400.1
- Nonradiological monitoring of treated effluent mandated by the NPDES permit
- Radiological monitoring of non-project-specific treated effluent mandated by the FFCA.

To fulfill the requirements of the integrated surface water program, surface water samples shall be collected from seven locations on Paddys Run and one location on the Great Miami River, and treated effluent shall be sampled at the Parshall Flume and the Sewage Treatment Plant. Sample locations are shown on Figure 4-9 and Figure 4-10. Surface water sampling frequency is summarized in Table 4-2.

Samples collected from each location shall be analyzed for the parameters listed in Tables 4-3 through 4-14. The analyte lists and locations may be refined by the project team lead based on the results of the IEMP and the ongoing remedial activities at the site.

4.5.2.1 Water Collection Procedure

Surface Water Sampling

Surface water samples shall be collected from locations on Paddys Run, drainage ditches to Paddys Run, the northeast drainage, and the Great Miami River. Sampling personnel will ensure that access to the sampling locations will not result in the inadvertent introduction of foreign materials into the water sample. Additional precautions will be taken to avoid the introduction of floating organic material such as leaves or twigs during sample collection. Samples will be collected without disturbing bottom sediment. Sample technicians shall approach sampling locations from downstream of the location or if sample locations are accessed by way of a bridge, samples shall be collected on the upstream side of the bridge.

Surface water sampling will be conducted according to Appendix K of the SCQ and the following procedures:

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TABLE 4-3

QUARTERLY SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWP-01 (PADDYS RUN BACKGROUND)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Total Metals: Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Lead Manganese Molybdenum Nickel Selenium Silver Thallium Vanadium Zinc	Water (W)	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Fluoride	Water (W)	B	28 Days	None	100 ml plastic
Mercury	Water (W)	B	28 Days	pH < 2, HNO_3	500 ml plastic or glass
Cyanide	Water (W)	B	14 Days	Cool 4°C pH > 12, NaOH	1 liter plastic or glass
Polychlorinated biphenyls: Alpha-chlordane Aroclor-1254 Aroclor-1260 Dieldrin	Water (W)	B	7 Days	pH 5 - pH 9 (add $Na_2S_2O_3$ if chlorinated water supply)	2 liter glass (amber)
Nitrate	Water (W)	B	48 Hours	Cool 4°C	100 ml plastic or glass
Volatiles: Benzene Bromodichloromethane Bromomethane Carbon disulfide Chloroform 1, 1-Dichloroethene 1, 2-Dichloroethene Methylene chloride Tetrachloroethene 1, 1, 1-Trichloroethane 1, 1, 2-Trichloroethane Trichloroethene	Water (W)	B	14 Days	Cool 4°C pH < 2, HCl	2 x 40 ml glass (Teflon)

TABLE 4-3
(Continued)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Semi-Volatiles: Benzo(a)anthracene Benzo(a)pyrene Bis(2-chloroisopropy)ether Bis(2-ethylhexyl)phthalate Dibenzo(a,h)anthracene 3, 3-dichlorobenzidine Di-n-butylphthalate Di-n-octylphthalate 4-methylphenol 4-nitrophenol	Water (W)	B	7 Days	Cool 4°C	2 liter glass (amber)
Ammonia	Water(W)	B	28 Days	Cool 4°C pH < 2, H_2SO_4	500 ml plastic or glass
Cesium-137	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Neptunium-237	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Lead-210	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Plutonium-238	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Plutonium-239/240	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Radium-266	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Radium-228	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Strontium-90	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Technetium-99	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Thorium-228	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Thorium-230	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Thorium-232	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Total Uranium	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass

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TABLE 4-4

MONTHLY SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWP-02 (PADDYS RUN)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Total Metals: Aluminum Beryllium Cadmium Chromium, Total Copper Manganese	Water (W)	B	6 Months	pH <2, HNO_3	1 liter plastic or glass
Mercury	Water (W)	B	28 Days	pH <2, HNO_3	500 ml plastic or glass
Technetium-99	Water (W)	B	12 Months	HNO_3, pH <2	2 x 1 liter plastic or glass
Total Uranium	Water (W)	B	12 Months	None	2 x 1 liter plastic or glass

TABLE 4-5

SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWP-03 (PADDYS RUN)

Analyte	Sampling Frequency	Sample Matrix	ASL	Holding Time	Preservative	Container
Total Metals: Aluminum Barium Beryllium Cadmium Chromium Copper Lead Manganese Selenium Silver Zinc	Monthly	Water (W)	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Mercury	Monthly	Water (W)	B	28 Days	pH < 2, HNO_3	500 ml plastic or glass
Cyanide	Monthly	Water (W)	B	14 Days	Cool 4°C pH > 12, NaOH	1 liter plastic or glass
Volatiles: Tetrachloroethene 1,1,1,-Trichloroethane	Monthly	Water (W)	B	14 Days	Cool 4°C pH < 2, HCl	2 x 40 ml glass (Teflon)
Semi-Volatiles: Di-n-octylphthalate bis(2-ethylhexyl)phthalate	Monthly	Water (W)	B	7 Days	Cool 4°C	2 liter glass (amber)
Semi-Volatiles: 3,3-Dichlorobenzidine Dibenzo(a,h)anthracene Benzo(a)anthracene Benzo(a)pyrene	Quarterly	Water (W)	B	7 Days	Cool 4°C	2 liter glass (amber)
Total Uranium	Monthly	Water (W)	B	12 Months	None	2 x 1 liter plastic or glass
Radium-226	Monthly	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Technetium-99	Monthly	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Strontium-90	Monthly	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Lead-210	Quarterly	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass

000149

TABLE 4-6

MONTHLY SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWD-01 (NORTHEAST DRAINAGE)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Total Metals: Aluminum Beryllium Lead Manganese Zinc	Water (W)	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Cyanide	Water (W)	B	14 Days	Cool 4°C pH > 12, NaOH	1 liter plastic or glass
Mercury	Water (W)	B	28 Days	pH < 2, HNO_3	500 ml plastic or glass

TABLE 4-7

QUARTERLY SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWD-02 (STORM SEWER OUTFALL DITCH)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Strontium-90	Water (W)	B	12 Months	HNO_3 pH < 2	1 liter plastic or glass
Technetium-99	Water (W)	B	12 Months	HNO_3 pH < 2	1 liter plastic or glass
Total Uranium	Water (W)	B	12 Months	HNO3 pH < 2	1 liter plastic or glass
Semi-volatile: Bis(2-ethylhexyl)phthalate	Water (W)	B	7 Days	Cool 4° C	2 liter glass (amber)
Total Metals: Aluminum Cadmium Manganese	Water (W)	B	6 Months	pH < 2, HNO_3	1 liter glass (amber)

000151

TABLE 4-8

MONTHLY SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWD-03 (WASTE STORAGE AREA)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Total Metals: Aluminum Barium Chromium Copper Lead Manganese Silver Zinc	Water (W)	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Cyanide	Water (W)	B	14 Days	Cool 4° C pH > 12, NaOH	1 liter plastic or glass
Mercury	Water (W)	B	28 Days	pH < 2, HNO_3	500 ml plastic or glass
Volatiles: Tetrachloroethene 1,1,1-Trichloroethane	Water (W)	B	14 Days	Cool 4° C pH < 2, HNO_3	2 x 40 ml glass (Teflon)
Semi-volatile: Bis(2-ethylhexyl)phthalate	Water (W)	B	7 Days	Cool 4° C	2 liter plastic or glass
Total Uranium	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Technetium-99	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass

TABLE 4-9

QUARTERLY SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION SWR-01 (GREAT MIAMI RIVER)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Total Metals: Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Lead Manganese Molybdenum Nickel Selenium Silver Thallium Vanadium Zinc	Water (W)	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Fluoride	Water (W)	B	28 Days	None	100 ml plastic
Mercury	Water (W)	B	28 Days	pH < 2, HNO_3	500 ml plastic or glass
Cyanide	Water (W)	B	14 Days	Cool 4°C pH > 12, NaOH	1 liter plastic or glass
Polychlorinated biphenyls: Alpha-chlordane Aroclor-1254 Aroclor-1260 Dieldrin	Water (W)	B	7 Days	pH 5 - pH 9 (add $Na_2S_2O_3$ if chlorinated water supply)	2 liter glass (amber)
Nitrate	Water (W)	B	48 Hours	Cool 4°C	100 ml plastic or glass
Volatiles: Benzene Bromodichloromethane Bromomethane Carbon disulfide Chloroform 1, 1-Dichloroethene 1, 2-Dichloroethene Methylene chloride Tetrachloroethene 1, 1, 1-Trichloroethane 1, 1, 2-Trichloroethane Trichloroethene	Water (W)	B	14 Days	Cool 4°C pH < 2, HCl	2 x 40 ml glass (Teflon)

000153

TABLE 4-9
(Continued)

Analyte	Sample Matrix	ASL	Holding Time	Preservative	Container
Semi-Volatiles: Benzo(a)anthracene Benzo(a)pyrene Bis(2-chloroisopropyl)ether Bis(2-ethylhexyl)phthalate Dibenzo(a,h)anthracene 3, 3-dichlorobenzidene Di-n-butylphthalate Di-n-octylphthalate 4-methylphenol 4-nitrophenol	Water (W)	B	7 Days	Cool 4°C	2 liter glass (amber)
Ammonia	Water(W)	B	28 Days	Cool 4°C pH < 2, H_2SO_4	500 ml plastic or glass
Cesium-137	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Neptunium-237	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Lead-210	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Plutonium-238	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Plutonium-239/240	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Radium-266	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Radium-228	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Strontium-90	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Technetium-99	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Thorium-228	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Thorium-230	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Thorium 232	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Total Uranium	Water (W)	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass

TABLE 4-10

TREATED EFFLUENT ANALYTICAL REQUIREMENTS AT LOCATION 4001 (PARSHALL FLUME)

Analyte	Sample Matrix	Sampling Frequency	Sample Type	ASL	Holding Time	Preservation	Container
Total Metals: Aluminum Beryllium Cadmium Chromium Manganese Silver	Water (W)	Monthly	24 Hour Composite	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Mercury	Water (W)	Monthly	Grab	B	28 Days	pH < 2, HNO_3	500 ml plastic or glass
Cyanide	Water (W)	Monthly	Grab	B	14 Days	Cool 4°C pH > 12, NaOH	1 liter plastic or glass
Volatiles: Trichloroethene	Water (W)	Monthly	Grab	B	14 Days	Cool 4°C pH <2, HCl	2 x 40 ml glass (Teflon)
Semi-volatiles: Di-n-octylphthalate	Water (W)	Monthly	Grab	B	7 Days	Cool 4°C	2 liter glass (amber)
Semi-volatiles: 3,3-Dichlorobenzidine Dibenzo(a,h)anthracene Benzo(a)anthracene Benzo(a)pyrene	Water (W)	Quarterly	Grab	B	7 Days	Cool 4°C	2 liter glass (amber)
Total Uranium	Water (W)	Monthly	Grab	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Lead-210	Water (W)	Quarterly	Grab	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Radium-226	Water (W)	Monthly	Grab	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Radium-228	Water (W)	Monthly	Grab	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Technetium-99	Water (W)	Monthly	Grab	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Strontium-90	Water (W)	Monthly	Grab	B	12 Months	HNO_3, pH < 2	1 liter plastic or glass
Oil and grease, total	Water (W)	Weekly	Grab	B	28 Days	Cool 4°C pH < 2, H_2SO_4	2 liters glass
Nitrogen, Ammonia	Water (W)	Weekly	24 hour Composite	B	28 Days	Cool 4°C pH < 2, H_2SO_4	500 ml plastic or glass

TABLE 4-10
(Continued)

Analyte	Sample Matrix	Sampling Frequency	Sample Type	ASL	Holding Time	Preservation	Container
Nitrogen, Nitrate	Water (W)	Weekly	24 hour Composite	B	48 Hours	Cool 4°C	100 ml plastic or glass
Fluoride, total	Water (W)	Weekly	24 hour Composite	B	28 Days	None	100 ml plastic
Chromium, hexavalent	Water (W)	Weekly	Grab	B	24 Hours	Cool 4°C	100 ml plastic or glass
Copper, total	Water (W)	Weekly	Composite	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Biochemical Oxygen Demand	Water (W)	Weekly	24 Hour composite	B	48 Hours	Cool 4°C	500 ml plastic or glass
Acute Toxicity *	Water (W)	•	Grab	B	NA	NA	NA
Total suspended solids	Water (W)	Daily	24 hour Composite	B	7 Days	Cool 4°C	250 ml plastic or glass
Flow rate	Water (W)	Daily	24 Hour total estimate	NA	NA	NA	NA

* Sampling performed by subcontractor

000157

TABLE 4-11

SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION 4002 (STORM WATER RETENTION BASIN)

Analyte	Sample Matrix	Sampling Frequency	Sample Type	ASL	Holding Time	Preservation	Container
Total suspended solids	Water (W)	2/year Daily, during overflow conditions	Composite	B	7 Days	Cool, 4°C	250 ml plastic or glass
Oil and grease, total	Water (W)	2/year Daily, during overflow conditions	Grab	B	28 Days	Cool, 4°C pH < 2, H_2SO_4	2 liters glass
Nitrogen, Ammonia	Water (W)	2/year Daily, during overflow conditions	Composite	B	28 Days	Cool, 4°C pH < 2, H_2SO_4	500 ml plastic or glass
Nitrate	Water (W)	2/year Daily, during overflow conditions	Composite	B	48 Hours	Cool, 4°C	100 ml plastic or glass
Total Metals: Chromium Copper Nickel Phosphorus Silver	Water (W)	2/year Daily, during overflow conditions	Composite	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Fluoride	Water (W)	2/year Daily, during overflow conditions	Composite	B	28 Days	None	100 ml plastic
Chromium, hexavalent	Water (W)	2/year Daily, during overflow conditions	Grab	B	24 Hours	Cool, 4°C	100 ml plastic or glass
Chlorine, residual	Water (W)	2/year Daily, during overflow conditions	Grab	B	Analyze Immediately	Cool, 4°C	250 ml plastic or glass
Flow rate	Water (W)	2/year Daily, during overflow conditions	24 Hour total estimate	NA	NA	NA	NA
Total uranium	Water (W)	2/year Daily, during overflow conditions		B	12 Months	None pH < 2, H_2SO_4	1 liter plastic or glass

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TABLE 4-12

SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATIONS STRM 4003, STRM 4004, AND STRM 4006

Analyte	Sample Matrix	Sampling Frequency	Sample Type	ASL	Holding Time	Preservation	Container
Oil and grease, total	Water (W)	2/year	Grab	B	28 days	Cool, 4°C pH < 2, H_2SO_4	2 liter glass
Total Suspended Solids	Water (W)	2/year	Composite	B	7 Days	Cool, 4°C	250 ml plastic or glass
Nitrogen, Ammonia	Water (W)		Composite	B	28 Days	Cool, 4°C pH < 2, H_2SO_4	500 ml plastic or glass
Nitrogen, Nitrite+Nitrate	Water (W)		Composite	B	28 Days	Cool, 4°C pH < 2, H_2SO_4	100 ml plastic or glass
Fluoride	Water (W)	2/year	Composite	B	28 Days	None	100 ml plastic
Total Metals: Chromium Copper Lead Nickel Phosphorus Silver	Water (W)	2/year	Composite	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Chromium, hexavalent	Water (W)	2/year	Grab	B	24 Hours	Cool, 4°C	100 ml plastic or glass
Flow rate	Water (W)	2/year	24 Hour total estimate	NA	NA	NA	NA

000159

TABLE 4-13

SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION STRM 4005

Analyte	Sample Matrix	Sampling Frequency	Sample Type	ASL	Holding Time	Preservation	Container
Oil and grease, total	Water (W)	2/year	Grab	B	28 days	Cool, 4°C pH < 2, H_2SO_4	2 liters glass
Total Suspended Solids	Water (W)	2/year	Composite	B	7 Days	Cool, 4°C	250 ml plastic or glass
Nitrogen, Ammonia	Water (W)		Composite	B	28 Days	Cool, 4°C pH < 2, H_2SO_4	500 ml plastic of glass
Nitrogen, Nitrite+Nitrate	Water (W)		Composite	B	28 Days	Cool, 4°C pH < 2, H_2SO_4	100 ml plastic of glass
Fluoride	Water (W)	2/year	Composite	B	28 Days	None	100 ml plastic
Total Metals: Chromium Copper Lead Nickel Phosphorus Silver	Water (W)	2/year	Composite	B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Chromium, hexavalent	Water (W)	2/year	Grab	B	24 Hours	Cool, 4°C	100 ml plastic or glass
Flow rate	Water (W)	2/year	24 Hour total estimate	NA	NA	NA	NA
Total Uranium	Water (W)	Monthly	Grab	B	12 Months	HNO_3, pH<2	

TABLE 4-14

SURFACE WATER ANALYTICAL REQUIREMENTS AT SAMPLE LOCATION 4601
(SEWAGE TREATMENT PLANT)

Analyte	Sample Matrix	Sampling Frequency	Sample Type	Lab	ASL	Holding Time	Preservation	Container
Biochemical Oxygen Demand, Carb.	Water (W)	2/week	Composite		B	48 Hours	Cool 4°C	500 ml plastic of glass
Total Suspended Solids	Water (W)	2/week	Composite		B	7 Days	Cool 4°C	250 ml plastic or glass
Nitrogen, Ammonia	Water (W)	1/2 weeks	Composite		B	28 Days	Cool 4°C pH < 2, H_2SO_4	500 ml plastic of glass
Total Metals: Cadmium, Chromium, Copper, Lead, Nickel, Zinc	Water (W)	2/year	Composite		B	6 Months	pH < 2, HNO_3	1 liter plastic or glass
Chromium, hexavalent	Water (W)	2/year	Grab		B	24 Hours	Cool 4°C	100 ml plastic or glass
Mercury		2/year	Grab		B	28 Days	pH < 2, H_2SO_4	500 ml plastic of glass
Fecal coliform		Weekly (summer only)	Grab		B	6 Hours	Cool 4°C	120 ml plastic of glass (sterile)
Flow rate	Water (W)	Daily	Composite					

- Surface Water Sampling, SMPL-16
- Horiba Water Quality Meter - Calibration, Operation, and Maintenance, EQT-02
- Collection of Field Quality Control Samples, SMPL-21
- Equipment Decontamination, EQT-01
- Chain of Custody/Request for Analysis Record for Sample Control, EW-0002.

Samples collected from the Great Miami River shall be composited from aliquots collected on a traverse at a minimum of 10 equally spaced points. Each aliquot sample shall represent approximately 10 percent of the composite sample. Due to the size of the stream or flow rate, this strategy may not be applicable to the other drainages (i.e., Paddys Run and storm sewer outfall ditch). In those instances, samples may be composited from sample aliquots collected on a traverse at three points.

Samples will be collected using a stainless steel grab container. As necessary, a length of rope will be attached to the container handle. The first sample aliquot collected at each location on the traverse will be transferred to a separate container for field parameter analysis of temperature, specific conductance, pH, and dissolved oxygen. The water in the aliquot used for field parameter measurement will be returned then to the stream. Water samples will then be collected, carefully transferred from the aliquot to the appropriate sample containers, preserved, and capped. To prevent dissolution of radionuclides from suspended solids, the amount of preservative added to highly buffered samples will be minimized. Sample preservative, volume, and container requirements for each location are listed on Tables 4-3 through 4-14.

Treated Effluent Sampling

Treated effluent is sampled by flow-proportional samplers at the Parshall Flume (location 4001) and at the sewage treatment plant (Location 4601). Sampling will be conducted according to Appendix K of the SCQ and the following procedures:

- Chain of Custody/Request for Analysis Record for Sample Control, EW-0002
- Sampling and Analyzing FEMP Water Supplies, SOP 43-C-324.

After every 24 hours of operation, the collected liquid is removed from the automatic sampler to provide a daily flow-weighted sample of the effluent. A portion of each daily sample is analyzed to determine the estimate of total uranium discharged to the Great Miami River for the day. In addition, a monthly composite is formed by combining the daily samples. This composite will be analyzed for

the parameters listed on Table 4-10. A monthly grab sample shall be collected and analyzed for the parameters listed on Table 4-14.

4.5.2.2 QA Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as sampling technique, may be responsible for introducing bias in the project's analytical results. Duplicates and trip blank (quality control) samples will be collected as outlined in the SCQ, Section 6.0 and Appendix K.

A duplicate sample shall be collected each quarter at a randomly selected sampling location by collecting the total volume to fulfill analytical requirements into one compositing container. The sample contained in the compositing container shall then be transferred to the required sample containers. The portion of the duplicate sample to be analyzed for volatile organic compounds shall not be composited, but shall be collected from the same aliquot used to collect the sample to be analyzed for volatile organic compounds.

Trip blanks shall be placed in coolers containing samples for volatile organic compound analysis and shall accompany the samples from collection to receipt at the laboratory.

4.5.2.3 Decontamination

Sampling equipment shall be decontaminated prior to transport to the sample field site, between sample locations, and after all sampling is completed to prevent cross contamination and to protect worker safety and health. The decontamination of equipment shall be a Level II Decontamination as referenced in Section K.11 of the SCQ and as described in Section 6.4.1 of the SCQ.

4.5.3 Change Control

Changes to the PSP will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the PSP must have approval by the designee and QA prior to implementation. PSP changes shall be documented on the Variance/Field Change Notice within 24 hours of verbal approval. The completed Variance/Field Change Notice

must be received by QA within one week of verbal approval. The Variance/Field Change Notice form shall be controlled and included in the field data package and become part of the project record. Permanent PSP changes will incorporate applicable Variance/Field Change Notice in annual PSP revisions. Scope changes to the PSP will require respective document changes.

4.5.4 Health and Safety Considerations

The FERMCO Health and Safety Department is responsible for the development and implementation of health and safety requirements for this PSP. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified field work will be addressed.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the field work required by this PSP. Daily safety meetings will be conducted prior to beginning field work to address specific health and safety issues.

All FERMCO employees and subcontractor personnel who will be performing field work required by this PSP are required to have completed applicable site training.

For areas which are subject to more restrictive radiological controls where the potential for exposure is greater, RWPs are necessary and will be obtained prior to the field work being performed in those areas. A radiological control technician will be assigned to each field crew performing any activities in an area requiring an RWP.

4.5.5 Data Management

Field and analytical data will be managed to meet the IEMP data reporting and quality objectives, including specific provisions for data management and recordkeeping in the NPDES permit. The field documentation and analytical data results shall be verified to ensure conformance to the appropriate SCQ sections and appendices. The process for management of the field and analytical data is described in the Environmental Data Management Plan (FERMCO 1996).

Field documentation will be verified by the sampling team for accuracy and completeness, followed by an independent field data validation in accordance with SCQ requirements for the corresponding

ASL. The project team leader must have processes in place to verify that chemical and radiological data results meet all applicable quality requirements specified in the SCQ for the respective ASL (SCQ Section 11.0 and Appendix F). The quality of analytical data shall be evaluated by independent project personnel qualified to determine accuracy, completeness and applicable statistical data necessary to evaluate data useability and data quality required for environmental monitoring reporting.

Both the field and analytical data will be entered into a controlled database using a double key or equivalent method to ensure accuracy. The hard copy data will be managed in the project files in accordance with FEMP record keeping procedures and DOE Orders.

4.5.6 Quality Assurance

Independent assessments of work processes shall be conducted to verify quality of performance. Such assessments may include audits, surveillances, inspections, tests, data verification and field validation, and peer reviews. Assessments shall include performance based evaluation of compliance to technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance to IEMP, SCQ, applicable DQOs, and FEMP Quality Assurance Program (RM-0012) requirements.

Independent assessment is the responsibility of designated project quality assurance personnel. The project team leader and QA will coordinate independent assessment oversight activities and comply with SCQ Section 12. Recommended quarterly QA surveillances shall be performed on some task specified in the PSP. The QA representative shall have "stop work" authority if significant adverse to quality conditions are identified or work conditions are unsafe. In accordance with SCQ Section 3, QA shall review and have approval signature of plans, procedures, and final documents supporting IEMP programs.

Only laboratories on the FEMP-Approved Laboratory List will be used for FEMP sample analyses in accordance with SCQ Section 12 and Appendix E.

4.6 IEMP SURFACE WATER MONITORING DATA EVALUATION AND REPORTING

Data resulting from the IEMP surface water monitoring program will be evaluated and reported. Data evaluation will consist of basic statistical analysis (e.g., mean and standard deviation) and comparison to historical data to identify long-term trends of constituents in surface water. Additionally, the data will be compared to FRLs and/or BTVs to assess impacts of site remedial activities to surface water and groundwater. Data obtained per the NPDES permit will be evaluated for compliance with NPDES permit provisions. This evaluation will serve to identify if immediate reporting of noncompliance to the EPA is necessary, and to determine the appropriate corrective actions to address the noncompliance.

Data from the surface water monitoring program are provided in three types of reports. Figure 4-11 identifies the current reporting schedule for these documents and identifies when IEMP reporting will assume responsibility for surface water monitoring reporting. Surface water monitoring activities are currently reported in the following documents:

- Monthly reports are prepared to demonstrate FEMP compliance with the NPDES permit.
- Since May 1996, quarterly reports have been prepared to meet the terms of the FFCA. May represents the first quarterly report, following renegotiation of the FFCA reporting requirements.
- Annual reporting is presented in the Site Environmental Report, which is published in June for the period covering the previous calendar year.

All three reporting requirements can be streamlined into the IEMP reporting strategy. For example, the NPDES permit will be renegotiated during the fall of 1997, with the new permit taking effect some time after the March 31, 1998, expiration date of the prior permit. DOE plans to negotiate the reporting requirement to transition from the current monthly report to a quarterly report that would be included in the IEMP status to be presented to the EPA and OEPA at quarterly meetings. In addition, the surface water reporting now documented in the annual Site Environmental Report would be incorporated into a new IEMP annual environmental report.

The following list identifies the transition point between current surface water reports and IEMP reporting:

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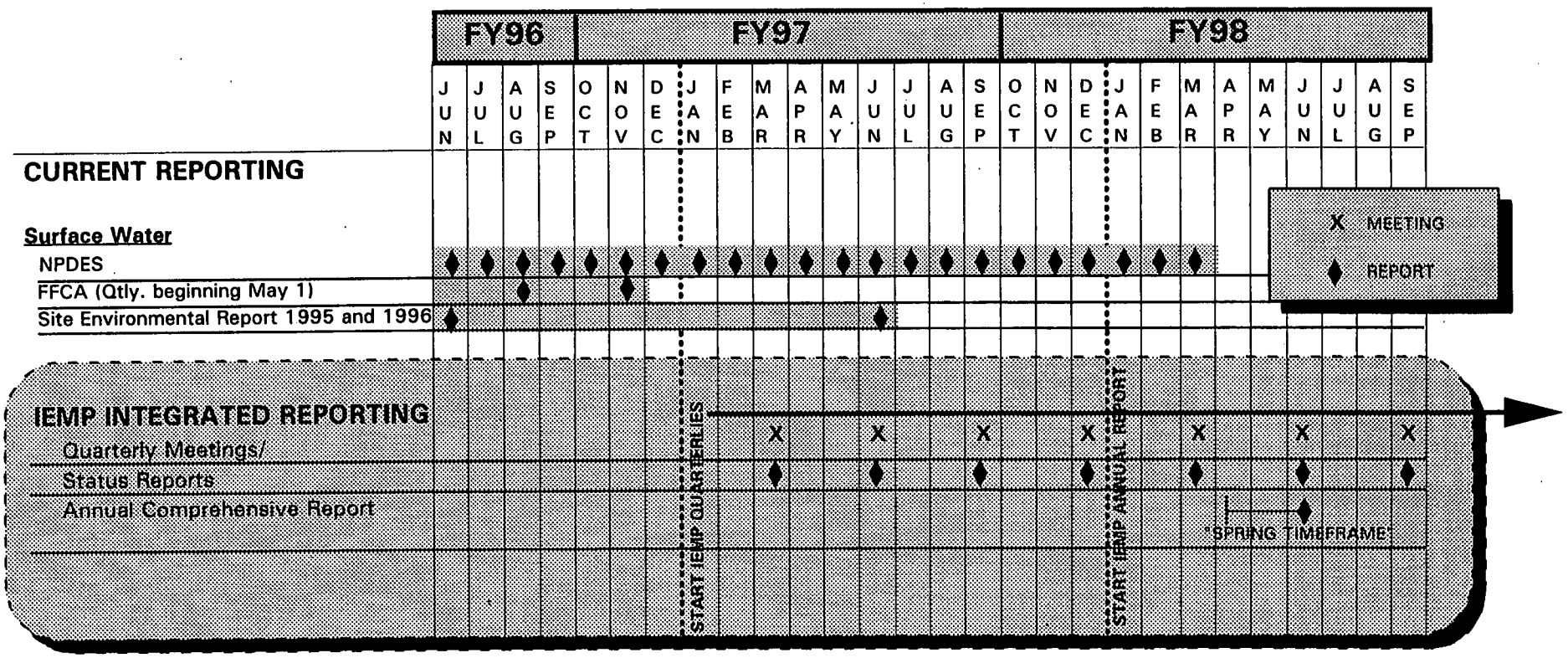
FIGURE 4-11
IEMP SURFACE WATER REPORTING STRATEGY



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- The NPDES monthly report will continue through March 1998. Beginning with the start of calendar year 1998, and pending OEPA approval of quarterly reporting in the next permit negotiations, the NPDES data will be reported quarterly in the IEMP status to regulators.

- Quarterly FFCA reporting will continue on the May, August, and November schedule through calendar year 1996. Beginning in 1997, the quarterly FFCA reporting frequency will be realigned to match the quarterly IEMP status in March, June, September, and December.

- Surface water data for calendar year 1995 will be reported in the 1995 Site Environmental Report being published in June 1996. Surface water data for calendar year 1996 will be reported in the 1996 Site Environmental Report to be published in June 1997. Beginning with calendar year 1997, surface water data will be published in a new IEMP annual environmental report.

5.0 SEDIMENT PROGRAM

Section 5.0 discusses the monitoring strategy for assessing the impact of remediation activities at the FEMP on sediments deposited along area surface water drainages. The focus of this program will be on sediment outside the areas where surface water and/or sediment controls are in place as a result of the FEMP's active remediation efforts. This strategy identifies integration objectives for the sediment program and the activities necessary to satisfy requirements for sediment monitoring. A project-specific plan for sediment monitoring activities is provided, along with a discussion of sediment data evaluation. The section concludes with a plan to integrate the FEMP's existing sediment reporting into a single IEMP-sponsored reporting structure.

5.1 INTEGRATION OBJECTIVES FOR THE SEDIMENT MONITORING PROGRAM

Unlike the groundwater and surface water programs (which were obligated to bring together a variety of existing compliance and reporting programs under the IEMP umbrella), the sitewide sediment monitoring program is a continuation of the existing EMP sediment monitoring program. However, the IEMP sitewide sediment monitoring program must be conducted in light of results from the site surface water program and in light of site surface water (and, thereby, sediment) controls that are in place now and those planned during remediation. The IEMP sediment monitoring program also must build on monitoring programs that have historically evaluated the sediment pathway at the FEMP. The design considerations for the IEMP sediment monitoring program (discussed in Section 5.4), especially the location of sampling points, incorporate these factors. The sitewide sediment pathway historically has been evaluated under two closely knit programs:

- The existing environmental monitoring program, which began in 1974, has provided comprehensive data in the storm sewer outfall ditch, Paddys Run, and the Great Miami River for site-specific radiological constituents.
- The remedial investigation/feasibility study characterization of sediment which focused on a broader range of constituents (both radiological and non-radiological) in site drainages as well as in the storm sewer outfall ditch, Paddys Run, Northeast Drainage, and the Great Miami River.

The information produced by these two FEMP programs through 1993 was reported and evaluated in the Operable Unit 5 Remedial Investigation Report (DOE 1995f) and carried forward into the Operable Unit 5 Feasibility Study for the development of sediment clean-up levels. The Operable

Unit 5 Record of Decision (DOE 1996) established health-protective FRLs for sediment. Achievement of these FRLs will be accomplished as site soil and sediment are remediated and contaminated source materials are removed. This presents an opportunity for integration between remediation activities and sediment sampling. For sediment, further investigation to refine remediation needs in the on-property drainages (which feed into Paddys Run) will be conducted, if determined necessary; this investigation would be part of the project-specific soil excavation planning to confirm the extent of sediment to be excavated, along with the contaminated soil in a specific area.

For sediment in Paddys Run and the Great Miami River, the Operable Unit 5 Feasibility Study (DOE 1995a) concluded that while COCs above FRLs or BTVs were detected intermittently at some locations, the data demonstrate no discernable trend of contamination to indicate that remediation of this sediment would be required (i.e., the current residual concentration of contaminants in the sediment is such that it is not a significant threat to human health or the environment). It is recognized, however, that sediment in Paddys Run and the Great Miami River is dynamic (i.e., conditions continually change, especially following a hard rain when sediment is washed out and replaced by new sediment) and that the sediment data set is limited.

Therefore, although the Operable Unit 5 Feasibility Study concluded, for planning purposes, that remediation of sediment in Paddys Run or the Great Miami River is not likely to be required, verification sampling of sediment will be performed to ensure that sediment remedial actions are not required. The sediment verification sampling is expected to be conducted following the completion of on-property soil remedial actions to ensure that sources which could release additional contaminated sediment to the environment are removed prior to the verification. This sediment verification sampling will be completed as part of the IEMP and will be defined in a future version of the IEMP when soil and source operable unit remediation is nearly complete. Ultimately, the IEMP will be used to verify and document that the FEMP's sitewide remedial actions result in a condition that no longer poses any long-term threat to human health and the environment through the sediment pathway.

In the interim, to address concerns of the community, the FEMP proposes to continue the current environmental monitoring sediment program in the IEMP for an initial period of two years (1997

and 1998), as site remediation is implemented. Monitoring during this period will provide an assessment concerning the sufficiency of the project-specific surface water and sediment controls. If the results of this two-year program are consistent with past sediment sampling programs (i.e., the concentration of any residual contamination detected in the sediment is determined to be such that it is not a significant threat to human health or to the environment as a result of remedial activities), then the sediment sampling program conducted as part of the IEMP likely may be reduced or eliminated, as appropriate.

5.2 ANALYSIS OF REGULATORY DRIVERS, DOE POLICIES, AND OTHER FEMP-SPECIFIC AGREEMENTS

This section presents an evaluation of the regulatory drivers governing sediment monitoring during site remediation. The intent of this section is to identify any pertinent regulatory requirements, including ARARs and TBC-based requirements, for the scope and design of the sediment monitoring program. These requirements will be used to confirm that the design specifications: 1) satisfy the regulatory obligations stated below; and 2) will achieve the intentions of other pertinent criteria (such as DOE Orders and the FEMP's existing agreements, as appropriate) that have a bearing on the scope of this monitoring. The results of the evaluation also are used to define, as appropriate for this media, the programmatic boundaries between the IEMP and project-specific emissions control monitoring conducted by individual project organizations.

5.2.1 Approach

The analysis of the regulatory drivers and policies was conducted by examining the FEMP's approved CERCLA Record of Decisions to identify any sediment-specific monitoring requirements. An evaluation of the FEMP's regulatory drivers for sediment monitoring was conducted to confirm that the existing EMP monitoring scope (which historically has satisfied public concerns and DOE order 5400.1 and 5400.5 requirements) also meets the additional requirements (if any) for sediment monitoring that may have been activated by the FEMP's CERCLA operable unit Record of Decisions. Although the Operable Unit 3 Record of Decision is not yet final, ARARs within the draft Operable Unit 3 Record of Decision were considered. Any ARAR changes in the final Operable Unit 3 Record of Decision from the draft Operable Unit 3 Record of Decision will be evaluated for impacts to the IEMP, and the monitoring program will be revised immediately, if necessary.

5.2.2 Results

The evaluation of regulatory drivers for sediment monitoring resulted in two regulatory requirements governing the technical scope and reporting for a sediment monitoring program at the FEMP:

- The CERCLA Record of Decision for Remedial Actions at Operable Unit 5 which requires remediation of the site such that the sediment pathway is protective of the underlying Great Miami Aquifer and is protective of the environmental receptors. The FRLs for sediment are specified in the operable unit 5 Record of Decision; however, a specified volume area of sediment to be remediated was not identified due to the sporadic and isolated detections of contaminants above FRLs in sediment.

- The CERCLA Operable Unit 5 Feasibility Study which identified a provision to verify, at the end of sitewide remediation, that the sediment in Paddy's Run and the Great Miami River meets the CERCLA FRLs for sediment, and to verify that sediment-specific remediation is not necessary. Continual monitoring for FRL parameters in the sediment is not necessary under the Operable Unit 5 Feasibility Study, provided verification sampling occurs at the end of remediation.

DOE Order 5400.1, General Environmental Protection Program, and DOE Order 5400.5, Radiation Protection of the Public, were also evaluated for any TBC criteria that may drive environmental monitoring of sediment at the FEMP. This evaluation concluded that, although sediment sampling has been conducted under the DOE Order-driven EMP, continued sediment monitoring is not mandated by DOE Orders in light of the well-characterized current site conditions, planned actions regarding IEMP surface water sampling, and the planned sediment verification sampling both on and off property.

To summarize, as described above, there are no regulatory requirements mandating continued EMP sediment monitoring as part of the IEMP monitoring program during remediation. However, due to public concern expressed during meetings, the existing EMP sediment sampling scope will be incorporated into the IEMP for a minimum of two years, as noted in Section 5.1.

5.3 PROGRAMMATIC BOUNDARY FOR THE SEDIMENT PROGRAM

This section identifies the programmatic boundary that has been established between the IEMP and project-specific activities. The intent behind the boundary definition is to: 1) clearly delineate the scope and geographic extent of the IEMP monitoring responsibility; and 2) establish a recognized interface between the "downstream" surveillance focus of the IEMP and the predominant emission-

control-and-verification (in on-property drainages as part of soil remediation) focus of project-specific monitoring.

The boundary of the IEMP's sediment sampling program is the storm sewer outfall ditch, Paddys Run, and the Great Miami River. Project-specific sediment investigation to refine remediation needs in the other-on-property drainages and the storm sewer outfall ditch will be conducted, if determined necessary, as part of the project-specific soil excavation planning. If project-specific sampling is determined to be required in the storm sewer outfall ditch, it will be coordinated with the IEMP monitoring of the sediments in the storm sewer outfall ditch. As described in Section 5.1, verification sampling of sediment in Paddys Run and the Great Miami River will be performed as part of a future version of the IEMP to ensure that remedial actions for sediment are not required.

5.4 PROGRAM EXPECTATIONS AND DESIGN CONSIDERATIONS

5.4.1 Program Expectations

The 1997-1998 IEMP sediment monitoring program is essentially a two-year continuation of the current EMP sediment surveillance monitoring program. The expectations for the program for 1997 and 1998 are to collect data sufficient to:

- Determine if substantive changes to current residual contaminant conditions (as defined by the current environmental sampling program) occur in the sediments found in the storm sewer outfall ditch, Paddys Run, and the Great Miami River as a result of runoff and treated effluent from the site
- Determine if the program should continue as is or be refined in scope as remediation progresses
- Continue to address the concerns of the community associated with remedial construction activity at the FEMP.

5.4.2 Sediment Program Design Considerations

The design considerations to address the above listed expectations are as follows:

- Sample locations should, in general, be consistent with current environmental monitoring locations so that comparable areas are evaluated
- Sampling frequency, parameters analyzed, and analytical support level should be consistent with the current environmental monitoring program so that appropriate comparisons can be made and the findings of the annual assessment can be reported to the public.

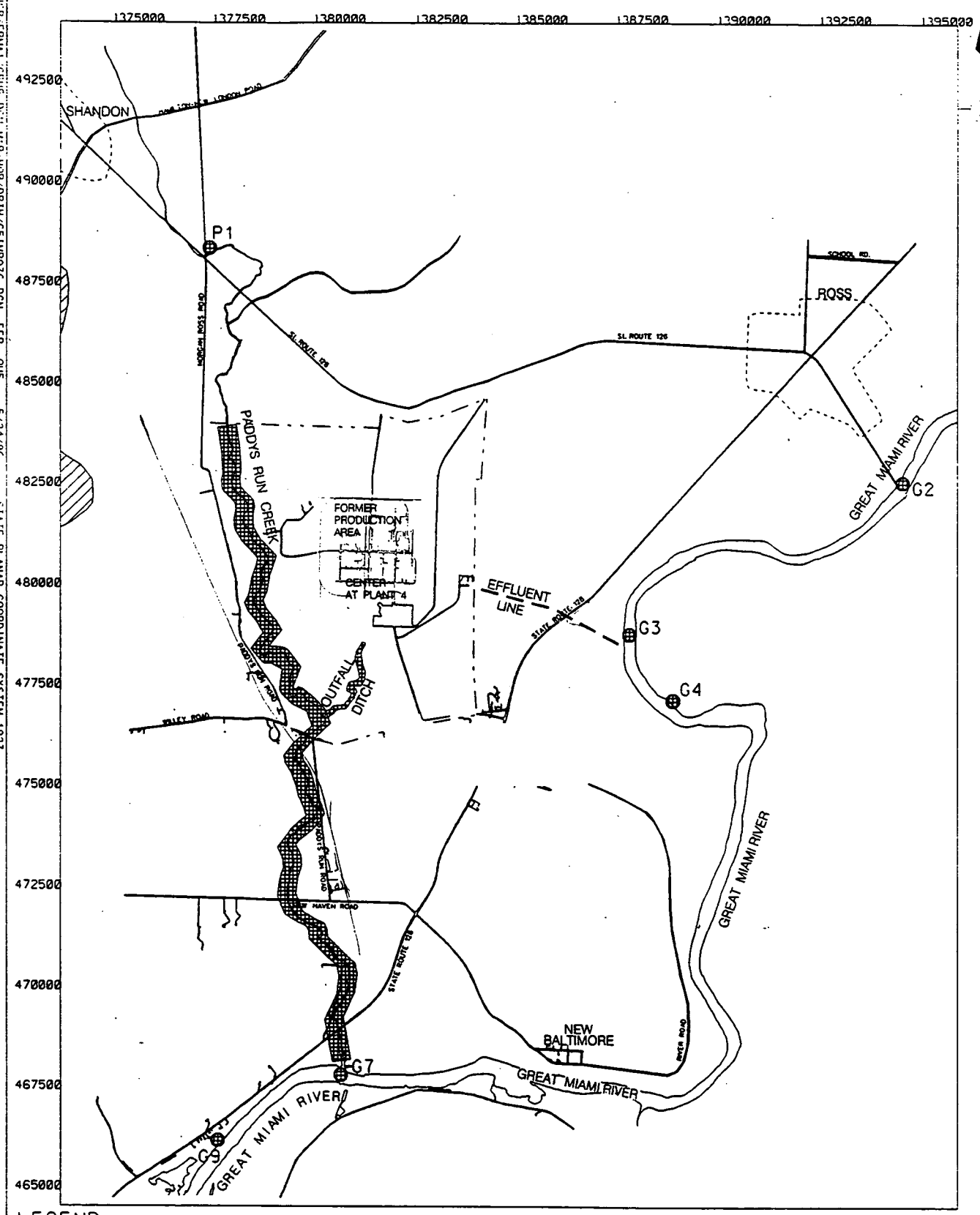
Regarding public concerns of contaminated sediment mobilization, it should be noted that controls currently in place (and planned future controls) for site surface water (and thereby, sediment) runoff from the more highly contaminated areas have reduced the contamination leaving the site. This is explained in detail for surface water in Section 4.0. As expected, the sediment sampling results from the 1994 and 1995 EMP indicate reductions of uranium contamination in sediment when compared to remedial investigation/feasibility study and earlier EMP program data collected in the late 1980s. These reductions are attributable to the control of contaminated surface water that began in 1986 with the installation of the storm water retention basins as described in Section 4.0. The 1994 and 1995 EMP sediment data indicate:

- Average uranium concentrations measured in sediment from Paddys Run, the storm sewer outfall ditch, and Great Miami River samples are far below the human-health-protective sediment FRL of 210 mg/kg for uranium (highest average was 8 mg/kg based on nine samples from the storm sewer outfall ditch in 1995)
- The maximum uranium detected was in the storm sewer outfall ditch, at 23 mg/kg
- The maximum uranium concentration in Paddys Run, downstream from the confluence with the storm sewer outfall ditch, was 10 mg/kg in 1995.

Based on the above data, in conjunction with the remedial investigation/feasibility study findings, it has been concluded that sediments from the FEMP currently do not pose an unacceptable risk to the public. However, continued monitoring at the current level is recommended in this IEMP to determine if this conclusion remains valid during the initial stages of remediation.

5.4.3 Sediment Program Design

The sediment monitoring program that will continue during fiscal years 1997 and 1998 will collect samples from the areas shown on Figure 5-1, as follows: one background location along Paddys Run, north of the site boundary; 10 locations along Paddys Run (five north of the storm sewer outfall ditch and five south of the storm sewer outfall ditch) taken at strategic locations to ensure that the most recent sediment deposited is collected; five locations along the storm sewer outfall ditch; and five locations along the Great Miami River (two background locations upstream of the FEMP treated effluent discharge point, one location just below the FEMP treated-effluent discharge point inside the Big Bend, one just downstream of the confluence with Paddys Run, and one additional downstream location).



LEGEND: — · — · FEMP BOUNDARY

DRAFT ⊕ SAMPLES COLLECTED AT STRATEGIC LOCATIONS ENSURING MOST RECENT SEDIMENT

SCALE
3500 1750 0 3500 FEET

FIGURE 5-1. SEDIMENT MONITORING LOCATIONS

Because radium-226, thorium, and uranium are primary contaminants in Operable Unit 1, Operable Unit 4, and the former production area, these constituents will be analyzed for at locations just downstream of these areas (i.e., Paddys Run north of the confluence with the storm sewer outfall ditch and in the storm sewer outfall ditch). Historic data indicate radium-226 and isotopic thorium have not been consistently detected at levels above sediment FRLs in Paddys Run south of the storm sewer outfall ditch and in the Great Miami River; therefore, samples collected from these areas will be analyzed only for total uranium. The program design is summarized in Table 5-1.

5.5 PROJECT-SPECIFIC PLAN FOR SEDIMENT MONITORING

This section serves as the PSP for implementation of the sampling, analytical, and data management activities associated with the sitewide environmental sediment monitoring program. The sampling, analytical, and data management activities described in this PSP were designed to provide sediment data of sufficient quality to meet the program expectations as stated in Section 5.4.1. The program expectations, in conjunction with the design considerations presented in Section 5.4.2, were used as the framework for developing the monitoring approach presented in this PSP. To ensure that the specific DQOs are met for this program, all sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the SCQ.

Subsequent sections of this PSP define the following:

- Project organization and associated responsibilities
- Sampling program
- Health and safety
- Change control
- Data management
- Project quality assurance.

5.5.1 Project Organization

A multi-discipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this PSP. The key positions and associated responsibilities required for successful implementation are described below.

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TABLE 5-1

ANNUAL SEDIMENT SAMPLING PROGRAM DESIGN

Location	Analyte	Expectation
Paddys Run background (1 sample)	Total uranium, isotopic thorium, radium-266	Establish range of background concentrations in Paddys Run
Paddys Run north of storm sewer outfall ditch (5 samples)	Total uranium, isotopic thorium, radium-226	Measure the impact of surface water runoff from western portion of the site, including the waste pits and K-65 areas
Paddys Run south of storm sewer outfall ditch (5 samples)	Total uranium	Measure impact of surface water runoff from the site
Storm sewer outfall ditch (5 samples)	Total uranium, isotopic thorium, radium-226	Measure the impact of any overflows of the SWRB, surface water runoff from the eastern portion of the site, and residual contaminant concentrations from past releases
Great Miami River (3 samples)	Total uranium	Measure the impact of the site effluent
Great Miami River background (2 samples)	Total uranium	Establish range of background concentrations in Great Miami River

The project team leader will have full responsibility and authority for the implementation of this PSP, in compliance with all regulatory specifications and sitewide programmatic requirements defined by the FERMCO Oversight and Program Integration Division. Integration and coordination of all PSP activities defined herein with other project organizations is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

Health and safety is the responsibility of all individuals working on this project scope. Qualified health and safety specialists shall participate on the project team to provide radiation protection and industrial hygiene support, and to assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance specialists will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the SCQ or other referenced standard, and to assist in evaluating and resolving all quality-related concerns.

5.5.2 Sampling Program

Sediment samples are collected annually in the spring from approximately 20 locations within the storm sewer outfall ditch, Paddys Run, and the Great Miami River. Sampling is performed in the spring in order to take advantage of the abundance of fresh sediment deposited during flood conditions that commonly occur after winter. Figure 5-1 illustrates the following locations for sediment sample collection:

- Five locations are planned for the storm sewer outfall ditch and connecting drainage ditches to measure the impact of any overflows of the storm water retention basin, surface water runoff from the eastern portions of the site, and residual contaminant concentrations from past. Samples collected from this area are analyzed for total uranium, isotopic thorium, and radium-226.

- Three locations along the Great Miami River downstream of the effluent line (locations G4, G7, and G9), to measure the impact of the site effluent. The first location is downstream of the effluent line inside of the Big Bend; the second location is just downstream of the confluence with Paddys Run to determine any additional influence from this stream on the river; the third location is collected farther downstream to identify any settling out of uranium downstream of the first two locations. Samples collected from the Great Miami River will be analyzed for total uranium.

- Ten locations are planned for Paddys Run, from the waste storage area to the confluence with the Great Miami River, to measure impacts of surface water runoff from the western section of the site. Paddys Run locations are separated into two groups: 1) north of the confluence with the storm sewer outfall ditch and 2) south of this confluence. Samples collected to the north are analyzed for total uranium, isotopic thorium, and radium-226. Samples collected from the south are analyzed for total uranium.

- One background location upstream of the site along Paddys Run (Location P1). Background locations along Paddys Run are analyzed for total uranium, isotopic thorium, and radium-226.

- Two background locations upstream of the site effluent line from the Great Miami River (Locations G2 and G3). Background locations along the Great Miami River are analyzed for total uranium.

5.5.2.1 Sediment Sample Collection and Procedures

Sample collection is performed according to Sediment Sampling, EP-REM-010. Sample handling and transfer is governed by Chain of Custody/Request for Analysis Record for Sample Control, EW-0002, and Logkeeping, EP-REM-002. The sampling considerations outlined in the procedures include:

- Only recently deposited surface sediment shall be collected, typically from deposition locations such as slow flow-rate areas (e.g., obstructions in the stream bed).
- Samples shall be collected from the top few centimeters.
- Begin sample collection at the farthest downstream location and proceed upstream.
- Discard any non-sediment materials from the sample, mix thoroughly, and place in the sample container.
- Dry the sediment samples in a clean, controlled area to prevent contamination.

The locations of the sediment sample points are approximate and change from year to year, based on where stream flow has deposited sufficient material for sampling. Sediment samples are analyzed according to Table 5-2.

Sampling equipment decontamination is addressed in procedure EP-REM-010, Sediment Sampling. Calibration of analytical equipment and disposition of wastes generated during analysis are per the requirements of the SCQ.

5.5.2.2 Quality Assurance Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed to evaluate the possibility that some controllable practice, such as decontamination or sampling technique, may be responsible for introducing bias in the project's analytical results. Additionally, approximately one field duplicate will be collected for every 10 samples and/or every general drainage basin area.

The State of Ohio, through its Agreement in Principle with the DOE, empowers the OEPA to take samples that are independent of split-sampling program. In addition, sediment samples are split annually in accordance with the Agreement in Principle. These samples further supplement the quality assurance program by providing a means to evaluate comparability between laboratories.

TABLE 5-2

SEDIMENT SAMPLE ANALYTICAL REQUIREMENTS

Location	Number of Samples[a]	Frequency	Analyte	ASL	Container	Hold Time	Preservative
Storm sewer outfall ditch	5	Annual	Total uranium, isotopic thorium, radium-266	B	500 mL glass jar or plastic bag	6 months	none
Great Miami River	3	Annual	Total uranium	B	500 mL glass jar or plastic bag	6 months	none
Paddys Run north of storm sewer outfall ditch	5	Annual	Total uranium, isotopic thorium, radium-226	B	500 mL glass jar or plastic bag	6 months	none
Paddys Run south of storm sewer outfall ditch	5	Annual	Total uranium	B	500 mL glass jar or plastic bag	6 months	none
Great Miami River background	2	Annual	Total uranium	B	500 mL glass jar or plastic bag	6 months	none
Paddys Run background	1	Annual	Total uranium, isotopic thorium, radium-226	B	500 mL glass jar or plastic bag	6 months	none

[a]The number of samples for each surface water stream or river may vary depending on the availability of recently deposited sediment.

Samples collected with the OEPA are analyzed for the same parameters as those established for the background sample locations.

5.5.3 Change Control

Changes to the PSP will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designated authority shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the PSP must have approval by the designated project authority and QA prior to implementation. PSP changes shall be documented on the Variance/Field Change Notice within 24 hours of verbal approval. The completed Variance/Field Change Notice must be received by QA within one week of verbal approval. The Variance/Field Change Notice form shall be controlled and included in the field data package and become part of the project record. Permanent PSP changes will incorporate applicable Variance/Field Change Notice in annual PSP revisions. Scope changes to the PSP or DQO will require respective document changes.

5.5.4 Health and Safety Considerations

The FERMCO Health and Safety Department is responsible for the development and implementation of health and safety requirements for this PSP. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified field work will be addressed.

All involved personnel will receive adequate training on the health and safety requirements prior to implementation of the field work required by this PSP. Daily safety meetings will be conducted prior to beginning field work to address specific health and safety issues.

All FERMCO employees and subcontractor personnel who will be performing field work required by this PSP are required to have completed all required site training.

For areas subject to more restrictive radiological controls where the potential for exposure is greater, radiation work permits (RWPs) are necessary and will be obtained prior to the field work being performed in those areas. A radiological control technician will be assigned to each field crew performing any activities in an area requiring a RWP.

5.5.5 Data Management

Field and analytical data will be managed to meet the IEMP data reporting and quality objectives. The field documentation and analytical data results shall be verified to ensure conformance to the appropriate SCQ sections and appendices. The process for management of the field and analytical data is described in the Environmental Data Management Plan (FERMCO 1996).

Field documentation will be verified for accuracy and completeness by the sampling team, followed by an independent field data validation in accordance with SCQ requirements for the corresponding ASL. The project team leader must have processes in place to verify that chemical and radiological data results meet all applicable quality requirements specified in the SCQ for the respective ASL (SCQ Section 11.0 and Appendix F). The quality of analytical data shall be evaluated by independent project personnel qualified to determine accuracy, completeness, and applicable statistical data necessary to evaluate data useability and data quality required for environmental monitoring reporting.

Both the field and analytical data will be entered into a controlled database using a double key or equivalent method to ensure accuracy. The hard copy data will be managed in the project files in accordance with FEMP recordkeeping procedures and DOE Orders.

5.5.6 Quality Assurance

Independent assessments of work processes shall be conducted to verify quality of performance. Such assessments may include audits, surveillances, inspections, tests, data verification and field validation, and peer reviews. Assessments shall include performance-based evaluation of compliance to technical and procedural requirements, and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance to IEMP, SCQ, applicable DQOs, and FEMP Quality Assurance Program (RM-0012) requirements.

Independent assessment is the responsibility of designated project quality assurance personnel. The project team leader and QA will coordinate independent assessment oversight activities and comply with SCQ Section 12. Recommended quarterly QA surveillances shall be performed on some task specified in the PSP. The QA representative shall have "stop work" authority if significant adverse-to-quality conditions are identified or work conditions are unsafe. In accordance with SCQ,

Section 3, QA shall review and have approval signature of plans, procedures, and final documents supporting the IEMP program.

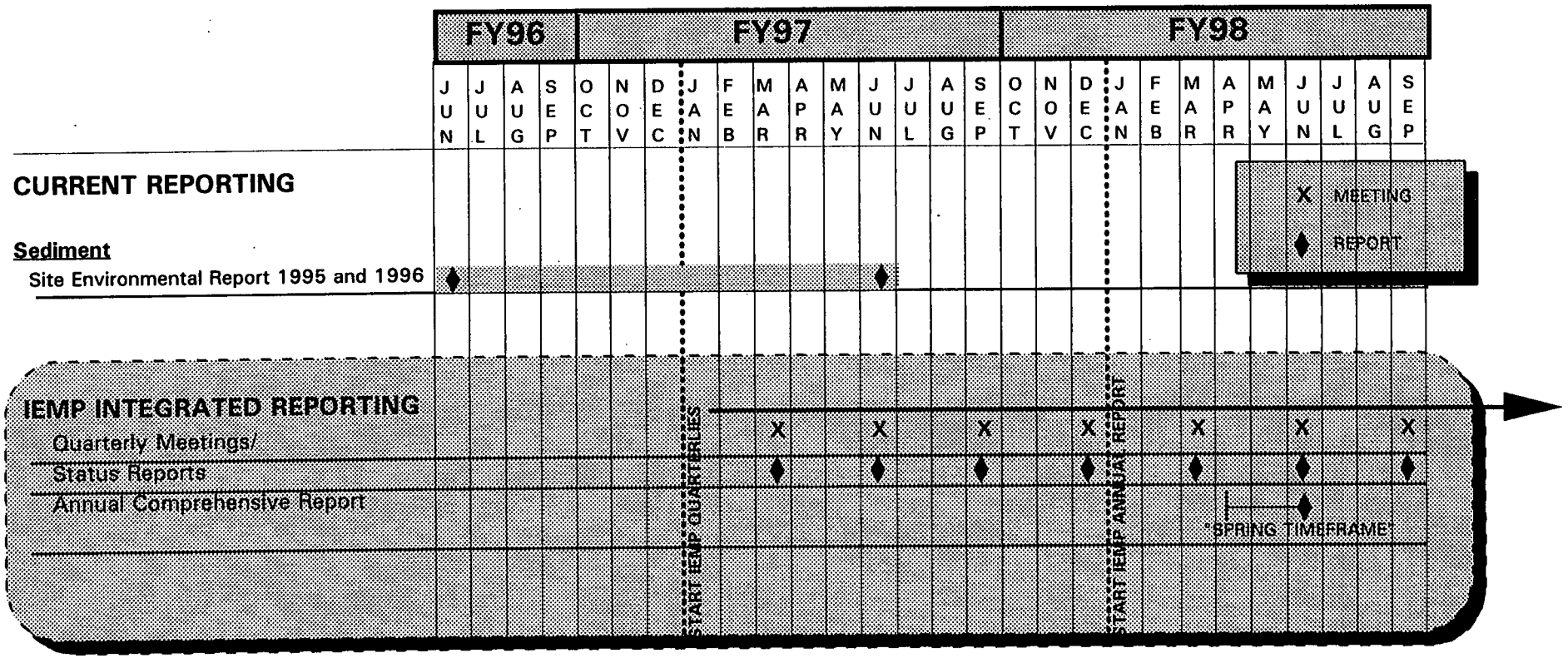
Only laboratories on the Approved Laboratory List will be used for FEMP sample analyses in accordance with SCQ Section 12 and Appendix E.

5.6 IEMP SEDIMENT MONITORING DATA EVALUATION AND REPORTING

Data from the IEMP sediment monitoring program will be evaluated and reported. Data evaluation will consist of statistical analysis and comparison to historical data in order to identify long-term trends of targeted radiological constituents in sediment.

Data from the sediment monitoring program are published annually in the Site Environmental Report. Figure 5-2 identifies the current reporting schedule for this document and identifies when IEMP reporting will assume responsibility for sediment monitoring reporting. Sediment data for calendar year 1995 will be reported in the 1995 Site Environmental Report published in June 1996. Sediment data for calendar year 1996 will be reported in the 1996 Site Environmental Report to be published in June 1997. Beginning with calendar year 1997, sediment data will be published in a new annual IEMP comprehensive environmental report.

FIGURE 5-2
IEMP SEDIMENT REPORTING STRATEGY



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6.0 AIR MONITORING PROGRAM

Section 6.0 discusses the monitoring strategy for assessing the sitewide impact of the FEMP's remediation activities on the air pathway. The strategy identifies the activities conducted to satisfy requirements for particulate, radon and direct radiation monitoring. A project-specific plan (PSP) for conducting sitewide and off-property air monitoring activities is provided, along with a phased plan to integrate several of the FEMP's air-related reports into a single IEMP-sponsored report.

6.1 INTEGRATION OBJECTIVES FOR AIR

Unlike the groundwater and surface water programs (which combine a variety of existing compliance and reporting programs together under the IEMP umbrella), the sitewide air pathway has historically been evaluated under two closely knit programs:

- The EMP program, which provided physical air monitoring at the K-65 silos, FEMP property boundary, and critical off-property locations of concern to public stakeholders
- The 40 CFR 61, Subpart H (NESHAP) air pathway dose assessment program, which provides calculated estimates of the FEMP's radiological impacts beyond the fenceline to comply with Clean Air Act provisions.

The information produced by these two FEMP programs was reported together in the FEMP's annual Site Environmental Report that historically satisfied DOE Orders 5400.1 and 5400.5 environmental monitoring and total dose assessment obligations. The NESHAP calculated dose estimates were also reported to EPA as a stand-alone report to satisfy the requirements of 40 CFR 61, Subpart H.

The IEMP will continue with the responsibility of physically monitoring the air pathway and providing calculated dose assessments to satisfy 40 CFR 61 Subpart H and the intentions of DOE Orders 5400.1 and 5400.5. As part of this responsibility, the IEMP monitoring results will be used to evaluate the emission estimates used as inputs to modeling conducted for NESHAP, to ensure that the most accurate techniques are used to estimate emissions from remedial activities underway at the FEMP.

The initial focus of the program will be to monitor the collective sitewide effects of remediation activities contemplated for fiscal years 1997 and 1998. The results will be evaluated periodically to provide necessary feedback to the projects to ensure that cumulative sitewide impacts remain within established thresholds. Ultimately, this initial information will assist in tracking trends during remediation to help identify necessary changes in program emphasis or allow for the scale back of monitoring activities, as appropriate.

A reporting plan is provided in Section 6.7 to combine the results of the air monitoring program and the NESHAP dose assessments into a single reporting mechanism to facilitate regulatory agency review of the success of the sitewide remedial activities and associated emission controls. The FEMP's plan for producing required dose assessments during remediation are provided in Appendix D.

6.2 SUMMARY OF REGULATORY DRIVERS, PERTINENT DOE POLICIES, AND FEMP-SPECIFIC AGREEMENTS

As mentioned in the previous section, the IEMP will be assuming sitewide responsibility for surveillance air monitoring as the successor program to the EMP. An evaluation of the FEMP's regulatory drivers for air monitoring was conducted to confirm that the existing EMP air monitoring scope (which historically has satisfied DOE Order 5400.1 and 5400.5 requirements for active DOE facilities) also meets the additional requirements (if any) for sitewide air monitoring that may have been activated by the FEMP's CERCLA operable unit Records of Decision. Although the Operable Unit 3 Record of Decision is not yet final, ARARs within the draft Operable Unit 3 Record of Decision were considered. Any ARAR changes in the final Operable Unit 3 Record of Decision from the draft Operable Unit 3 Record of Decision will be evaluated for impacts to the IEMP, and the monitoring program will be revised immediately, if necessary.

The results of the evaluation also are used to define, as appropriate for the air pathway, the programmatic boundaries between the sitewide IEMP responsibilities and the project-specific emissions-control monitoring conducted by the individual project organizations. (Note: During the active uranium production years of the FEMP, the historical EMP program also monitored source emissions as part of its broad air effluent responsibility; these former EMP source characterization responsibilities now reside within the scope of individual remediation projects, as appropriate).

6.2.1 Approach

The analysis of the additional regulatory drivers and policies for air monitoring was conducted by identifying the suite of ARARs and TBC requirements in the FEMP's approved CERCLA Records of Decision and FEMP legal agreements that contain specific air-monitoring requirements. This subset was then divided further to identify those monitoring requirements with sitewide implications (and which, therefore, fall under the scope of the IEMP) and those which pertain to emission controls/emission control monitoring that would be the responsibility of the individual remediation projects.

6.2.2 Results

The following regulatory drivers were found to govern the technical scope and reporting requirements for the IEMP's sitewide air monitoring program, and include:

- DOE Order 5400.1, General Environmental Protection Program, which requires DOE facilities that use, generate, release, or manage significant pollutants or hazardous materials to develop and implement an environmental monitoring plan. Each DOE site's environmental monitoring plan must contain the design criteria and rationale for the routine effluent monitoring and environmental surveillance activities of the facility. The FEMP's existing EMP provides the initial basis for the development of the IEMP strategy that is responsive to the changing site mission and associated remediation needs while still DOE Order compliant.

- DOE Order 5400.5, Radiation Protection of the Public and Environment, which establishes radiological dose limits and guidelines for the protection of the public and environment. Under this requirement, the exposure to members of the public associated with activities from DOE facilities from all pathways must not exceed, in one year, an effective dose equivalent of 100 mrem. For radiological dose due to airborne emissions only, the order requires compliance with the 40 CFR 61, Subpart H, limit of an effective dose equivalent of 10 mrem per year to a member of the public. Demonstration of compliance with this standard is to be based on CAP88-PC, or other techniques for which prior EPA approval is obtained. The order also provides guidelines for radionuclide concentrations in air, known as Derived Concentration Guides (DCGs), and radon concentration limits for interim storage of sources during remediation. These radon limits are: 100 pCi/L at any given point, 30 pCi/L annual average sitewide, 3 pCi/L annual average at the facility fenceline, and 20 pCi/m^2-sec flux rate for storage of radon generating wastes (per 40 CFR 61, subpart Q). The guidance document associated with this Order (DOE 1991) recommends confirmatory air monitoring surveillance, which was previously conducted under the EMP and will be incorporated into the IEMP.

- Proposed 10 CFR 834, DOE Facilities Radiation Protection of the Public and Environment, is similar in intent to DOE Order 5400.5. Differences however, include: deletion of the 100 pCi/L limit and 30 pCi/L annual limit, lowering the fenceline limit to 0.5 pCi/L above background, changes to facility and site/facility boundary definitions, and clarifications to the

definition of point of compliance. Because this is only a proposed rule, these limits are to be used as guidelines and should not override the requirements of DOE Order 5400.5, above.

- National Emissions Standards for Hazardous Air Pollutants (NESHAP) 40 CFR 61, Subpart H, which provides national emissions standards for radionuclides other than radon. Per this requirement, emissions of radionuclides (excluding radon) 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/year. Demonstration of compliance with this standard is to be based on CAP88-PC, or other techniques for which prior EPA approval is obtained. The FEMP's air pathway dose assessment calculation generated by CAP88-PC is then used as an input to the annual sitewide dose assessment (which includes all media pathways) required for the Site Environmental Report under DOE Order 5400.1.

- Federal Facility Agreement (FFA), Control and Abatement of Radon-222 Emissions, signed November 19, 1991, which ensures that DOE takes all necessary actions to control and abate radon-222 emissions at the FEMP, under the authority of 40 CFR 61, Subpart Q. This agreement acknowledges that the K-65 silos (Operable Unit 4) exceed the radon emission of 20 pCi/m2/s , but allows the FEMP to address this exceedance by implementing a removal action to bring radon emissions from the silos to a level ALARA, and to attain the NESHAP Subpart Q standard upon completion of final remediation. The remediation work plan included a radon monitoring system, which was previously monitored under the predecessor EMP, and which will be incorporated into the IEMP. The FFA also requires demonstration of compliance with the Subpart Q standard (upon completion of remedial actions) for the waste pits, clearwell, and any other sources found to emit radon in excess of 20 pCi/m^2-sec.

- Ohio Ambient Air Quality Standards, OAC 3745-17-02 and OAC 3745-17-05, which provide general standards for meeting and maintaining ambient air quality standards for total suspended particulates. Per the standards, concentrations of total suspended particulates (TSP) can not exceed an average of 150 μ/m^3 for 24 hours, and an average of 50 μ/m^3 annually. Additionally, any significant and avoidable deterioration of air quality in the area is prohibited. The IEMP air monitoring program includes TSP analytes to ensure compliance with this standard.

Ten other regulatory drivers were found to have air monitoring implications but only of a project-specific emissions-control nature. These drivers fall outside the scope of the IEMP but are within the scope of one or more of the FEMP's individual remediation projects. Some of the drivers pertain to emission controls and do not explicitly require monitoring; however, monitoring may be conducted during the project to demonstrate the effectiveness of the emission control. The project-specific air monitoring drivers include:

- DOE Order 5820.2A Chapter III.3.k, Environmental Monitoring, which requires low-level radioactive waste disposal facilities to perform environmental monitoring for all media, including the air pathway. This requirement applies only to the On-site Disposal Facility, as it is the only disposal facility at the FEMP. A project-specific air monitoring plan is being

developed as part of the On-site Disposal Facility Remedial Design and Remedial Action document.

- Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Control of Radon Emissions, 40 CFR 192.32(b)(l)(ii), which requires that disposal areas be closed in a manner that limits releases of radon from uranium by product materials to no more than an annual average release rate of 20 pCi/m^2/s. Proper closure of the on-site uranium disposal area (the on-site disposal facility) so as to meet this standard will be addressed in the appropriate remedial design and remedial action documents.

- National Emissions Standards for Hazardous Air Pollutants (NESHAP) 40 CFR 61, Subpart H, which provides national emissions standards for radionuclides other than radon. This regulation requires continuous sampling of certain point sources (stacks or vents) for radionuclides. Such point source monitoring may be required in remediation treatment units and will be addressed with project remedial design and remedial action documents.

- National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61, Subpart Q, which provides national emissions standards for radon. The standard per this regulation is that no source at a DOE facility shall emit more than 20 pCi/m2-s of radon-222 as an average for the entire source, into the air. Source is defined in the regulation as any building structure, pile, impoundment, or areas used for storage or disposal that contains sufficient quantities of radium to exceed the standard. To demonstrate compliance with the standard, radon monitoring should be conducted at the source. Such source monitoring, with the exclusion of that conducted at the K-65 silos, will be addressed within project remedial design and remedial action documents. The K-65 silo monitoring will be conducted under the IEMP.

- National Primary and Secondary Ambient Air Quality Standards (NAAQS), 40 CFR 50, which establishes standards for ambient air quality for sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, lead, and particulates. Demonstrating compliance with these NAAQS is the responsibility of state and local regulatory agencies. However, these regulatory agencies impose permit conditions and regulations on emission sources that limit the amount of contaminants so that NAAQS are not exceeded in within a given area. It is the responsibility of the projects to ensure that substantive requirements of permit conditions and regulations are met by incorporating appropriate emission control and monitoring for emission sources within remedial design and remedial action documents.

- Ohio General Provisions on Air Pollution Control, OAC 3745-15-07 and ORC 3704.01-.05, which prohibits the emission or escape into the open air of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, and odors in such amounts that may cause a public nuisance. Control of such emissions is the responsibility of the projects through source control, and is outside of the scope of the IEMP.

- Ohio Emissions of Particulate Matter, OAC 3745-17-08, which provides for the restriction of emission of fugitive dust by the use of control measures. Such control measures include, for example, water or dust suppression chemicals for control of fugitive dust from demolition of buildings or on dirt or gravel roads, the use of hoods or fans to enclose and control fugitive dust, and the use of canvas or other coverings for stockpiles. Such control measures are the responsibility of the remedial action project and are described in the appropriate remedial design and remedial action documents.

- Ohio Particulate Matter Standards, OAC 3745-17-11, which describes emission restrictions for particulates from industrial processes. These restrictions apply to operations, processes, or activity other than those subject to OAC 3745-17-08 (discussed above) and are therefore applicable to process units.

- Ohio Emissions of Particulate Matter, OAC 3745-17-12 (F)(1) and (2), which is the standard used by Ohio EPA to restrict particulate emissions from roadways and parking areas. For unpaved roadways and parking areas, there shall be no visible particulate emissions except for 3 minutes or less in any 60 minute period. From paved roadways and parking areas, there shall be no visible particulate emissions except for 1 minute or less in any 60 minute period. Emission controls for such emissions are subject to OAC 3745-17-08, discussed above, and will be addressed in project remedial design and remedial action documents.

- Ohio Standards for Active and Inactive Asbestos Disposal Sites, OAC 3745-20-06 and OAC 3745-20-07(A) and (C), which prohibit visible emissions of asbestos during and after placement. Asbestos management is primarily limited to asbestos removal prior to building demolition and disposal either off-site or in the on-site disposal facility. The visible emission standard for asbestos is closely tied to asbestos management, and is not within the scope of the IEMP.

The results of the regulatory evaluation indicate that there are no additional regulatory-based requirements activated by the FEMP's CERCLA ARARs or TBCs that are not already accommodated within the scope of the IEMP's predecessor EMP air monitoring program. The FEMP therefore plans to incorporate the June 1995 (latest approved) version of the EMP air monitoring scope into the IEMP to initiate the sitewide air program for fiscal years 1997 and 1998.

6.3 BOUNDARY DEFINITION

This section identifies the programmatic boundary(s) that have been established between the IEMP and the project-specific activities. The intent behind the boundary definition is to: (1) clearly delineate the scope and geographic extent of the IEMP's monitoring responsibility and (2) establish a recognized interface between the sitewide focus of the IEMP and the predominant emission control focus of the project-specific monitoring.

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In general, the programmatic boundary for the IEMP's air monitoring program is established at the facility fenceline and off-property monitoring locations. In some cases, however, it may be necessary to monitor the sources of emissions to aid the interpretation of fenceline data or even as a requirement (e.g., continuous radon monitoring of the K-65 silo headspace and selected monitoring locations). The emission control focus of project-specific monitoring is not within the scope of this program and is the responsibility of the individual projects. However, as may be indicated in the individual remedial design documents and/or remedial action work plans submitted by the projects, those projects that are physically located adjacent to or near the fence-line may defer some or all of their emission-control air-monitoring to the IEMP, if appropriate. The emission source terms represented by the projects will also be used (as appropriate) in the CAP88-PC air modeling reported through the IEMP to calculate annual air pathway dose assessments in accordance with the NESHAP regulatory driver discussed in the previous section.

6.4 PROGRAM EXPECTATIONS AND DESIGN

6.4.1 Program Expectations

As discussed in the Section 6.2, the FEMP is adopting the existing sitewide surveillance air monitoring program (based on the June 1995 EMP) as the program for the IEMP. The existing program has stakeholder acceptance and has provided comprehensive surveillance monitoring dating back to 1972, accommodating many of the active uranium production years at the FEMP. Since production ceased in 1989, the EMP sitewide program has also provided additional useful baseline information (representing inactive conditions) in preparation for the increased level of construction activity that will accompany the remediation projects.

As the short-term risk assessments accompanying the FEMP's Records of Decision have demonstrated, the potential for air emissions during site remediation will be far lower than the levels that occurred during the active production years at the facility. The extensive ARAR-based emission controls required of each remediation project will reduce the potential for air emissions even more. Recognizing that the EMP program has proven satisfactory during historical active uranium production operations at the facility, the following expectations guide the continuation of the program in its more focused, remediation-based role under the IEMP:

- Provide a program that can independently appraise the collective emissions accompanying multiple concurrent remediation projects at the FEMP and provide necessary "early warning" feedback regarding the cumulative sitewide effectiveness of project-specific emission controls

- Provide a program that can independently evaluate the emission estimates used as inputs to the FEMP's NESHAP Subpart H CAP88-PC fate-and-transport model

- Provide a program that promotes the continued confidence of the public and is responsive to concerns raised by stakeholders concerning forthcoming remediation activities

- Provide a program capable of assessing trends from year to year so that necessary modifications or adjustments in program focus can be accommodated.

6.4.2 Program Design

The existing EMP air monitoring program being adopted by the IEMP has already undergone public and regulatory review. Therefore, the program design discussed below is a summary of the program and pertinent design considerations, unlike the other media sections in the IEMP which are adding and integrating programs historically outside of the scope of the pre-existing EMP. The sitewide air monitoring program being adopted by the IEMP is comprised of three distinct components:

- Radiological particulate air monitoring
- Radon monitoring
- Direct radiation monitoring.

Collectively, these components form a comprehensive surveillance program which historically fulfilled very similar program expectations (during the production years) to those identified above. As such, the program will continue to be responsive to local stakeholder concerns by documenting sitewide air emissions. Additionally, the IEMP further defines the role of the air monitoring program as a tool to evaluate the effectiveness of emissions control measures on a sitewide basis, and to be used in identifying any needed refinements in the emission estimates used as inputs to the model used to demonstrate compliance with 40 CFR 61 Subpart H. The continued role of the program (beyond the initial two-year period) will be defined in subsequent revisions of the IEMP beginning in fiscal year 1998.

Each component of the sitewide air monitoring program is designed to address a unique aspect of air pathway monitoring, and as such, reflects distinct sampling methodologies and analytical procedures. The following sections provide a summary discussion of the design of each component of the IEMP air monitoring program.

6.4.2.1 Radiological Air Particulate Monitoring Design Summary

The radiological air particulate monitoring component of the IEMP air program is designed to collect data that is representative of ambient air conditions at select locations on property, at the facility fenceline, and in the surrounding community. The monitoring approach utilizes a network of 20 high-volume air monitoring stations sited to address the following:

- Prevailing wind directions (Figure 6-1)
- Location of source areas
- Sensitive receptor locations
- Location of physical obstructions
- Topography
- Available utilities.

DOE guidance (DOE 1991) and EPA siting criteria (40 CFR 58, Appendix E) were considered in selecting monitoring locations (Table 6-1 and Figure 6-2).

Monitors are located at the property boundary to provide coverage for all potential source areas located on the FEMP property. The community-based monitors provide data at sensitive receptor locations such as local schools and businesses as well as providing background data. Background locations (AMS 21 and AMS 16) are located outside the influence of FEMP emissions. The on-site locations are primarily focused around the waste pit area. Additional monitors were installed in the waste pit area to assess the waste pit source term emission calculations used as input to the CAP88-PC fate-and-transport model. The monitors have been maintained at these locations in order to monitor and characterize pit emissions, a potentially large source of fugitive emissions, and to provide fenceline data for the northwest corner of the site. Data from the monitors also aids the review and interpretation of fenceline data from other areas of the site.

The high-volume air monitors located at the fenceline and in the community are designed to collect a representative sample by establishing a continuous air flow of 1 m^3/min through a $>.5$ micron filter. The intake of the air monitor is placed at a 2-meter elevation in accordance with EPA siting criteria. The air monitors are designed to sample a large volume of air (for analytical detection purposes) that is representative of air breathed by a hypothetical receptor.

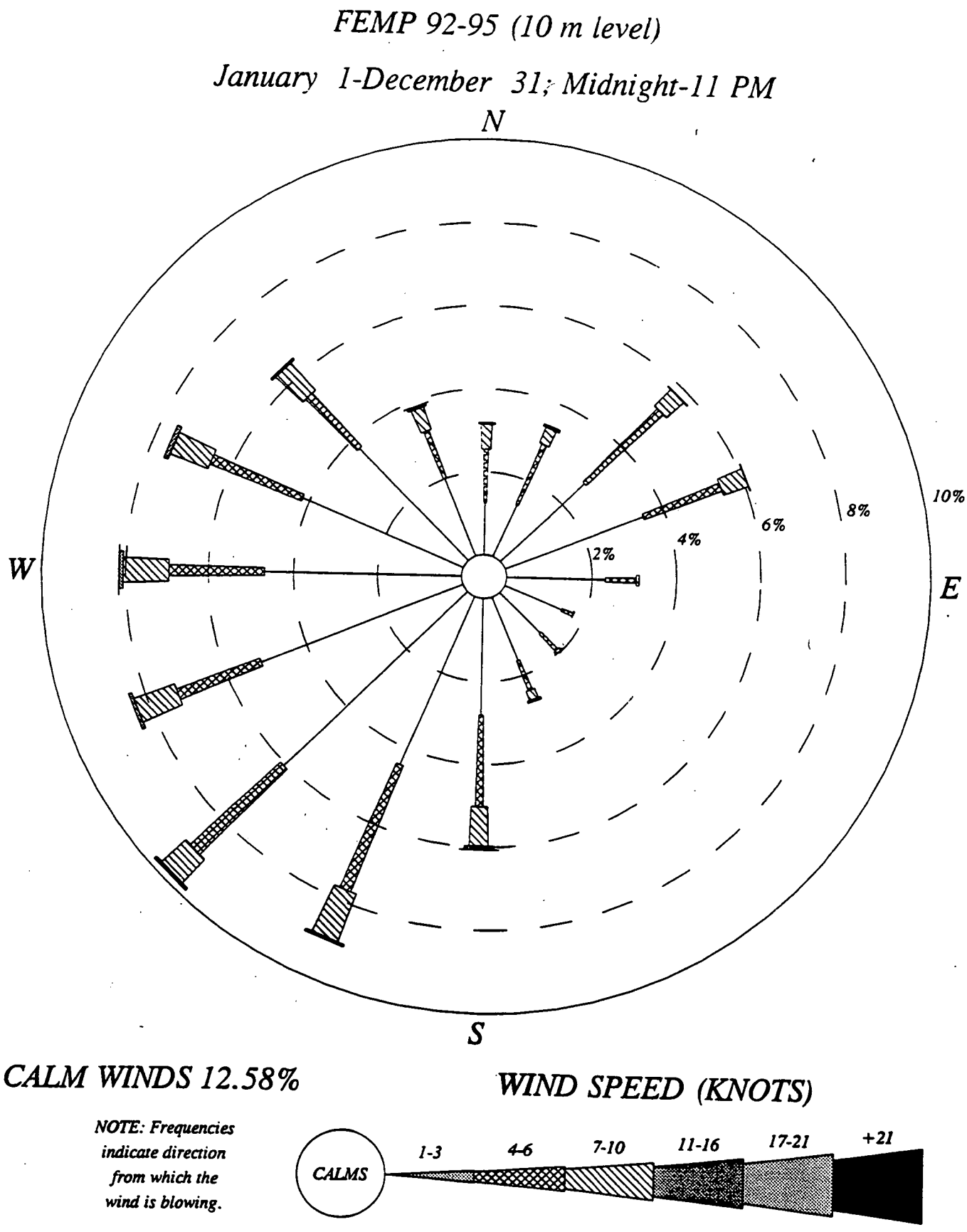

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FIGURE 6-1. AVERAGE FEMP WIND ROSE, 1992-1995

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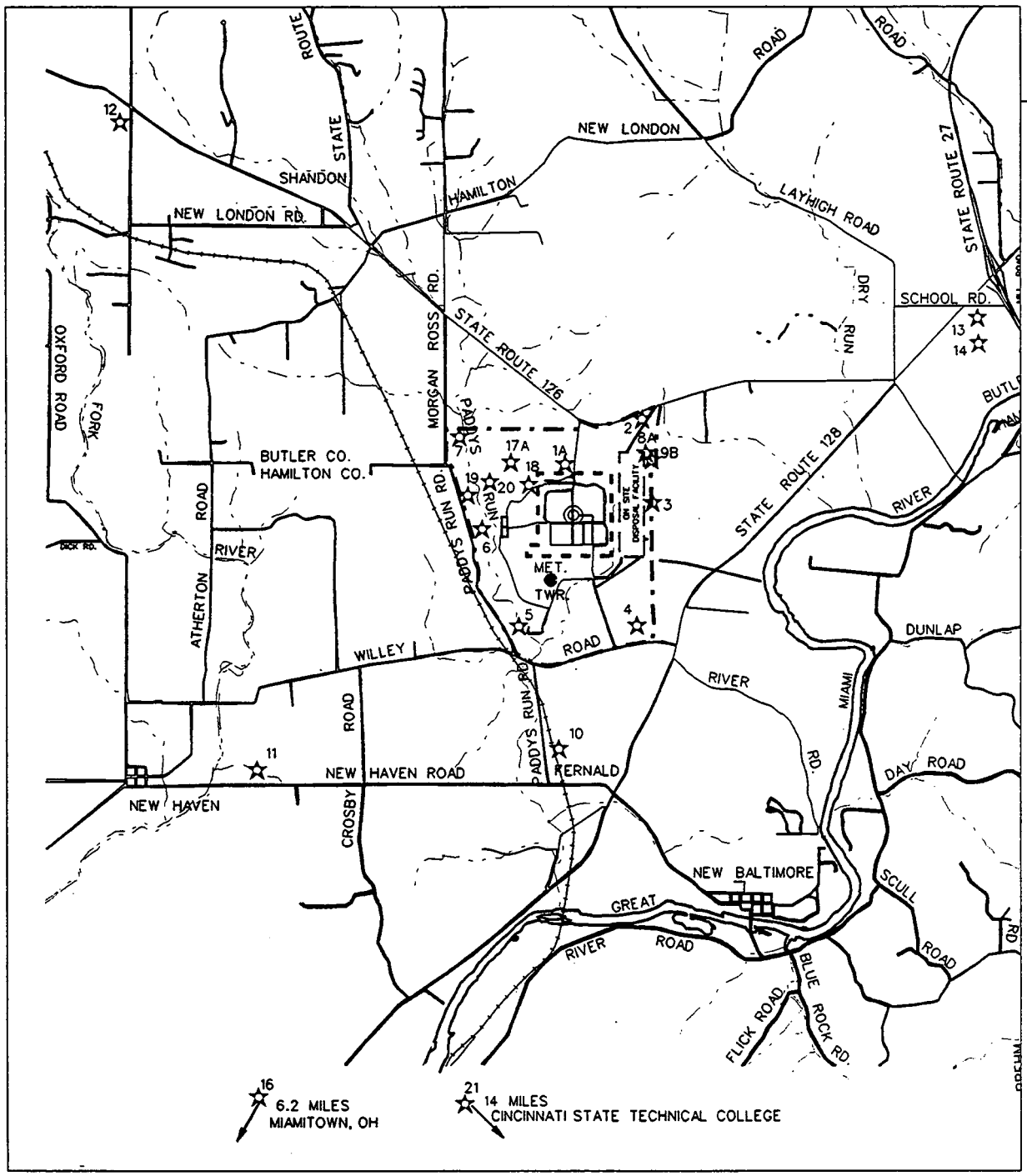

LEGEND:

- DISTANCE FROM CENTER OF PRODUCTION AREA TO SAMPLING LOCATIONS OFF MAP
- AIR MONITORING LOCATION
- METEOROLOGICAL TOWER (MET. TWR.)
- FEMP BOUNDARY
- PRODUCTION AREA BOUNDARY

SCALE

1 ½ 0 1 MILE

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FIGURE 6-2. AIR MONITORING LOCATIONS

TABLE 6-1

SAMPLE LOCATION AND ANALYTICAL SUMMARY FOR RADIOLOGICAL AIR PARTICULATE SAMPLES

Location	Frequency	Parameter	Location Considerations
On Site:			
AMS-1A	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Prevailing wind direction
AMS-8	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Prevailing wind direction
AMS-9A	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Prevailing wind direction
Waste Pit:			
AMS-17	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Source
AMS-18	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Source
AMS-19	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Source
AMS-20	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Source
Fenceline:			
AMS-2	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Prevailing wind direction
AMS-3	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Prevailing wind direction
AMS-4	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Indicator
AMS-5	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Indicator
AMS-6	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Indicator
AMS-7	Bi-weekly Annual composite	Total Uranium, TSP Radionuclide suite	Indicator

Location	Frequency	Parameter	Location Considerations
Off Site:			
AMS-10	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Indicator
AMS-11	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Indicator
AMS-12	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Indicator
AMS-13	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Indicator
AMS-14	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Indicator
Background			
AMS-15	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Background
AMS-21	Bi-weekly Annual composite	Total Uranium Radionuclide suite	Background

The monitoring configuration of the four monitors located on-site surrounding the waste-pit area have an intake elevation of one meter above grade. The lower intake is intended to provide data that is representative of waste pit fugitive emissions that originate at or below grade.

All air filters are changed on a bi-weekly schedule. This provides a sufficient air volume passing through the filter to generate detectable levels of target analytes. The analytical regime for the bi-weekly samples includes total uranium and total suspended particulates analyzed at the on-site laboratory and an annual composite (for each monitor) prepared from the bi-weekly samples is analyzed at an off-site laboratory for a suite of site-specific radionuclides. Total uranium was selected for routine analysis because it represents the most pervasive contaminant on site, can be readily analyzed at the on-site laboratory (providing quick turn-around time), and is a relatively inexpensive analysis. The total uranium data will be used as an indicator to track the cumulative emissions at the facility fenceline. The total suspended particulate data will be used to confirm compliance with ambient air quality standards. This information will be provided to the remediation projects to assess the effectiveness of project-specific emission controls on a periodic basis. The data from the annual composite sample will be used to independently appraise the calculated air pathway dose assessments

(Appendix D) produced by the FEMP's NESHAP Subpart H CAP88-PC fate-and-transport model. Table 6-2 summarizes the analytical regime for the radiological particulate air monitoring program. The annual composite target analyte list was developed to represent the full range of radiological materials stored and processed at the facility, including principal decay products.

6.4.2.2 Radon Monitoring Design Summary

The radon monitoring component of the IEMP program is designed to collect measurements of environmental radon concentrations resulting from radon-generating materials contained on-site, in addition to fulfilling the monitoring requirements imposed by the Federal Facilities Agreement (FFA). The monitoring design incorporates overlapping networks of alpha track-etch radon cups and alpha scintillation continuous radon monitors (Table 6-3 and Figure 6-3). The monitoring program for ensuring environmental monitoring compliance with DOE Order 5400.5 annual limits primarily utilizes alpha track-etch detectors. The use of these long-term integrating detectors produces data used for assessing compliance with the annual limits contained in DOE 5400.5. The track-etch detectors do not require electrical power and hence the detectors can be placed in any needed location.

Alpha scintillation detectors, which are continuous radon monitors, produce data that are used to assess compliance with the instantaneous ambient air radon concentration requirement of DOE Order 5400.5, which is 100 pCi/l at any given point over a facility. Monitors are placed near a variety of sources or are used during site-specific project activities that could release radon. In addition, the FFA requires monitoring at nine locations both on- and off-site, including the K-65 silo headspace. The continuous radon monitors require electrical power to operate; consequently, placement of these monitors is more constrained and related to the availability of electrical power.

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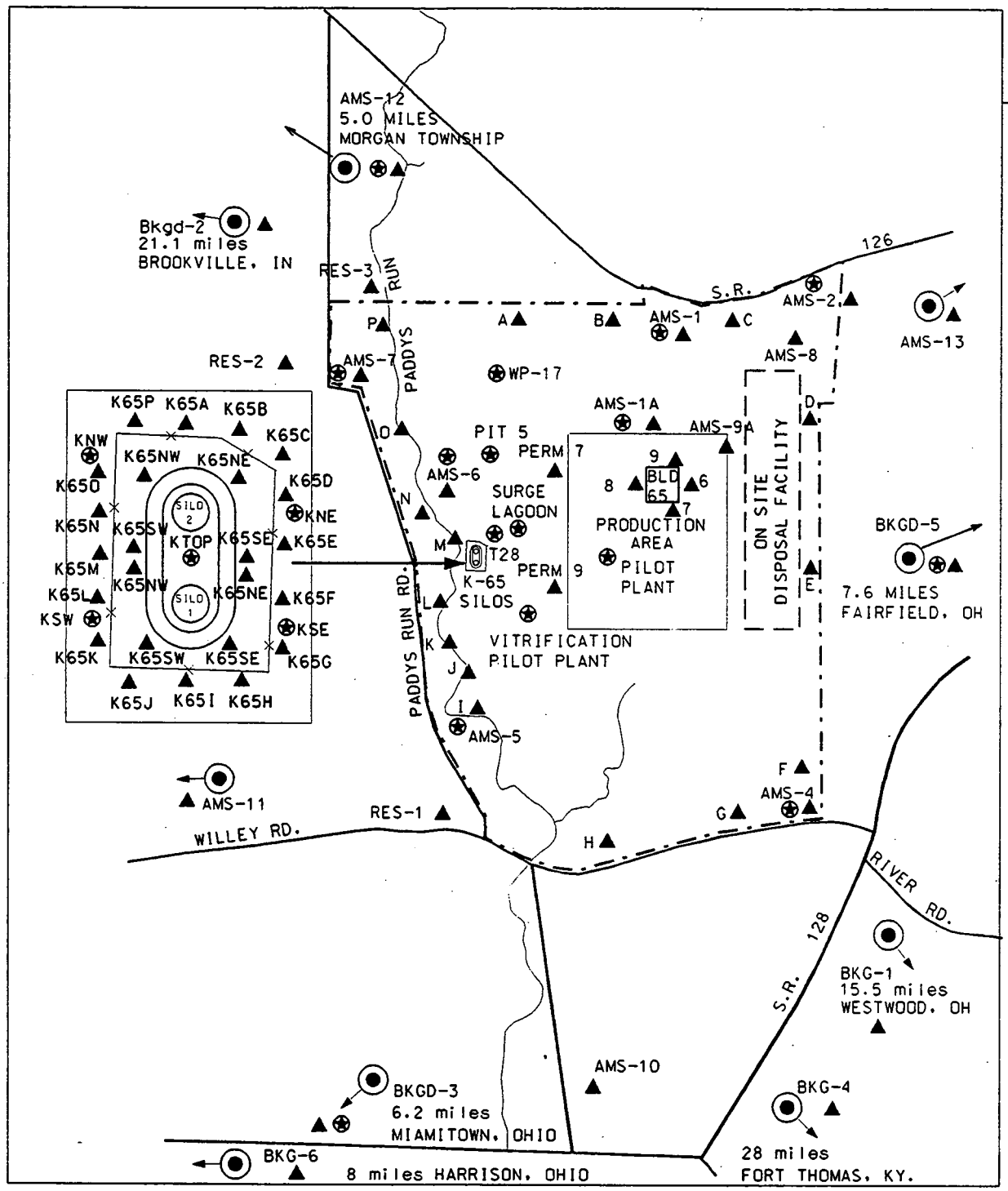

LEGEND:

- FEMP BOUNDARY
- CONTINUOUS RADON MONITORING LOCATION
- TRACK-ETCH MONITORING LOCATION
- DISTANCE FROM CENTER OF PRODUCTION AREA TO LOCATION OFF THE MAP

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NOT TO SCALE

FIGURE 6-3. RADON MONITORING LOCATIONS

TABLE 6-2

ANALYTICAL SUMMARY FOR RADIOLOGICAL AIR PARTICULATE SAMPLES

Analyte	Sample Matrix	Sample Frequency	Lab	ASL	Holding Time	Preservative	Detection Level	Container
Total Uranium	Air	Bi-weekly	On Site	B	12 months	N/A	2 μg/filter	20 cm x 25 cm polyester filter<0.5 μm
TSP (total suspended particulate)	Air	Bi-weekly	On Site	A	N/A	N/A	N/A	20 cm x 25 cm polyester filter<0.5 μm
Rad Suite:	Air	Annual composite	Contract	B	12 months	Prepared by lab as composite is formed from bi-weekly batch per location		2 liter glass
• U-234							7.0×10^{-6} pCi/m^3	
• U-235/236							7.0×10^{-6} pCi/m^3	
• U-238							7.0×10^{-6} pCi/m^3	
• Th-228							2.3×10^{-6} pCi/m^3	
• Th-230							2.3×10^{-6} pCi/m^3	
• Th-232							2.3×10^{-6} pCi/m^3	
• Pu-238							0.7×10^{-6} pCi/m^3	
• Pu-239/40							0.7×10^{-6} pCi/m^3	
• Ra-226							0.8×10^{-6} pCi/m^3	
• Ra-228							8.0×10^{-6} pCi/m^3	
• Sr-90							0.7×10^{-6} pCi/m^3	
• Cs-137							1.1×10^{-5} pCi/m^3	
• Tc-99[a]							7.4×10^{-5} pCi/m^3	

[a] Tc-99 requires apportioned filter from each bi-weekly sample.

000199

TABLE 6-3

SAMPLE LOCATION AND ANALYTICAL SUMMARY FOR RADON MONITORING PROGRAM

Location	Frequency	Parameter	Location Considerations
On Site:			
AMS-1A	Semi-annual	Radon-222	Prevailing wind direction
AMS-8	Semi-annual	Radon-222	Prevailing wind direction
AMS-9A	Semi-annual	Radon-222	Prevailing wind direction
BLDG-65-1	Semi-annual	Radon-222	Source
BLDG-65-2	Semi-annual	Radon-222	Source
BLDG-65-3	Semi-annual	Radon-222	Source
BLDG-65-5	Semi-annual	Radon-222	Source
K-65 Silos (Silo Dome Locations):			
K-65-SILO1-NE	Semi-annual	Radon-222	Source
K-65-SILO1-NW	Semi-annual	Radon-222	Source
K-65-SILO1-SE	Semi-annual	Radon-222	Source
K-65-SILO1-SW	Semi-annual	Radon-222	Source
K-65-SILO2-NE	Semi-annual	Radon-222	Source
K-65-SILO2-NW	Semi-annual	Radon-222	Source
K-65-SILO2-SE	Semi-annual	Radon-222	Source
K-65-SILO2-SW	Semi-annual	Radon-222	Source
Exclusion Fence:			
K-65-A	Semi-annual	Radon-222	Source
K-65-B	Semi-annual	Radon-222	Source
K-65-C	Semi-annual	Radon-222	Source
K-65-D	Semi-annual	Radon-222	Source
K-65-E	Semi-annual	Radon-222	Source
K-65-F	Semi-annual	Radon-222	Source
K-65-G	Semi-annual	Radon-222	Source
K-65-H	Semi-annual	Radon-222	Source
K-65-I	Semi-annual	Radon-222	Source
K-65-J	Semi-annual	Radon-222	Source
K-65-K	Semi-annual	Radon-222	Source
K-65-L	Semi-annual	Radon-222	Source
K-65-M	Semi-annual	Radon-222	Source
K-65-N	Semi-annual	Radon-222	Source

TABLE 6-3
(Continued)

Location	Frequency	Parameter	Location Considerations
Exclusion Fence: (Contd.)			
K-65-O	Semi-annual	Radon-222	Source
K-65-P	Semi-annual	Radon-222	Source
Fenceline:			
FEMP-A	Semi-annual	Radon-222	Source
FEMP-B	Semi-annual	Radon-222	Source
FEMP-C	Semi-annual	Radon-222	Prevailing wind direction
FEMP-D	Semi-annual	Radon-222	Prevailing wind direction
FEMP-E	Semi-annual	Radon-222	Indicator
FEMP-F	Semi-annual	Radon-222	Indicator
FEMP-G	Semi-annual	Radon-222	Indicator
FEMP-H	Semi-annual	Radon-222	Indicator
FEMP-I	Semi-annual	Radon-222	Indicator
FEMP-J	Semi-annual	Radon-222	Source
FEMP-K	Semi-annual	Radon-222	Receptor
FEMP-L	Semi-annual	Radon-222	Source
FEMP-M	Semi-annual	Radon-222	Source
FEMP-N	Semi-annual	Radon-222	Source
FEMP-O	Semi-annual	Radon-222	Source
FEMP-P	Semi-annual	Radon-222	Source
AMS-2	Semi-annual	Radon-222	Prevailing wind direction
AMS-4	Semi-annual	Radon-222	Indicator
AMS-6	Semi-annual	Radon-222	Source
AMS-7	Semi-annual	Radon-222	Source
Off Site:			
AMS-10	Semi-annual	Radon-222	Indicator
AMS-11	Semi-annual	Radon-222	Indicator
AMS-12	Semi-annual	Radon-222	Indicator
AMS-13	Semi-annual	Radon-222	Prevailing wind direction
RES-1	Semi-annual	Radon-222	Indicator
RES-2	Semi-annual	Radon-222	Receptor
RES-3	Semi-annual	Radon-222	Indicator

000201

TABLE 6-3
(Continued)

Location	Frequency	Parameter	Location Considerations
Background:			
BKGD-1	Semi-annual	Radon-222	Background
BKGD-2	Semi-annual	Radon-222	Background
BKGD-3	Semi-annual	Radon-222	Background
BKGD-4	Semi-annual	Radon-222	Background
BKGD-5	Semi-annual	Radon-222	Background
BKGD-6	Semi-annual	Radon-222	Background
On Site:			
AMS-1A	Daily	Radon-222	Prevailing wind direction
Pilot Plant	Daily	Radon-222	Prevailing wind direction
WP-17	Daily	Radon-222	Indicator
Pit-5	Daily	Radon-222	Indicator
T-28	Daily	Radon-222	Indicator
VIT Plant	Daily	Radon-222	Indicator
Surge Lagoon	Daily	Radon-222	Prevailing wind direction
K-65 Silos (Exclusion Fence):			
K-65-NE	Daily	Radon-222	Source
K-65-NW	Daily	Radon-222	Source
K-65-SE	Daily	Radon-222	Source
K-65-SW	Daily	Radon-222	Source
K-TOP	Daily	Radon-222	Source
Fenceline:			
AMS-2	Daily	Radon-222	Prevailing Wind Direction
AMS-4	Daily	Radon-222	Indicator
AMS-5	Daily	Radon-222	Indicator
AMS-6	Daily	Radon-222	Indicator
AMS-7	Daily	Radon-222	Indicator
Background:			
BKGD-1	Daily	Radon-222	Background
BKGD-2	Daily	Radon-222	Background
AMS-12	Daily	Radon-222	Background

The overall monitoring locations reflect DOE guidance (DOE 1991) for locating environmental monitors. For comparison purposes, both indicator and background monitoring locations have been selected. The siting criteria are consistent with those considered for air particulate monitoring. Radon monitoring locations may be designated by FFA monitoring requirements, the need to monitor near specific sources in order to maintain regulatory compliance, or project-specific monitoring plans. As remedial activities are undertaken at the site, the site radon monitoring program may change to ensure proper radon monitoring as a result of changing work activities. Table 6-4 summarizes the analytical regime for the radon monitoring program.

TABLE 6-4

ANALYTICAL SUMMARY FOR RADON DETECTORS

Analyte	Sample Matrix	Sample Frequency	ASL	Holding Time	Preservative	Detection Level	Container
Radon-222	Air	Semi-annual	B	N/A	N/A	0.15 pCi/L	Plastic
Radon-222	Air	Continuous/weekly	A	N/A	N/A	0.3 pCi/L	CPRD

Alpha Track-etch Cups

Alpha track-etch cups provide data on the long-term average environmental radon concentration at selected monitoring locations on site, at the facility fenceline, and in the local community.

Because the K-65 silos are the single largest source of radon at the FEMP, the radon cup locations radiate outward from the silo area with emphasis on the nearby and publicly accessible western boundary of the site (Figure 6-3). Radon detectors also are co-located at air monitoring stations along the facility fenceline and in the local community, as well as background locations considered outside the influence of the FEMP radon sources.

Sample locations at the boundary fenceline provide data used in assessing compliance with established limits under DOE Order 5400.5. In addition, the data collected will be used to assess radon concentrations during remediation activities both on site and at the fenceline.

Two to three detectors are located at each alpha track-etch monitoring location. The use of multiple detectors corresponds with industry recommendations and is useful in assessing the precision of

monitoring data, as well as addressing any spurious results. The alpha track-etch cups are placed at a height of one to two meters (i.e., attached to a fencepost) and exchanged semi-annually to provide sufficient exposure time given the low ambient radon concentrations and the analytical limits of detection. Radon data from the alpha track-etch cups are used to estimate a dose at the fenceline in response to public concerns. This radiation dose estimate for radon is not required under DOE 5400.5, however, to respond to the public interest in this information, it is reported in the annual site environmental report.

Alpha Scintillation Monitors

Alpha scintillation radon monitors provide data on the short-term (typically one hour) fluctuations in radon concentration. In accordance with established requirements of the FFA, approximately 9 alpha scintillation radon detectors are located on FEMP property and at off-property locations. As with the radon cups, the monitoring locations for the alpha scintillation monitors radiate outward from the K-65 silos and include areas in close proximity to sites (i.e., waste pits, vitrification plant) where significant amounts of radon may be released during the remediation process (Figure 6-3).

These continuous monitors provide hourly readings which are used to establish compliance with short-term limits on radon concentrations (the 100 pCi/l limit at or above any site). The data also are used to aid the quantification of radon releases from the K-65 silos. Data from the monitors also are compiled into 24-hour averages and included into a monthly report under the FFA. Continuous monitors are also placed at other locations to gather additional on-site data.

6.4.2.3 Direct-Radiation Monitoring Design Summary

The direct-radiation monitoring component of the IEMP program is designed to collect measurements of environmental radiation levels resulting from radioactive materials onsite. This is accomplished using a network of 30 environmental thermoluminescent dosimeters (TLD). DOE guidance (DOE 1991) and ANSI recommendations (ANSI 1975) were considered in selecting monitoring locations. The primary siting criteria are the same as for the air particulate monitoring, excluding utilities location and wind direction.

The K-65 silos are the single largest source of direct (gamma) radiation at the FEMP. Therefore, TLD locations radiate outward from the silo area with emphasis on the nearby and publicly accessible western boundary of the site (Figure 6-4). Additional TLDs are located at air monitoring stations at the facility fenceline and in the local community. Six TLD locations serve as background measurement points.

The network of TLDs provides a mechanism to measure and track ambient radiation levels at the facility fenceline as gamma emitting radioactive materials (primarily Radon-266, Thorium-232, and their decay products) that are handled and processed during remediation.

Three individual TLDs are placed at each location in order to assess the precision of the measurement data, as well as to address any spurious results that may occur. The TLDs are placed at one meter above the ground and exchanged quarterly in accordance with industry standards and DOE guidance (DOE 1991). The TLDs are processed at the DOE Laboratory Accreditation Program-approved on-site dosimetry laboratory.

Data from the TLD are used to assess the direct radiation component of the air pathway dose calculation (see Appendix D). Table 6-5 summarizes the analytical regime for the direct radiation monitoring program.

TABLE 6-5

ANALYTICAL SUMMARY FOR DIRECT RADIATION (TLD)

Analyte	Sample Matrix	Sample Frequency	ASL	Holding Time	Preservative	Detection Level	Container
Gamma Radiation (TLD)	Air	Quarterly	B	NA	NA	5 mrem	NA

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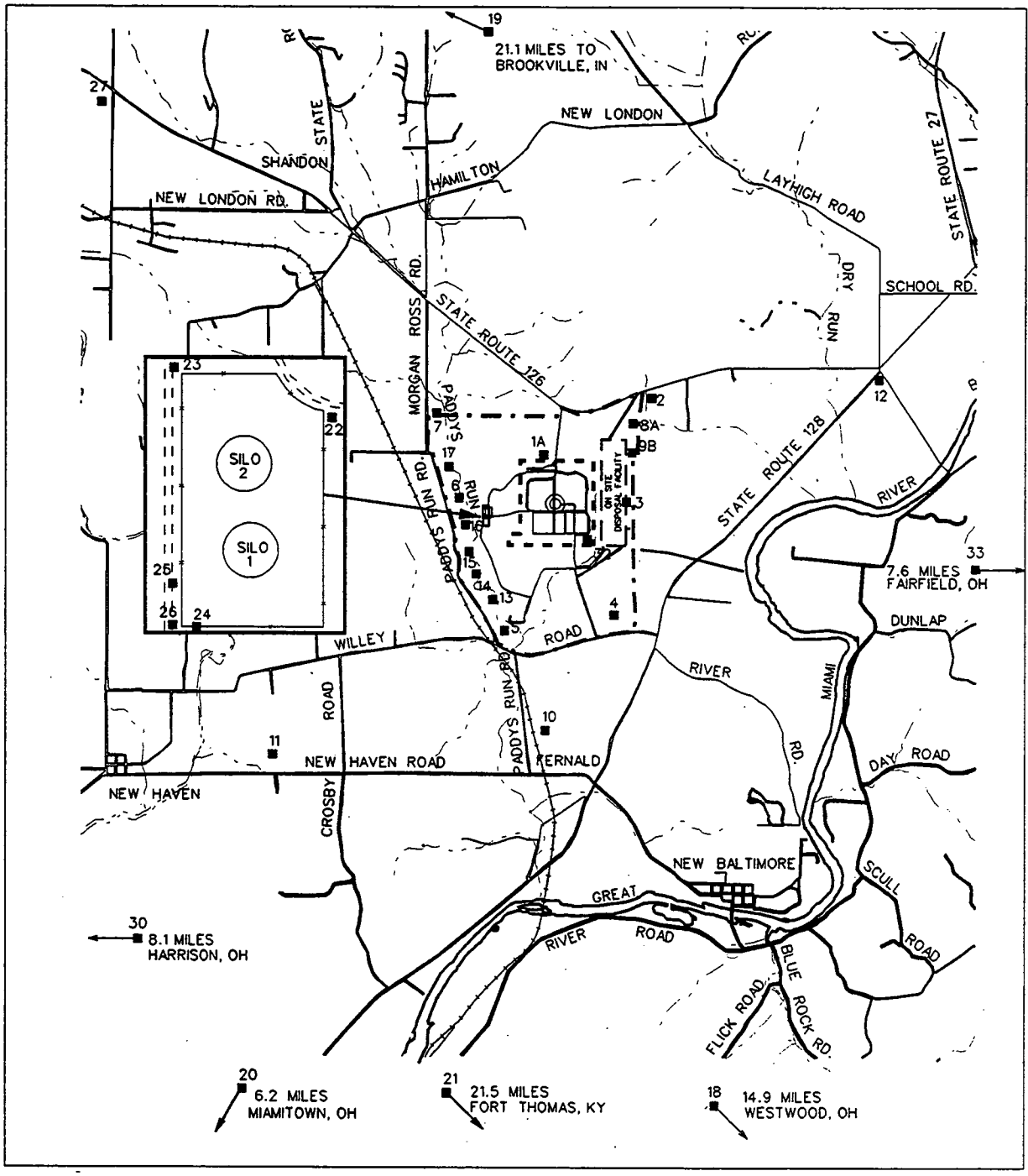

LEGEND:

- DISTANCE FROM CENTER OF PRODUCTION AREA TO SAMPLING LOCATIONS OFF MAP
- TLD MONITORING LOCATION
- FEMP BOUNDARY
- PRODUCTION AREA BOUNDARY

DRAFT

SCALE

1 ½ 0 1 MILE

FIGURE 6-4. TLD MONITORING LOCATIONS

6.4.2.4 Meteorological Monitoring Program Design Summary

Although not a distinct component of the existing sitewide air monitoring program, the meteorological monitoring program is designed to provide data on the atmospheric conditions which influence the dispersion and transport of contaminants in the air pathway. This program provides critical data in support of the design and conduct of the IEMP air monitoring program and as such, is presented in this section.

The FEMP meteorological monitoring system consists of a single 60 meter meteorological tower located west of the Storm Water Retention Basin (Figure 6-2). Monitoring instruments record wind speed and direction, temperature, barometric pressure, precipitation and relative humidity and store 1-minute and 15-minute average data on the meteorological database. The system has been developed based on the requirements of DOE Order 5400.5 and DOE guidance (DOE 1991), and complies with industry standards for calibration and data recovery.

Meteorological data is used in the evaluation and interpretation of environmental data collected from the air, radon, and project-specific monitoring data. Sporadic and prolonged increases in environmental measurements at one or more monitoring locations are evaluated using short-term meteorological data and records of remediation work activity to determine which project or source is likely to have caused the increase. The data also supplies one of the inputs to CAP88-PC used in the NESHAP compliance demonstration. In addition to supplying data necessary to support monitoring and surveillance, the meteorological data serves to support the day-to-day operations for construction, emergency preparedness, and engineering design.

6.5 PROJECT-SPECIFIC PLAN FOR SITEWIDE ENVIRONMENTAL AIR MONITORING

This section serves as the PSP for implementation of the sampling, analytical, and data management activities associated with the sitewide environmental air monitoring program. The program expectations and design presented in Section 6.4 were used as the framework for developing the monitoring approach presented in this PSP. The sampling, analytical, and data management activities described herein were designed to provide environmental data of sufficient quality to meet the intended data use as described in the program design. All sampling procedures and analytical protocols described or referenced in this PSP are consistent with the requirements of the FEMP SCQ (DOE 1993).

The sitewide environmental air monitoring program is comprised of the following three distinct components:

- Radiological air particulate monitoring
- Radon monitoring
- Direct radiation monitoring.

The sampling and analytical aspects of each component are unique, therefore this PSP is organized to present a separate discussion of the sampling program for each component. The subsections of this PSP define the following:

- Program organization and associated responsibilities
- Sampling programs (radiological air particulate, radon, direct radiation)
- Change control
- Health and safety
- Data management
- Project quality assurance.

6.5.1 Project Organization

A multidiscipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this PSP. The key positions and associated responsibilities required for successful implementation are described below.

The project team leader will have full responsibility and authority for the implementation of this PSP in compliance with all regulatory specifications and sitewide programmatic requirements defined by the Oversight and Program Integration Division. Integration and coordination of all PSP activities defined herein with other project organizations is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

Health and safety is the responsibility of all individuals working on this project scope. Qualified health and safety specialists shall participate on the project team to provide radiation protection and industrial hygiene support and assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance specialists will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the SCQ or other referenced standard and assist in evaluating and resolving all quality related concerns.

6.5.2 Sampling Program - Radiological Air Particulates

This sampling program is designed to collect radiological air particulate data which is representative of ambient air conditions at select locations on-site, at the facility fenceline and in the local community (see Figure 6-2). The data collected under this program will be used to assess the collective effect of concurrent remediation activities on the air pathway and provide feedback to refine air modeling inputs. As such, field procedures and analytical methods are designed to support the necessary level of data quality.

The monitoring design incorporates a network of 20 high-volume continuous air monitoring stations. Filter media are collected on a bi-weekly basis and analyzed at the on-site laboratory for total uranium at ASL B. A portion of each bi-weekly sample is retained for an annual composite sample which is analyzed at an off-site laboratory for trace fission and activation products as well as isotopic uranium and thorium at ASL B. Greater detail on the sampling design is provided in Section 6.4.2.1.

6.5.2.1 Sampling Procedures

The air filters from the high-volume environmental monitors are collected and analyzed in accordance with the following:

- DOE Order 5400.5, "Radiation Protection of the Public and Environment"
- "Environmental Regulatory Guide for Radiological Effluent Monitoring" (DOE 1991)
- FEMP SCQ Section 6.0 and Appendix K
- Standard Operating Procedure SRS-REM-001, High Volume Air Monitoring (June 1995)
- Data Quality Objective AR-006, "Routine Air Monitoring"
- Standard Operating Procedure EW-0002, Chain of Custody/Request for Analysis Record for Sample Control.

Table 6-2 provides a sample and analytical summary for the radiological air-particulate monitoring program. 000209

Sample collection is accomplished using high-volume environmental air monitors that continuously collect samples of airborne particulates by drawing air through a 20 cm x 25 cm filter at the rate of approximately 1 m^3/minute. Any changes in flow are accounted for by the automatic flow controller in the monitor and are documented on a flow chart recorder which continuously records flow data. Air monitoring equipment must meet the following criteria per DOE guidance and industry practice:

- Environmental air samplers shall be mounted in locked, all-weather stations with the sampler discharge positioned to prevent the recirculation of air.
- The air sampling system shall have a flow-rate meter, and the total air flow or total running time should be indicated.
- The air sampling rate should not vary by more than 20 percent for the collection of a given sample.
- Linear flow rate across air particulate filters should be maintained between 20 and 50 m/min.
- Air sampling systems shall be flow-calibrated, tested, and inspected routinely according to written procedures (DOE 1991). Flow calibration shall be at least as often as recommended by the manufacturer.

The monitors are inspected and calibrated at least once yearly in accordance with recommendations from the manufacturer. All units placed in the field are tracked via a field tracking log which provides information pertaining to when calibrations were last completed and the date of the next scheduled calibration.

6.5.2.2 <u>QA Sampling Requirements</u>

Quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as decontamination, sampling or analytical practice, may be responsible for introducing bias in the project's analytical results. The following quality assurance samples will be collected under this sampling program:

Air Particulate Samples

- One blank sample will be submitted for analysis with each batch of bi-weekly filters. The blank results are evaluated to determine if possible filter media contamination is present naturally within filter fibers.

- One spike sample with a known amount of uranium will be submitted for analysis with each batch of bi-weekly filters. The spike sample results are used to monitor the laboratory performance within defined tolerance limits within the established contract and in accordance with the SCQ (typically between 0.75 and 1.25 of the known value).

- The laboratory is also required to perform analyses on method blanks, matrix spikes and laboratory control samples as required by the SCQ for the corresponding ASL and analytical method.

6.5.2.3 Decontamination

Decontamination of air filters collected on site is not necessary since the filters are collected from stationary cassettes identified for each monitor. Only monitoring units that have been stationed in the former production area are required to undergo cleaning and decontamination if deemed necessary by a radiological survey. Radiological surveys are performed when equipment and/or samples are required to be released from the former process area for transport and/or analysis.

6.5.2.4 Waste Dispositioning

Contact wastes generated by field technicians during sample collection activities are collected, maintained, and dispositioned, as necessary, depending on the location of waste generation (i.e., former production area or offsite).

Waste associated with the air monitoring program is generated and handled by the respective laboratory identified for conducting the analyses.

6.5.3 Sampling Program - Radon Monitoring

This sampling program is designed to collect measurements of environmental radon concentrations released from the radon generating materials contained on-site and in the K-65 silos. Sample locations onsite, at the boundary fencelines and off-site locations provide representative measurements in assessing compliance with established limits. In addition, data collected will be used to assess radon

concentrations during remediation activities both onsite and at the fenceline. As such, field procedures and analytical methods are designed to support the necessary level of data quality.

The monitoring design incorporates a network of approximately 64 alpha track-etch radon cup locations. The cups are exchanged on a semi-annual basis (twice yearly) and measured at ASL B. Additionally, in accordance with established agreements, approximately 20 alpha scintillation radon detectors are located onsite and offsite. Data from selected continuous monitors provide hourly readings which are compiled into 24-hour averages and included into the monthly FFA report to the EPA, as required. The data collected from the monitors are collected at ASL A. Greater detail on sampling design is provided in Section 6.4.2.2.

6.5.3.1 Sampling Procedures

The alpha track-etch radon cups and continuous radon monitors are collected and analyzed in accordance with the following:

- DOE Order 5400.5 "Radiation Protection of the Public and Environment"
- Environmental Regulatory Guide for Radiological Effluent Monitoring (DOE 1991)
- FEMP SCQ, Appendix K
- Standard Operating Procedures:

  EM-REM-001, Environmental Radon Monitoring
  EM-RM-014, Real-Time Environmental Radon Monitoring
  EP-REM-016, Downloading the Pylon AB-5
  EM-RM-002, Logkeeping Procedure.
- Standard Operating Procedure EW-0002, Chain of Custody/Request for Analysis Record for Sample Control.

Table 6-3 provides a sample and analytical summary for the radon monitoring program. Sample collection is accomplished by two different modes: one is the radon cup which utilizes an alpha track-etch detector and the second is continuous radon monitoring via a Continuous Passive Radon Detector (CPRD) and a Pylon AB-5 radon monitor. Radon alpha track-etch allows for radon to penetrate a membrane filter within a plastic cup. Once the radon decays, an alpha particle is emitted that can interact with the plastic chip within the cup (hence the measurement is based on the "etch" left in the plastic). The continuous environmental radon monitors operate in a passive mode, allowing radon to

diffuse through the foam barrier of the CPRD into the detector. The units are set to collect measurements of a one-hour duration , with a 24-hour period averaged into a monthly summation of minimum, maximum, and average radon concentrations.

Continuous monitors are calibrated as a contiguous unit at least once per year with National Institute of Standards and Technology traceable sources. The radon cups are received new from the vendor and therefore do not require periodic calibration. Both types of units are tracked upon deployment in the field via an equipment tracking log and field logbooks. Additionally, an equipment maintenance/calibration logbook is used to track and schedule units requiring any necessary maintenance and/or calibrations.

6.5.3.2 QA Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed to evaluate the possibility that some controllable practice, such as decontamination, sampling, or analytical practice, may be responsible for introducing bias in the project's analytical results. The following quality assurance samples will be collected under this sampling program, as applicable:

- Approximately 5-10 percent of the alpha track-etch detectors deployed are reserved for blanks which allow for correction of radon already present within the cup.
- Approximately 5-10 percent of the alpha track-etch detectors (in addition to the blanks) will be reserved for spike samples. The spike sample results are used to monitor laboratory performance within defined tolerance limits.
- QA practices for the electronic monitoring will be maintained as per established maintenance and calibration schedules.
- The vendor is also required to perform analyses on their internal control blanks, spikes and laboratory control samples as required by the SCQ for the corresponding ASL and analytical method.

6.5.3.3 Decontamination

The decontamination of the radon monitoring equipment is necessary only for those detectors deployed in the former process area. Decontamination for these detectors is conducted under the radiological controls program for releasing equipment off-site. Radiological surveys are performed when equipment

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and/or samples are required to be released from the former process area for transport an/or analysis. These surveys are conducted in accordance with established procedures.

6.5.3.4 Waste Dispositioning

Contact wastes are generated by the field technicians during sampling field activities are collected, maintained, and dispositioned, as necessary, depending upon the location of waste generation (i.e., former production area or off site). Any other waste generated is covered by the established contract(s) with the vendor(s).

6.5.4 Sampling Program - Direct Radiation (TLDs)

This sampling program is designed to measure the direct radiation at the FEMP from locations which are representative of radiological environmental conditions at select locations on-site, at the facility fenceline and in the local community (see Figure 6-4). The data collected under this program will be used to assess the collective effect of current remediation activities on the air pathway. As such, field procedures and analytical methods are designed to support the necessary level of data quality.

The monitoring design incorporates a network of 30 thermoluminescent dosimeter (TLD) locations. Three TLD are deployed quarterly and submitted to the onsite dosimetry laboratory for analysis. External gamma radiation measurements are recorded from each TLD read. All TLDs are analyzed to ASL B. Greater detail on the sampling design is provided in Section 6.4.2.3.

6.5.4.1 Sampling Procedures

The TLDs are collected from environment monitoring locations and analyzed in accordance with the following:

- DOE Order 5400.5 Radiation Protection of the Public and Environment
- Environmental Regulatory Guide for Radiological Effluent Monitoring (DOE 1991)
- FEMP SCQ Section 6.0 and Appendix K, Section 6.5
- Standard Operating Procedure EM-RM-010, Environmental Direct Radiation
- Data Quality Objective MS-004 REM Direct Radiation Measurements

- Standard Operating Procedure EW-0002, Chain of Custody/Request for Analysis Record for Sample Control

Table 6-5 provides a sample and analytical summary for the direct radiation monitoring program.

Sample collection is accomplished using Panasonic UD-814 dosimeters. Environmental TLDs must meet the following criteria as per DOE guidance:

- Environmental TLDs shall be mounted at 1 meter above ground.
- The frequency of exchange should be based on predicted exposure rates from site operations.
- The exposure rate should be long enough (typically 1 calendar quarter) to produce a readily detectable dose (DOE 1991).
- Annealing, calibration, readout, storage and exposure periods used should be consistent with the ANSI standard recommendations (ANSI 1975).

All TLDs placed in the field are tracked via a field tracking log which provides information pertaining to when and where dosimeters were deployed as well as scheduled collection date.

6.5.4.2 QA Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as decontamination, sampling or analytical practice, may be responsible for introducing bias in the project's analytical results. The following quality assurance samples will be collected under this sampling program:

- Spiked dosimeters with a known amount of gamma radiation will be submitted for analysis (must agree within 10 percent of known dose).
- Interlaboratory comparisons will be conducted with the DOE Environmental Measurements Laboratory.

6.5.4.3 Decontamination

Decontamination of environmental TLD is not necessary since the units are self contained, unless collected from known areas of high radiation. Only the units which hold the TLD that have been stationed in the former process area are required to undergo cleaning and decontamination if deemed

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necessary upon a radiological survey. Radiological surveys are performed when equipment and/or samples are required to be released from the former process area for transport and/or analysis. These surveys are conducted in accordance with established procedures.

6.5.4.4 Waste Dispositioning

Contact wastes generated by the field technicians during sample collection activities are collected, maintained and dispositioned as necessary, depending upon the location of waste generation (i.e., former production area or offsite).

6.5.5 Change Control

Changes to the PSP will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the PSP must have approval by the designee and QA prior to implementation. PSP changes shall be documented on the Variance/Field Change Notice (Variance/Field Change Notice) within 24 hours of verbal approval. The completed Variance/Field Change Notice must be received by QA within one week of verbal approval. The Variance/Field Change Notice form shall be controlled and included in the field data package and become part of the project record. Permanent PSP changes will incorporate applicable Variance/Field Change Notices in annual PSP revisions. Scope changes to the PSP will require respective document changes.

6.5.6 Health and Safety Considerations

The FERMCO Health and Safety Department is responsible for the development and implementation of health and safety requirements for this PSP. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified field work will be addressed.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the field work required by this PSP. Daily safety meetings will be conducted prior to beginning field work to address specific health and safety issues.

All FERMCO employees and subcontractor personnel who will be performing field work required by this PSP are required to complete all site applicable training.

For areas which are subject to more restrictive radiological controls where the potential for exposure is greater, Radiation Work Permits (RWPs) are necessary and will be obtained prior to the field work being performed in those areas. A radiological control technician will be assigned to each field crew performing any activities in an area requiring an RWP.

6.5.7 Data Management

Field and analytical data will be managed to meet the IEMP data reporting and quality objectives. The field documentation and analytical data results shall be verified to ensure conformance to the appropriate SCQ sections and appendices. The process for management of the field and analytical data is described in the EDMP (FERMCO 1996).

Field documentation will be verified for accuracy and completeness by the sampling team followed by an independent field data validation in accordance with SCQ requirements for the corresponding ASL. The project team leader must have processes in place to verify that chemical and radiological data results meet all applicable quality requirements specified in the SCQ for the respective ASL (SCQ Section 11.0 and Appendix F). The quality of analytical data shall be evaluated by independent project personnel qualified to determine accuracy, completeness and applicable statistical data necessary to evaluate data useability and data quality required for environmental monitoring reporting.

Both the field and analytical data will be entered into a controlled database using a double key or equivalent method to ensure accuracy. The hard copy data will be managed in the project files in accordance with FEMP recordkeeping procedures and DOE Orders.

6.5.8 Quality Assurance

Independent assessments of work processes shall be conducted to verify quality of performance. Such assessments may include audits, surveillances, inspections, tests, data verification and field validation, and peer reviews. Assessments shall include performance based evaluation of compliance to technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance to IEMP, SCQ, applicable DQOs, and FEMP Quality Assurance Program (FERMCO 1994c) requirements.

Independent assessment is the responsibility of designated project Quality Assurance personnel. The project team leader and QA will coordinate independent assessment oversight activities and comply with SCQ Section 12.0. Recommended quarterly QA surveillances shall be performed on some task specified in the PSP. The QA representative shall have "stop work" authority if significant adverse to quality conditions are identified or work conditions are unsafe. In accordance with SCQ Section 3.0, QA shall review and have approval signature of plans, procedures, and final documents supporting IEMP programs.

Only laboratories on the Approved Laboratory List will be used for FEMP sample analyses in accordance with SCQ Section 12.0 and Appendix E.

6.6 IEMP Air Monitoring Data Evaluation and Reporting

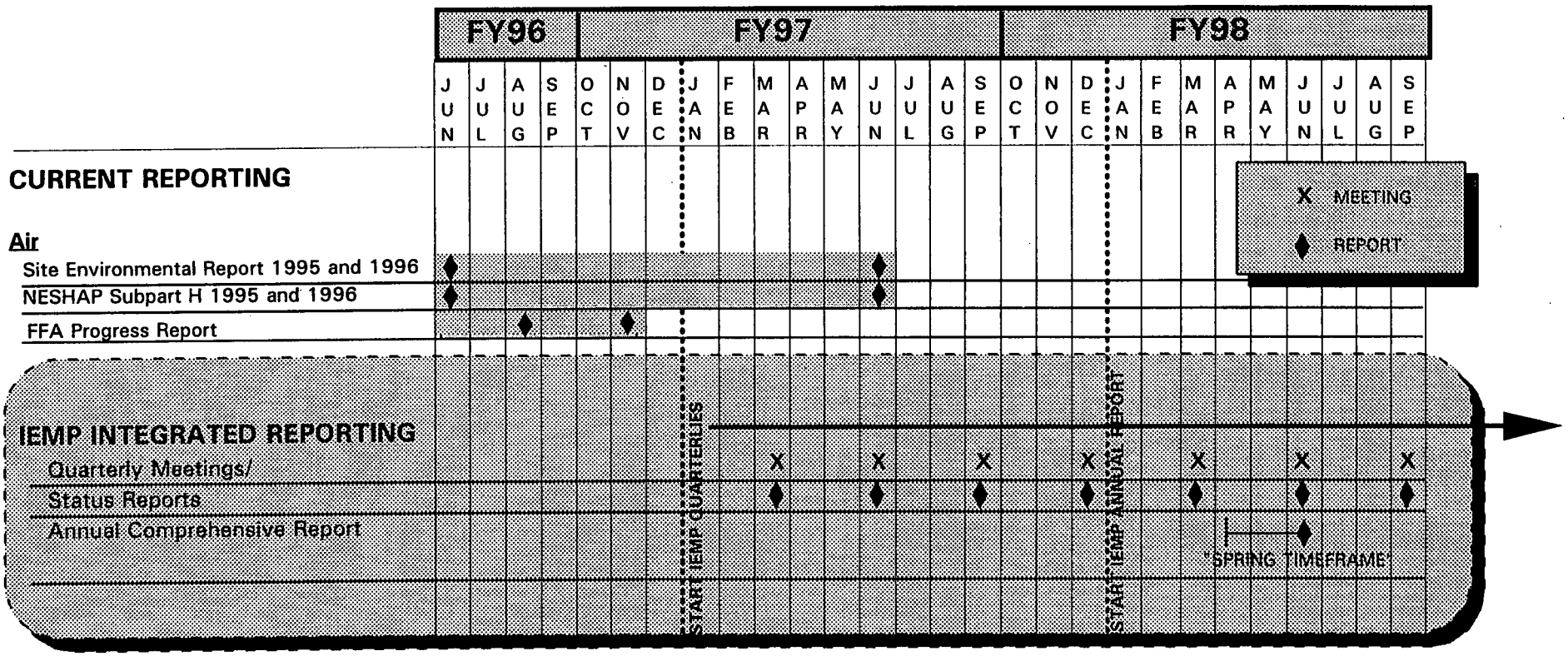
Data from air monitoring will be evaluated and reported. Data evaluation will consist of comparing TSP levels to the Ohio ambient air quality standards, comparing data to historical data for trending analysis, and comparing data to DOE guidelines in DOE Order 5400.5. Two documents have included the sitewide surveillance air monitoring data and effective dose estimates for the air pathway. Figure 6-5 identifies the current reporting schedule for these documents and identifies when IEMP reporting will assume responsibility for air monitoring reporting. The current air monitoring program reports include:

- Site Environmental Report, which provides monitoring data annually
- NESHAP Subpart H Report - required to be submitted annually by June 30 to demonstrate compliance with the NESHAP Subpart annual offsite dose limit.
- FFA reports for radon data at K-65 silos.

Both of the above reporting requirements will be streamlined into the IEMP reporting strategy, as follows:

- Air monitoring data for calendar year 1995 will be reported in the 1995 Site Environmental Report being published in June 1996. Air monitoring data for calendar year 1996 will be reported in the 1996 Site Environmental Report to be published in June 1997. Beginning with calendar year 1997, air monitoring data will be included in a new IEMP annual environmental report, to be issued during the spring of 1998. Project-specific air emission control monitoring data will be included, if needed, in the SER, to support data from the IEMP's air monitoring program.

FIGURE 6-5
IEMP AIR REPORTING STRATEGY



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- The NESHAP Subpart H report for calendar year 1995 is being published in June 1996. The report for calendar year 1996 will be published in June 1997. Approval will be requested from EPA to submit the report, beginning with the 1997 report, as part of a new IEMP comprehensive annual environmental report.

- Additionally, monthly reporting will continue for the FFA radon monitoring data at the K-65 silos.

7.0 BIOTA MONITORING PROGRAM

Section 7.0 provides the monitoring strategy for assessing the sitewide impact of the FEMP's remediation activities on biota (primarily produce) in the vicinity of the FEMP; identifies the integrated objectives for biota monitoring; analyzes program drivers; describes the programmatic boundary for the IEMP biota monitoring program; presents the program expectations and design considerations, a produce sampling and analysis project-specific plan, and a discussion of data evaluation. This section concludes with a plan to integrate the FEMP's existing biota reporting into a single IEMP-sponsored reporting structure. The IEMP program for monitoring produce during remediation is much more limited than the other monitoring programs presented. The distinctions are discussed in detail in this section.

7.1 INTEGRATION OBJECTIVES FOR THE BIOTA MONITORING PROGRAM

At 3-year intervals beginning in 1997 during remediation, the IEMP will be used to determine concentrations of uranium (the principal site contaminant) in samples of area produce for comparison to current and historic concentrations; this will assess impacts to produce that may be related to site remediation. This assessment will be integrated with the assessments of the other media sampled under the IEMP in an annual IEMP-sponsored site environmental report, according to the reporting schedule established in Section 7.6 and summarized for all media in Section 8.0. Ultimately, the IEMP will provide the approach for determining when biota monitoring related to remediation can be discontinued.

7.2 SUMMARY OF REGULATORY DRIVERS, DOE ORDERS, AND OTHER FEMP-SPECIFIC AGREEMENTS

7.2.1 Approach

This section presents an evaluation of the regulatory drivers governing biota monitoring during site remediation. The intent of this section is to identify any pertinent regulatory requirements, including CERCLA-driven ARAR- and TBC-based requirements, for the scope and design of the biota monitoring program. Although the Operable Unit 3 Record of Decision is not yet final, ARARs within the draft Operable Unit 3 Record of Decision were considered. Any ARAR changes in the final Operable Unit 3 Record of Decision from the draft Operable Unit 3 Record of Decision will be evaluated for impacts to the IEMP, and the monitoring program will be revised immediately, if necessary.

The analysis of the regulatory drivers and policies was conducted by examining the FEMP's approved CERCLA Record of Decisions to identify any biota-specific monitoring requirements. An evaluation of the FEMP's regulatory drivers for biota monitoring was conducted to confirm that the existing environmental monitoring program scope, which historically has satisfied public concerns and DOE Order 5400.1 and 5400.5 requirements, also meets any additional requirements for biota monitoring that may have been activated by the FEMP's CERCLA Record of Decisions.

7.2.2 Results

The results of the evaluation indicate the drivers of the IEMP Biota Monitoring Program are the following DOE Orders (no CERCLA-driven requirements were identified):

- DOE Order 5400.1, General Environmental Protection Program, which requires DOE facilities that use, generate, release, or manage significant pollutants or hazardous materials to develop and implement an environmental monitoring plan. Each DOE site's environmental monitoring plan must contain the design criteria and rationale for the routine effluent monitoring and environmental surveillance activities of the facility. The FEMP's existing EMP provides the initial basis for the development of the IEMP strategy that is responsive to the changing site mission and associated remedial needs while still DOE-Order compliant.

- DOE Order 5400.5, Radiation Protection of the Public and the Environment, which establishes radiological dose limits and guidelines for the protection of the public and environment. Under this requirement, the exposure to members of the public associated with activities at DOE facilities from all pathways must not exceed, in one year, an effective dose equivalent of 100 mrem. Compliance with this limit is determined by calculating the radiological dose using monitoring data. Supporting Guidance (DOE 1991) to DOE Order 5400.5 indicates that if combined doses from secondary pathways (such as produce, fish, meat, milk, sediment, and grass), are less than 1 mrem per year, then media-specific surveillance monitoring is not required. As noted in the annual site environmental reports, the total dose from all evaluated FEMP pathways to the hypothetical, maximally exposed individual near the FEMP site has been 1 mrem or less for the last four years. Therefore, fish in the Great Miami River, produce, grass, meat, and milk obtained from the area surrounding the FEMP do not specifically require monitoring according to this 1 mrem threshold criterion.

This IEMP proposes to discontinue monitoring of secondary and tertiary exposure pathways, with the exception of produce. As discussed below, produce sampling will be continued to accommodate specific public interest in this medium. The IEMP is focusing on those primary pathways (air, surface water, and groundwater) to various receptors to provide indications about the impacts of site remediation on the surrounding environment. If, in the future, monitoring of the primary pathways suggests a potential for increased levels of exposure through the secondary or tertiary pathways, then further evaluation may be warranted. The evaluation to determine additional monitoring needs in

secondary and tertiary pathways will be completed annually as part of IEMP review and reporting, and is consistent with the "living document" role of the IEMP.

The implementing guidance for DOE Orders 5400.1 and 5400.5 also specifies that surveillance monitoring of various media may be necessary for other reasons, including addressing public concerns. During meetings, members of the public have expressed an interest in the continuation of produce sampling near the FEMP as an assurance measure; therefore, the produce sampling program will continue through 1997. Sampling of soil co-located with produce has been discontinued. To date, no strong correlation between uranium concentrations in soil and produce has been established. Meat and milk sampling previously have been phased out of the existing environmental monitoring program as a result of the discontinuance of nearby dairy operations. Additionally, the historical sampling results indicate no definitive site impact to meat, milk, and grass in the vicinity of the FEMP.

The following factors were considered in the discontinuation of the Great Miami River fish-monitoring program:

- The program has evaluated fish populations in the river for the past 10 years and has not identified a significant difference in the health or diversity of the fish population in the river when comparing upstream populations (isolated from the site by a dam) to populations in the vicinity of the FEMP-treated effluent discharge point and in the vicinity of the river confluence with Paddys Run.

- IEMP monitoring will provide comprehensive monitoring for contaminants in surface water and treated effluent leaving the site. Data collected from this monitoring will be compared to BTVs from the Sitewide Ecological Risk Assessment to assess any potential site impacts to ecological receptors in both the river and in Paddys Run.

- Annual average uranium concentrations in the Great Miami River, downstream from the FEMP-treated effluent discharge and Paddys Run, have been less than 2 μg/l for each of the last five years. This is less than 0.5 μg/l above background and two orders of magnitude below the ecologically protective BTV of 890 μg/l that was established in the Operable Unit 5 Ecological Risk Assessment.

- Operable Unit 5 Record of Decision (DOE 1996f) requirements mandate that effective January 1, 1998, the monthly average concentration of uranium in the FEMP treated effluent to the River must be 20 μg/l or less.

- Ohio EPA periodically studies Great Miami River water quality and aquatic life (including game fish) to assess any impacts from industry discharges. These studies are completed along portions of the river and include monitoring in the vicinity of the FEMP. The OEPA's ongoing studies will provide a surveillance function beyond the comprehensive discharge monitoring planned as part of this IEMP.

Based on the above considerations, this IEMP proposes to discontinue the fish monitoring program after the 1996 sampling and analysis are completed.

7.3 PROGRAMMATIC BOUNDARY FOR THE IEMP BIOTA MONITORING PROGRAM

This section identifies the programmatic boundary that has been established between the IEMP and activities conducted by other projects. The intent behind the boundary definition is to clearly delineate the scope and geographic extent of the IEMP's monitoring responsibility. For 1997 and every third year thereafter, IEMP biota monitoring program will include only produce sampling. A second boundary important to discussion of the biota monitoring program is the physical boundary. The FEMP property boundary represents the beginning point from which produce samples will be taken.

7.4 PROGRAM EXPECTATIONS AND DESIGN CONSIDERATIONS

7.4.1 Biota Monitoring Program Expectations

The IEMP biota sampling program is essentially a continuation of the current EMP produce surveillance monitoring program for 1997 and every third year thereafter. The expectations for the program are to collect data sufficient to:

- Determine if substantive changes occur in uranium concentrations observed in area produce (as defined by the scope equivalent of the current surveillance produce sampling program)
- Determine if the program should continue as is, be refined in scope, or be discontinued in the future, based on accumulated results
- Continue to address the concerns of the community associated with future remedial construction activity at the FEMP.

7.4.2 Biota Monitoring Program Design Considerations

The design considerations to address the above expectations are as follows:

- Sample locations should, in general, be consistent with current environmental monitoring locations so that comparable areas are evaluated.

- Sampling frequency, parameters analyzed, and ASL should be consistent with the current environmental monitoring program so that appropriate comparison findings can be made.
- Sampling should provide uranium data to continue to confirm that dose received from eating produce grown near the site is below the threshold established by DOE Order 5400.5.

The produce sampling program was initiated in the late 1980s in response to stakeholder concerns about the impacts of historical and then current emissions from the site. Through the 1990s, the program has been scaled back gradually as the data repeatedly confirmed that site emissions had no measurable impact on produce.

7.4.3 Biota Monitoring Program Design

Produce sampling locations are selected using the following guides:

- Locations that are next to or near the site are preferred.
- Locations that are downwind of the site (based on the predominant wind direction) are preferred.
- Locations that have commonly grown vegetables (tomatoes, beans, corn) are preferred.
- Background locations that are at least five miles from the site and in the least predominant wind direction are preferred.

Sampling locations vary from year to year, depending on the willingness of the property owner to participate in the program and on local weather fluctuations that can influence the success and desirability of domestic gardening.

Typically, 20 to 40 samples from about 20 locations are collected and analyzed annually for total uranium.

7.5 PROJECT-SPECIFIC PLAN FOR PRODUCE SAMPLING

This section serves as the PSP for implementation of the sampling, analytical, and data management activities associated with the sitewide environmental produce sampling program. The sampling, analytical, and data management activities described in this project-specific plan were designed to provide produce sampling data of sufficient quality to meet the program expectations as stated in Section 7.4.1. The program expectations in conjunction with the design considerations presented in

Section 7.4.2 were used as the framework for developing the monitoring approach presented in this project-specific plan. To ensure that the specific DQOs for this program are met, all sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the SCQ.

Subsequent sections of this project-specific plan define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Health and safety
- Data management
- Project quality assurance.

7.5.1 Project Organization

A multidiscipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this project-specific plan. The key positions and associated responsibilities required for successful implementation are described below.

The project team leader will have full responsibility and authority for the implementation of this PSP in compliance with all regulatory specifications and sitewide programmatic requirements defined by the Oversight and Program Integration Division. Integration and coordination of all project-specific plan activities defined herein with other project organizations is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

Health and safety is the responsibility of all individuals working on this project scope. Qualified health and safety specialists shall participate on the project team to provide radiation protection and industrial hygiene support, and to assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance specialists will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the SCQ or other referenced standard and to assist in evaluating and resolving all quality-related concerns.

7.5.2 Produce Sampling Program

Figure 7-1 illustrates the locations for produce sample collection. The locations shown in Figure 7-1 are approximate and change yearly based on the availability of samples from farms and gardens and the willingness of local residents to participate in the program. An estimated minimum of 15 produce samples are required annually to meet the program expectations.

Produce samples are collected once per year and analyzed according to Table 7-1.

7.5.2.1 Sampling Procedures

Sample collection is performed according to EP-REM-006, Produce Sampling. Sample handling and transfer is governed by Chain of Custody/Request for Analysis Record for Sample Control, EW-0002, and Logkeeping, EP-REM-002. Sampling conditions to be considered are as follows:

- Produce should be in good (edible) condition.
- Commonly grown fruits and vegetables (e.g., tomatoes, beans, and corn) should be selected for sampling.
- When possible, collect a portion of the total sample from several plants within the garden. The produce should not be rinsed.
- Collect a minimum of 500 grams of produce per sample.

The sampling location shall be described and/or sketched in the field log for the sampling event. Calibration of the field balance before field activities is required by the SCQ.

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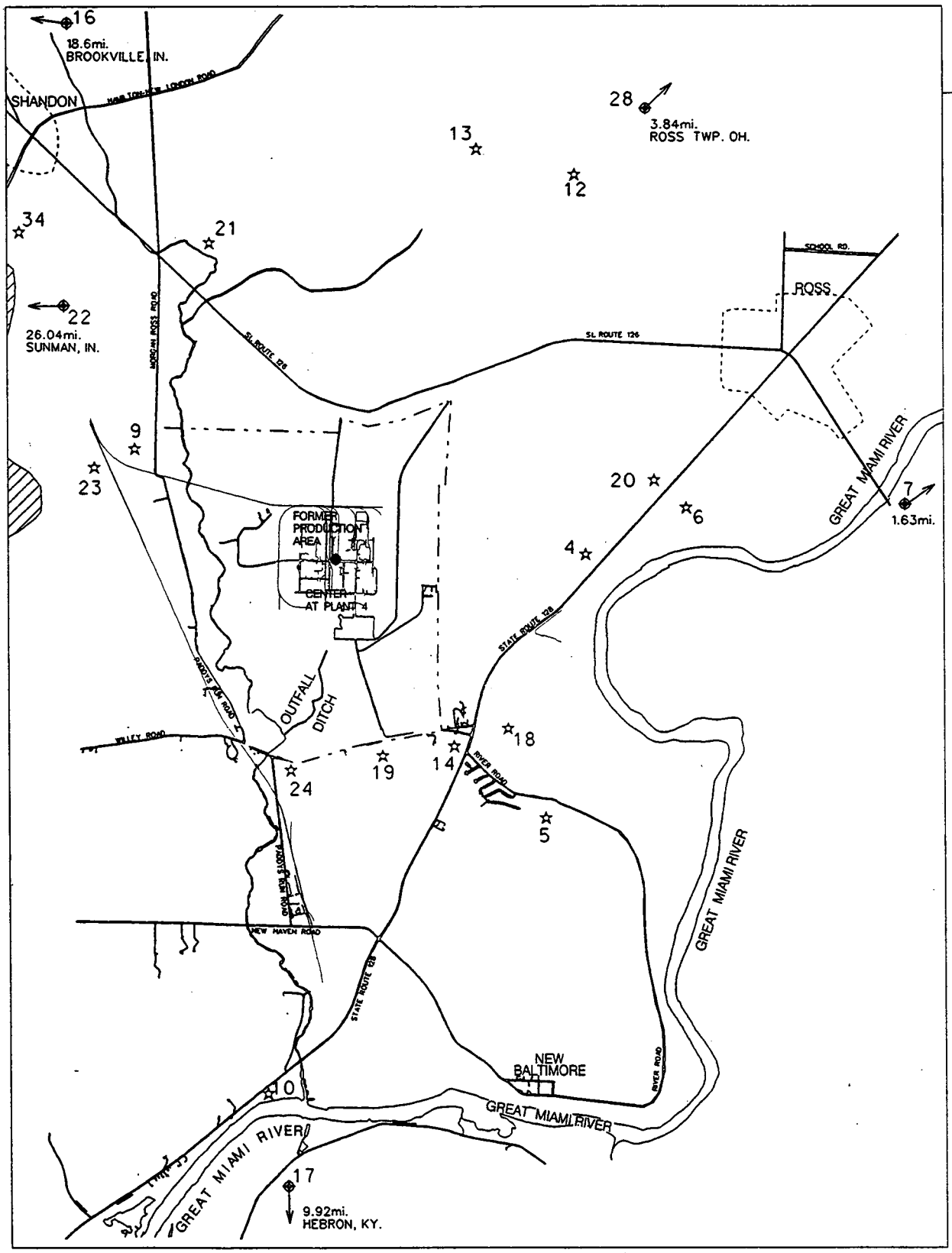

LEGEND:

FEMP BOUNDARY

SINGLE SAMPLING LOCATION

DISTANCE FROM FORMER PRODUCTION AREA TO SAMPLING LOCATIONS OFF MAP

SCALE

3500 1750 0 3500 FEET

DRAFT FINAL

FIGURE 7-1. PRODUCE MONITORING LOCATIONS

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TABLE 7-1

ANNUAL PRODUCE SAMPLE ANALYTICAL REQUIREMENTS

Location	Sample Size (grams)	Type	Number of Samples[a]	Analyte	ASL	Container	Hold Time	Preservative
See Figure 7-1	500 Min.	Grab	Min. of 15	Total Uranium	B	Plastic Bag	6 Months	Freezing

[a]The number of individual produce samples will vary dependent upon private participation and availability. Approximately 20 produce or crop locations exist for which samples may be collected.

7.5.2.2 QA Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as decontamination or sampling technique, may be responsible for introducing bias in the project's analytical results. The radiological data will be sampled and analyzed at ASL B. Field duplicates will be collected for every 20 samples. Quality control samples shall be collected in accordance with Section 6.0 and Appendix K of the SCQ.

7.5.2.3 Decontamination

Sampling equipment shall be decontaminated prior to transport to the sample field site, between sampling locations, and after all sampling is completed. The decontamination of equipment is covered in procedure EP-REM-006.

7.5.3 Change Control

Changes to the PSP will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the project-specific plan must have approval by the designated project authority and QA prior to implementation. Project-specific plan changes shall be documented on the Variance/Field Change Notice within 24 hours of verbal approval. The completed Variance/Field Change Notice must be received by QA within one week of verbal approval. The Variance Field Change Notice form shall be controlled and included in the field data package and become part of the project record. Permanent project-specific plan changes will incorporate applicable Variance/Field Change Notices in annual project-specific plan revisions. Scope changes to the project-specific plan or DQO will require respective document changes.

7.5.4 Health and Safety Considerations

The FERMCO Health and Safety Department is responsible for the development and implementation of health and safety requirements for this project-specific plan. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified field work will be addressed.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the field work required by this project-specific plan. Daily safety meetings will be conducted prior to beginning field work to address specific health and safety issues.

All FERMCO employees and subcontractor personnel who will be performing field work required by this project-specific plan are required to have completed all site required training.

7.5.5 Data Management

Field and analytical data will be managed to meet the IEMP data reporting and quality objectives. The field documentation and analytical data results shall be verified to ensure conformance to the appropriate SCQ sections and appendices. The process for management of the field and analytical data is described in the EDMP (FERMCO 1996).

Field documentation will be verified for accuracy and completeness by the sampling team, followed by an independent field data validation in accordance with SCQ requirements for the corresponding ASL. The project team leader must have processes in place to verify that chemical and radiological data results meet all applicable quality requirements specified in the SCQ for the respective ASL (SCQ Section 11.0 and Appendix F). The quality of analytical data shall be evaluated by independent project personnel qualified to determine accuracy, completeness, and applicable statistical data necessary to evaluate data useability and data quality required for environmental monitoring reporting.

Both the field and analytical data will be entered into a controlled database using a double key or equivalent method to ensure accuracy. The hard copy data will be managed in the project files in accordance with FEMP record keeping procedures and DOE Orders.

7.5.6 Quality Assurance

Independent assessments of work processes shall be conducted to verify quality of performance. Such assessments may include audits, surveillances, inspections, tests, data verification and field validation, and peer reviews. Assessments shall include performance-based evaluations of compliance to technical and procedural requirements, and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance with the IEMP, SCQ, applicable DQOs, and FEMP Quality Assurance Program (RM-0012) requirements.

Independent assessment is the responsibility of designated project quality assurance personnel. The project team leader and QA will coordinate independent assessment oversight activities and comply with SCQ Section 12. Recommended quarterly QA surveillances shall be performed on some task specified in the project-specific plan. The QA representative shall have "stop work" authority if significant adverse quality conditions are identified or work conditions are unsafe. In accordance with SCQ Section 3, QA shall review and have approval signature of plans, procedures, and final documents supporting IEMP programs.

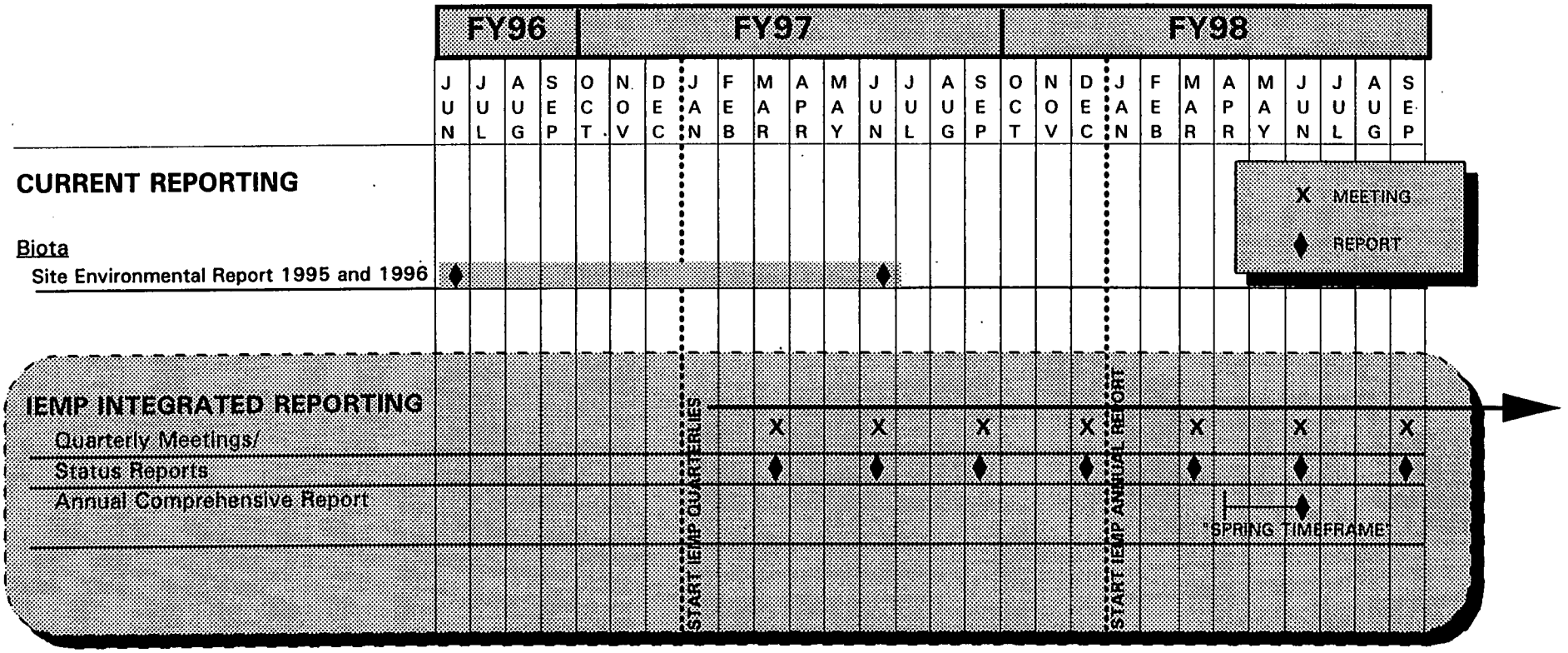
Only laboratories on the Approved Laboratory List will be used for FEMP sample analyses in accordance with SCQ Section 12 and Appendix E.

7.6 IEMP BIOTA MONITORING DATA EVALUATION AND REPORTING

The evaluation of biota monitoring data will include a comparison of the concentration of uranium in locally grown produce to background locations in order to determine any measurable site impact on this produce.

Data from the biota monitoring program are published annually in the Site Environmental Report. Figure 7-2 identifies the current reporting schedule for this document and identifies when IEMP reporting will assume responsibility for biota monitoring reporting. Biota data for calendar year 1996 will be reported in the 1996 Site Environmental Report to be published in June 1997. Beginning with calendar year 1997 and every third year thereafter, biota data will be included in an IEMP sponsored annual environmental report, to be issued during the spring of 1998.

FIGURE 7-2
IEMP BIOTA REPORTING STRATEGY



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8.0 PROGRAM SUMMARY

8.1 INTRODUCTION

This section summarizes the IEMP, highlighting two key program areas: program design and integrated reporting strategy. The program design section explains the technical approach taken in developing the IEMP and outlines the strategy for reviewing and revising the IEMP. The reporting section integrates the reporting discussion in Sections 3.0 through 7.0 and provides an overview of the entire IEMP reporting strategy.

8.2 PROGRAM DESIGN

As discussed throughout this plan, the IEMP combines pertinent elements of the FEMP's existing long-term EMP with the additional sitewide remediation-based environmental monitoring requirements that have been activated by the ARARs and TBCs contained in the FEMP's CERCLA remedy decision documents. Additionally, other ongoing monitoring programs required by other regulatory requirements have been integrated with the IEMP. In combining these elements, the IEMP establishes a sitewide environmental monitoring program that is aligned with the broad range of remedial activities scheduled for implementation at the FEMP, and continues to meet the effluent and surveillance monitoring requirements of DOE Orders 5400.1 and 5400.5. Furthermore, by acknowledging the global remediation strategy and focusing the monitoring program design on a discrete two-year window of remediation activities, the IEMP will forecast and be responsive to emerging monitoring needs.

IEMP media-specific monitoring programs were developed through a systematic evaluation of existing monitoring scope, technical considerations, pertinent regulatory drivers, and critical stakeholder concerns. Programmatic boundaries between the IEMP and project-specific monitoring were identified during this evaluation to clearly delineate the scope and geographic extent of the IEMP monitoring and reporting responsibilities.

8.2.1 Programmatic Boundaries

Programmatic boundaries between the sitewide environmental monitoring program and the projects have been identified as part of the IEMP. These boundaries are defined for monitoring and reporting activities. The IEMP presents a sitewide monitoring approach focused on assessing the collective

impacts of site remediation activities. As such, a fundamental programatic boundary exists between the global monitoring approach of the IEMP and the primarily emissions-control monitoring focus of the individual remediation projects.

The IEMP is designed to provide accurate, accessible, and manageable environmental monitoring information during remediation to support the following:

- Continued compliance with the monitoring and reporting requirements contained in DOE Orders 5400.1 and 5400.5
- Monitoring the performance of the Great Miami Aquifer groundwater remedy, including determination of when restoration activities are complete
- Providing a consolidated reporting mechanism for environmental data.

The following list summarizes the activities that fall outside the scope of the IEMP:

- Project-specific emission-control monitoring for both point and area sources.
- The soil remediation precertification and certification sampling program which will be conducted as part of the work scope of the Soil Characterization and Excavation Project
- Ecological impacts: A Natural Resource Impact Monitoring Plan (NRIMP) will also be prepared independent of the IEMP. This plan will provide the strategy for the monitoring of ecological impacts to wetlands, threatened and endangered species, and terrestrial and aquatic habitats. The NRIMP will identify the drivers and strategies for monitoring each resource.
- The ambient air sampling and direct radiation measurements conducted for worker health and safety purposes as part of the FEMP's occupational monitoring program
- The FEMP's spill and chemical release reporting required under SARA Title III.

8.2.2 IEMP Monitoring Summary for Fiscal Years 1997 and 1998

The IEMP 1997-1998 monitoring scope for groundwater, surface water, sediment, air, and biota has been described in detail in Sections 3.0 through 7.0. The summary that follows is intended to provide a synopsis of and basis for each media monitoring program. Evaluation of each program will form the basis for any IEMP program modifications in the future.

Groundwater: The groundwater monitoring program for the Great Miami Aquifer provides for monitoring of 144 existing monitoring wells distributed over the aquifer restoration area, along the FEMP's downgradient property boundary, and at a few private well locations. These wells provide a monitoring network to track the progress of the

aquifer restoration, monitor groundwater quality in the area of the on-site disposal facility and provide assurance that contaminants are not migrating beyond the groundwater restoration area that is defined in the FEMP's sitewide hydraulic capture zone. The analytical regime for this monitoring program is based on the FRLs documented in the Operable Unit 5 ROD.

Surface Water: The surface water monitoring program is designed to assess the impacts of site remedial activities on surface water. The non-radiological discharge monitoring and reporting related to the NPDES permit have been incorporated into the IEMP. The radiological discharge monitoring related to the FFCA has been incorporated into the IEMP with minor modifications. All constituents that exceeded FRLs and/or BTVs will be monitored. There are 14 monitoring locations.

Sediment: The sediment sampling program consists of 21 monitoring locations for key site-specific radiological constituents. It is designed to determine whether substantial changes to current residual contaminant conditions occur in the sediment along the storm sewer outfall ditch, Paddys Run, and the Great Miami River, as a result of runoff and treated effluent from the site.

Air: The air monitoring program consists of three distinct sampling elements: airborne particulate monitoring, radon monitoring, and direct radiation monitoring, with each element supported by the meteorological monitoring program. Each element has a network of monitoring locations on site, at the FEMP boundary, and off site that are used to measure the collective sitewide effects of remediation activities. Data from the airborne particulate monitoring element will be used to develop and refine an emissions model for future remediation activity. The analytical regime for the air monitoring program focuses on the principle contaminants of each monitoring element.

Biota: The biota monitoring program consists of the analysis of produce samples from approximately 15 local farms and gardens in order to address stakeholder concerns regarding this secondary pathway. Frequency of sampling is once every three years. All samples are analyzed for uranium, the principle contaminant of concern.

8.2.1 Program Review and Revision

As stated in Section 1.0, the IEMP is a "living document" and, as such, is anticipated to change over the life of the FEMP's remediation program. This approach to developing the IEMP acknowledges the dynamic nature of the remediation effort, allowing the plan to focus on the current and evolving mix of site remediation activities from year to year that accompany the FEMP's accelerated site remediation schedule.

To facilitate timely changes to the IEMP program, a structured schedule of annual reviews and two-year mandatory revisions has been incorporated into the IEMP. This schedule meets the requirements

of DOE Order 5400.1 for review and revision of environmental monitoring plans. Annual reviews will evaluate the current IEMP program against the anticipated mix of remediation activities scheduled to occur in the subsequent two years. The annual review cycle provides the mechanism for identifying and initiating any program modifications that are necessary to align the IEMP with the mix of near-term remediation activities. For example, parameter selection and sampling locations, frequency, and media will be reviewed and evaluated annually. Any resultant modifications to the IEMP will be communicated to the regulatory agencies.

The two-year revision will incorporate all changes initiated as a result of the annual review process. The revision also will identify any program modifications necessary as a result of progressive findings of the IEMP and any changes to existing regulatory agreements or requirements applicable to sitewide monitoring. The specific schedule dates for review and revision of the IEMP will be based on the approval date of the IEMP.

In addition to the IEMP-sponsored review and revision obligations identified above, an independent review and assessment mechanism exists through the agreement in principle reached between the OEPA and the DOE. The AIP (approved in October 1993) provides an avenue for the OEPA to conduct an independent review of DOE environmental monitoring programs. The OEPA's role, as defined in the AIP, is to independently verify the adequacy and effectiveness of DOE's environmental monitoring programs through program review and limited independent data collection. Results of the OEPA review are summarized in an annual report that will be considered during the IEMP annual review process. Modifications to the scope or focus of the IEMP as a result of the OEPA's activities will be incorporated as necessary via the annual IEMP review process.

8.3 REPORTING

As stated in Section 1, a primary objective of the IEMP is to successfully integrate the numerous routine environmental reporting requirements under a single comprehensive framework. The IEMP provides the vehicle to centralize, streamline, and focus sitewide environmental monitoring and associated reporting under a single controlling document. Centralization will occur by consolidating environmental data reporting, that currently exists under various programs, under the IEMP umbrella. Streamlining will be achieved as reporting frequencies are transitioned to the new IEMP reporting schedule in fiscal years 1997 and 1998. Greater focus will occur as the DOE meets quarterly with

EPA and OEPA to review IEMP and project-specific monitoring data. This consolidation is intended to facilitate timely technical review and discussion of the monitoring data generated during remediation. The IEMP seeks to accomplish this integration objective for reporting through a phased transition which is presented on a media-specific basis in Sections 3.0 through 7.0 and is summarized below.

8.3.1 Regulatory Drivers for Reporting Monitoring Data

An analysis of regulatory drivers and policies was conducted by examining ARARs within operable unit RODs, FEMP compliance agreements, and DOE Orders applicable to monitoring each media. These regulatory drivers are identified in Sections 3.0 through 7.0 of the IEMP and were evaluated for reporting requirements. The following reporting drivers will be phased into the IEMP reporting strategy:

- DOE Order 5400.1, General Environmental Protection Program Requirements, which requires DOE facilities to submit annual site environmental reports that summarize the environmental monitoring data results
- The September 10, 1993, Ohio EPA Director's Findings and Orders (OEPA 1993), which requires submittal, by March 1 of each year, of groundwater monitoring data collected over the previous year in the RCRA Annual Report, to fulfill RCRA/Ohio hazardous waste regulations for groundwater monitoring. Groundwater monitoring data provided in the annual report is compiled from quarterly sampling of 33 property boundary wells.
- The Abandonment and Plugging of the KC-2 Warehouse/Well No. 67 Groundwater Sampling Work Plan Addendum, which includes a provision to submit, in an annual letter report, the groundwater monitoring data from sampling Well No. 67
- The South Plume Design Monitoring Evaluation Program Plan, which requires semi-annual reporting of performance monitoring data from the South Plume Removal Action pumping system
- The current NPDES permit for the FEMP, which requires monthly reports to demonstrate compliance with provisions in the NPDES permit
- The 1986 FFCA, which, per an agreement made with EPA and OEPA in January 1996, requires submittal of quarterly progress reports
- NESHAP 40 CFR 61, Subpart H, which requires submittal of an annual NESHAP report to demonstrate compliance with emission standards for radionuclides other than radon
- The FFA, Control and Abatement of Radon-222 Emissions, signed November 19, 1991, which

requires, per an agreement made with EPA and OEPA in January 1996, submittal of the continuous air monitoring data in selected on-site areas in a quarterly progress report.

8.3.2 Reporting Responsibilities

Under the IEMP consolidated reporting concept, each project will be responsible for maintaining records of its project-specific monitoring program and reporting the data as defined in the appropriate project-specific controlling document. Concurrently, the data generated by sitewide environmental monitoring will be maintained and managed by the IEMP program. Project-specific data and interpretation thereof would be transmitted to the IEMP program to support quarterly meetings with and status reports to the regulators, to support the annual review and bi-annual revision of the IEMP, and to support an IEMP-sponsored annual site environmental report. IEMP data will be communicated to the projects as warranted by evaluation of the IEMP data.

8.3.3 Transition to IEMP Reporting

As discussed in Sections 3.0 through 7.0, a number of reports are currently being prepared to fulfill regulatory requirements and other site commitments for each of the media monitoring programs. Figure 8-1 details the range of current environmental reporting to be consolidated under the IEMP umbrella. In addition, key transition dates are called out for each report to be phased in under the IEMP reporting strategy. Complete transition from the current reporting schedule to IEMP reporting will be phased in, as most appropriate for each media.

The following presents a summary of reports that will be integrated under the IEMP and the associated schedule.

Groundwater Monitoring Reporting: Four groundwater monitoring reports will transition into the new IEMP reporting format starting in January 1997. Affected reports include the Site Environmental Report, the DMEPP semi-annual reports, the KC-2 warehouse well monitoring report, and the RCRA Annual Report. Groundwater monitoring data currently presented in the annual Site Environmental Report will be published in an expanded IEMP-sponsored Site Environmental Report beginning in 1998 (report covering calendar year 1997).

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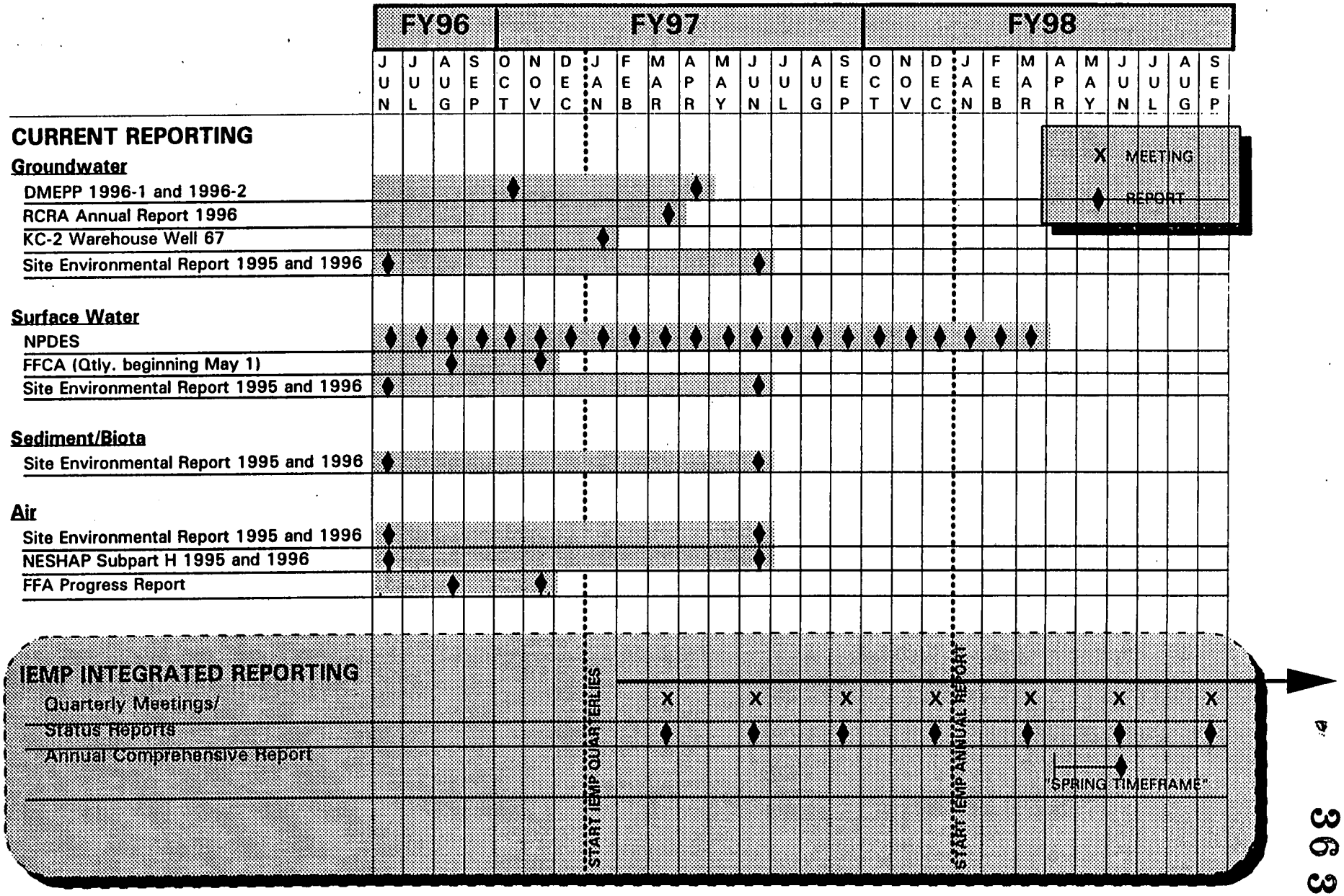
FIGURE 8-1
IEMP REPORTING STRATEGY



Surface Water Monitoring Reporting: Three surface water monitoring reports are currently prepared to document surface water monitoring results. The NPDES monthly report will transition into a Quarterly reporting schedule beginning in March 1998 under the IEMP. Surface water monitoring data currently presented in the annual Site Environmental Report will be published in a new IEMP annual Site Environmental Report beginning in 1998 (report covering calendar year 1997).

Sediment Monitoring Reporting: Sediment monitoring data currently presented in the annual Site Environmental Report will be published in a new IEMP annual Site Environmental Report beginning in 1998 (report covering calendar year 1997).

Air Monitoring Reporting: Air monitoring data currently presented in the annual Site Environmental Report will be published in a new IEMP annual Site Environmental Report beginning in 1998 (report covering calendar year 1997). The NESHAP subpart H report will also be incorporated into the Site Environmental Report beginning in 1998.

Biota Monitoring Reporting: Biota monitoring data currently presented in the annual Site Environmental Report will be published in a new IEMP annual Site Environmental Report beginning in 1998 (report covering calendar year 1997).

The Site Environmental Report, published annually in June, currently documents the technical approach and data reported for the groundwater, surface water, sediment, air, and biota monitoring programs, and summarizes CERCLA, RCRA, and waste management activities. Under the IEMP umbrella, the current Site Environmental Report format would be presented through June 1997 (report covering calendar year 1996). Data for the 1997 Site Environmental Report would be gathered from the backup for the quarterly status updates that DOE will present to both EPAs during quarterly meetings. This quarterly input will be used to develop an expanded Site Environmental Report to be submitted in the spring/summer of 1998. Since this report must serve a wide audience, the format and content will be developed through a collective effort incorporating input from the EPA, OEPA, and involved stakeholders.

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APPENDIX A

DETAILED EXPLANATION OF PARAMETER SELECTION FOR THE GROUNDWATER MONITORING PROGRAM

APPENDIX A
DETAILED EXPLANATION OF
PARAMETER SELECTION FOR GROUNDWATER MONITORING

A.1 INTRODUCTION

As discussed in Section 3.0 of the IEMP, the groundwater monitoring program for the Great Miami Aquifer consists of 144 monitoring wells distributed over six restoration modules, along the FEMP's downgradient property boundary, and at several private well locations. These wells provide an extensive monitoring network that will allow module-specific performance measures to be tracked and provide assurance that contaminants are not migrating beyond the groundwater restoration area that is defined by the sitewide hydraulic capture zone of the Fernald Environmental Management Project (FEMP). Because of the extensive nature of this system, it is important to recognize that if all 144 of these wells were monitored quarterly for the full suite of the FEMP's groundwater final remediation level (FRL) constituents (50 constituents, total), the analytical costs alone would exceed 18 million dollars over the life of the FEMP's groundwater restoration program. Clearly, these costs are prohibitive, and it is not cost-effective to monitor the full suite of parameters at each successive monitoring interval at all available wells during the active restoration process.

The intent of this appendix is to develop a cost-effective, representative list of analytical parameters that can be used to successfully track the progress of the remedy, satisfy regulatory requirements, and ultimately determine when restoration activities are complete for each module. The FEMP recognizes its obligation to verify that all 50 FRL constituents are below their corresponding FRL values in order to deem the restoration activities as complete. During the active restoration process, the FEMP is proposing to track the progressive success of the remedy using a logical "short list" of zone-specific indicator parameters (developed through the methodology described in this appendix), and then verify the completion for the remedy (step-wise for each module, as appropriate) using the full suite of 50 FRL constituents identified in the Operable Unit 5 Record of Decision (DOE 1996). In accordance with the current scope and revision cycles for the Integrated Environmental Management Plan (IEMP), this appendix focuses primarily on the development of analytical parameters that can support the next two years of monitoring efforts for the aquifer (years 1997 and 1998). Subsequent versions of the IEMP are expected to focus on the monitoring activities and the parameters needed to support a collective decision on the part of U.S. Department of Energy (DOE), U.S. Environmental

Protection Agency (EPA), and Ohio Environmental Protection Agency (OEPA) that restoration activities are complete for each module. Later versions will also define the FEMP's long-term groundwater monitoring activities (such as the long-term monitoring associated with the FEMP's on-site disposal facility) that may extend beyond completion of the restoration program.

The remainder of the appendix is organized into the following sections:

- Objectives: defines the overall parameter selection strategy for groundwater monitoring over the life of the remedy, along with the specific intentions and needs to support the next two years of activity
- Approach: defines the parameter selection criteria and describes the historical information reviewed to develop zone-specific parameter lists that are responsive to regulatory requirements and the remedy performance tracking needs
- Results: presents the zone-specific parameter and sampling frequencies that will support the next two years of monitoring activities
- Future Activities: defines the process for modifying and revising the lists as needed to support future versions of the IEMP and ultimate completion of the Operable Unit 5 groundwater remedy.

A.2 OBJECTIVES

The objective of the parameter selection process is to develop a cost-effective, representative list of parameters that can be used to successfully track the progress of the remedy, satisfy regulatory commitments, and ultimately determine when restoration activities are complete for each module. This section presents the strategy used to meet this objective.

Restoration of the aquifer will be measured by the achievement of the FEMP's 50 groundwater FRLs. FRLs for the aquifer are presented in the Operable Unit 5 Record of Decision for 50 constituents of concern. Developed during the remedial investigation/feasibility study process, these 50 FRL constituents either 1) have concentrations that have been detected in the aquifer, or 2) have the potential to reach the aquifer within 1,000 years (assuming no source control actions are in place) and pose an unacceptable risk to human health and/or the environment. A detailed discussion of how FRLs were developed can be found in Section 2.0 of the Operable Unit 5 Feasibility Study Report (DOE 1995).

The 50 FRL constituents have been organized into four categories for the purpose of establishing a parameter hierarchy and identifying a "short list" of indicator parameters which will be targeted for more frequent monitoring than the other FRL constituents. The objective will be to track all 50 FRL constituents at various intervals throughout the restoration, but to track the short-list of indicator parameters more frequently. This approach provides a more cost-effective and realistic method to track remedy performance.

Constituents from each of the four different categories were organized into specific monitoring parameter lists based upon specific monitoring objectives and the geographic locations of the monitoring module/program. The specific monitoring objectives considered in subdividing the parameters into specific groups are:

- Is the success of the groundwater remedy proceeding satisfactorily at the pace that is desired?
- Are physical adjustments to the restoration system (flow rates, well locations, etc.) needed?
- Are FRL constituents migrating beyond the hydraulic zone of capture created by the restoration system?
- Are new FRL constituents arriving in the aquifer as a result of migration through the glacial overburden or as a result of surface water infiltration?
- Is sufficient information being gathered to ultimately demonstrate that remedial objectives contained in the Operable Unit 5 Record of Decision have been obtained?
- Have all specific regulatory-based monitoring requirements for specific parameters been satisfied in the selection process?

Figure A-1 illustrates the parameter selection process. The selection process results in a parameter categorization hierarchy that identifies a short-list of 10 indicator constituents that will be sampled more frequently to track the progress of the restoration and assess the need for changes in operating conditions as necessary. The remaining constituents will be sampled less frequently to determine whether new FRL exceedances are occurring in the aquifer due to migration through the glacial overburden or surface water and to ultimately demonstrate that remedial objectives are being achieved. Figure A-1 also shows how the categories are organized into the different aquifer zones. The aquifer was divided into five geographic zones to determine zone-specific monitoring lists. Four of these five zones correspond to the restoration modules. The fifth zone (Zone 0) consists of the areas outside Zones 1 through 4. The five aquifer zones are illustrated in Figure A-2.

A.3 APPROACH

This section on approach defines the parameter selection criteria, and describes the historical information reviewed to develop zone-specific parameter lists that are responsive to regulatory requirements and the remedy performance tracking needs. These criteria are used to divide the 50 FRL constituents into four categories for monitoring the aquifer restoration as follows:

- FRL constituents with at least one validated FRL exceedance in the aquifer (using data collected between 1988 through 1995) will be grouped together and identified using a > symbol. FRL constituents that have not had a validated FRL exceedance in the aquifer will be grouped together and identified using a < symbol.

- FRL constituents predicted to have the ability to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk to human health and the environment will be grouped together. These constituents are considered "mobile and persistent", and will be identified using the letters MP. FRL constituents that are predicted not to have the ability to migrate to the aquifer and create and unacceptable risk will be grouped together. These constituents are considered not mobile and persistent, and will be identified using the letter N.

- FRL constituents that have not been sampled for in the aquifer, but are predicted to be unable to migrate to the aquifer and create an unacceptable risk will be categorized as not having a validated FRL exceedance (<).

- FRL constituents that have not been sampled for in the aquifer, but do have the ability to migrate to the aquifer and create an unacceptable risk will be categorized as having a validated FRL exceedance (>).

- FRL constituents that are common laboratory contaminants and do not have a confirmed FRL exceedance will be categorized as not having a validated FRL exceedance (<).

- FRL constituents analyzed using a method detection limit above the FRL value and predicted to be unable to migrate to the aquifer and create an unacceptable risk will be categorized as not having a validated FRL exceedance (<).

- FRL constituents analyzed using a method detection limit above the FRL value and predicted to have the ability to migrate to the aquifer and create an unacceptable risk will be categorized as having a validated FRL exceedance (>).

After the 50 FRL constituents are identified as being ["<" or ">"] and ["MP" or "N"], they are grouped into the four categories, ">MP", ">N", "<MP", and "<N". The ">MP" constituents are considered to be the short-list of indicator parameters and will be targeted for more frequent monitoring. The remaining constituents [">N", "<MP", and "<N"] will be targeted for less frequent monitoring.

In addition to monitoring restoration performance, there are regulatory commitments that specify the need to monitor select constituents at specific locations:

- The Paddys Run Road Site constituents are monitored at key locations in the South Plume/South Plume Optimization Module.
- Two specific constituents (technetium-99 and total uranium) are proposed for monitoring at the on-site disposal facility to satisfy State of Ohio disposal facility monitoring requirements.
- An established short-list of specific constituents are monitored for the KC-2 warehouse monitoring program.
- Total uranium is monitored in the FEMP's private well monitoring program.
- Constituents that have caused FRL exceedances in Zones 0 through 3 are proposed for monitoring at the FEMP's downgradient property boundary (RCRA Property Boundary Monitoring Program).

The March 1996 RCRA annual report provided recommendations to update and align the monitoring parameters evaluated for the RCRA Property Boundary Program with the FRLs for groundwater contained in the February 1996 Operable Unit 5 Record of Decision. The parameter selection process outlined in this appendix serves to implement this proposal.

A.4 RESULTS

A.4.1 FRL Constituents that Have Been Detected in the Great Miami Aquifer at a Concentration above their Established FRLs

The Operable Unit 5 remedial investigation/feasibility study data set, supplemented with groundwater data collected in 1994 and 1995, was reviewed to identify constituents that have been detected in the Great Miami Aquifer at concentrations above the established FRLs, and where they occur. The majority of the groundwater data collected in 1994 and 1995 is obtained from the RCRA Property Boundary Monitoring Program and the DMEPP monitoring program for the South Plume. All filtered and unfiltered samples from Type 2 and Type 3 monitoring wells were evaluated. Data from Type 4 monitoring wells were not reviewed because there is no contamination related to the FEMP at the Type 4 well depth.

Table A-1 summarizes the results of the data evaluation. Columns 1 through 4 list the FRL constituents, the assigned groundwater FRL value, units for the FRL value, and the basis for the FRL value, respectively. As discussed in Section 2.0 of the Operable Unit 5 Feasibility Study Report, the

FRLs were developed based on ARARs, detection limits, background concentrations, and/or risk assessment results.

Column 5 of Table A-1 lists the number of validated samples included in the data sets. Column 6 lists the number of validated results (either "-" or "J") that were detected for each constituent above their established FRLs. Using validated data rather than using non-validated data provides results which should be more accurate at determining where actual exceedances occur. Constituents that were not detected in the aquifer at a concentration above their FRL will still be monitored, but not as frequently as those that have been detected.

Column 7 lists, by aquifer zone, the number of wells with FRL exceedances. Using total uranium as an example, 14 wells have shown exceedances of the uranium FRL in aquifer Zone 4. The last column of the table lists the range of validated results above the FRL and also provides the validation aquifer (either "-" or "J").

The data evaluation indicates that:

- Twenty-nine of the 50 FRL constituents have had exceedances of their FRL in the Great Miami Aquifer at least one time, using data collected from 1988 through 1995
- Four of the 50 FRL constituents (boron, chromium VI, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and octochorodibenzo-p-dioxin) have not been analyzed in every zone. Of these four constituents, only boron has not been analyzed in any zone. Nonetheless, these four constituents were categorized as either having an exceedance or not having an exceedance based upon the criteria presented in the previous section.
- One of the 50 FRL constituents (bis(2-ethylhexyl)phthalate) had three reported historical FRL exceedances (.015 mg/L, .013 mg/L and .007 mg/L) at three different wells. Confirmatory sampling of each exceedance indicated that the result was most likely due to laboratory contamination. This constituent was, therefore, categorized as not having a FRL exceedance.
- Four of the 50 FRL constituents (aroclor-1254, bis[2-chloroisopropryl]ether, chloroethane, and octochlorodibenzo-p-dioxin) have been analyzed using a method detection limit above the FRL value. These four constituents were categorized as either having an exceedance or not having an exceedance based upon criteria presented in the previous section.

Figures A-3 through A-31 illustrate, by constituent, where FRL exceedances have occurred. The figures also show the modeled hydraulic capture zone associated with the 10-year aquifer remediation scenario.

A.4.2 Constituents that Could Migrate to the Great Miami Aquifer Through the Glacial Overburden

A constituent's ability to migrate to the Great Miami Aquifer vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk to human health and the environment was also used to categorize the 50 FRL constituents. While at present, the data evaluation of historical results (1988 through 1995) indicates that FRL exceedances in the aquifer have only been detected for 29 of the 50 FRL constituents, it was recognized during the FRL development process that a constituent could potentially migrate through the glacial overburden to the aquifer in the future and cause a FRL exceedance.

During the remedial investigation/feasibility study process, the mobility, and persistence characteristics of 93 constituents were assessed and modeled to predict which constituents had the ability to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk to human health and the environment. Table F.2-2 of the Operable Unit 5 Feasibility Study Report presents the results of the model screening process. In order to be conservative, the modeling assumed that no sources of contamination were removed (i.e., the "no-action alternative" was selected for the FEMP).

For the purpose of parameter selection, the terms "mobile and persistent" are used to describe those constituents that are predicted to be able to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk in the absence of the source-control actions (i.e., identified as failing the Operable Unit 5 feasibility study model screening in Table F.2-2). These FRL constituents are identified in Column 4 of Table A-2 with the letters "MP". Those FRL constituents that do not have the ability to migrate to the aquifer and create an unacceptable risk (not "mobile and persistent"), and are identified in Column 4 of Table A-2 with the letter "N" (identified as failing the Operable Unit 5 feasibility study model screening in Table F.2-2).

The first three columns of Table A-2 summarize the information included in Table A-1. The information in Column 4 originated from Table F.2-2 of the Operable Unit 5 Feasibility Report. (Note: Table A-2 is identical to Table 3-2 of the IEMP).

Three of the 50 FRL constituents were not specifically modeled during the Operable Unit 5 feasibility study process: chloroethane, 4-nitrophenol, and 2,3,7,8-tetrachlorodibenzo-p-dioxin. The upper range of half-lives found in literature for chloroethane and 4-nitrophenol in groundwater are eight weeks and 9.8 days, respectively (Howard 1991). Due to these relatively short half lives, chloroethane and 4-nitrophenol are not expected to reach the aquifer. Although 2,3,7,8-tetrachlorodibenzo-p-dioxin has a half-life of about 3.23 years, dioxin-like compounds are primarily associated with particulate and organic material due to their high lipophilicity and low water solubility, and therefore are not considered mobile. Dioxins exhibit little potential for significant leaching and are not mobile into the aquifer. Therefore, dioxin-like compounds in Table F.2-2 passed the model screening and are not predicted to be able to migrate to the aquifer and create an unacceptable risk. For these reasons, the above three constituents were considered to be not mobile and persistent and assigned "N" in Table A-2 as they either have high degradation rates or low water solubility.

The Operable Unit 5 feasibility study modeling predicted that bis(2-chloroisopropyl)ether and carbazole had the ability to migrate vertically through the glacial overburden, reach the aquifer and create an unacceptable risk in the absence of source control measures. It has since been determined that the decay rate used for these two constituents was overly conservative. This conservative assumption was used because no literature decay half-life was found, at the time, for these two constituents. A recent study (Grosser 1995) concluded that the degradation rate of carbazole is similar to phenanthrene and anthracene. The upper range of half-lives found in literature for bis-(2-chloroisopropyl)ether in groundwater is one year (Howard 1991). Additional model screening simulations were conducted using the half-life of anthracene (i.e., five years) for carbazole and one year for bis(2-chloroisopropyl)ether. Based on the last modeling results, both constituents passed the model screening and are, therefore, not considered to be mobile and persistent. For this reason, these constituents were assigned "N" in Table A-2.

In summary, none of these five constituents (chloroethane, 4-nitrophenol, 2,3,7,8-tetrachlorodibenzo-p-dioxin, bis(23-chloroisopropyl)ether, and carbazole) are considered sufficiently mobile and persistent to impact the aquifer. As mentioned, they have been assigned the "N" characteristic in Table A-2. It is also important to point out that none of these five constituents have been detected in the aquifer at concentrations above the groundwater FRLs.

From review of Table A-2, Column 4, it can be determined that:

- Thirteen of the 50 constituents (26 percent) are considered mobile and persistent ("MP"). These constituents are: fluoride, nitrate, boron, chromium VI, mercury, neptunium-237, strontium-90, technetium-99, total uranium, alpha-chlordane, bromodichloromethane, 1,2-dichloroethane, and vinyl chloride.

- Thirty-seven of the 50 constituents (74 percent) are considered not mobile and persistent ("N"). The constituents are identified in the table.

A.4.3 Zone-Specific Parameter Lists and Sampling Frequencies

Information from Column 3 of Table A-2 was combined with information from Column 4 to produce four categories (">MP", "<MP", ">N", "<N"). Columns 5 through 9 of Table A-2 provide a zone-specific sort of how each FRL constituent is categorized. The four terms to describe the combined constituent information by zone are:

- **>MP** The constituent has been detected in the aquifer at concentrations "greater than its established FRL" and is considered "Mobile and Persistent." It has been predicted to be able to migrate from the glacial overburden to the aquifer and has already caused a FRL exceedance in the aquifer.

- **>N** The constituent has been detected in the aquifer at concentrations "greater than its established FRL" but is "Not considered mobile and persistent." This constituent is not predicted to be able to migrate vertically through the glacial overburden, reach the aquifer, and create an unacceptable risk. Background conditions and/or surface water infiltrations may be the cause of the isolated FRL exceedances noted in the historical record.

- **<MP** The constituent has "not been detected is the aquifer at concentrations greater than its established FRL," but is considered both "Mobile and Persistent." This constituent is predicted to be able to migrate through the glacial overburden to the aquifer (if no source actions are taken), but as yet has not caused exceedances of its established FRL.

- **<N** The constituent has "not been detected is the aquifer at concentrations greater than its established FRL" and is "Not considered mobile and persistent."

A zone-specific breakdown of the number of constituents in each of the four categories is presented below.

BREAKDOWN OF FRL CATEGORY CONSTITUENTS BY ZONE

Constituent Characteristic	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
>MP	9	7	6	6	8
>N	13	16	12	14	18
<MP	4	6	7	7	5
<N	24	21	25	23	19

The constituents that are in the >MP category in at least one zone are:

- Fluoride
- Nitrate
- Boron
- Chromium VI
- Mercury
- Neptunium-237
- Strontium-90
- Technetium-99
- Total Uranium
- 1,2-Dichloroethane.

These constituents are considered to be the master short-list of indicator parameters from which zone-specific short-lists will be developed. These short-list parameters will be monitored more frequently than the other constituents in order to track the overall success and progress of the remedy. These parameters have been detected in the aquifer at concentrations above their established FRL and they are both mobile and persistent.

Each of the four categories of constituents will be targeted for monitoring at the following frequency:

- **>MP** Are to be monitored quarterly in source areas and at the property boundaries because they have been detected in the Great Miami Aquifer above their established FRL and are considered mobile and persistent.

- >N Are to be monitored annually in source areas and at the property boundaries because they have been detected in the Great Miami Aquifer above their established FRL and because they are not considered mobile and persistent.

- <MP Are to be monitored annually because they have not been detected in the Great Miami Aquifer above their established FRL and because they are considered mobile and persistent.

- <N Will be monitored every five years to verify that these lowest-priority FRL constituents remain below their established FRL.

Exception:

- The constituents with the >MP characteristic in the two areas where groundwater cleanup is not expected to begin in the next five years (Plant 6 and Waste Storage Area modules) the groundwater will be monitored semi-annually instead of quarterly. The frequency will be increased to quarterly one year before the groundwater remediation begins in these areas.

Parameter lists for the monitoring modules/programs were developed using Columns 5 through 9 of Table A-2. These module-/program-specific parameter lists can be found in Section 3.5.1 and 3.5.2 of the IEMP. Columns 5 through 9 indicate how constituents have been categorized for each aquifer zone. Specific monitoring modules and programs fall in one or more of these zones as follows:

- South Plume/South Plume Optimization Module is located in Zones 2 and 4
- South Field/Injection Demonstration Modules are located in Zone 2
- Waste Storage Area Module is located in Zone 1
- Plant 6 Area Module is located in Zone 3
- RCRA Boundary Monitoring Program monitors downgradient of Zones 0 through 3.

Exceptions:

- KC-2 warehouse, private well monitoring, and on-site disposal facility monitoring programs and Paddys Run Road Site Activity of the South Plume/South Plume Optimization Module have established parameter lists that were put together to meet specific objectives. These will be maintained as discussed in Section 3.5 of the IEMP.

Although the FRLs listed in Table 9-3 of the Operable Unit 5 Record of Decision were developed for nitrate and chromium VI, future monitoring modules/programs will be analyzed for nitrate/nitrite and total chromium, respectively. This was done to facilitate laboratory procedures and minimize cost. In both cases, the constituent for which the FRL was developed is a portion of what will be analyzed. For example, the quantity of chromium VI is reflected in total chromium analysis. Consequently, if a

total chromium analysis does not indicate an FRL exceedance, then the chromium VI will also be below the FRL since there is less chromium VI than total chromium. This is also the case for nitrate/nitrite.

A.5 FUTURE ACTIVITIES

A.5.1 Modifying Parameter Lists

For the first round of groundwater sampling under the IEMP, all constituents characterized as ">MP", ">N", and "<MP" will be sampled. After a year of data are collected and reviewed, the parameter list for each module/program will be reevaluated using the same logic outlined previously in this appendix. The new data collected may indicate that is it necessary to increase or decrease the monitoring frequency for some of the constituents.

Modifying and revising parameter lists and sampling locations will be an ongoing process for the groundwater monitoring program, as more data are obtained and trends become apparent. Formal revisions to the IEMP will occur every two years. No parameter will be removed from a sampling list until the EPA and OEPA have concurred with the decision.

A.5.2 Ongoing Background Issues

Several of the naturally occurring constituents examined had occasional detections near or slightly above the corresponding FRL. For the majority of these constituents, the FRL was based on background concentrations developed through the Operable Unit 5 remedial investigation process. Generally, these occasional detections reaffirm the uncertainties and data limitations noted in both the Operable Unit 5 Remedial Investigation and Feasibility Study Reports concerning the precision with which natural background concentrations can be determined at the FEMP. These detections highlight the inherent difficulty in differentiating site-related impacts from natural background distributions for some constituents when concentration levels are in the vicinity of the FRL. These occasional detections that fluctuate above and below the background-based FRLs indicate a need to revisit the uncertainties and data limitations in the background values that were established in the Operable Unit 5 Remedial Investigation Report so proper termination decisions for the groundwater remedy can be made.

Some of the constituents that have this background problem are lead, nickel and zinc. It is important to note that the data set used to determine background of the Operable Unit 5 remedial investigation/feasibility study process had:

- Only one detectable concentration for both lead and nickel
- Higher background concentrations for lead and zinc from filtered samples than from unfiltered samples.

The reassessment of background concentrations for select constituents is identified as part of a formal Operable Unit 5 activity (Restoration Area Verification Sampling) in the Operable Unit 5 Remedial Design Work Plan (DOE 1996b). The results of this ongoing RD Work Plan activity will be incorporated into the future revisions of the IEMP parameter lists as appropriate.

A.5.3 Documenting that Aquifer Restoration Objectives have been Met and FRLs have been Obtained

Ultimately, the IEMP will be used to document the approach for determining when the various modules can be removed from service, once remedial action objectives for the Great Miami Aquifer (provided in the Operable Unit 5 Record of Decision) are achieved.

In future revisions to the IEMP (beyond this first two-year increment), the following decision-making criteria will need to be established:

- The amount and type of data needed to establish that an extraction or injection well can be turned off
- The number of confirmatory sampling events which will be required to document that FRLs have been achieved.

A.5.4 Addressing Sporadic and Isolated Detections Outside the Restoration Zone

During the groundwater parameter selection process, a review of the Operable Unit 5 remedial investigation/feasibility study data set, supplemented with groundwater data collected in 1994 and 1995, identified a number of constituents that occasionally and sporadically exceeded their established FRL outside of the restoration zone. These sporadic and isolated exceedances outside the restoration zone were acknowledged in the remedial investigation/feasibility study and targeted for future investigation. This investigation will be part of a formal Operable Unit 5 activity (Restoration Area

Verification Sampling) as identified in the Operable Unit 5 Remedial Design Work Plan (DOE 1996b). Groundwater monitoring program parameter lists and/or monitoring locations will be modified as necessary in later versions of the IEMP based on the outcome of this task.

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TABLE A-1

GROUNDWATER FRL EXCEEDANCES BASED ON SAMPLES AND LOCATIONS

Constituents	Groundwater FRL[a]	Units	Basis for FRL[b]	No. of Validated Samples[c]	No. of Validated Samples > FRL[c,d]	Zones with FRL Exceedances (No. of Wells with exceedances in each Zone)[c,d]	Range Above FRL[c,d]
Total Uranium	20	µg/L	A	1385	239	0(2) 1(19) 2(29) 3(4) 4(14)	20.6-/2070-
Lead	0.002	mg/L	B,D	1209	204	0(32) 1(29) 2(37) 3(15) 4(23)	.0021-/.295-
Zinc	0.021	mg/L	B	614	114	0(20) 1(24) 2(14) 3(14) 4(10)	.0223-/2.3J
Fluoride	0.89	mg/L	B	1177	93	0(18) 1(8) 2(9) 3(4) 4(1)	0.9/23J
Arsenic	0.05	mg/L	A	1324	56	0(12) 1(2) 2(4) 3(2) 4(8)	.0516J/.55-
Manganese	0.9	mg/l	B	1200	40	0(5) 1(7) 2(2) 3(7) 4(4)	.931-/139-
Nitrate[e]	11	mg/L	B	713	35	0(8) 1(10) 2(1) 4(2)	11.1J/158J
Thorium-228	4	pCi/L	R*	1186	35	0(9) 1(1) 2(10) 3(2) 4(5)	4.01-/14.2J
Antimony	0.006	mg/L	A	600	25	0(5) 1(6) 2(3) 3(3) 4(3)	.0245-/41.2J
Nickel	0.1	mg/L	A	1253	18	0(2) 1(5) 2(3) 3(2) 4(4)	.131J/3.93-
Technetium-99	94	pCi/L	R*	1186	18	0(1) 1(5)	100-/5510-
Cadmium	0.014	mg/L	B	1214	17	0(3) 1(5) 2(1) 3(6) 4(2)	.0154-/3-
Vanadium	0.038	mg/L	R	877	17	0(1) 1(5) 3(3) 4(5)	.0382-/.361J
Mercury	0.002	mg/L	A	1208	14	0(5) 1(4) 2(1) 3(1) 4(3)	.0023J/.0139J
Strontium-90	8	pCi/L	A	893	9	0(2) 1(1) 3(2) 4(1)	8.14J/38.5-
Thorium-232	1.2	pCi/L	R*	1265	9	0(4) 2(4) 4(1)	1.3-/2.73-
Carbon disulfide	0.00555	mg/L	A	579	6	1(4) 2(1) 3(1)	.008-/.026J
Trichloroethene	0.005	mg/L	A	610	6	0(1) 1(1) 2(1) 4(1)	.007-/.15-
Selenium	0.05	mg/L	A	1196	5	1(1) 2(2) 3(1) 4(1)	.0563J/.246-
Neptunium-237	1	pCi/L	R*	739	4	0(2) 2(1) 4(1)	1.46J/2.5J
Silver	0.05	mg/L	A	1236	4	0(1) 1(1) 4(2)	.0598-/.12-
Beryllium	0.004	mg/L	A	623	3	1(1) 3(1) 4(1)	.0116-/.178-
Cobalt	0.17	mg/L	R	626	3	1(1) 3(1) 4(1)	.305-/.528-
Molybdenum	0.1	mg/L	A	784	3	1(1) 3(1)	.2-/.618-
Barium	2	mg/L	A	1222	2	4(1)	3.11-/8.69-
Benzene	0.005	mg/L	A	622	1	0(1)	.16J
1,1-Dichloroethene	0.007	mg/L	A	581	1	4(1)	.11-
1,2-Dichloroethane	0.005	mg/L	A	581	1	4(1)	.31-
Radium-226	20	pCi/L	A	1204	1	4(1)	39.8-
1,1-Dichloroethane	0.28	mg/L	A	609	0	N/A	N/A
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.00001	mg/L	D	19	0	N/A[f]	N/A

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TABLE A-1
(Continued)

Constituents	Groundwater FRL[a]	Units	Basis for FRL[b]	No. of Validated Samples[c]	No. of Validated Samples > FRL[c,d]	Zones with FRL Exceedances (No. of Wells with exceedances in each Zone)[c,d]	Range Above FRL[c,d]
4-Methylphenol	0.028	mg/L	R	181	0	N/A	N/A
4-Nitrophenol	0.32	mg/L	R	180	0	N/A	N/A
Alpha-chlordane	0.002	mg/L	A	130	0	N/A	N/A
Aroclor-1254	0.0002	mg/L	D	130	0[g]	N/A	N/A
Bis(2-chloroisopropyl)ether	0.005	mg/L	D	117	0[g]	N/A	N/A
Bis(2-ethylhexyl)phthalate	0.006	mg/L	A	182	0[h]	N/A	N/A
Boron	0.33	mg/L	R	0	0	N/A[i]	N/A
Bromodichloromethane	0.1	mg/L	A	579	0	N/A	N/A
Bromomethane	0.0021	mg/L	R	579	0	N/A	N/A
Carbazole	0.011	mg/L	R	137	0	N/A	N/A
Chloroethane	0.001	mg/L	D	580	0[g]	N/A	N/A
Chloroform	0.1	mg/L	A	581	0	N/A	N/A
Chromium VI[j]	0.022	mg/L	R	5	0	N/A[k]	N/A
Copper	1.3	mg/L	A	1231	0	N/A	N/A
Methylene chloride	0.005	mg/L	A	609	0	N/A	N/A
Octachlorodibenzo-p-dioxin	0.0000001	mg/L	D	15	0[g]	N/A[f]	N/A
Radium-228	20	pCi/L	A	1218	0	N/A	N/A
Thorium-230	15	pCi/L	R*	1330	0	N/A	N/A
Vinyl Chloride	0.002	mg/L	A	581	0	N/A	N/A

[a]From OU5 Record of Decision Table 9-3
[b]From OU5 feasibility study Table 2-16:
A - ARAR based
B - Based on 95th percentile background concentrations.
D - Based on lowest achievable detection limit.
R - Risk based Preliminary Remediation Goal (PRG)
R*- Risk based Preliminary Remediation Level includes the radionuclide risk-based PRG plus its 95th percentile background concentration.
[c]Based on filtered and unfiltered samples from the OU5 remedial investigation/feasibility study data set and supplemented with 1994 and 1995 groundwater data.
[d]Validation qualifiers - or J were used:
- (dash) = result is confident as reported
J = result is quantitatively estimated
[e]Nitrate/nitrite will be analyzed in future modules/programs.
[f]Constituent not analyzed in samples from Zones 2 and 4
gAnalyses of constituent had method detection limit above FRL value
[h]This constituent showed FRL exceedances in three samples (.015- mg/L, Well 3043 in Zone 1; .013- mg/L, Well 3016 in Zone 2; .007J mg/L, Well 2037 in Zone 3). Confirmatory sampling indicated that each exceedance was due to laboratory contamination.
[i]Constituent not analyzed in samples from Zones 0, 1, 2, 3 and 4.
[j]Total chromium will be analyzed in future modules/programs.
[k]Constituent not analyzed in samples from Zones 0 and 3.

TABLE A-2

CATEGORIZATION OF GROUNDWATER FRL CONSTITUENTS BASED ON EXCEEDANCES, MOBILITY, AND PERSISTENCE

Constituents	Groundwater FRL[a]	Zones with Groundwater Concentrations > FRL[b]	Mobility/Persistence Characteristic[c]	Characterization by Zone[d]				
				Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
General Chemistry	**mg/L**							
Fluoride	.89	0,1,2,3,4	MP	>MP	>MP	>MP	>MP	>MP
Nitrate[e]	11	0,1,2,4	MP	>MP	>MP	>MP	<MP	>MP
Inorganics	**mg/L**							
Antimony	.0060	0,1,2,3,4	N	>N	>N	>N	>N	>N
Arsenic	.050	0,1,2,3,4	N	>N	>N	>N	>N	>N
Barium	2.0	4	N	<N	<N	<N	<N	>N
Beryllium	.0040	1,3,4	N	<N	>N	<N	>N	>N
Boron	.33	-[f]	MP	>MP[f]	>MP[f]	>MP[f]	>MP[f]	>MP[f]
Cadmium	.014	0,1,2,3,4	N	>N	>N	>N	>N	>N
Chromium VI[g]	.022	-[h]	MP	>MP[h]	<MP	<MP	>MP[h]	<MP
Cobalt	.17	1,3,4	N	<N	>N	<N	>N	>N
Copper	1.3	-	N	<N	<N	<N	<N	<N
Lead	.0020	0,1,2,3,4	N	>N	>N	>N	>N	>N
Manganese	.90	0,1,2,3,4	N	>N	>N	>N	>N	>N
Mercury	.0020	0,1,2,3,4	MP	>MP	>MP	>MP	>MP	>MP
Molybdenum	.10	1,3	N	<N	>N	<N	>N	<N
Nickel	.10	0,1,2,3,4	N	>N	>N	>N	>N	>N
Selenium	.050	1,2,3,4	N	<N	>N	>N	>N	>N
Silver	.050	0,1,4	N	>N	>N	<N	<N	>N
Vanadium	.038	0,1,3,4	N	>N	>N	<N	>N	>N
Zinc	.021	0,1,2,3,4	N	>N	>N	>N	>N	>N
Radionuclides	**pCi/L**							
Neptunium-237	1.0	0,2,4	MP	>MP	<MP	>MP	<MP	>MP
Radium-226	20	4	N	<N	<N	<N	<N	>N
Radium-228	20	-	N	<N	<N	<N	<N	<N
Strontium-90	8.0	0,1,3,4	MP	>MP	>MP	<MP	>MP	>MP
Technetium-99	94.0	0,1	MP	>MP	>MP	<MP	<MP	<MP
Thorium-228	4.0	0,1,2,3,4	N	>N	>N	>N	>N	>N
Thorium-230	15	-	N	<N	<N	<N	<N	<N
Thorium-232	1.2	0,2,4	N	>N	<N	>N	<N	>N
	µg/L							
Total Uranium	20	0,1,2,3,4	MP	>MP	>MP	>MP	>MP	>MP
Organics	**mg/L**							
Alpha-chlordane	.0020	-	MP	<MP	<MP	<MP	<MP	<MP
Aroclor-1254	.00020	-[i]	N	<N	<N	<N	<N	<N
Benzene	.0050	0	N	>N	<N	<N	<N	<N
[illegible]2-chloroisopropyl)ether	.0050	-[i]	N[j]	<N	<N	<N	<N	<N

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TABLE A-2
(Continued)

Constituents	Groundwater FRL[a]	Zones with Groundwater Concentrations > FRL[b]	Mobility/Persistence Characteristic[c]	Characterization by Zone[d]				
				Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
Bis(2-ethylhexyl)phthalate[k]	.0060	-	N	<N	<N	<N	<N	<N
Organics (Contd.)	**mg/L**							
Bromodichloromethane	.1	-	MP	<MP	<MP	<MP	<MP	<MP
Bromomethane	.0021	-	N	<N	<N	<N	<N	<N
Carbazole	.011	-	N[j]	<N	<N	<N	<N	<N
Carbon disulfide	.0055	1,2,3	N	<N	>N	>N	>N	<N
Chloroethane	.0010	-[i]	N[l]	<N	<N	<N	<N	<N
Chloroform	.10	-	N	<N	<N	<N	<N	<N
1,1-Dichloroethane	.28	-	N	<N	<N	<N	<N	<N
1,1-Dichloroethene	.0070	4	N	<N	<N	<N	<N	>N
1,2-Dichloroethane	.0050	4	MP	<MP	<MP	<MP	<MP	>MP
Methylene chloride	.0050	-	N	<N	<N	<N	<N	<N
4-Methylphenol	.029	-	N	<N	<N	<N	<N	<N
4-Nitrophenol	.32	-	N[l]	<N	<N	<N	<N	<N
Octachlorodibenzo-p-dioxin	.0000001	-[i,m]	N	<N	<N	<N[m]	<N	<N[m]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	.000010	-[m]	N[l]	<N	<N	<N[m]	<N	<N[m]
Trichloroethene	.0050	0,1,2,4	N	>N	>N	>N	<N	>N
Vinyl Chloride	.0020	-	MP	<MP	<MP	<MP	<MP	<MP

Shading indicates short list of indicator parameters.
[a]From Table 9-3 in OU5 Record of Decision.
[b]0,1,2,3,4 indicate the zone(s) where constituent was detected in the aquifer above the FRL. From OU5 remedial investigation/feasibility study data set and supplemented by 1994 and 1995 groundwater data.
- indicates that the constituent was not detected in the aquifer above the FRL.
[c]From OU5 Feasibility Study Report Table F.2-2. A constituent that failed modeling (model screening predicted that it has the ability to migrate to the aquifer) is considered mobile and persistent, and is listed as MP. A constituent that passed modeling (model screening indicated that it could not reach the aquifer) is considered not mobile and persistent, and is listed as N.
[d]>MP = Has been detected in the aquifer at concentrations greater than the FRL, and has the ability to migrate to the aquifer.
>N = Has been detected in the aquifer at concentrations greater than the FRL, and does not have the ability to migrate to the aquifer.
<MP = Has not been detected in the aquifer at concentrations greater than the FRL, and has the ability to migrate to the aquifer.
<N = Has not been detected in the aquifer at concentrations greater than the FRL, and does not have the ability to migrate to the aquifer.
[e]Nitrate/Nitrite will be analyzed in future modules/programs.
[f]Not analyzed in Zones 0, 1, 2, 3 or 4, but categorized as having a valid FRL exceedance in these zones since it has been predicted to have the ability to migrate to the aquifer and create an unacceptable risk.
[g]Total chromium will be analyzed in future modules/programs.
[h]Not analyzed in Zones 0 or 3, but categorized as having a valid FRL exceedance in these zones since it has been predicted to have the ability to migrate to the aquifer and create an unacceptable risk.
[i]Analyses of constituent had method detection limit above FRL, but categorized as not having a valid FRL exceedance since model predictions indicate that it does not have the ability to migrate to the aquifer and create an unacceptable risk.
[j]Failed modeling in F.2-2. Constituent was since remodeled with updated information and passed modeling. It was therefore assigned an N.
[k]This constituent showed FRL exceedances in three samples (.015- mg/L, Well 3043 in Zone 1; .013- mg/L, Well 3016 in Zone 2, .007J mg/L, Well 2037 in Zone 3). Confirmatory sampling indicated that each exceedance was due to laboratory contamination.
[l]Not in Table F.2-2. Constituent assigned an N based on literature review which shows high degradation rates for chloroethane and 4-nitrophenol and low water solubility for 2,3,7,8 tetrachlorodibenzo-p-dioxin.
[m]Not analyzed in Zones 2 or 4, but categorized as not having a valid FRL exceedance in these zones since it does not have the ability to migrate to the aquifer and create an unacceptable risk.

50 FRL Constituents based on OU5 ROD

50 FRL constituents are categorized using the criteria below.

Constituent is categorized as >, <, MP, or N if it has:

>
- At least one validated FRL exceedance in the aquifer
- Not been sampled in the aquifer but has been predicted to have the ability to migrate to the aquifer and cause an unacceptable risk
- Been analyzed using a method detection above the FRL value and predicted to have the ability to migrate to the aquifer and cause an unacceptable risk

<
- No validated FRL exceedance in the aquifer
- Not been sampled in the aquifer but has been predicted to not have the ability to migrate to aquifer and cause an unacceptable risk
- Been analyzed using a method detection unit above FRL value and predicted to not have the ability to migrate to the aquifer and cause an unacceptable risk
- Been identified as a common laboratory contaminant with unconfirmed FRL exceedance

MP
- Been predicted to be able to migrate to the aquifer and cause an unacceptable risk; constituent is considered to be "mobile and persistent"

N
- Been predicted to be unable to migrate to the aquifer and cause an unacceptable risk; constituent is not considered to be "mobile and persistent"

Zone	> MP	> N	< MP	< N	Total
0	9	13	4	24	50
1	7	16	6	21	50
2	6	12	7	25	50
3	6	14	7	23	50
4	8	18	5	19	50

(> MP) represents a 'short list' of 10 indicator parameters that will be monitored more frequently because they have FRL exceedances and are mobile and persistent.

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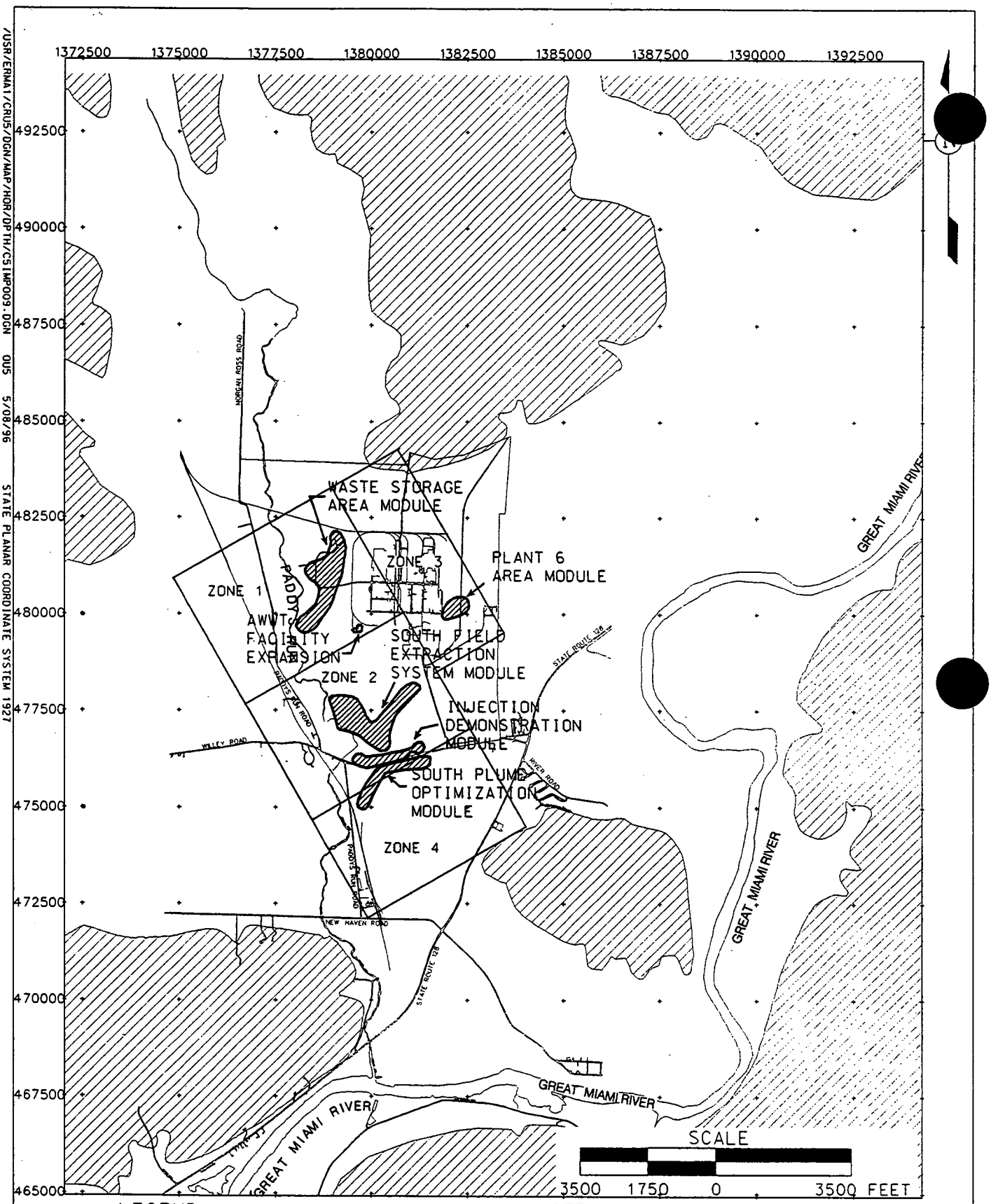
FIGURE A-1. PARAMETER SELECTION PROCESS USED FOR FRL CONSTITUENTS



LEGEND:

— · — · — FEMP BOUNDARY

NOTE:
SHADED AREAS REPRESENT GEOGRAPHIC LOCATIONS WITHIN WHICH EXTRACTION AND/OR INJECTION WELLS ARE PLANN
ZONE 0 CONSISTS OF ALL AREAS OUTSIDE ZONES 1, 2, 3, AND 4.

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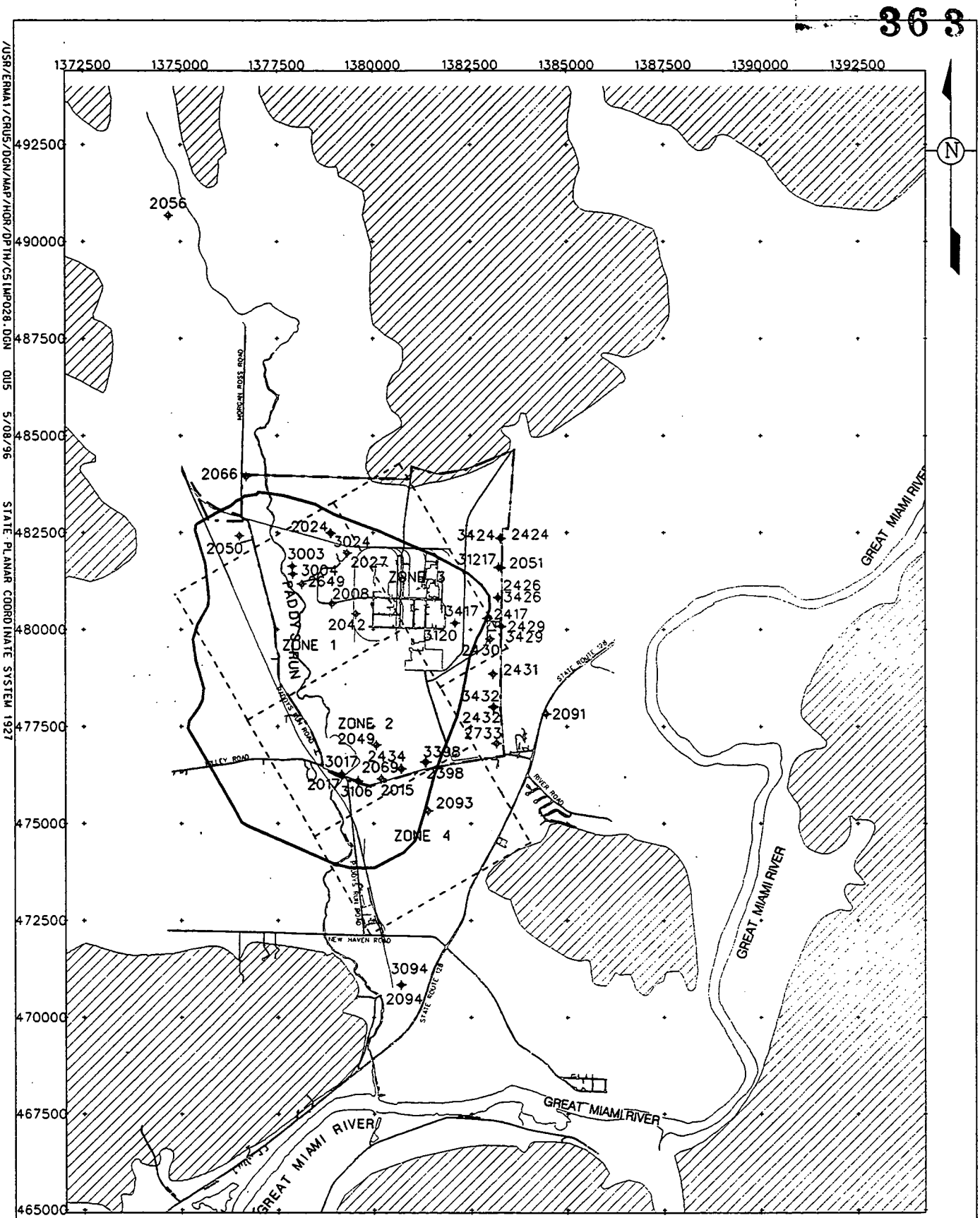
FIGURE A-2. GROUNDWATER MONITORING ZONES



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

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NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

FIGURE A-3. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR FLUORIDE

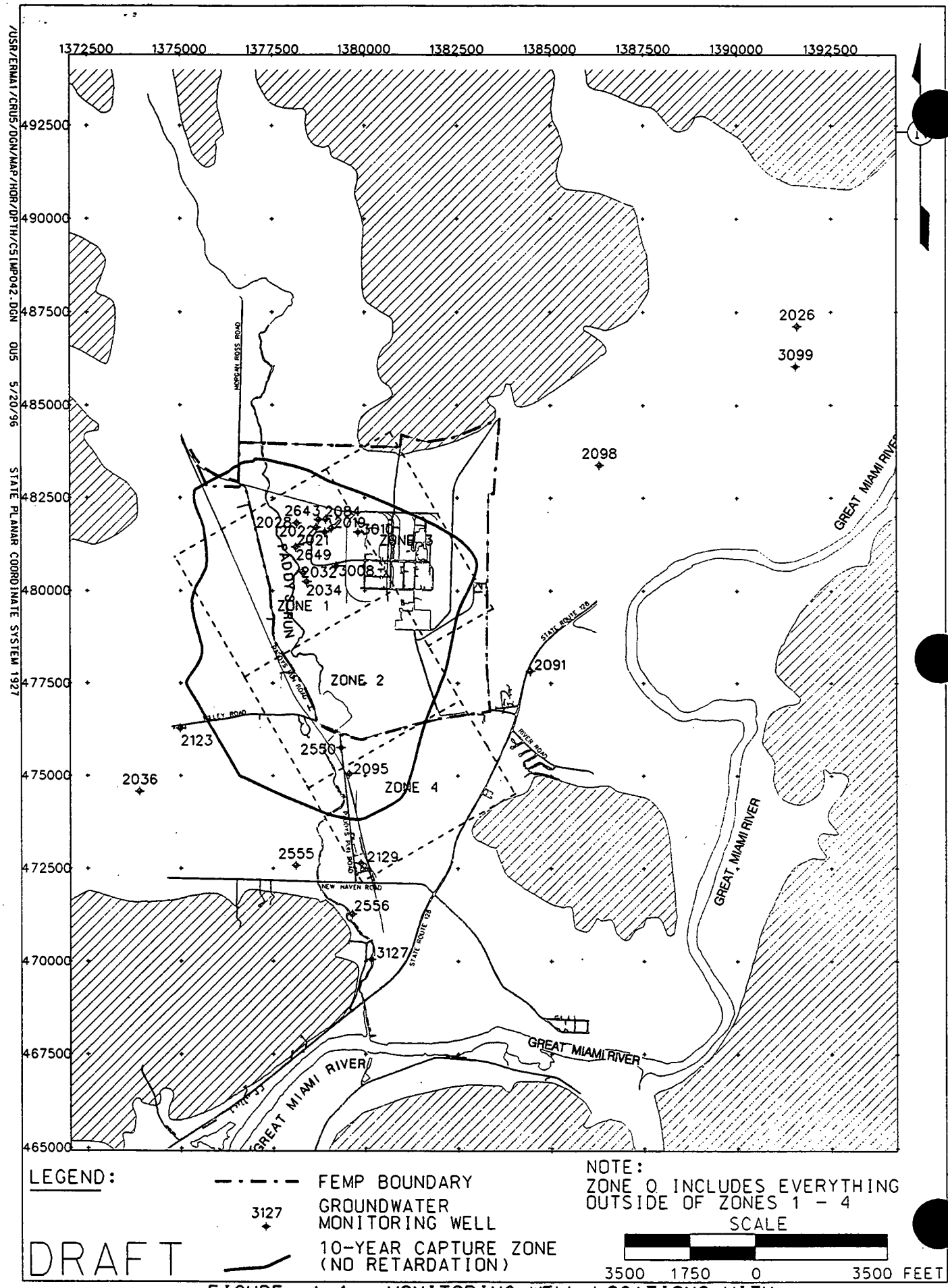


FIGURE A-4. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR NITRATE

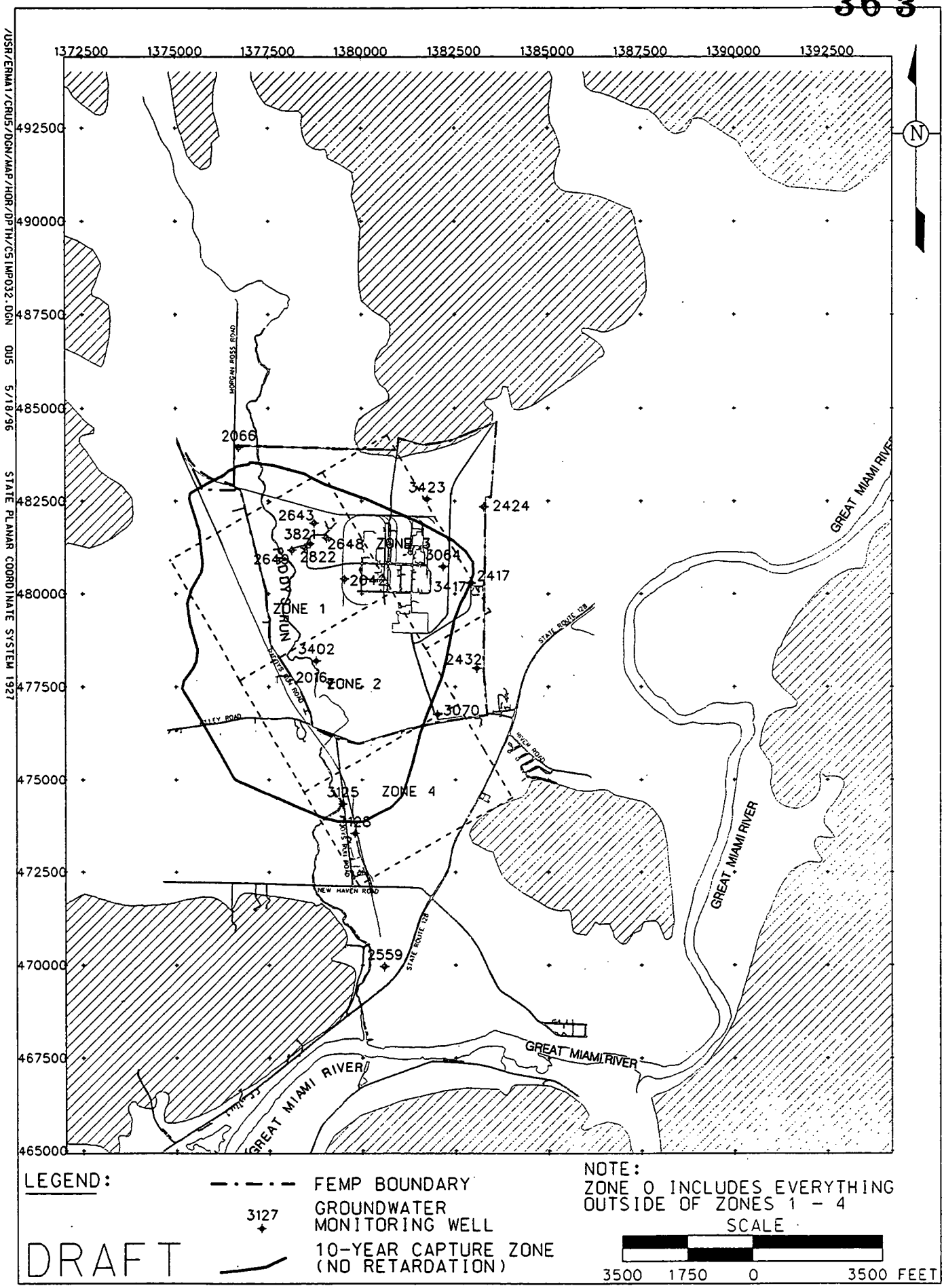
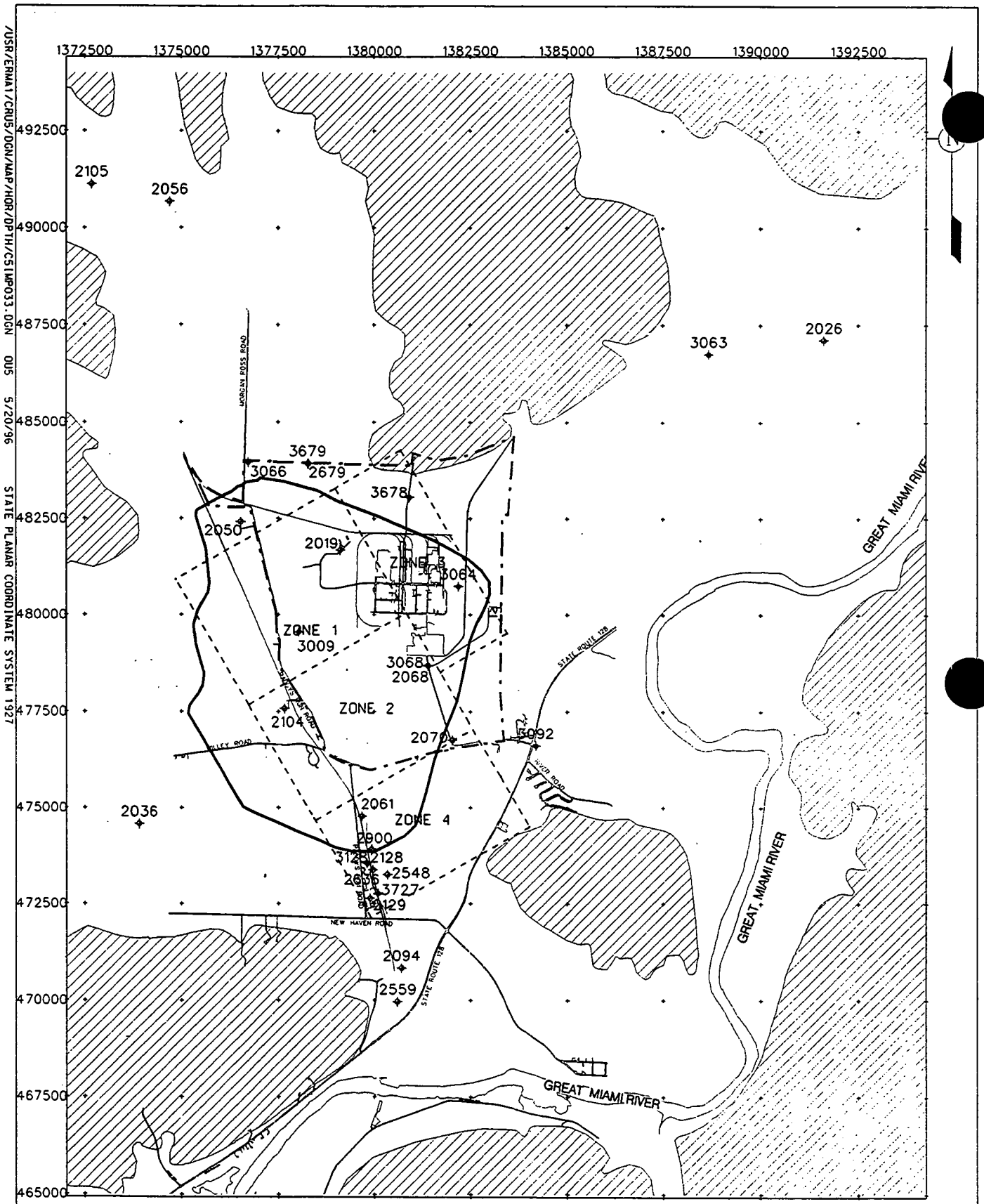


FIGURE A-5. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR ANTIMONY



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

DRAFT

NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

FIGURE A-6. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR ARSENIC

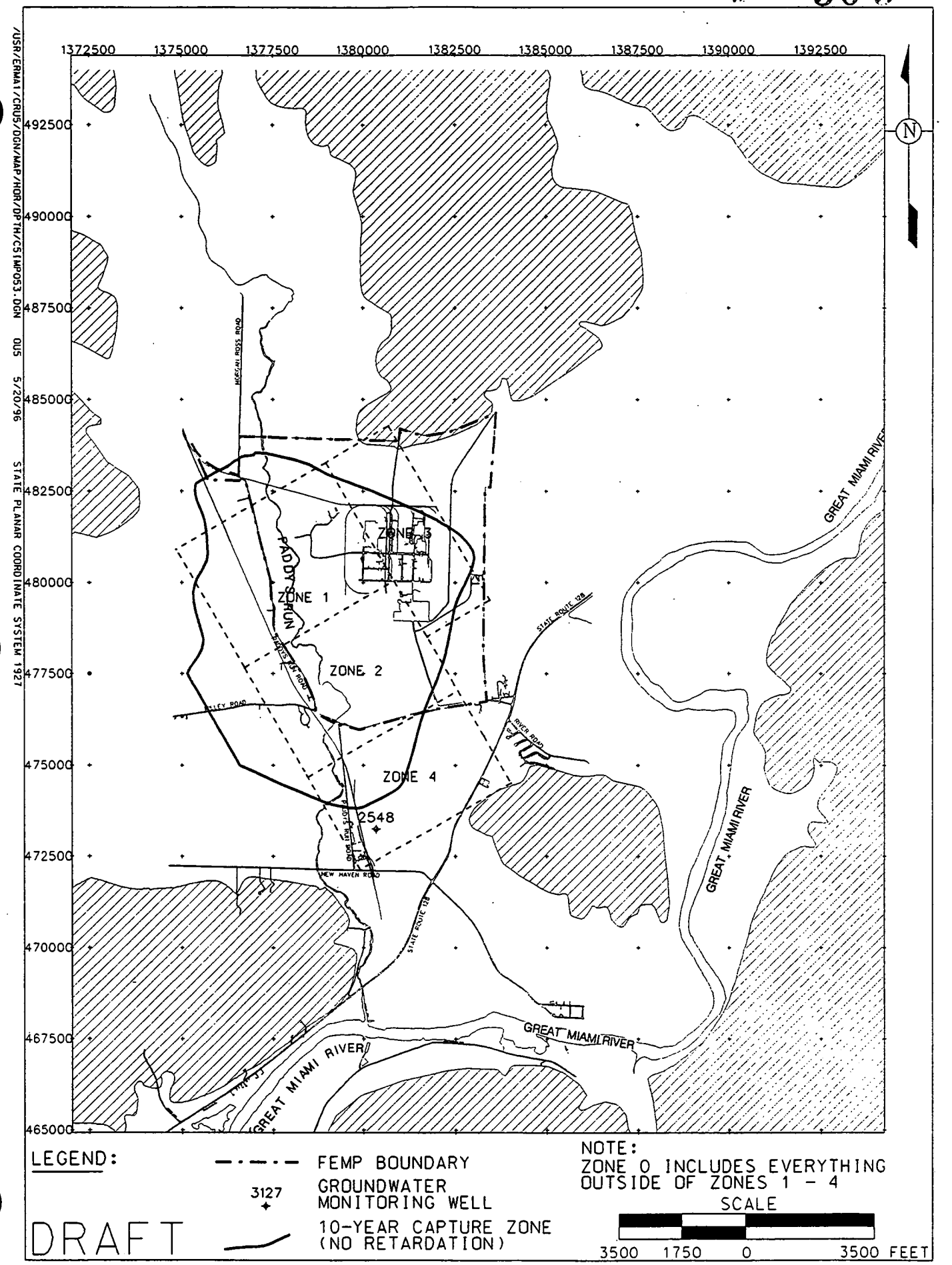


FIGURE A-7. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR BARIUM

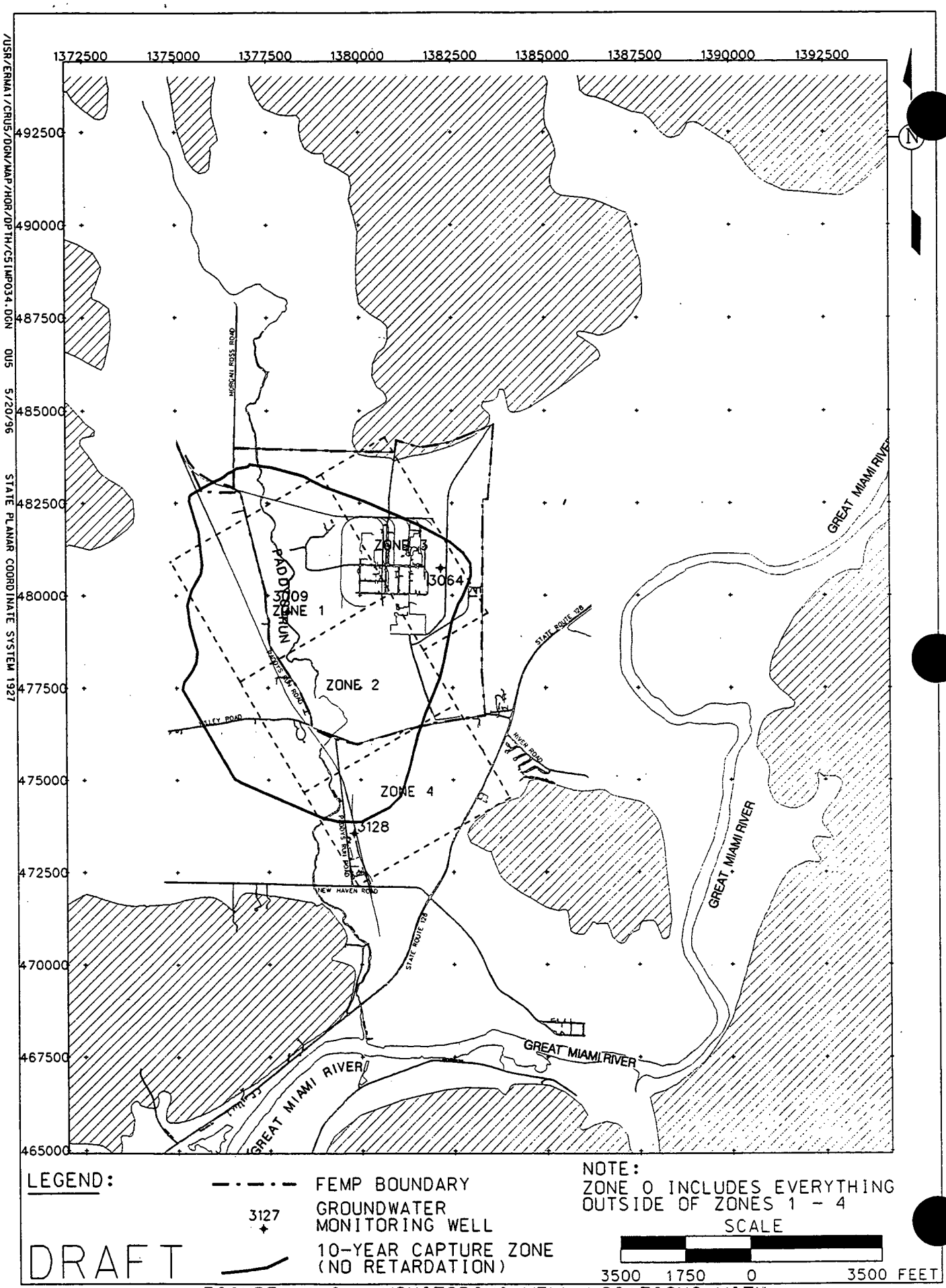
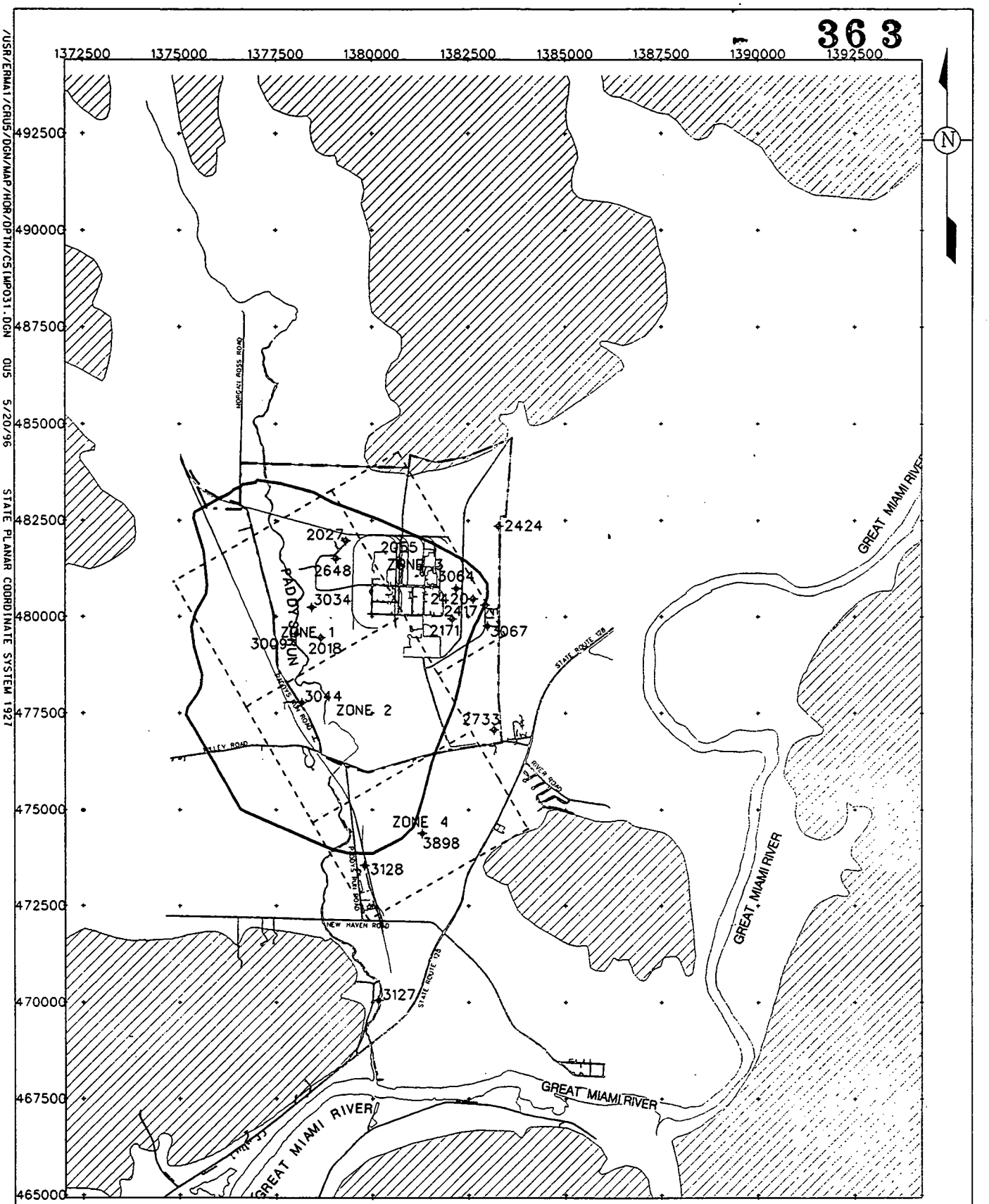


FIGURE A-8. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR BERYLLIUM

/USR/ERMA1/CRU5/DGN/MAP/HOR/OPTH/C51MP031.DGN OU5 5/20/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

DRAFT

FIGURE A-9. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR CADMIUM

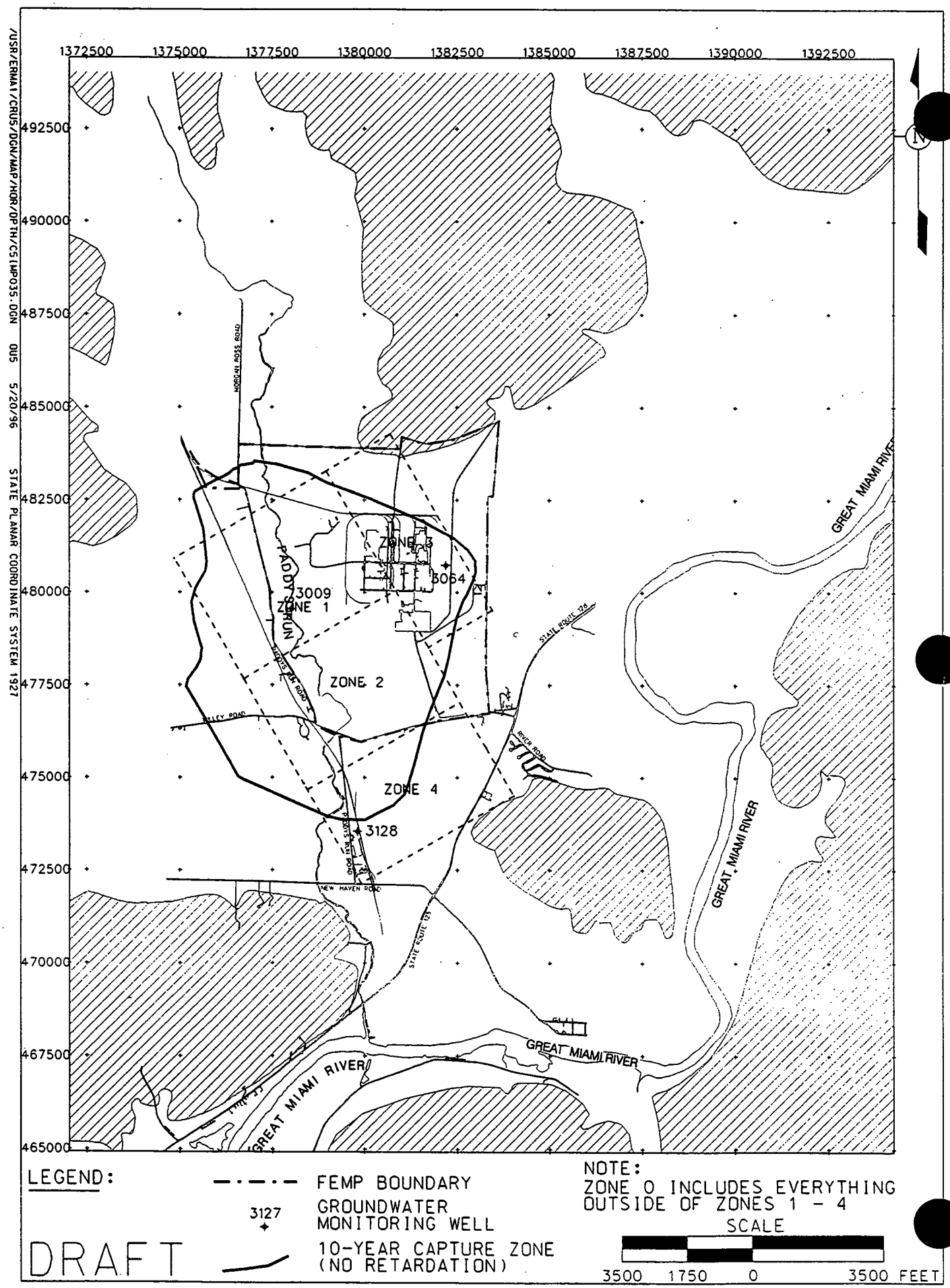
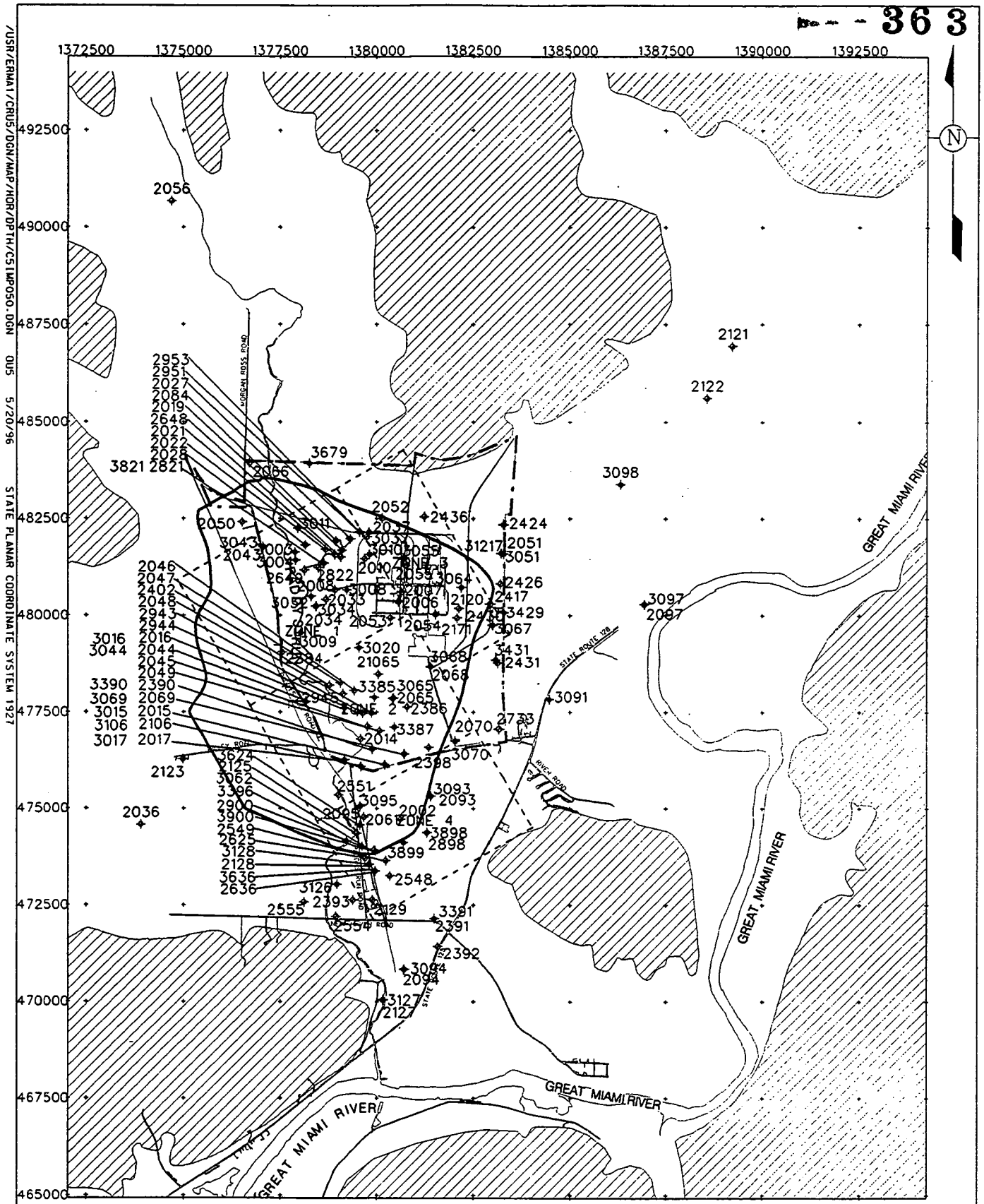


FIGURE A-10. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR COBALT



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

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FIGURE A-11. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR LEAD

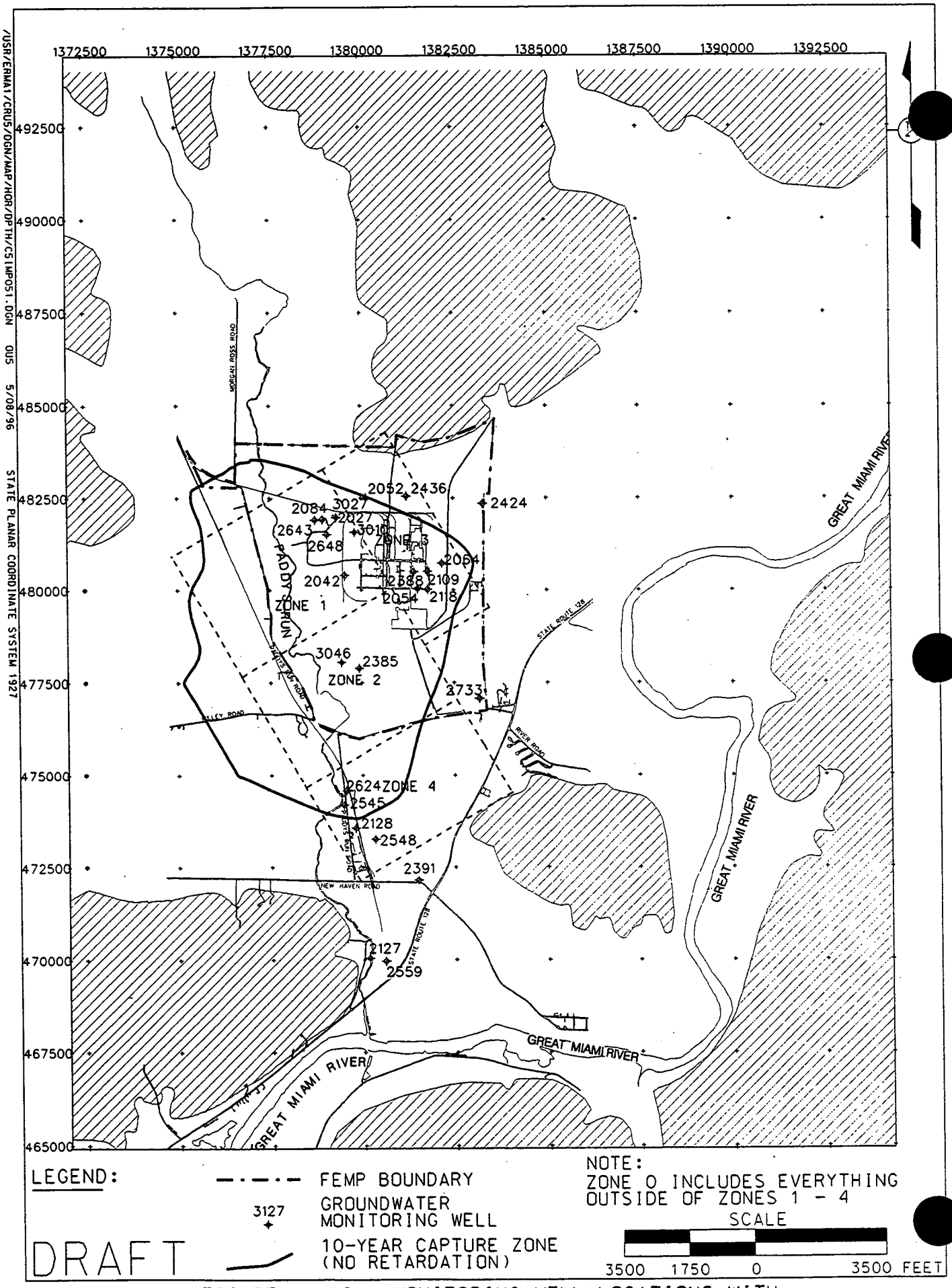


FIGURE A-12. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR MANGANESE

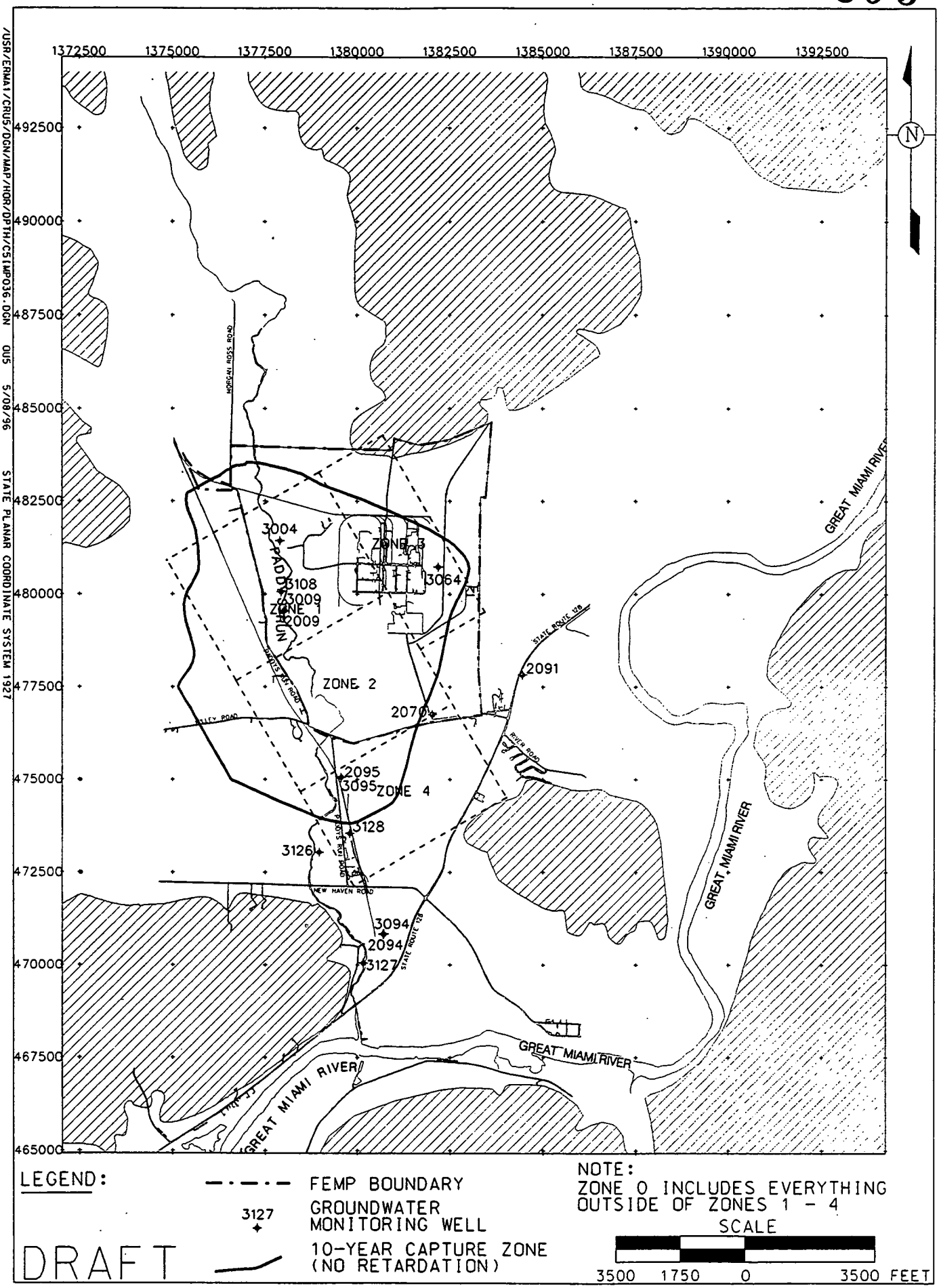


FIGURE A-13. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR MERCURY

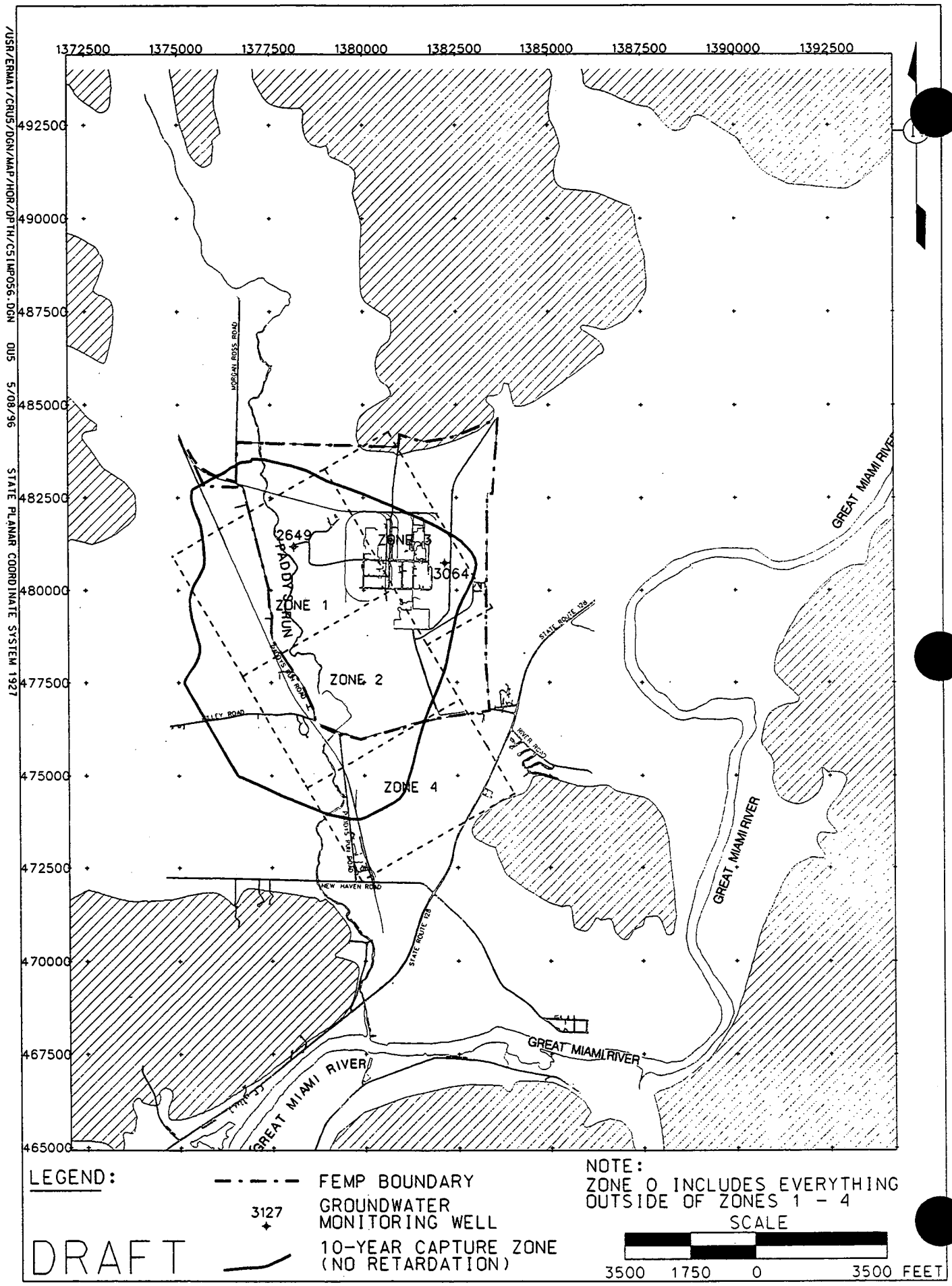


FIGURE A-14. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR MOLYBDENUM

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C51MP052.DGN OU5 5/08/96 STATE PLANAR COORDINATE SYSTEM 1927

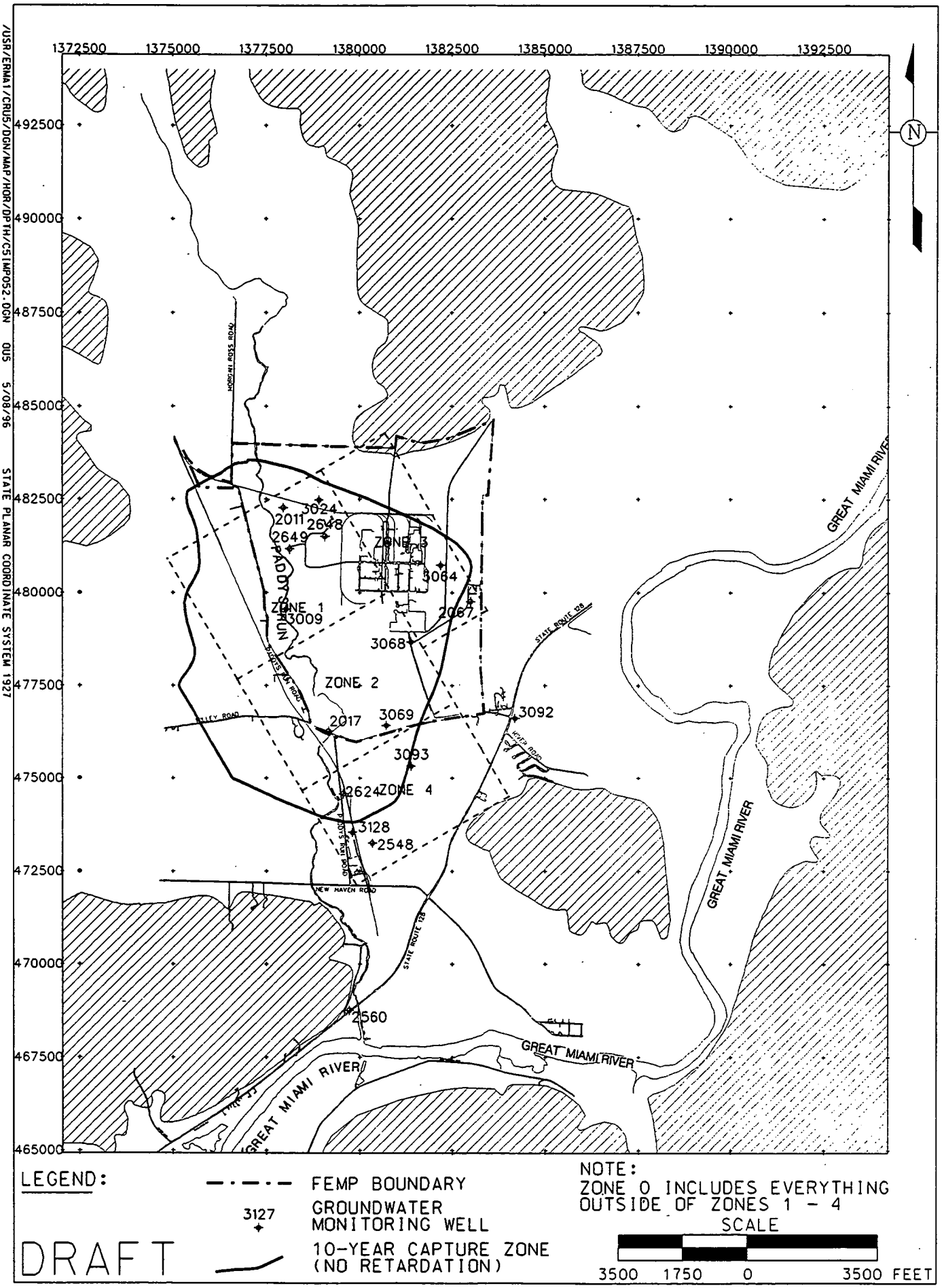


FIGURE A-15. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR NICKEL

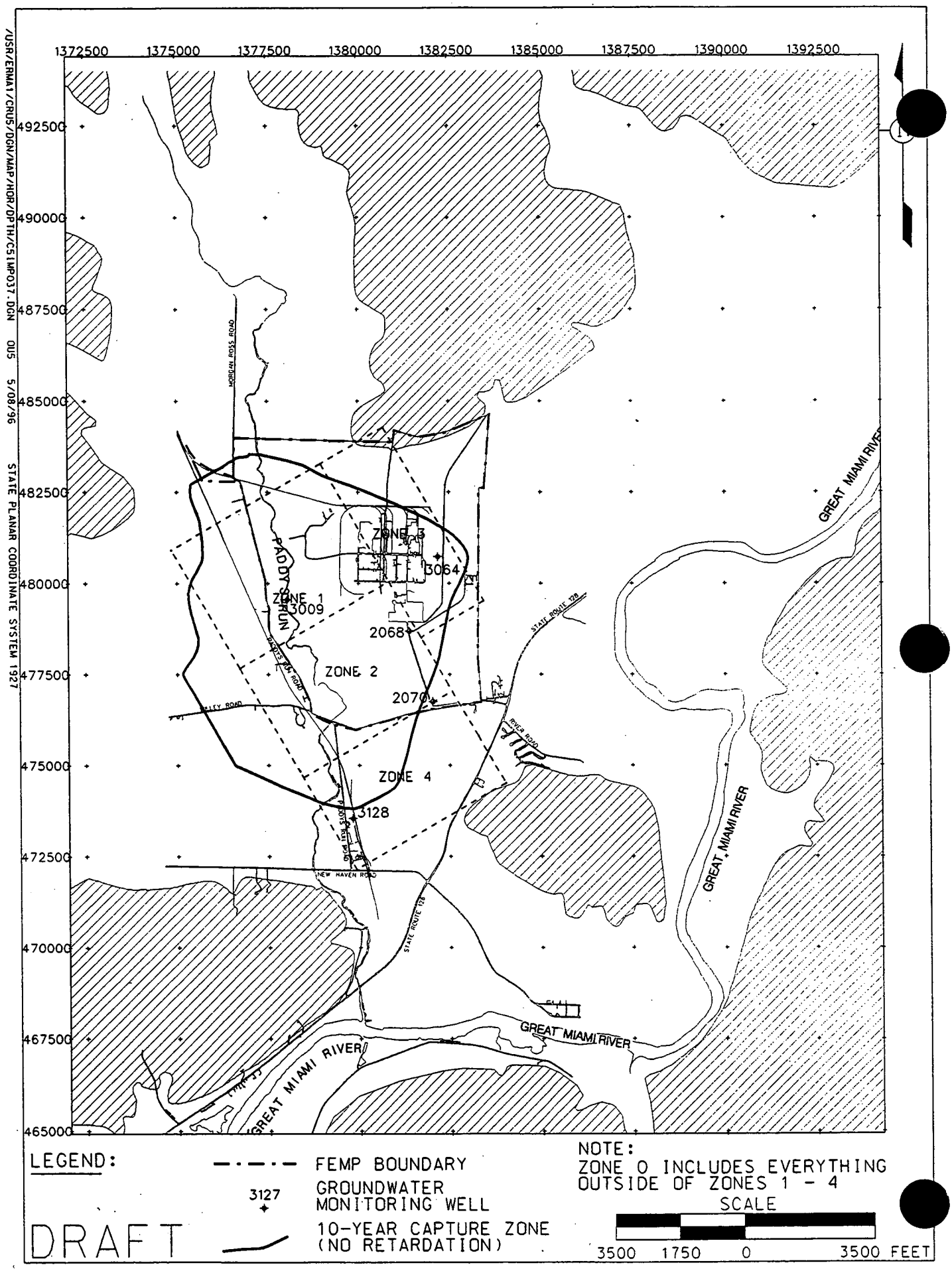


FIGURE A-16. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR SELENIUM

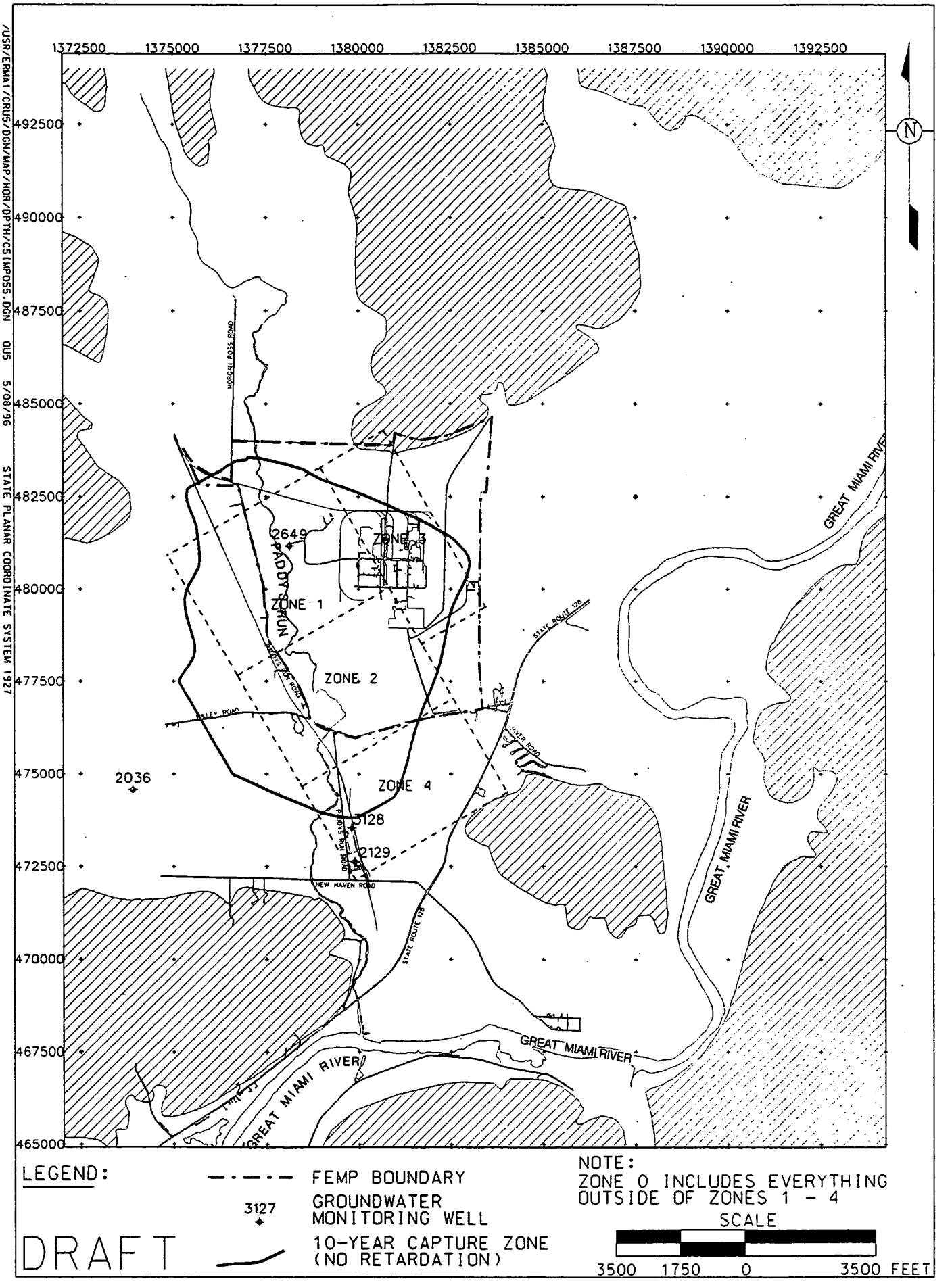


FIGURE A-17. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR SILVER

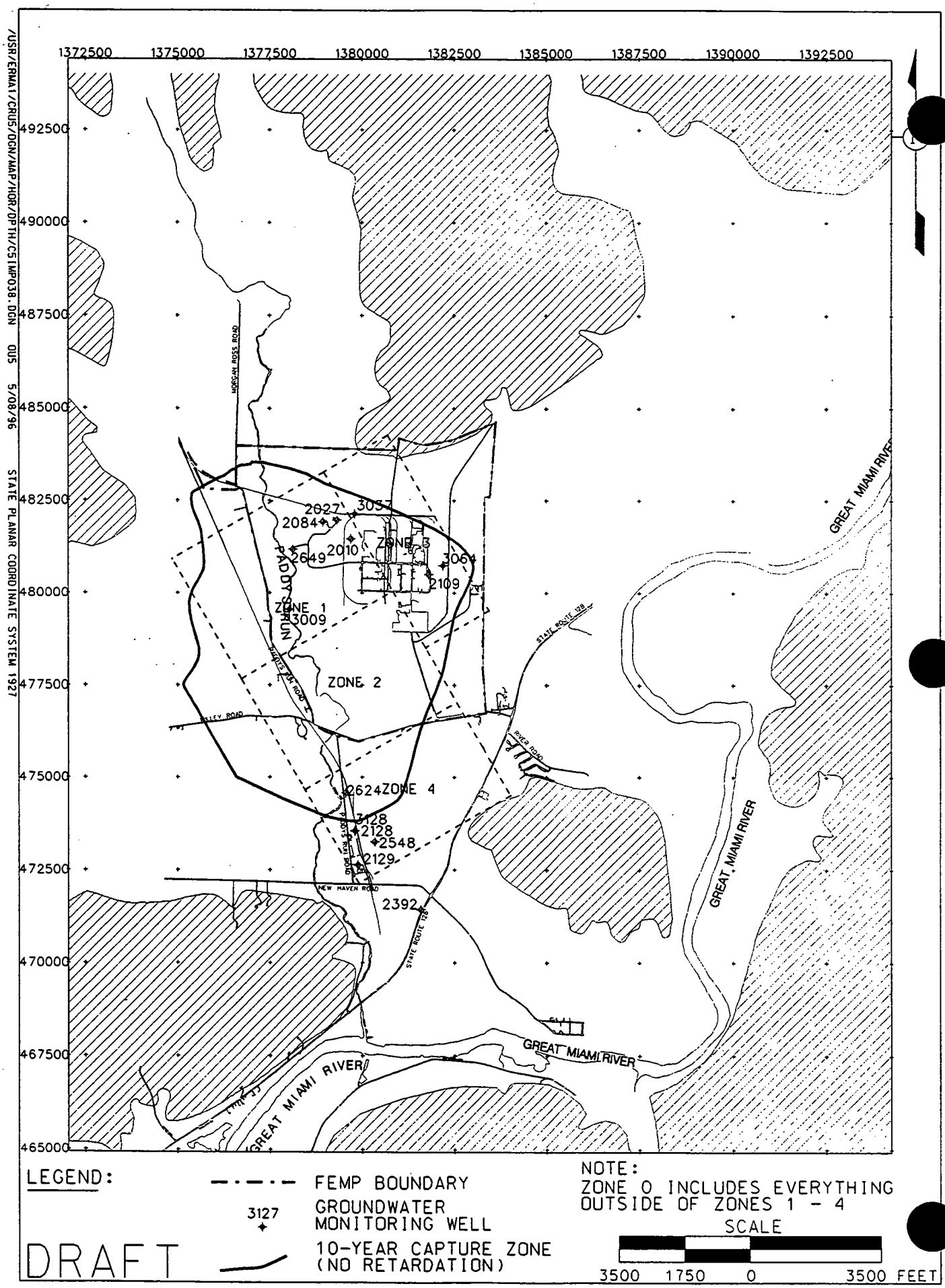
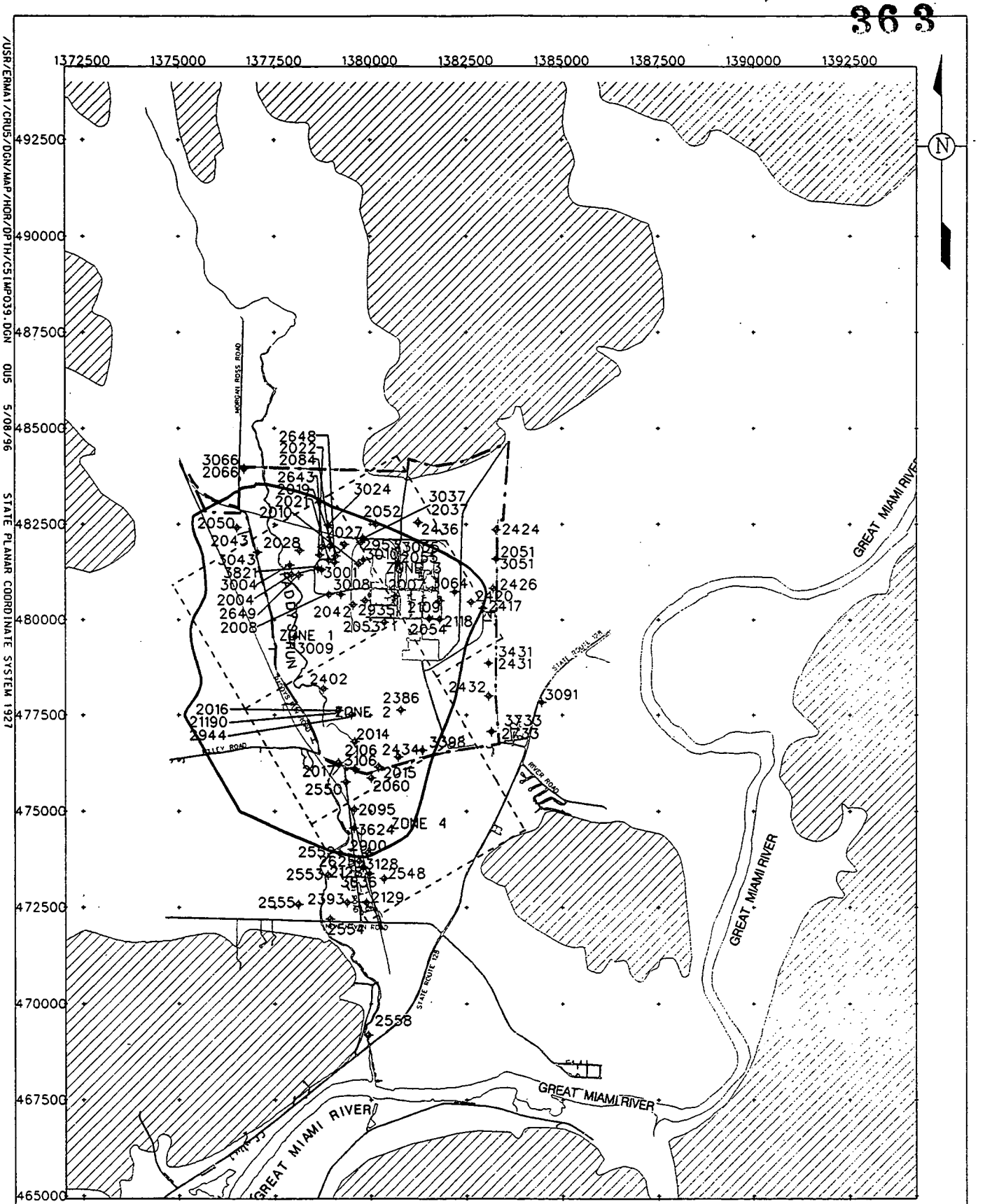


FIGURE A-18. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR VANADIUM

/USR/ERMA1/CRUS/DGN/MAP/HOR/DPTH/C51MP039.DGN OU5 5/08/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

DRAFT

NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

FIGURE A-19. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR ZINC

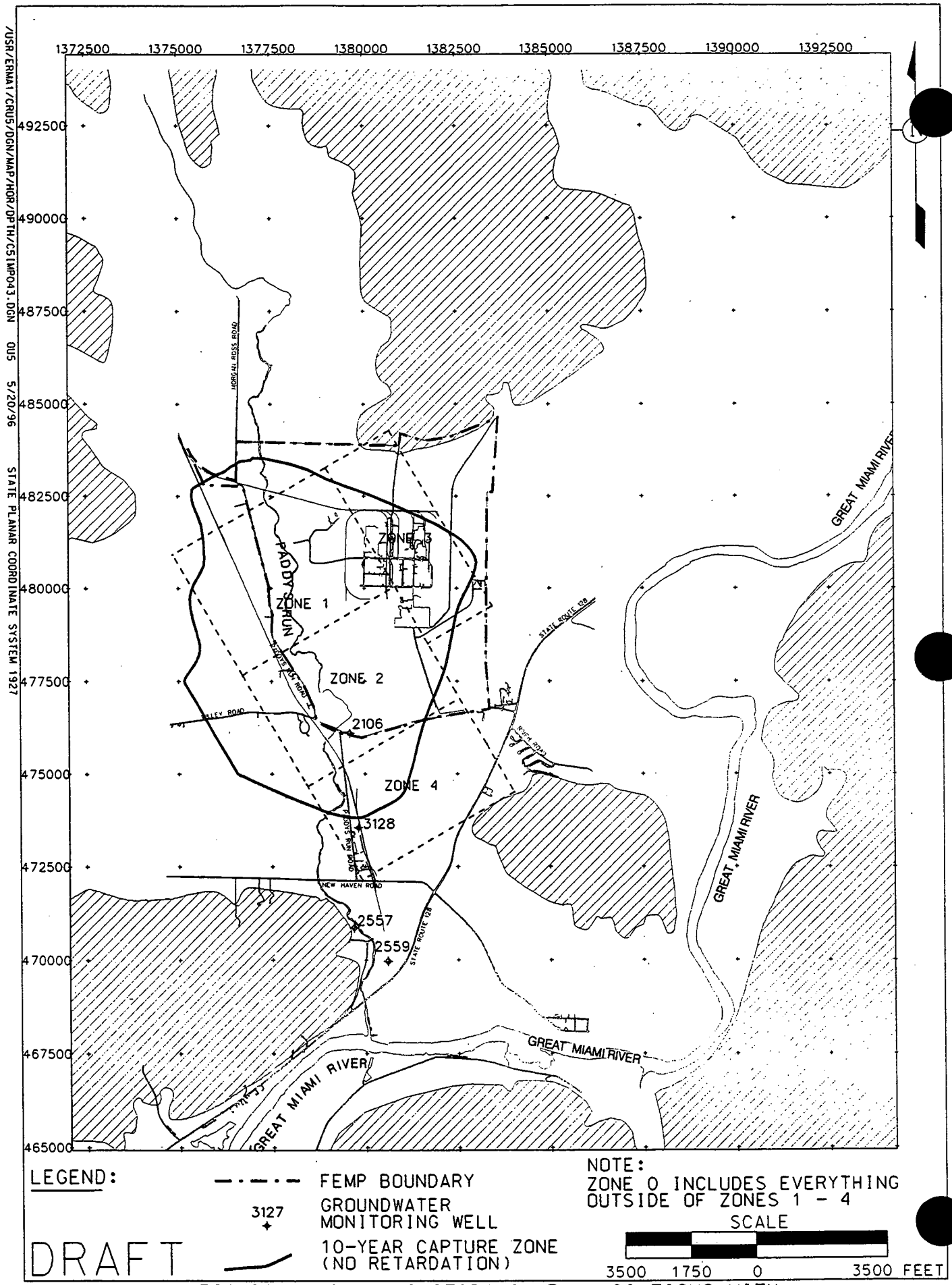


FIGURE A-20. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR NEPTUNIUM-237

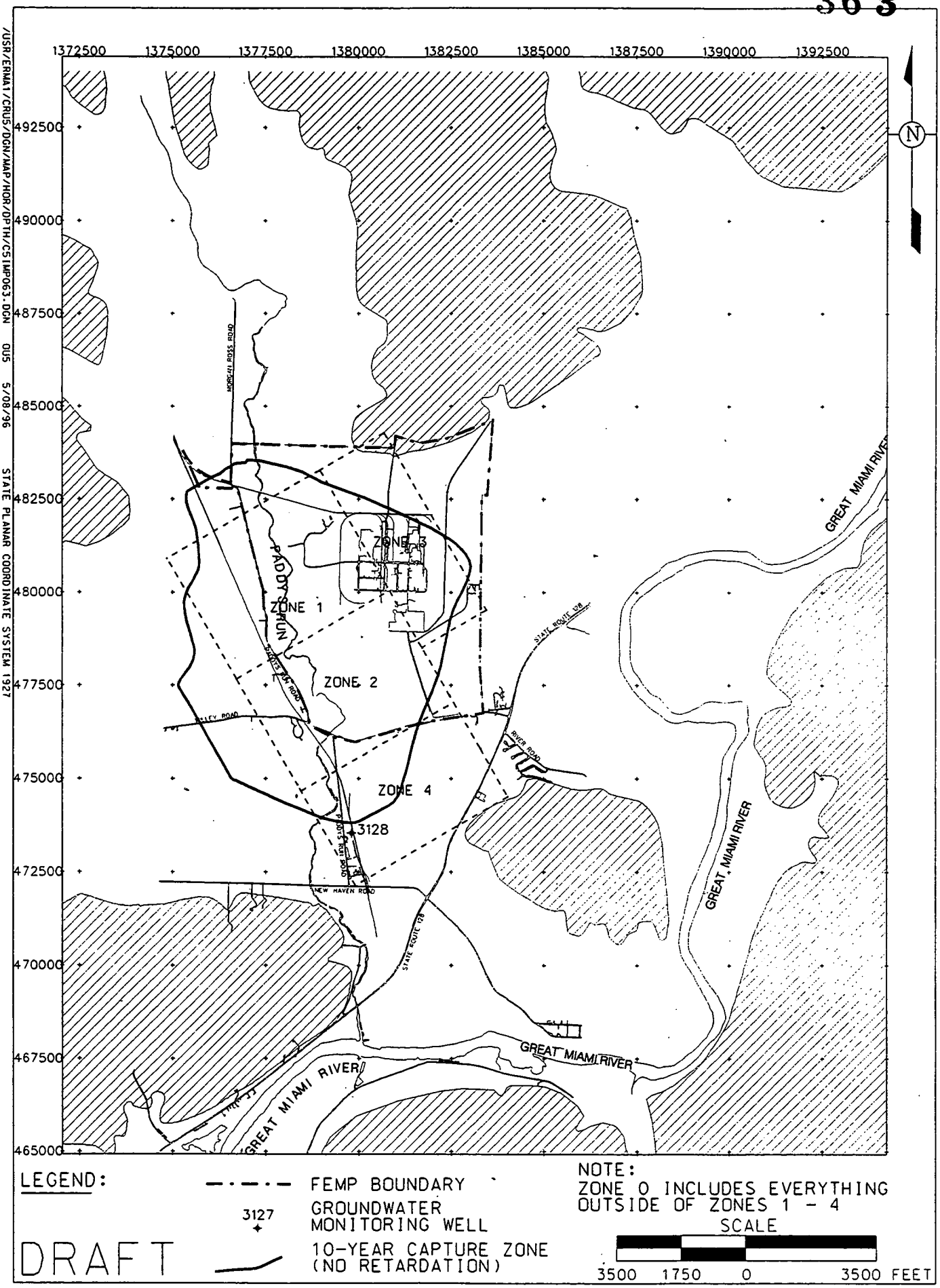


FIGURE A-21. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR RADIUM-226

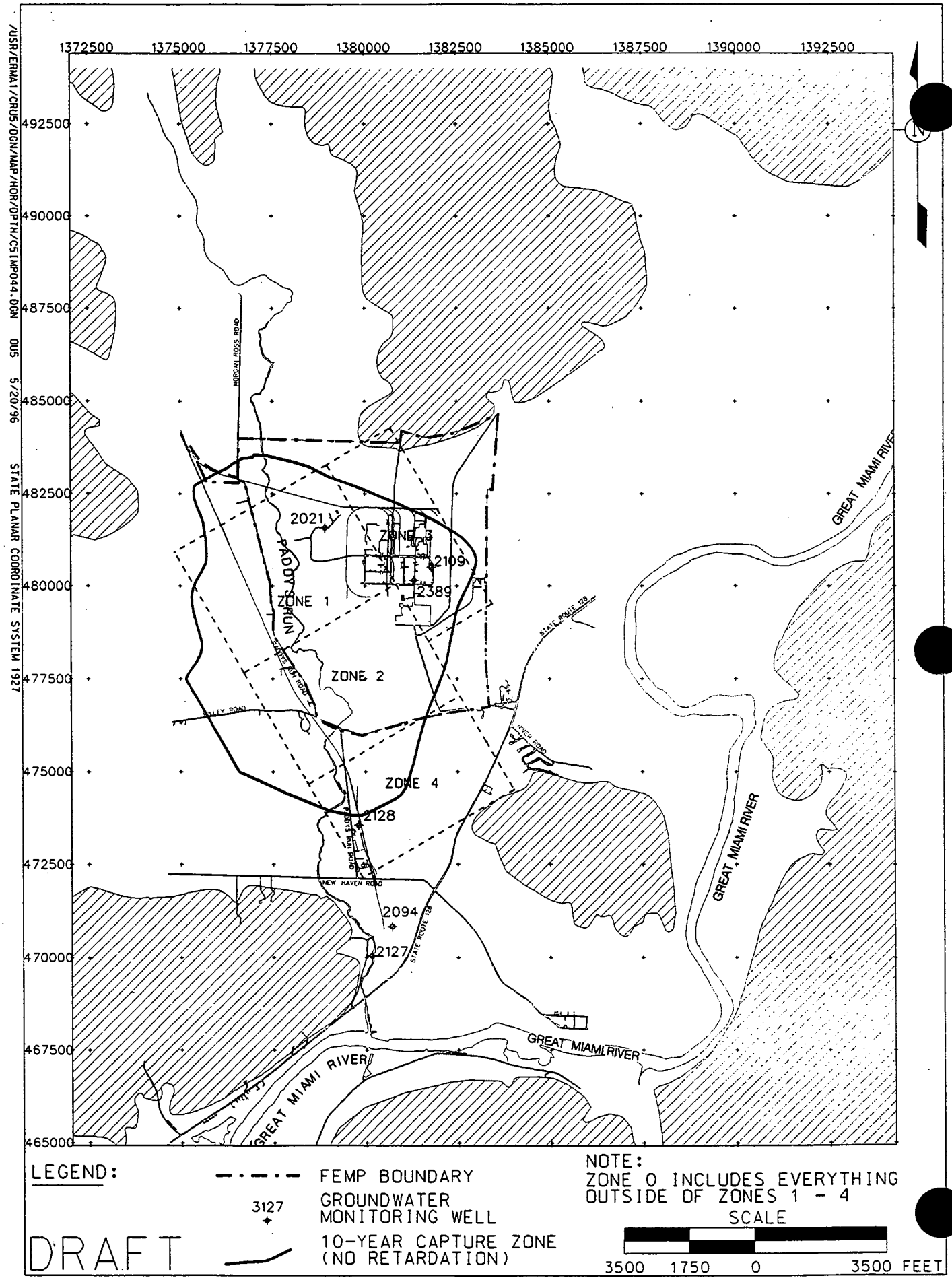


FIGURE A-22. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR STRONTIUM-90

000285

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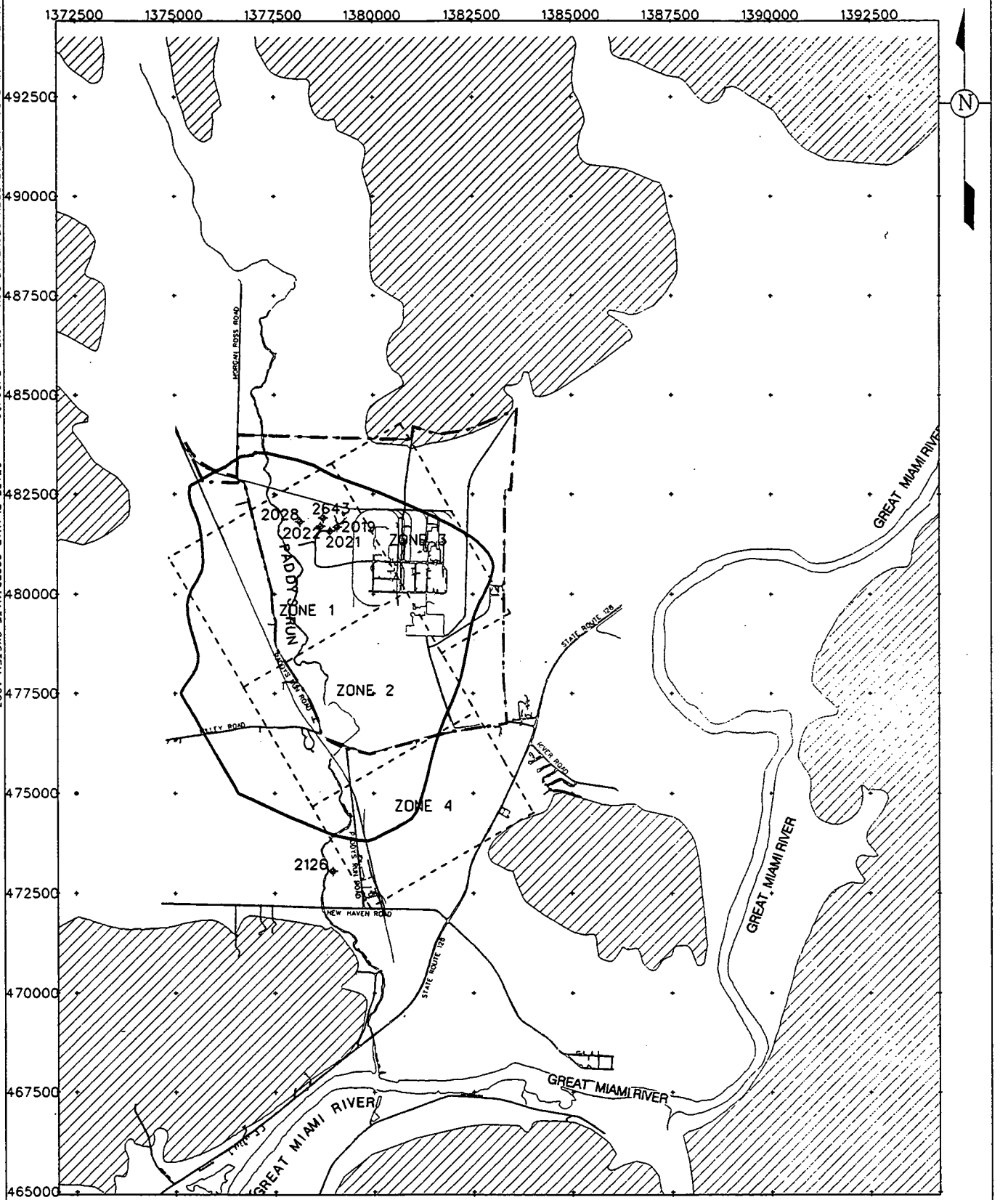


LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

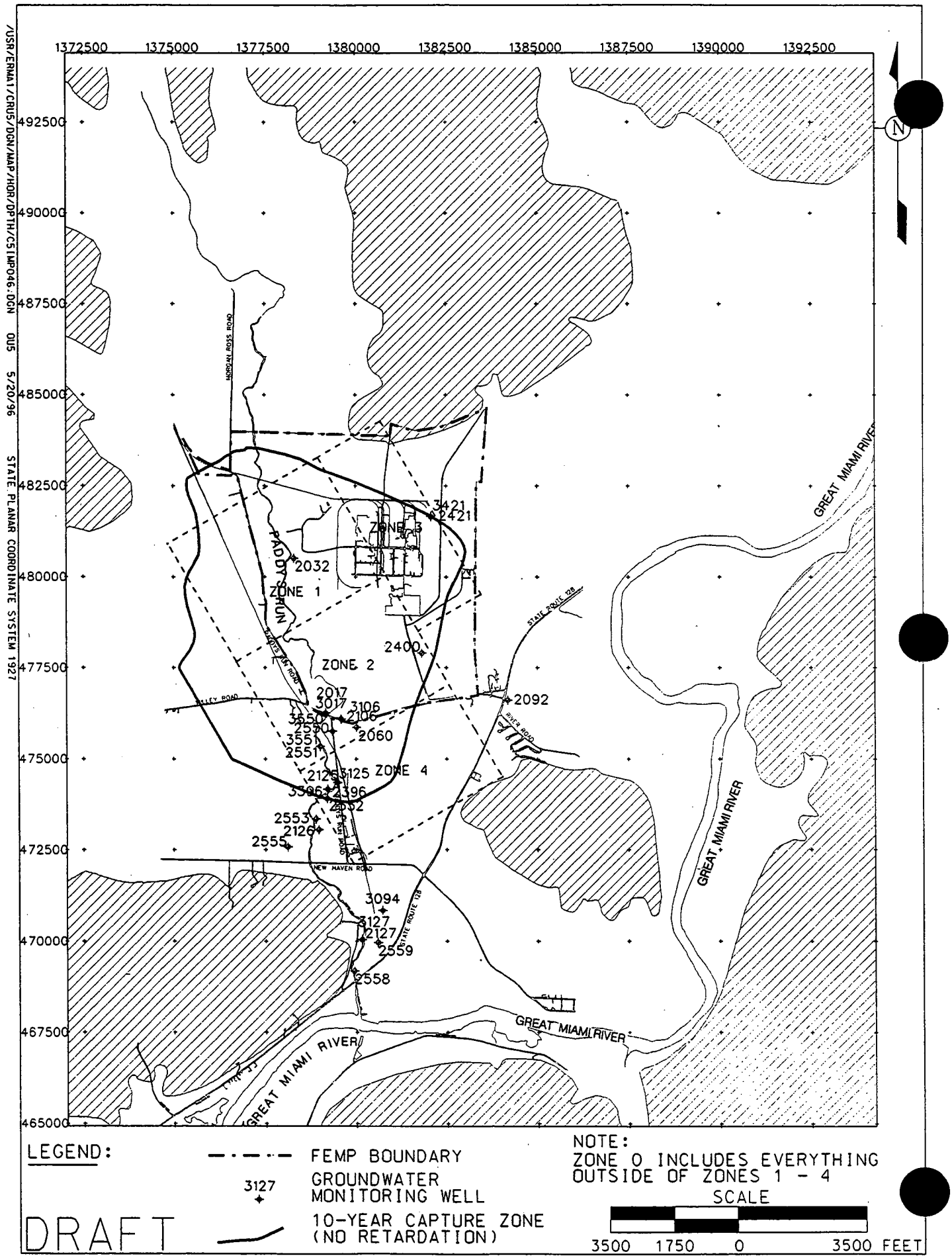
NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

DRAFT

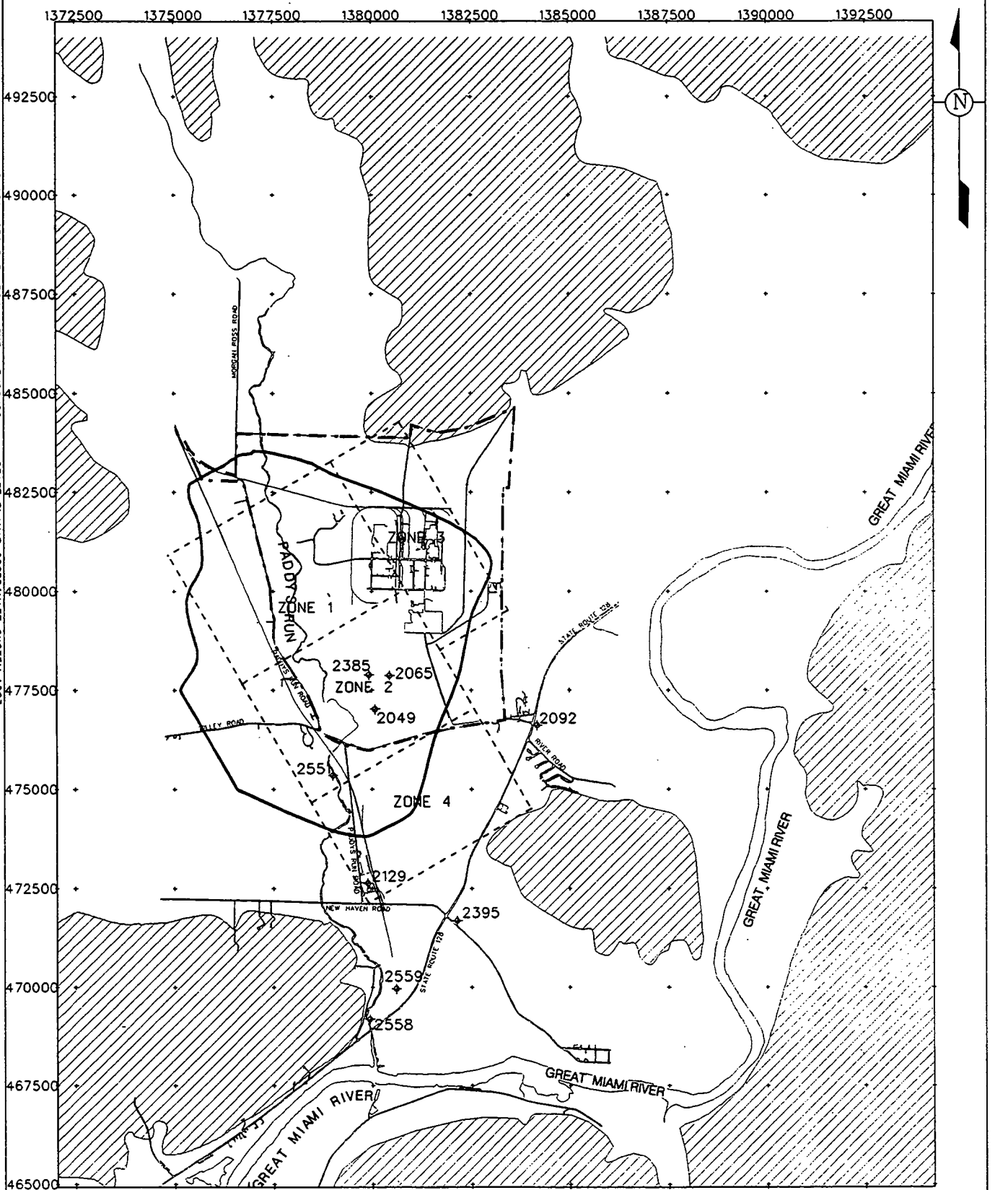
FIGURE A-23. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR TECHNETIUM-99



000287

FIGURE A-24. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR THORIUM-228

/USR/FERMAT/CRU5/DGN/MAP/HOR/OPTH/C51MP054.DGN OU5 5/20/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

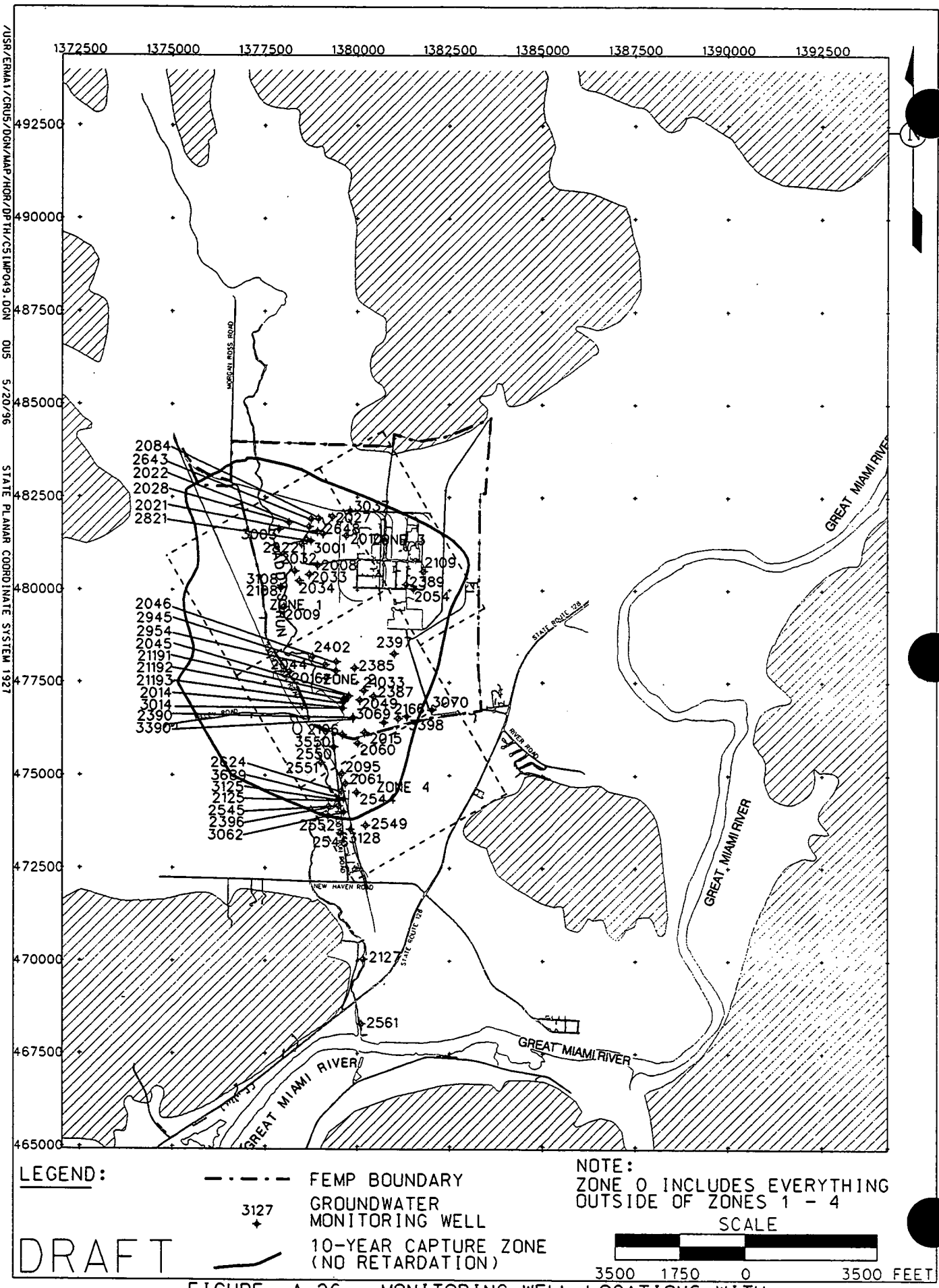
NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

DRAFT

FIGURE A-25. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR THORIUM-232



LEGEND:

FEMP BOUNDARY

3127 GROUNDWATER MONITORING WELL

10-YEAR CAPTURE ZONE (NO RETARDATION)

NOTE:
ZONE 0 INCLUDES EVERYTHING OUTSIDE OF ZONES 1 - 4

SCALE

3500 1750 0 3500 FEET

DRAFT

FIGURE A-26. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR TOTAL URANIUM

000289

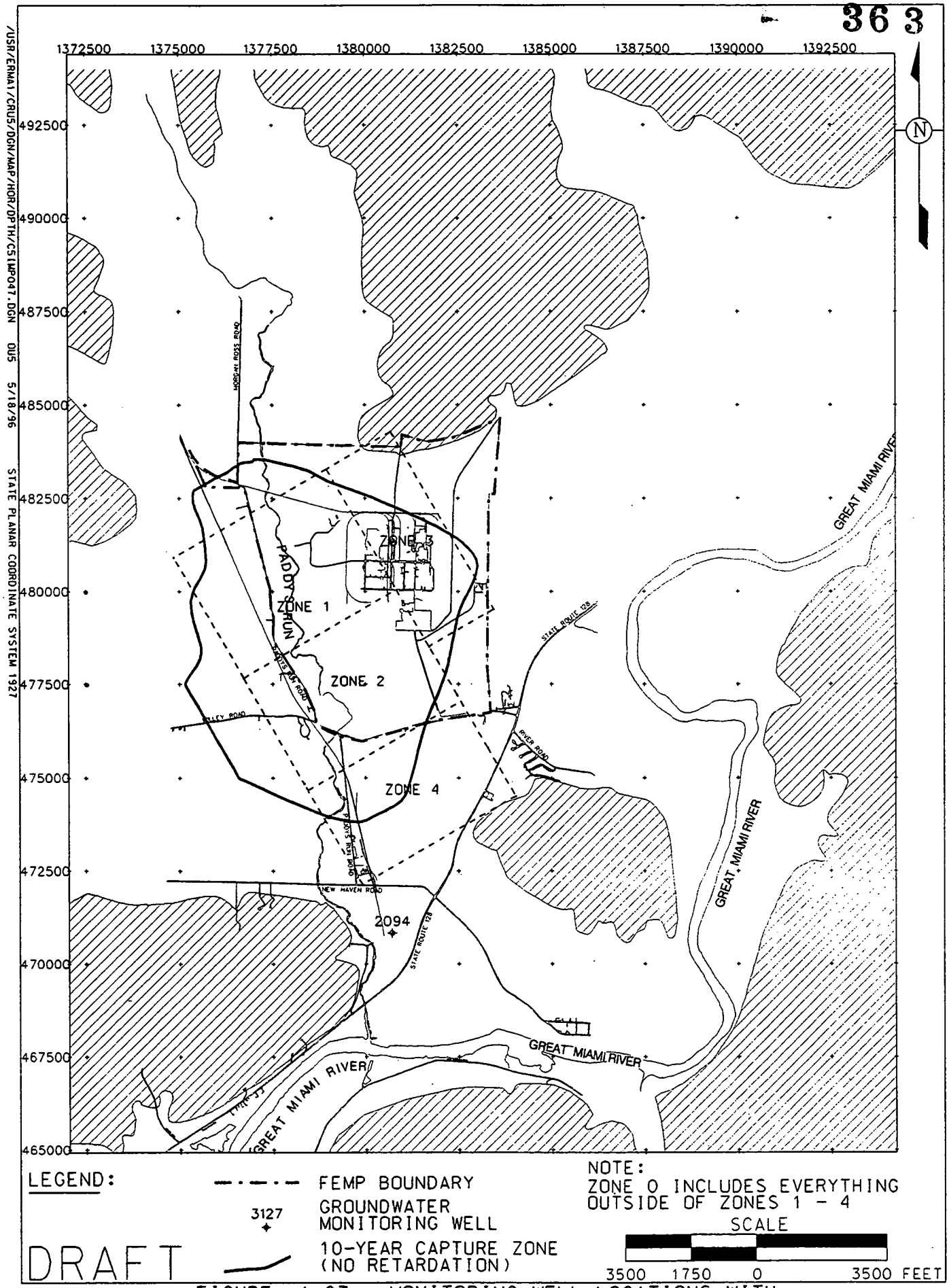


FIGURE A-27. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR BENZENE

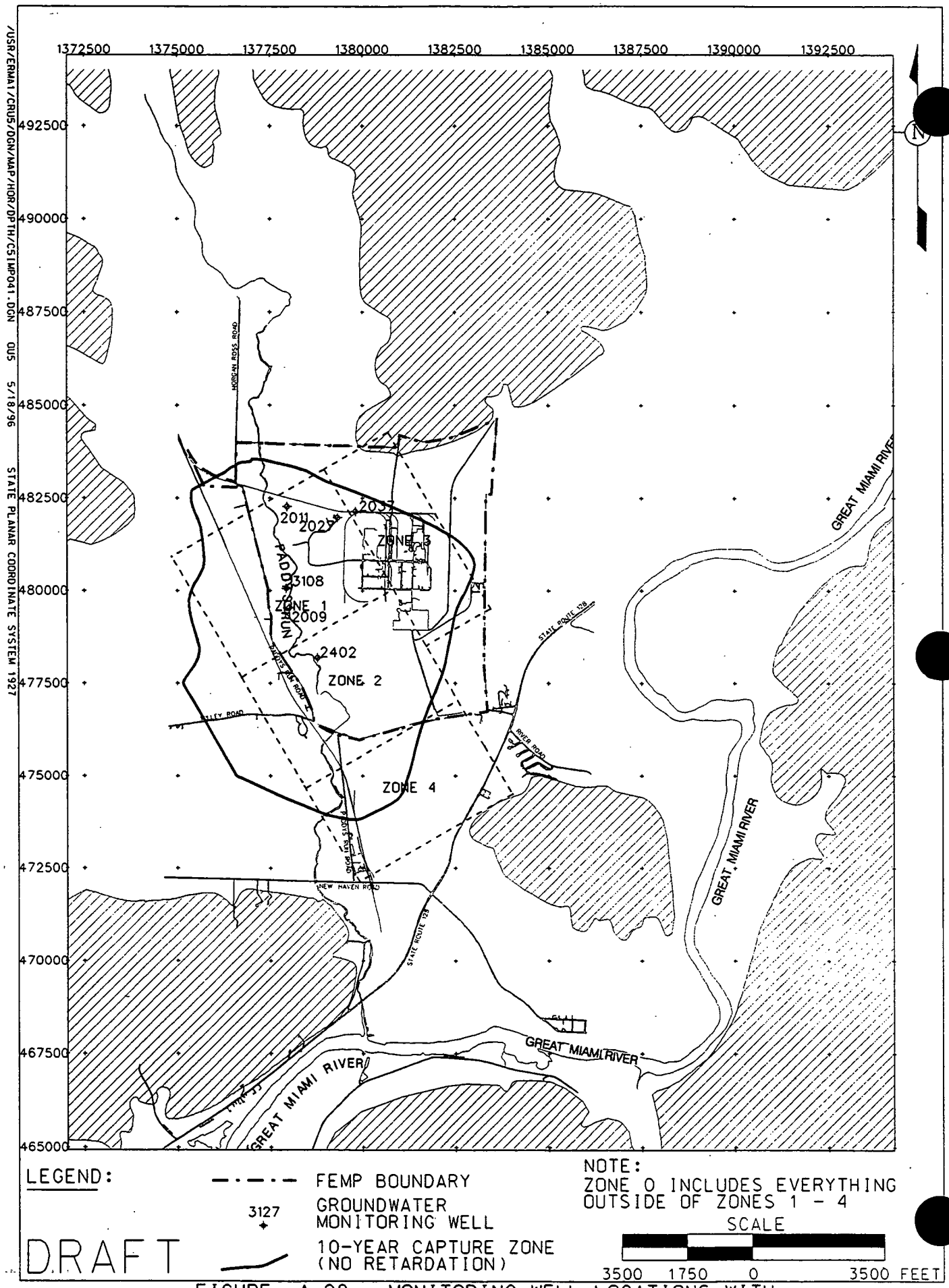


FIGURE A-28. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR CARBON DISULFIDE

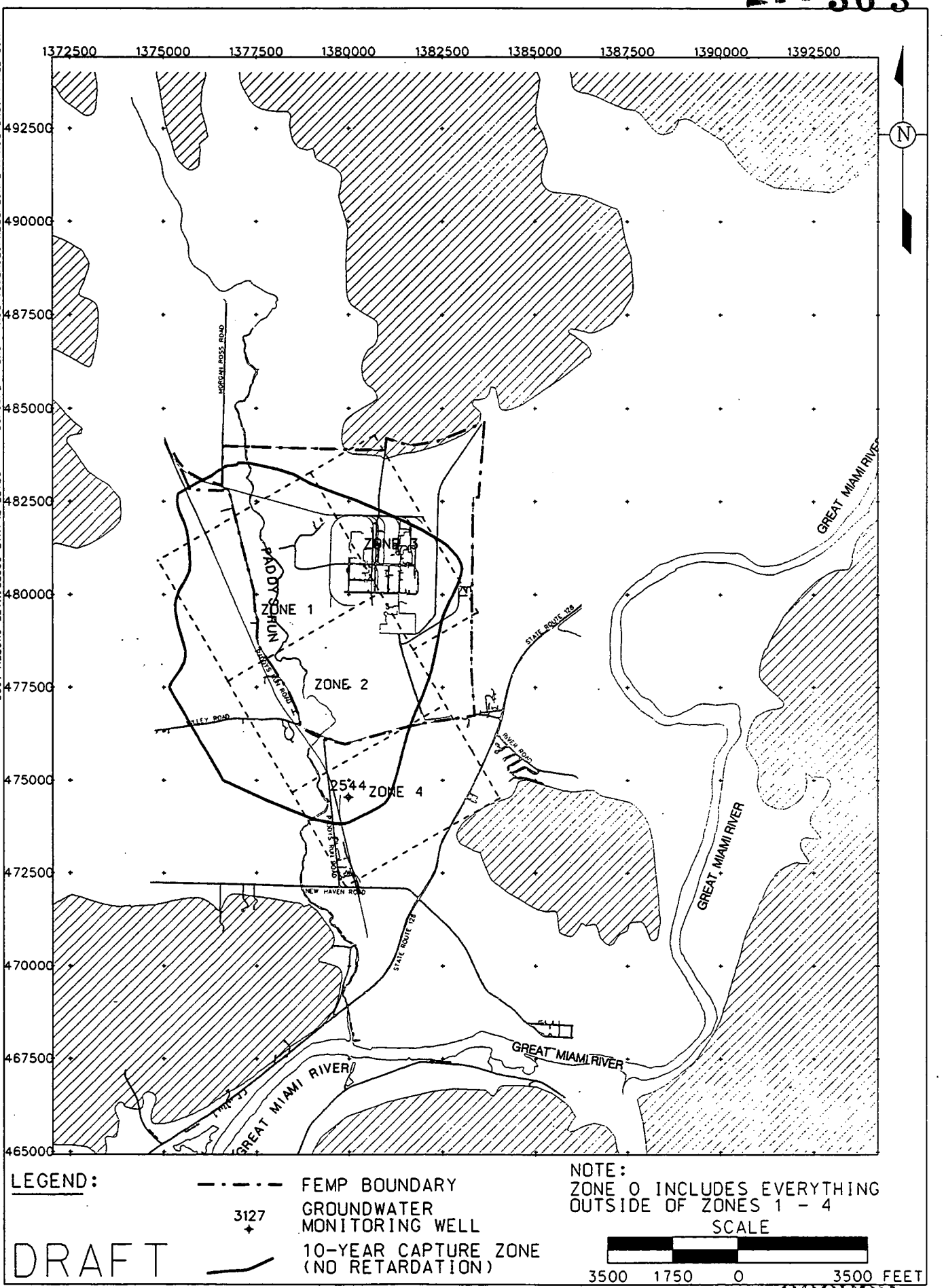
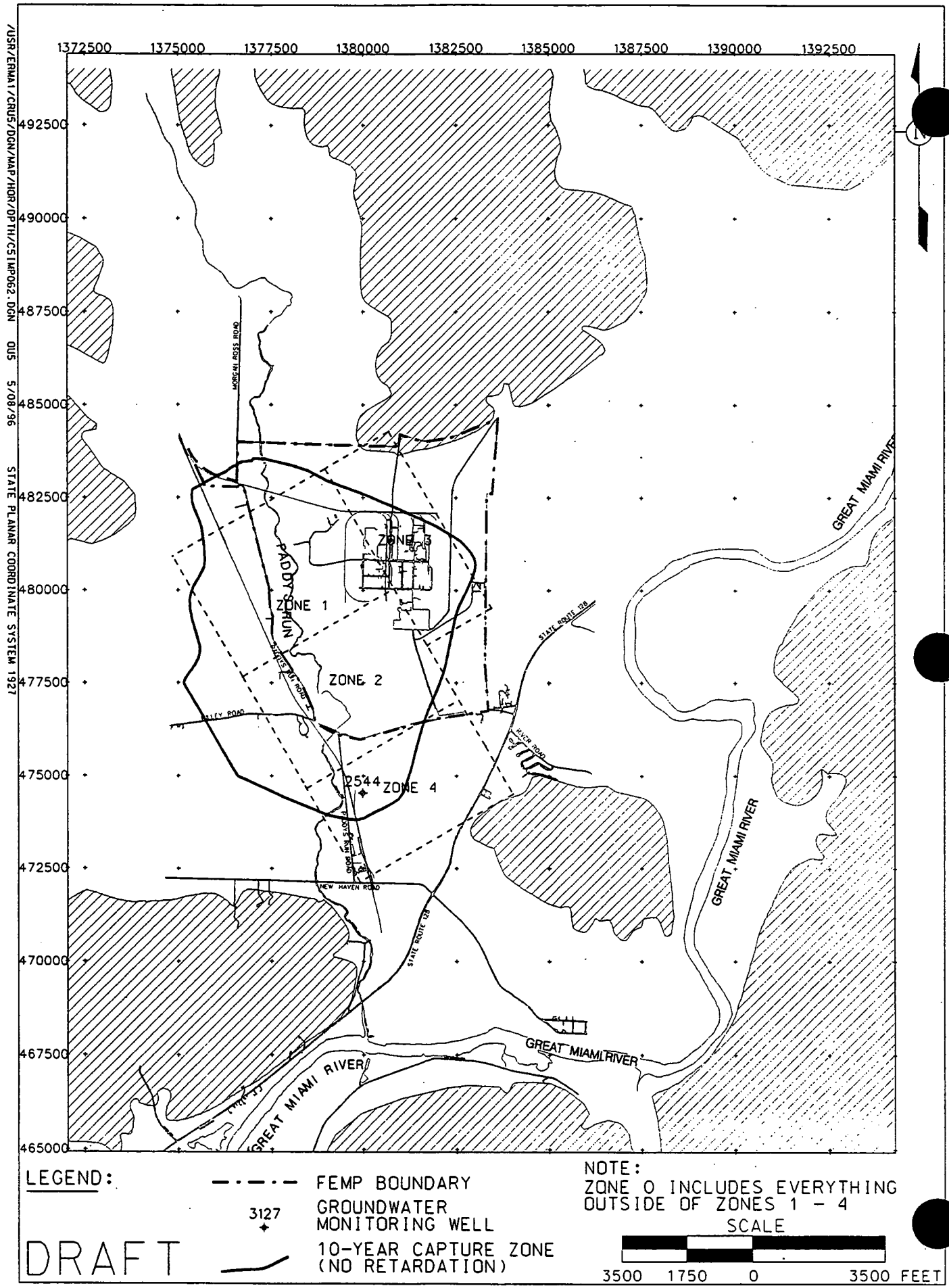


FIGURE A-29. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR 1,1-DICHLOROETHENE



000293

FIGURE A-30. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR 1,2-DICHLOROETHANE

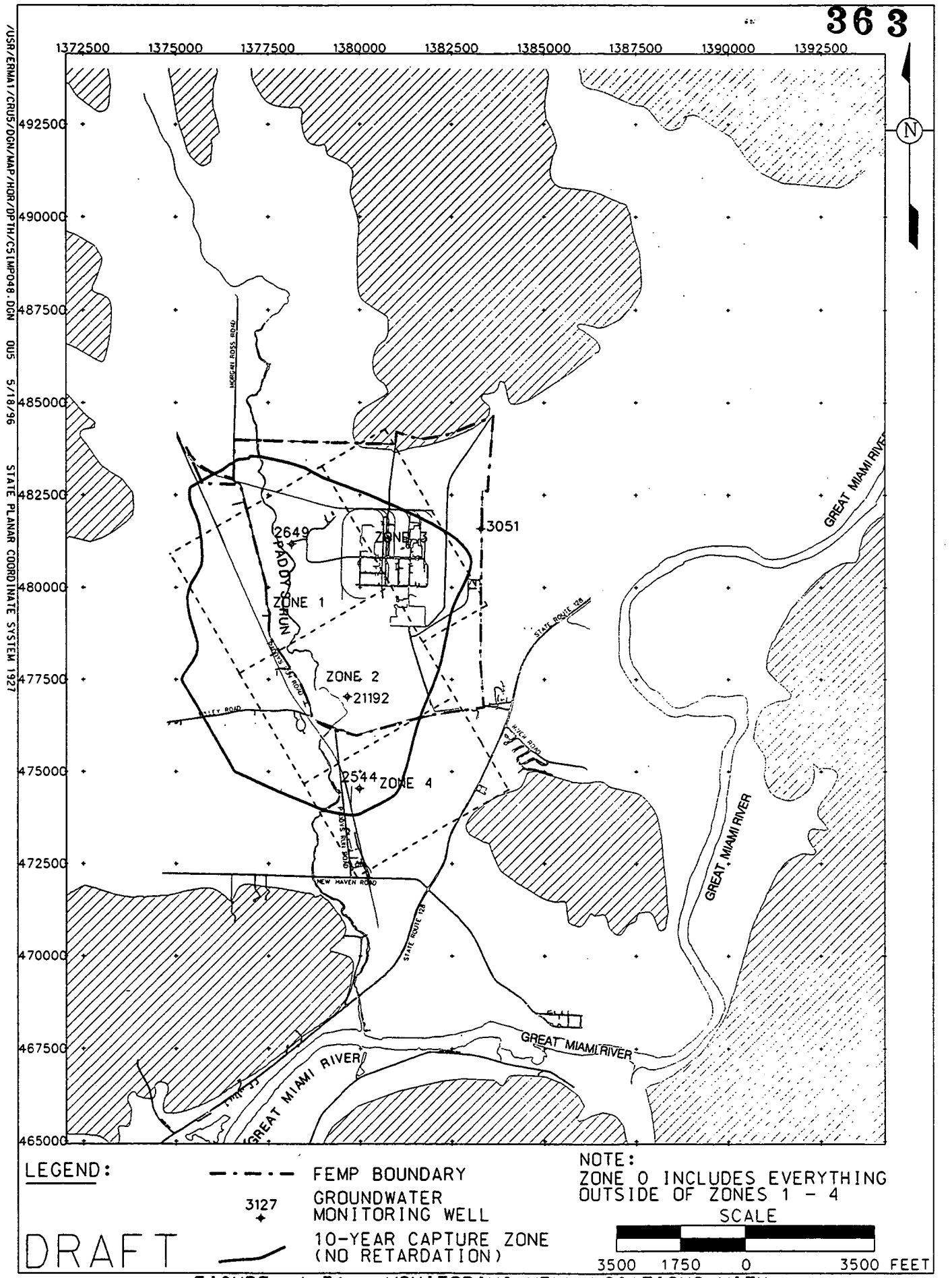


FIGURE A-31. MONITORING WELL LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR TRICHLOROETHENE

APPENDIX B

GROUNDWATER MONITORING STRATEGY OF THE FEMP'S ON-SITE DISPOSAL FACILITY

APPENDIX B

B.1 INTRODUCTION

This project-specific plan (PSP) presents the groundwater monitoring program for the on-site disposal facility (OSDF). The groundwater monitoring program includes the collection of groundwater data from the glacial till and the Great Miami Aquifer. Groundwater data will be integrated with leachate data collected from within the on-site disposal facility to evaluate the performance of the on-site disposal facility

Groundwater monitoring will be conducted in the glacial till beneath the on-site disposal facility liner system. The primary objective is to provide a monitoring point that would allow detection of a leachate release from the on-site disposal facility upon first entry of the release into the environment. A monitoring well will be installed in the till for each waste cell during construction of the cell. The potential for success of till monitoring will be increased by locating the wells in an area beneath each individual on-site disposal facility cell where a leachate release is most like to occur. Concentration data will be collected quarterly and trended statistically at each monitoring point to document changes in water quality. Section 4.0 provides additional details on the design and expectations of the till monitoring wells.

Groundwater monitoring will be conducted in the Great Miami Aquifer. Monitoring wells completed in the aquifer will be positioned around the perimeter of the on-site disposal facility. Each of the eight to nine individual waste cells in the on-site disposal facility will have an upgradient and downgradient aquifer monitoring well. During active remediation of the aquifer, water quality data will be collected quarterly and trended statistically at each well to document changes in water quality. Once remediation of the Great Miami Aquifer is complete, the monitoring program in the aquifer will be expanded to also include upgradient verses downgradient statistical comparisons of data.

This PSP meets all of the substantive requirements for groundwater monitoring of all of the hydrogeological components for the Great Miami Aquifer and the overlying Wisconsin age till. These requirements are discussed in detail in Section 2.0 and the guidance documents are referenced throughout the document.

Geologic and hydrogeologic conditions in the area of the on-site disposal facility have been well defined (DOE, 1995). Approximately 51 borings, 54 wells have been drilled, and 116 sieve analysis, and soundings from 88 cone penetrometer tests (CPT) have been conducted to characterize the geology of the area.

Twenty-three slug tests, 22 flow meter readings, and several geotechnical tests have been conducted to characterize the hydrogeology. The geology and hydrogeology are discussed in Section 3.0.

The selection of the most effective monitoring strategy and monitoring locations for the on-site disposal facility considered all of the available information (i.e., current geology and hydrogeology, contaminant transport modeling, and the anticipated impacts of construction and remediation on the geology and the hydrogeology). Well locations and the monitoring strategy are discussed in Section 4.0.

A parameter selection process was developed to select the most suitable parameters for detection of a release from the on-site disposal facility. The selection process is discussed in detail in Section 5.0. The analytes selected are those which would best detect a leak from the on-site disposal facility.

This PSP also includes the requirements for groundwater sampling and analysis (Section 6.0), quality assurance/quality control (Section 7.0), data management (Section 8.0), health and safety (Section 9.0), and schedule of implementation (Section 10.0).

B.2 PROGRAM OVERVIEW

ARARs for groundwater monitoring requirements for the on-site disposal facility have been developed and approved, and will be met (on-site disposal facility permitting plan). At the FEMP, pre-existing contamination in the perched groundwater beneath the on-site disposal facility, the geology and hydrogeology of clay rich glacial deposits, and the influence of aquifer restoration activities in the Great Miami Aquifer add complexity to the development of a groundwater monitoring program. The groundwater monitoring program for the on-site disposal facility provides for monitoring groundwater beneath the on-site disposal facility liner system in the till, and within the Great Miami Aquifer. Intrawell concentration trending will be conducted on concentration data collected from the till and aquifer. Upgradient to downgradient statistical comparisons of concentration data in the aquifer will

begin when restoration activities in the aquifer have been completed. It is expected that the groundwater monitoring program for the on-site disposal facility will be implemented by modifying the 1993 Directors of Findings and Orders (DFO).

B.3 GEOLOGY/HYDROGEOLOGY

Geological and Hydrogeological Conditions

A Predesign Investigation was conducted to select a location at the FEMP for the on-site disposal facility with the most suitable geology and hydrogeology for protection of human health and the environment. The findings of this investigation were documented in the *Predesign Investigation and Site Selection Report for The On-site Disposal Facility* (DOE 1995). The following summarizes the geology and hydrogeology conditions to support the development of the groundwater monitoring plan for the on-site disposal facility. For more detailed information the reader should refer back to the Predesign Investigation and Site Selection Report.

Geology

The on-site disposal facility will be constructed on the eastern side of the FEMP. The facility is underlain (in ascending order) by Ordovician age bedrock consisting of shales with thin interbedded limestone. Above the shale and limestone are Illinoisan age outwash deposits of poorly sorted sands and gravels in a Pleistocene age trough called the New Haven Trough. These sands and gravels make up the regional Great Miami Aquifer, which is the most significant groundwater zone at the FEMP and is approximately 175 feet thick.

The Illinoisan outwash deposits are overlain by Wisconsin age till deposits ranging from approximately 23 to 57 feet in total thickness. Based on the results of 116 sieve analyses, the till can best be described as a heterogeneous sandy lean clay, with occasional interstitial sands and gravel. The till can be further subdivided into the upper brown till and the lower gray till. The gray till is normally consolidated and the brown till is over consolidated. The over consolidation of the brown till may be due to desiccation. Under the location for the on-site disposal facility, the gray till ranges in thickness from approximately 15 to 42 feet, and the brown till has a thickness of approximately 8 to 15 feet.

Determining the location of the thickest gray till with the least amount of interbedded (interstitial) coarse granular material (sands and gravels) was one of the primary objectives of the Predesign Investigation. The selected location for the on-site disposal facility has a minimum thickness of gray till of approximately 15 feet, and an average thickness of approximately 30 feet. The percentage of interstitial sands and gravels is approximately 4.4 percent (DOE 1995).

Hydrogeology

The FEMP has two distinctive zones of saturation, the Great Miami Aquifer, and a perched groundwater system in the overlying till. The Great Miami Aquifer (a regional sole source aquifer) is the most significant zone of saturation at the FEMP and represents the upper most aquifer. The Great Miami Aquifer is a classic example of an unconfined buried valley aquifer.

The Great Miami Aquifer is a well defined aquifer system. The depth to water in the Great Miami Aquifer, in the area of the on-site disposal facility, ranges from 45 to 90 feet below the ground surface and the unsaturated zone ranges from 20 to 30 feet in thickness. The range fluctuation in the depth to water is due to seasonal water table fluctuations. The Great Miami Aquifer groundwater flow direction is from west to east with an average gradient of approximately 0.000625. The average hydraulic conductivity is approximately 1.6×10^{-2} cm/sec, the average effective porosity is approximately 30 percent, the bulk density averages 1.6 gm/cm^3. Using a uranium distribution coefficient (K_d) of 1.87 L/kg, the retardation factor for uranium in the Great Miami Aquifer is 10.9.

Perched groundwater exists above the unsaturated zone of the Great Miami Aquifer within the saturated glacial overburden (till). The till is heterogeneous, exhibits between 90 to 100 percent saturation (close to field capacity), and has the properties of an aquitard. When the till reaches field capacity it will "leak" into the underlying vadose zone of the Great Miami Aquifer. The till in the area of the on-site disposal facility is dense and slightly over consolidated and composed primarily of sandy lean clay. Although the till is saturated, there are no known extensively continuous or significantly thick permeable zones beneath the on-site disposal facility that are capable of supporting a perched groundwater monitoring system. The present amount of saturation will be even further reduced in the future by the cap of the on-site disposal facility which will operate to significantly reduce infiltration.

The slug test data from 24 wells collected during the Addendum activity to the Predesign Investigation indicate that the average horizontal hydraulic conductivity for wells screened across the brown/gray till interface is 6.30 x 10^{-6} cm/sec or 4.90 ft/year. The gray till beneath the zone encompassing the brown/gray interface acts, in part, as an aquitard. The gray till has a measured vertical hydraulic conductivity ranging from 9.53 x 10^{-9} cm/sec to 5.83 x 10^{-8} cm/sec, an average horizontal hydraulic conductivity of 4.0 x 10^{-7} cm/sec, and an effective porosity of 4 to 10 percent. The till has a bulk density of 1.85 gm/cm^3. The ubiquitous presence of low permeability sandy-lean clay controls the rate at which fluids can migrate through the more permeable portions of till, either vertically or laterally.

Unlike flow in the Great Miami Aquifer, the upgradient and downgradient designation of fluid movement in the till is difficult to assign. Flow meter readings from 22 wells taken during the Addendum activities indicated the horizontal flow directions varied abruptly from well to well. Consequently, horizontal flow regimes are very localized and not extensive laterally.

B.4 ON-SITE DISPOSAL FACILITY MONITORING STRATEGY

Introduction

The success of a groundwater monitoring strategy for the on-site disposal facility is dependent upon how well the strategy integrates with facility integrity concerns (leachate collection within facility, cap and liner system) and how well the strategy addresses geologic and hydrogeologic conditions which are known to be present in the till and aquifer. Monitoring wells should not interfere with or compromise the integrity of the cap and liner system of the on-site disposal facility and groundwater monitoring data needs to be integrated with leachate collection data to evaluate on-site disposal facility performance. As presented in the last section, hydrogeologic conditions are very good for supporting a monitoring system in the Great Miami Aquifer because a definite flow system can be defined, but not very good for supporting a monitoring system in the glacial till because a definite flow system cannot be defined.

The challenge presented in monitoring the glacial till is how to best locate monitoring wells so that the probability of obtaining false positive and false negative results is minimized and the structural stability of the on-site disposal facility cap and liner system is not sacrificed. Given what is known about the heterogeneity and hydraulic conductivity of the glacial till, any contaminant release into the

glacial till should slowly move out from the point of release, in both a vertical and horizontal direction. Because the till is saturated, vadose zone monitoring techniques would not be applicable. Two strategies can be considered to monitor for such a release: (1) locate monitoring wells around the perimeter of the on-site disposal facility; or (2) locate monitoring wells beneath the on-site disposal facility.

Monitoring wells installed around the perimeter of the on-site disposal facility would have to be located at a minimum distance of 200 feet from the waste material in each cell to avoid interfering with the protective cap of the facility. Therefore, a contaminant would have to move laterally through 200 feet of glacial till before reaching the area of the monitoring well. Given the heterogeneous and clay rich nature of the till, the time of travel of a fluid moving through the glacial till is a function of the thickness of the till through which the fluid must move. A contaminant would only have to travel through 23 feet to 57 feet of glacial till in a vertical direction to reach the vadose zone of the Great Miami Aquifer. Given the much shorter travel distance in the vertical direction, a unit gradient in the vertical direction, and the absence of any known extensively continuous or significantly thick permeable zone beneath the on-site disposal facility, a contaminant would reach the Great Miami Aquifer vertically long before it would ever reach a perimeter monitoring well located 200 feet away. It is also possible that a perimeter detection monitoring system in the till would lead to false conclusions concerning the integrity of the on-site disposal facility because surface water infiltration outside the on-site disposal facility (i.e., former production area) with residual contamination (at concentrations below final remediation levels [FRLs] in soil) could potentially cause false positive detections. The conclusion is that a perimeter monitoring network in the till would not be protective of the Great Miami Aquifer.

Monitoring wells located in the till directly beneath the on-site disposal facility would have to be installed at the time of cell placement or using some type of horizontal installation technique to avoid compromising the cap and liner system of the on-site disposal facility. The heterogeneity of the till will cause any release from the on-site disposal facility to follow a tortuous lateral and vertical pathway through the overburden. Because no defined flow system has been detected in the till there would always be a high degree of doubt as to whether or not a well positioned beneath the on-site disposal facility was positioned in the right location to detect a contaminant release. Another concern is whether or not the till will yield a fluid sample to a well located beneath the on-site disposal

facility. Characterization efforts to date indicate that there are no known extensively continuous or significantly thick permeable zones beneath the on-site disposal facility that are capable of supporting a groundwater monitoring network. The clay rich till does not readily yield fluid to a well. The present amount of saturation will be further reduced in the future by the cap and liner system of the on-site disposal facility which will operate to significantly reduce infiltration.

The issue is one of where to place a till well. One area within the till does hold promise for maximizing the opportunity of detecting a leak from the on-site disposal facility. The on-site disposal facility will consist of eight to nine individual waste cells when completed. Each waste cell will contain a leachate collection system which collects and directs leachate to a sump along the western edge of the cell. A monitoring well located in the glacial till beneath the sump area has the greatest chance of detecting a release from the facility. Groundwater monitoring within the glacial till (beneath cell sumps) and within the Great Miami Aquifer is a proposed component of the FEMP on-site disposal facility monitoring strategy.

To further maximize the success of a monitoring well located beneath the sump in the till, it is proposed that the well be installed as part of the subgrading construction activities for the cell. This will get the well installed prior to waste placement, and eliminate placement uncertainties that would be associated with horizontal drilling techniques.

The on-site disposal facility monitoring strategy described below meets the intent of providing the earliest warning of a release from the on-site disposal facility, within the complex hydrogeologic regime at the FEMP. The program is described in five parts -- elements of the program, sampling, leak evaluation, response, and record keeping and reporting.

Monitoring Program Elements

On-site disposal facility monitoring will consist of monitoring leachate within the facility, and groundwater beneath the facility. When complete, the on-site disposal facility will consist of eight to nine individual waste cells. Each cell can be monitored separately and have its own leachate collection system, leak detection system, till monitoring well (located beneath the sump), and upgradient and downgradient Great Miami Aquifer monitoring wells. The four elements, leachate collection system, leak detection system, till monitoring well, and Great Miami Aquifer monitoring

wells are described below. Data will be collected and qualitatively analyzed from the liner system, beneath the liner system in the till, and from the Great Miami Aquifer. The design of the on-site disposal facility is presented in detail in the on-site disposal facility design package. The liner is a composite liner (Figure B-1) made up of a cushion layer, leachate collection (pea gravel with drain pipe), primary liner (HDPE membrane and bentonite geocomposite), leak detection (pea gravel with drain pipe), HDPE membrane and bentonite geocomposite, secondary liner (three feet of compacted clay). The sumps are centered on the west side of each cell.

Monitoring Within the Facility

Samples will be collected within the on-site disposal facility from the leachate collection system and the leak detection system for each of the eight to nine individual waste cells. The data collected will be used to conduct a collective qualitative trend analysis for the on-site disposal facility.

Leachate Collection System

A leachate collection system will be built into each cell to collect infiltration water and keep it from entering the environment. The leachate collection system will drain to the west through a sump located beneath the western portion of each individual waste cell. From there it will flow by gravity to a lift station and be pumped to the bio surge lagoon.

Leak Detection System

By design, the on-site disposal facility primary liner underneath the leachate collection system should not leak. Not withstanding this design requirement a leak detection system is located beneath the leachate collection system. Between the leachate collection system and the leak detection system is a primary liner (a high-density polyethylene [HDPE] membrane and bentonite geocomposite). Below the leak detection system is a secondary liner comprised of 3 feet of compacted clay.

Groundwater Monitoring Beneath the on-site disposal facility in the Till

Till monitoring will be conducted using wells located beneath the sumps of each individual waste cell. If a leak were to occur in the on-site disposal facility the liner penetration area (sump) is the most likely place to detect a leak because these are the areas that have the potential for having the highest hydraulic head pressure. The monitoring wells and sumps will be located along the west side of the facility and will be installed prior to waste placement (See Figure B-2). The wells will be installed

via trenching during the construction of each individual cell. The sample collection interval will be positioned approximately five feet underneath the secondary liner (three foot compacted clay) (Figure B-3). A sample collection receptor will be constructed of HDPE and filled with fine sand to improve permeability. HDPE is being used in the on-site disposal facility liner system also. From the sample collection receptor the well casing will be installed in a trench with a 1.5 percent downward slope westward for approximately 200 feet. Then a vertical riser casing will be installed and connected to the horizontal casing. Below the juncture of the horizontal and vertical casing there will be a sample collection sump, which is the vertical riser casing with a sealed end extended downward past the juncture of the vertical and horizontal casing.

Groundwater Monitoring of the Great Miami Aquifer

An upgradient and downgradient 2000 series Great Miami Aquifer groundwater monitoring well will be installed for each individual cell during construction of the cell. Upon completion of the CERCLA remediation and the construction of the on-site disposal facility, a monitoring well network of 21 wells will exist surrounding the on-site disposal facility that will provide both the upgradient and downgradient monitoring points needed to conduct an upgradient versus downgradient detection monitoring program (Figure B-2). Three of the 21 wells (2424, 2051, and 2426) are existing monitoring wells.

The on-site disposal facility will be constructed from north to south. Eleven existing monitoring wells (2421, 2439, 2064, 2120, 2171, 2446, 2430, 2429, 2426, 2051, & 2424) will be sampled in the south to establish a baseline while individual cells of the on-site disposal facility and associated permanent monitoring wells are being constructed in the north. Existing wells in the south will eventually be in the way of cell construction and have to be abandoned and replaced with permanent wells outside of the cell boundary. Replacement of the existing wells will be phased with construction of individual cell components. All new monitoring wells will be constructed in accordance with the SCQ and approved work plans.

Sampling

Quantitative data collected from the leak detection system and leachate collection system data will provide early detection of a possible leak in the cap or liner system. Quantitative data collected from the till monitoring wells will be used to detect a possible leak in the secondary liner system.

Quantitative data collected from the Great Miami Aquifer groundwater monitoring wells will be used to document to stakeholders the qualitative effect that the facility is having on groundwater.

Target Analytes

The target analytes for the leachate collection system, the leak detection system, and the groundwater monitoring system are total uranium and technetium-99 (See Section 5.0 for selection process). Total uranium was selected because uranium will be the most abundant contaminant in the on-site disposal facility. However, another indicator parameter is necessary because uranium moves approximately 12 times slower than groundwater. Technetium-99, which moves at approximately the same rate as groundwater, was also selected due to its high mobility.

Sampling Frequency

Leachate Collection System/Leak Detection System

Leachate samples will be collected from the leachate collection system every month starting at the time of waste placement for the first year to develop a baseline . After the first year, sampling will be conducted quarterly through post closure. Quarterly sampling will be conducted to observe seasonal impacts. Leachate volumes will be recorded and the samples will be tested for target analyte concentrations.

The leak detection system also will be monitored monthly for the first year of waste placement for each cell, concurrently with the leachate collection system to develop a baseline. Water samples will be collected from the leak detection system if enough fluid is present. Sample volumes will be recorded and samples collected will be tested for target analyte concentrations.

After the first year, the monitoring and sampling frequency for the leachate collection system and leak detection system will be quarterly, to coincide with the frequency for groundwater monitoring.

Groundwater

The groundwater monitoring wells for both the till and Great Miami Aquifer will be sampled quarterly to represent seasonal variation in the indicator parameters.

Leak Evaluation Strategy

The leak evaluation strategy is two-fold: 1) trend analysis for the leachate collection system and leak detection system, and trend analysis for the Great Miami Aquifer groundwater and for the perched groundwater will identify potential problems within each program element; and 2) the monitoring results from all elements will be correlated to evaluate whether a release has occurred and if a response action is necessary.

Trend Analysis Results

Monitoring during the first year will provide enough data to construct a meaningful baseline data set for leachate (12 data points). Monitoring during the first two years will provide enough data to construct a meaningful baseline for groundwater (8 data points). These baselines will be used to begin a qualitative trend analysis of the volume of leachate, and concentrations of target analytes.

A trend analysis was chosen because it can apply to data from all the elements -- the leachate collection system, leak detection system, and groundwater monitoring systems. Additionally, a trend analysis is the most appropriate statistical method for groundwater given the variable flow directions which will be created during the aquifer restoration. A Mann-Kendall statistical method, as is currently used to evaluate concentration trends in the South Plume Area, is being considered for on-site disposal facility data.

Correlation Monitoring Data

If liquid is collected from the leak detection system, it does not necessarily mean that the leachate is leaking through the primary liner into the leak detection system. Liquid in the leak detection system could be from capillary action pulling in-situ water within the clay liner into the leak detection system. To determine whether liquid in the leak detection system is leachate and the primary liner is leaking, a correlation must exist between the leak detection system and leachate collection system target analyte concentrations. If volumes and target analyte concentrations between the two systems correlate then a leak through the primary liner will be suspected. The significance of the suspected leak to the protection of the environment depends upon the concentrations of the target analytes found in the leak detection system and the volume of water present. Target analyte concentrations in groundwater collected from the till monitoring wells will be correlated with leachate collection system

and leak detection system data to detect a leak in the secondary liner system that contains the 3-foot compacted line.

If the trend analysis of the groundwater monitoring data indicate an upward trend, and the leachate collection system, leak detection system, and till monitoring wells do not indicate leakage from the on-site disposal facility has occurred, then it will be assumed that the on-site disposal facility is *not* the source. In this event the cause of the upward trend will be determined under the Aquifer Restoration Project. The increase could be the result of changing pumping conditions within the aquifer or a breach in source control at another remediation project.

Response

If it is determined that both the cap and primary liner have failed, then an on-site disposal facility response action will be required. A response action will include initiating cap repair, investigating whether or not contamination has breached the secondary three-foot compacted clay liner that lies beneath the leak detection system, and increasing Great Miami Aquifer monitoring. Potential leakage through the secondary three-foot liner will be assessed by using the till well installed beneath the sump area and secondary liner.

Groundwater monitoring will also be increased to determine if leakage from the on-site disposal facility has entered the Great Miami Aquifer, although given the distances involved it would be unlikely that leakage from the on-site disposal facility would be able to migrate to the Great Miami Aquifer in the short time frame between leak detection and response.

Reporting Responsibilities

Monitoring of the leachate collection system, leak detection system and till monitoring wells will be conducted by the on-site disposal facility Project Group. Monitoring of groundwater beneath the on-site disposal facility and in the Great Miami Aquifer will be conducted by the Aquifer Remediation Group.

To provide an integrated approach to reporting on-site disposal facility monitoring data, the annual IEMP comprehensive environmental report will serve as the mechanism by which leachate collection system, leak detection system, and till well volumes and concentrations will be reported, along with

Great Miami Aquifer groundwater monitoring results. Presenting data in one report will facilitate a qualitative assessment of the impact of the on-site disposal facility on the aquifer, as well as the operational characteristics of on-site disposal facility cap and liners. However, the data will be available quarterly for review upon request.

B.5 PARAMETER SELECTION

Introduction

Any successful monitoring program needs to focus on the parameters that are primary concerns to human health and the environment and are the best indicators, on a real-time basis, of a release. The following is the process used to identify these analytes.

The intent of the on-site disposal facility groundwater detection monitoring program is to detect potential releases from the on-site disposal facility to the perched groundwater within the till and the Great Miami Aquifer. If a release is detected during the Groundwater Detection Monitoring Program a Groundwater Quality Assessment Monitoring Program will be developed and initiated.

Scope of Detection Parameters

In accordance with OAC 3745-27-10(D)(3), an alternate inorganic parameter list can be proposed to the director to be used to meet the requirements of the Groundwater Detection Monitoring Program in lieu of some or all of the parameters listed in Appendix I of the rule. Four considerations must be made to propose an alternate inorganic parameter list:

- The types, quantities, and concentrations of constituents to be managed at the facility
- The mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the facility
- The detectability of the parameters, waste constituents, and their reaction products in the groundwater
- The concentrations or values and coefficients of the variation or monitoring parameters or constituents in the background/baseline groundwater quality.

Selection Process

Criteria were developed to provide the necessary technical information to select a suitable sample parameter list for the on-site disposal facility Groundwater Monitoring Detection Program. The

results of the comparison of the criteria were ranked to determine which parameters should be monitored to best detect a release from the disposal facility in the most efficient and cost-effective manner.

The selection process involves a comparison of constituents included as on-site disposal facility Waste Acceptance Criteria (WAC), and the constituents included in the preliminary verification and certification compounds list (pVCC). The WAC list contains 41 constituents, of which 18 have specified maximum concentrations for soil placed in the on-site disposal facility; and the remaining 23 constituents have no specified maximum concentration (see Table B-1).

The pVCC list consists of 33 constituents of concern that had concentrations in soil samples higher than the established final remediation level (FRL) for each respective constituent in soil (Table B-2). A comparison of the 18 WAC parameters that have specified concentration limits, and the pVCC list indicates that there are nine constituents that were detected above the FRL, and are WAC parameters. The identified nine constituents and their respective FRLs are summarized in Table B-3. The remaining nine WAC constituents of the 18 with specified maximum concentrations were not included in the table because the constituents were not detected above the respective FRLs. All the constituents for which WACs and FRLs have been developed for soil are included in the OU5 Record of Decision, August 1995.

The criteria used to develop the parameter list are listed in order of their importance in regard to detection monitoring:

1) Comparison of the distribution coefficient (K_d) for the constituents in the glacial overburden, the lower the K_d, the higher the rate of mobility (Table B-4, Mobility)

   This comparison ranks the 9 constituents from the highest rates of mobility in the glacial overburden to the lowest mobility. This comparison indicates that vinyl chloride and technetium-99 would have the highest potential to impact the Great Miami Aquifer before less mobile constituents.

2) Comparison of detections at concentrations above FRLs on a per constituent basis (Table B-4, Detections > FRLs)

   This comparison ranked the constituents by the percentage of detections that exceeded the FRL for each constituent. The number of detections above the FRL for each constituent was divided by the total number of samples collected for that constituent. The results of this comparison

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provide an indication of the primary constituents in the waste deposited in the on-site disposal facility. Uranium (total) and technetium-99 have the highest potential to be in the on-site disposal facility waste at concentrations above the FRL.

3) Comparison of detections at concentrations above WACs on a per constituent basis (Table B-4, Detections > WAC)

   This comparison ranked the constituents by the percentage of detections that exceeded the WAC for each constituent. The number of detections above the WAC for each constituent was divided by the total number of samples collected for that constituent. This comparison is similar to the ranking by detections above the FRL, it also provides an indication of which constituents will be prevalent in the on-site disposal facility waste. Again, total uranium and technetium-99 have the highest potential to be in the on-site disposal facility waste.

4) Comparison of decay half-lives for each constituent (Table B-4, Decay half-life)

   This comparison will determine which of the 33 constituents have decay half-lives that will enable each constituent to be present in a release that could impact the Great Miami Aquifer within the design life period (1000 years) of the on-site disposal facility. The radionuclides compared (with the exception of strontium-90 with a decay half-life of 28.6 years) have sufficient half-lives to enable the constituents to be present in the waste throughout the design life period of the on-site disposal facility. All organics compared (with the exception of carbazole, for which a decay half-life is unknown) have decay half-lives that they will biodegrade before the design life period of the on-site disposal facility.

Each of the nine constituents were ranked with respect to 1) mobility, 2) detections > FRLs, 3) detections > WACs, and 4) decay half-life. The results of each separate comparison were compared to develop the most suitable parameter list for detection monitoring (Table B-4).

Technetium-99 was selected due to its high mobility (K_d of 0.118 mL/g), the amount of samples that were detected above the FRL, and detections above the WAC . The decay half-life for technetium-99 is approximately 213,000 years. Therefore, groundwater samples analyzed for technetium-99 should provide a means for leak detection monitoring.

Uranium (total) was selected due to the large volume of uranium-contaminated soil and other debris that will be placed in the on-site disposal facility. The waste volume, combined with the mobility rate for uranium [K_d of 3.1 mL/g in the glacial overburden (OU5 Feasibility Study March, 1995)], and the decay half-life of approximately 4.5 billion years (uranium-238) makes uranium a suitable parameter to be used for leak detection monitoring for the disposal facility.

These two parameters (technetium-99 and total uranium) were selected because of their rates of mobility through the glacial overburden, percentage of samples detected above the FRL, percentage of samples detected above the WAC, and their half-lives. These factors indicate that technetium-99 and uranium (total), as compared to the other constituents, will be the most reliable indicators of contaminant migration. An even weighted ranking was compiled by averaging the rank from each comparison (average rank), see Table B-4. The results of the even weighted ranking indicate that the other constituents would not be suitable detection parameters.

Of the constituents considered, vinyl chloride has the highest rate of mobility (K_d of 0.0221 mL/g) in the glacial overburden. However, only one sample of 1095 samples analyzed, detected a concentration greater than the FRL for vinyl chloride. The decay half-life of vinyl chloride is 7.91 years; this short decay half-life and the assumed small volume of vinyl chloride-contaminated waste present at the FEMP make vinyl chloride a poor leak detection monitoring parameter. The same type of argument is justified for the other organic constituents considered in Table B-4.

Strontium-90 and neptunium-237 are unsuitable for use as leak detection monitoring parameters due to the estimated small volume of these two constituents that will be deposited in the on-site disposal facility, which will inhibit the detection of these constituents in a release.

In addition to technetium-99 and uranium (total), a list of groundwater quality parameters and groundwater contamination indicator parameters is proposed to be used as a supplement to the primary parameter list (technetium-99, and uranium) that was developed. These parameters are required for RCRA Interim Status Treatment, Storage, or Disposal Facilities (40 CFR 265.92) to aid in the detection of releases from disposal facilities. The supplemental parameters are pH, Specific Conductance, Total Organic Carbon, and Total Organic Halogens (Table B-5). These parameters will provide an added means to detect contaminant migration, and will be useful as indicators for groundwater quality degradation.

B.4 Summary

The selected constituents for the detection monitoring program are total uranium, technetium-99, pH, specific conductance, total organic carbon, total organic halogens. Total uranium, and technetium-99 were selected due to anticipated percentages of the total volume of waste contaminated with these

constituents, mobility, and the decay half-life. The mobility and waste volume are the most important because (1) the waste must have a constituent concentration high enough when leached that it can be detected if a release were to occur, and (2) a constituent with higher mobility will be detected in a release earlier than constituents with lower rates of mobility. The parameters of pH, specific conductance, total organic carbon, and total organic halogens were selected because they can respond quickly if the groundwater quality is being effected, thereby triggering a potentially quicker response to contaminant migration.

B.6 SAMPLING AND ANALYSIS

Sampling Requirements

In accordance with OAC 3745-27-10(D)(5), the Groundwater Detection Monitoring Program monitoring wells, the LCS, and LDS will be sampled monthly for the first year and quarterly thereafter. Baseline upgradient wells will be sampled quarterly for one year following their installation for new wells or the implementation of the Groundwater Detection Monitoring Program for existing wells. One year after installation or implementation, the baseline upgradient wells will be sampled quarterly.

Prior to sampling and purging at each well location, the water level shall be measured and recorded on the Water Sample Collection Log by Groundwater Monitoring Sampling Technicians. Field groundwater analysis will also be conducted for pH and specific conductance at a minimum prior to sampling as per Standard Operating Procedure SC-GROUNDWATER MONITORING-FO-201, "Groundwater Sampling Activities." A dedicated Teflon bailer or pump shall then be used to purge the well of the required purge volume prior to sampling in accordance with the procedure. Following removal of the required purge volume, the sample shall be collected using the dedicated Teflon bailer. The field data from the above activities will be recorded on the appropriate documents, and subsequently entered into the Sitewide Environmental Database (SED).

If a well does not yield sufficient volumes of water prior to removal of the required purge volume, then the well will be purged dry once using a dedicated Teflon bailer. After the well has been purged dry once, sample collection shall begin within 24 hours. Samples shall be collected using a dedicated Teflon bailer. All sampling and purging activities shall be completed in accordance with Standard Operating Procedure SC-GROUNDWATER MONITORING-FO-201, "Groundwater Sampling

Activities." All samples collected for analysis shall be filtered prior to being containerized. Table B-6 summarizes the sampling requirements for this program.

B.6.2 Sample Chain-of-Custody Records and Field Data Documents

Sample custody procedures outlined in the SCQ shall be adhered to throughout the sample handling process from field collection to shipment of the samples to the laboratory. A Custody Record/Request For Analysis (COC/RFA) shall be used to document collection data, chain-of-custody, and geotechnical parameters requested for each sample in accordance with SSOP-0018 "Chain Of Custody/Request For Analysis Record For Sample Control Procedure."

In addition to the custody records, a Sample Collection Log shall be completed which summarizes all samples collected from a single borehole. All field work shall be documented in detail on a daily basis using the Field Activity Log (FAL). All field documentation will be completed by the Field Geologist or Lead Sampling Technician.

Sample Packaging, Storage, and Shipping

Sample custody seals and labels, and COCs will be examined and verified by FERMCO Groundwater Monitoring and personnel of the FERMCO Sample Management Organization prior to acceptance and shipment of samples. The field screening results will be clearly displayed on the sample label and the SWAR/CR. Sample packaging shall be performed in accordance with the SCQ Section K.10.

Final sample handling, screening, storage, and shipping activities will be completed by FERMCO Groundwater Monitoring. Samples will be shipped to the designated off-site lab for the analyses required.

Calibration of Field Equipment

All equipment used during this investigation shall be operated and calibrated according to the manufacturer's specification and in accordance with Standard Operating Procedure SC-GROUNDWATER MONITORING-FO-201, "Groundwater Sampling Activities.". Written logs of equipment calibration are maintained by the FERMCO personnel responsible for performing the instrument calibrations.

Equipment Decontamination

Sampling equipment shall be decontaminated prior to transport to the sample field site and after all sampling is completed to limit the introduction of contaminants from equipment to sampled media and to protect worker safety and health.

The decontamination of equipment shall be a Level II Decontamination as referenced in Section K.11 of the SCQ and as described in Section 6.4.1 of the SCQ and Section 5.7.6 of SOP SC-GROUNDWATER MONITORING-FO-201, "Groundwater Sampling Activities."

Disposition of Investigation-Derived Wastes

During completion of sampling activities, Groundwater Monitoring Sampling Technicians may generate contact wastes and decontamination waste. Following completion of sampling, the Groundwater Monitoring Sampling Technicians shall place contact wastes into properly labeled bags and disposition in accordance with appropriate FEMP waste management policies. Purge water will go to the Biosurge Lagoon. The Groundwater Monitoring Sampling Technicians shall decant decontamination solution into appropriate containers which will be ultimately transferred to Plant 8 for treatment or the Advanced Wastewater Treatment (AWWT) Facility.

B.7 QUALITY ASSURANCE/QUALITY CONTROL

Introduction

The primary objectives of the Quality Assurance/Quality Control (QA/QC) section of this plan relate to the collection of field information and data sufficient to evaluate the Groundwater Monitoring Detection Program. Specific objectives of this field sampling effort shall be designed, organized, and implemented in a manner which will optimize the collection of information which meets the DQOs (Appendix B) specified in this PSP. To ensure information is gathered in such a manner that DQOs are met, QA/QC measures will be used to determine conformance with overall SRP objectives.

The fundamental mechanisms used to achieve these quality goals can be characterized as prevention, assessment, and correction. These components are further described as follows:

- Prevention of defects in the data quality through planning and design, documented instruction and procedures, and careful selection and training of skilled, qualified personnel.

- Quality assessment through program or regular audits and surveillance to supplement continual informal review.
- Permanent correction of conditions adverse to quality objectives through a close-looped corrective action system.

Quality Assurance/Quality Control Requirements

All FEMP sampling programs follow protocol established in the Sitewide CERCLA Quality Assurance Project Plan, Vol I, Section 4, Vol II, Appendix K.

Self-assessment and independent assessments of work processes and operations shall be undertaken to assure quality of performance. Self-assessment shall be performed by the Quality Assurance Officer assigned to the on-site disposal facility groundwater Monitoring detection program. Self-assessment activities shall encompass technical and procedure requirements, and may be conducted at any point in the project.

At a minimum, one surveillance shall be conducted per sampling event, consisting of monitoring/observing on-going project activity and work areas to verify conformance to specified requirements. Surveillance shall be planned and documented in accordance with Section 12.3 of the SCQ.

Field Changes to the Project Specific Plan

Prior to the implementation of field changes, the on-site disposal facility groundwater project manager and groundwater monitoring manager shall be informed of the proposed field changes. Once the on-site disposal facility groundwater project manager has obtained approval (verbal or written) from the project manager and QA representative for the field changes to the PSP, the field changes may be implemented. Field changes to the PSP shall be noted on a Variance Request form. QA must receive the completed Variance Request form, which includes the signatures of the groundwater manager, project manager, and the QA/QC representative, within one week of the granting of the verbal approval.

Quality Assurance Samples

Field quality assurance samples for all sampling shall include one rinsate, one field blank, and one matrix spike/matrix spike duplicate for the entire analytical suite. One field duplicate will be taken for every 20 samples.

B.8 DATA MANAGEMENT PLAN

Introduction

This data management plan will be implemented so that information collected during the investigation will be properly managed following completion of the field activities. Data and field documentation generated during the investigation shall be validated to ensure compliance with the DQOs outlined in Appendix B of this PSP.

Field Documentation

As specified in Section 5.1 of the SCQ, sampling teams shall describe daily activities on the FAL sufficient for the sampling team to reconstruct a particular situation without reliance on memory. Sample collection logs shall be completed according to instructions specified in Appendix B of the SCQ.

Field Documentation Validation

To assure appropriate documentation was completed during field activities and that documentation was completed correctly, field documentation shall be validated by the Environmental Monitoring group and Quality Assurance (QA) as described in the SCQ, Section D.5.

Analytical Data Validation

Analytical data shall be validated by ETS Data Quality Group upon receipt. ASL D deliverables shall be requested from the laboratory for all parameters. Validation shall be performed to the highest ASL permitted by the data.

The Data Quality Group shall provide to the project manager and to Analytical Data Management (ADM) copies of the summary reports listing validation qualifiers applied along with copies of the validated data sheets. All original validation summary forms and validation reports shall be submitted to ADM for permanent storage.

Data Entry

Analytical data shall be received from the contract laboratory by electronic data transfer in a compatible format with the FEMP database and in hard-copy format. Validated field data shall be entered into the FEMP Site-Wide Environmental Database (SED) by ADM. Manual, double keyed, data entry shall be completed and the entered data shall be compared to the original data sheets; corrections shall be initialed and dated, and made as necessary. Hard-copy documents are kept in permanent storage in the Project Files; the electronic database is permanently archived in a neutral ASCII file format.

B.9 HEALTH AND SAFETY

Health and Safety Requirements

The health and safety issues regarding all sampling specified under this PSP will be addressed by the Programmatic Health and Safety Plan for the Groundwater Monitoring Section - Routine Monitoring, Sampling, and Well Maintenance Activities.

Each Groundwater Monitoring sampling technician shall conform to all applicable precautionary surveys performed by the personnel representing the Utility Engineer, Industrial Hygiene, and Radiological Control. Concurrence to applicable safety permits (indicated by the signature of each Groundwater Monitoring sampling technician assigned to this project) is expected of each Groundwater Monitoring sampling technician in the performance of their assigned duties.

The Groundwater Monitoring Section supervisor shall ensure that each Groundwater Monitoring sampling technician assigned to this project has read, understands, and signs the Programmatic Health and Safety Plan and applicable surveys and permits. Any technician who does not sign these documents shall not participate in the execution of any sampling activities related to the completion of assigned project responsibilities. A current copy of the health and safety plan shall be in the field with the sampling technicians during sampling events.

B.10 SCHEDULE OF IMPLEMENTATION

Both groundwater monitoring and the construction of the northernmost waste cell of the on-site disposal facility will begin in 1997. Groundwater monitoring in existing monitoring wells in the on-site disposal facility area (2421, 2439, 2064, 2120, 2171, 2446, 2430, 2429, 2426, 2051, and 2424)

will begin on a quarterly basis in January of 1997. Monitoring in these existing aquifer wells will continue until the wells need to be abandoned to make way for on-site disposal facility cell construction. They will be replaced with permanent aquifer wells during cell construction. Quarterly monitoring will be conducted in the permanent wells upon their completion.

The first till monitoring well will be installed in 1997 during the initial phase of construction of the northernmost cell. Monitoring of the till well will begin in 1997 during construction and before waste placement. Additional till monitoring wells will be installed as the other waste cells are constructed.

REFERENCES

GeoSyntec Consultants (GeoSyntec), *"Pre-Design Investigation and Site Selection Report, On-Site Disposal Facility, Fernald Environmental Management Project,"* July, 1995, GeoSyntec Consultants, Atlanta, GA, 1996.

GeoSyntec Consultants (GeoSyntec), *"Intermediate Design Package, On-Site Disposal Facility, Fernald Environmental Management Project,"* April, 1996, GeoSyntec Consultants, Atlanta, GA, 1996.

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TABLE B-1

CONSTITUENTS WITH ON-SITE DISPOSAL FACILITY WASTE ACCEPTANCE CRITERIA (WAC)

Radionuclides	Inorganics
Neptunium-237	Boron
Strontium-90	Mercury
Technetium-99	Chromium VI
Total Uranium	Barium

Organics	Inorganics
1,2-Dichloroethane	1,1-Dichloroethene
Carbazole	1,2-Dichloroethene
Bis(2-chlorisopropyl)ether	Acetone
Alpha-chlordane	Benzene
Bromodichloromethane	Endrin
4-Nitroaniline	Ethylbenzene
Chloroethane	Heptachlor
1,1,1-Trichloroethane	Heptachlor epoxide
1,1-Dichloroethane	Hexachlorobutadiene
Carbon tetrachloride	Methoxychlor
Chloroform	Methyl ethyl ketone
Methylene chloride	Methyl isobutyl ketone
Chloromethane	Toluene
Vinyl Chloride	Toxaphene
Tetrachloroethane	Xylenes
Trichloroethene	

TABLE B-2

CONSTITUENTS LISTED AS PRELIMINARY VERIFICATION AND CERTIFICATION COMPOUNDS

Radionuclides	
Cesium-137	Plutonium-238
Lead-210	Radium-226
Neptunium-237	Radium-228
Strontium-90	Thorium-228
Technetium-99	Thorium-230
Total Uranium	Thorium-232

Inorganics	
Arsenic	Manganese
Beryllium	Vanadium
Lead	

Organics	
Aroclor-1254	Aroclor-1260
Benzo(a)anthracene	Benzo(a)pyrene
Benzo(b)fluoranthene	Dibenzo(a,h)anthracene
Dieldrin	1,1-Dichloroethene
Carbazole	Heptachlorodibenzo-p-dioxins
Indeno(1,2,3-cd)pyrene	Octachlorodibenzo-p-dioxin
Trichloroethane	Pentachlorophenol
Tetrachloroethane	Vinyl Chloride

TABLE B-3

CONSTITUENTS WITH on-site disposal facility WAC LISTED AS PVCCS > FRLS

Constituent	Soil FRL	Total Samples	Conc. > FRL	Samples > FRL (%)
Uranium, Total	20 (mg/kg)	5963	1013	16.99
Technetium-99	30 (pCi/g)	1539	46	2.99
Tetrachlorethene	3.6 (mg/kg)	1084	11	1.01
Neptunium-237	3.2 (pCi/g)	1339	11	0.82
Strontium-90	14 (pCi/g)	1498	7	0.47
Carbazole	12 (mg/kg)	484	2	0.41
Trichloroethane	25 (mg/kg)	1093	4	0.37
1,1-Dichloroethene	0.41 (mg/kg)	1088	1	0.09
Vinyl Chloride	0.13 (mg/kg)	1088	1	0.09

TABLE B-4

PARAMETER COMPARISON

MOBILITY (Kd)

		(mL/g)
1	Vinyl Chloride	2.21E-02
2	Technetium -99	1.18E-01
3	1,1	1.67E-01
4	Tetrachlorethene	1.88E+00
5	Trichloroethene	1.88E+00
6	Uranium, Total	3.10E+00
7	Strontium -90	1.00E+01
8	Carbazole	1.08E+01
9	Neptunium -237	5.50E+01

DETECTIONS > FRL

		Soil FRL	Total Samples	Percentage Conc. > FRL	Samples > FRL
1	Uranium, Total	20 (mg/kg)	5963	1013	16.99
2	Technetium -99	30 (pCi/g)	1539	46	2.99
3	Tetrachlorethene	3.6 (mg/kg)	1084	11	1.01
4	Neptunium-237	3.2 (pCi/g)	1339	11	0.82
5	Strontium-90	14 (pCi/g)	1498	7	0.47
6	Carbazole	12 (mg/kg)	484	2	0.41
7	Trichloroethene	25 (mg/kg)	1093	4	0.37
8	1,1-Dichloroethene	0.41 (mg/kg)	1088	1	0.09
9	Vinyl Chloride	0.13 (mg/kg)	1088	1	0.09

DETECTIONS > WAC

		OSDF WAC	Range Min - Max (Unit)	Percentage Samples > WAC
1	Uranium, Total	1030 (mg/kg)	0.28 - 57410 mg/kg	1.86
2	Technetium -99	29.1 (pCi/g)	0.05 - 581.0 pCi/g	1.23
3	Tetrachlorethene	11.4 (mg/kg)	0.001- 48.0 mg/kg	0.37
4	Neptunium-237	3.12E+9 (pCi/g)	0.10 - 144 pCi/g	0.00
5	Strontium-90	5.67E+10 (pCi/g)	0.25 - 57.5 pCi/g	0.00
6	Carbazole	7.27E+4 (mg/kg)	0.001- 8.90 mg/kg	0.00
7	Trichloroethene	128 (mg/kg)	0.001- 150 mg/kg	0.09
8	1,1-Dichloroethene	11.4 (mg/kg)	0.001 - 0.460 mg/kg	0.00
9	Vinyl Chloride	1.51 (mg/kg)	0.002 - 0.670 mg/kg	0.00

DECAY HALF-LIFE

		(Years)
1	Carbazole	none
2	Uranium, Total	4.47E+09
3	Neptunium-237	2.eL+06
4	Technetium-99	2.13E+05
5	Strontium-90	2.86E+01
6	Vinyl Chloride	7.91E+00
7	Tetrachlorethane	4.52E+00
8	Trichloroethane	4.52E+00
9	1,1-Dichloroethene	4.90E-01

Kd = distribution coefficient
FRL = Final Remediation Level
OSDF = on-site disposal facility

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TABLE B-5

URANIUM (TOTAL), AND CONTAMINATION INDICATOR BACKGROUND VALUES FOR PERCHED, AND GREAT MIAMI AQUIFER GROUNDWATER

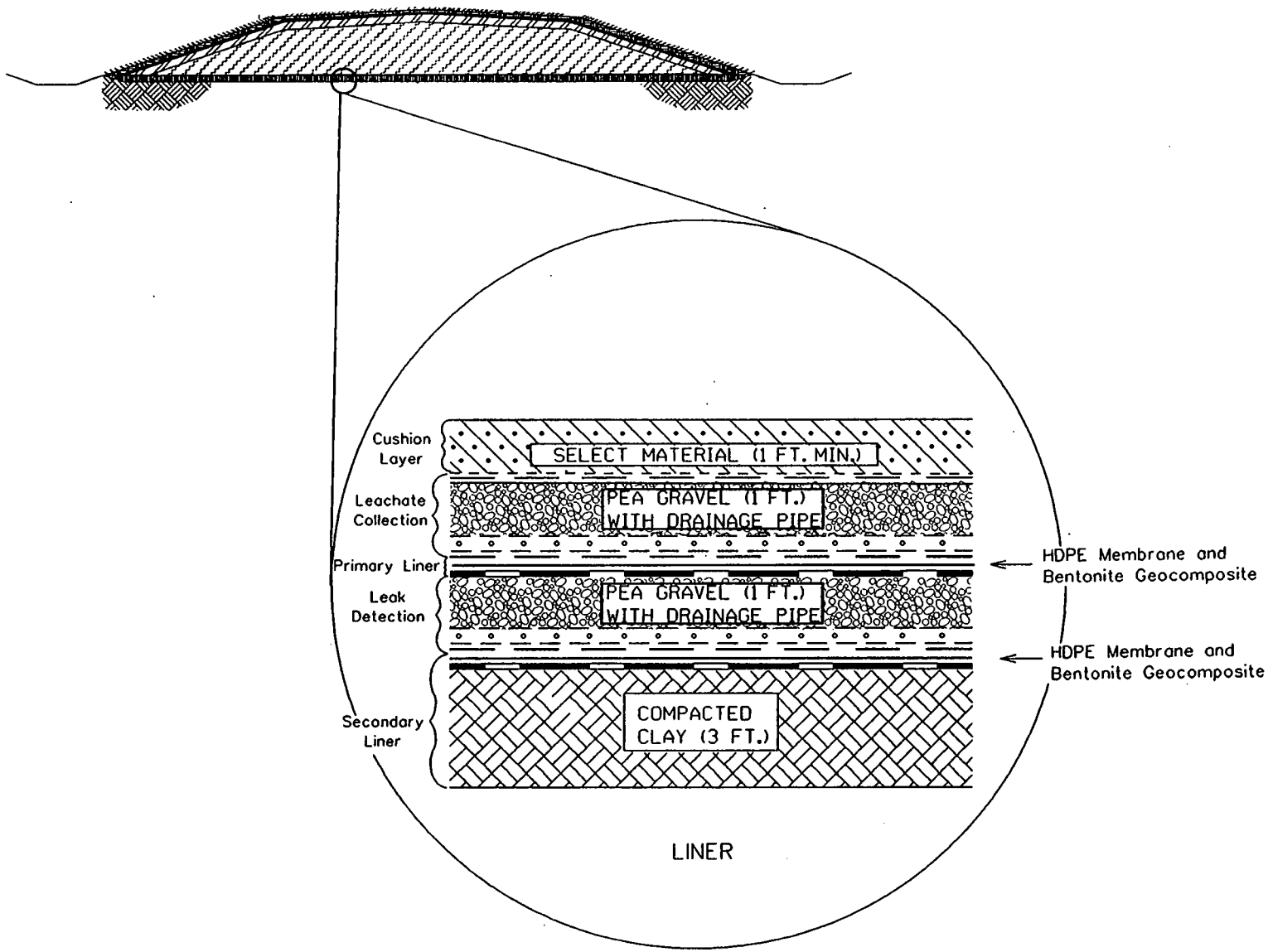
Parameter	Perched GW Background	GMA GW Background
Uranium (total)	3.4 μg/L	1.3 μg/L
pH	7.7 std units	7.7 std units
Specific Conductance		928 umhos/cm
Total Organic Carbon	9 mg/L	3.87 mg/L
Total Organic Halogens	0.126 mg/L	0.052 mg/L

TABLE B-6

SAMPLING REQUIREMENTS

Analyte	ASL	Method	Units	Preservation	Container
total uranium	D	kinetic phosphorescence	μg/L	HNO_3 < pH 2	1 L plastic
technetium-99	D	proportional counting	pCi/L	HNO_3 < pH 2	1 L plastic
total organic carbon	B	as specified	mg/L	HNO_3 < pH 2	250 mL plastic
total organic halogens	B	as specified	mg/L	none	250 mL plastic

FIGURE B.1 COMPOSITE LINER CROSS SECTION



/usr/ermo5/2ardi/dgn/sitecel4.dgn

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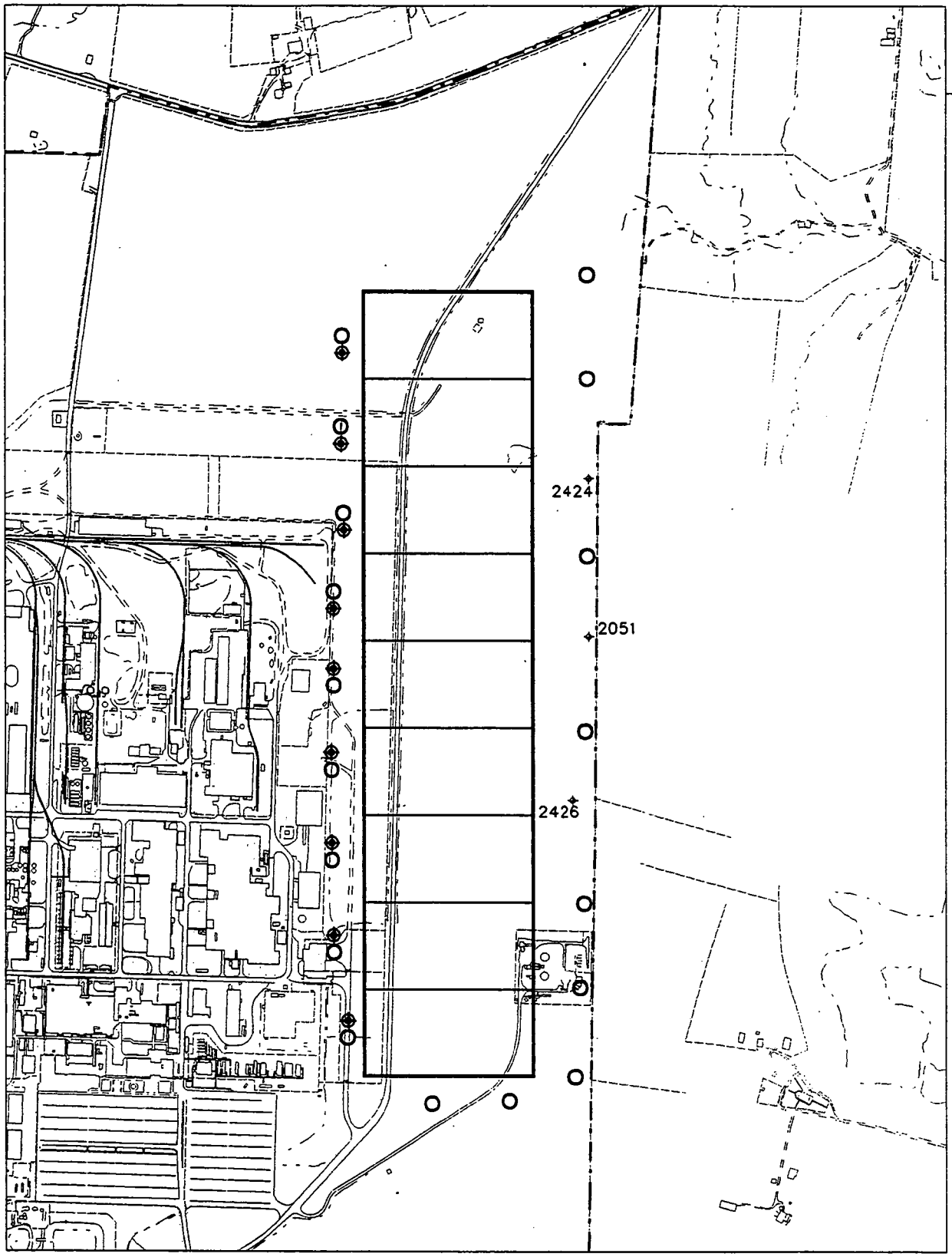
/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMP075.DGN FER OU5 5/21/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

PROPOSED OSDF GMA DETECTION MONITORING WELL

PROPOSED OSDF TILL DETECTION MONITORING WELL

SCALE

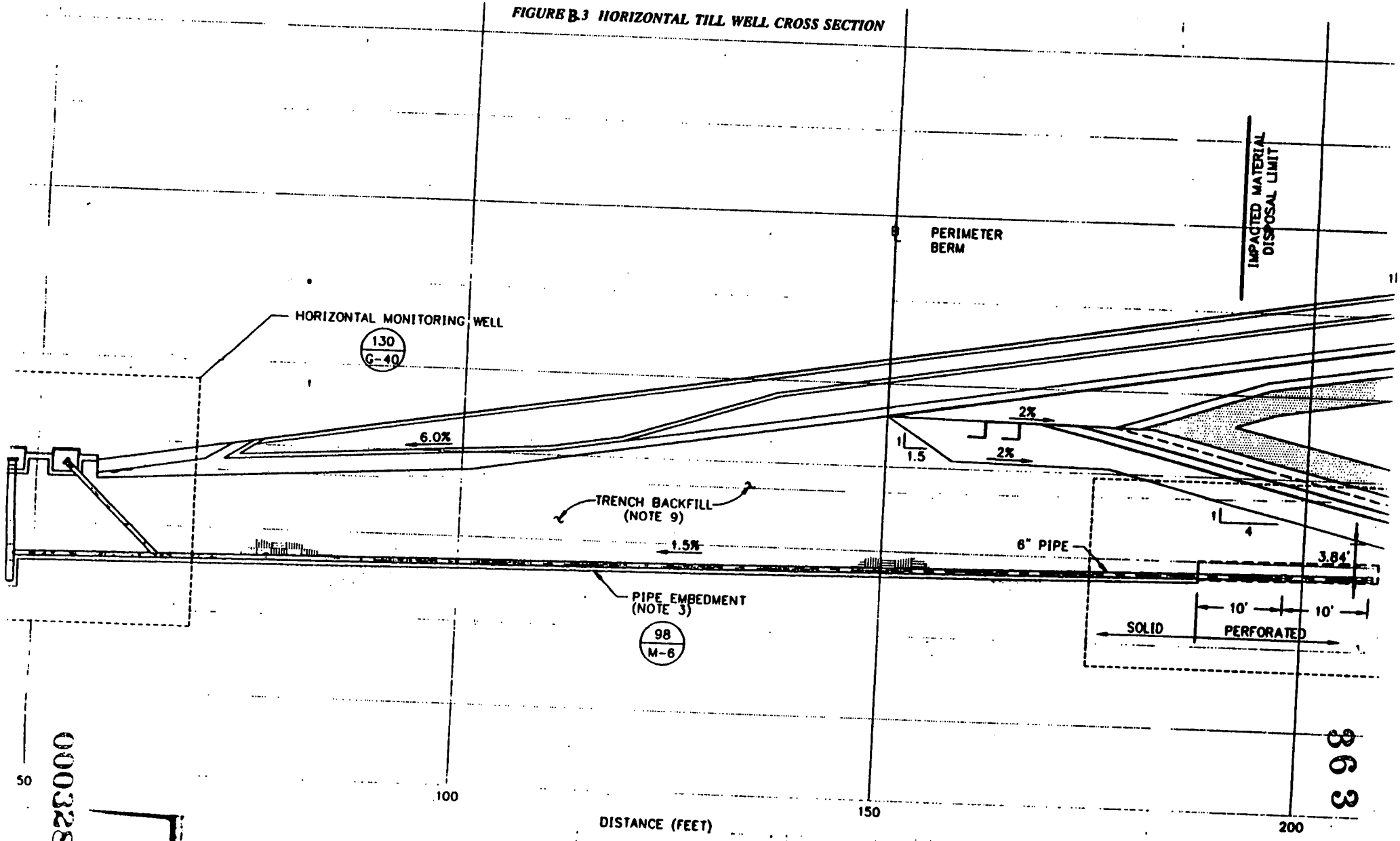
700 350 0 700 FEET

DRAFT

FIGURE B.2. OSDF GROUNDWATER MONITORING SYSTEM

PRELIMINARY

FIGURE B-3 HORIZONTAL TILL WELL CROSS SECTION



000328

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Appendix C

APPENDIX C

SURFACE WATER FRL AND BTV EXCEEDENCES

APPENDIX C

SURFACE WATER FRL AND BTV EXCEEDENCES

This appendix provides backup information regarding the FRL/BTV exceedances which were summarized in Table 4-1 as part of the parameter selection criteria for the IEMP surface water sampling program. As discussed in Section 4.4.2.3, a limited number of constituents have been detected above the respective FRL and/or BTV at sporadic surface water monitoring locations. To better quantify the actual number and location of exceedances, historical surface water data were compiled and compared to FRLs and BTVs to determine the number and locations of the exceedances.

This appendix provides figures which document by constituent, the particular sampling locations where FRLs and BTVs have been exceeded. The figures also depict the number of exceedances for a particular constituent at each location. Drainage basin flow patterns (see Figure C-1) were also evaluated to determine appropriate downstream sampling locations. Figures C-2 to C-12 depict by constituent those locations where FRLs have been exceeded. BTV exceedances are summarized in Figures C-13 to C-22. On all these figures the number of exceedances is shown in parentheses for each location when the number of exceedences was greater than one.

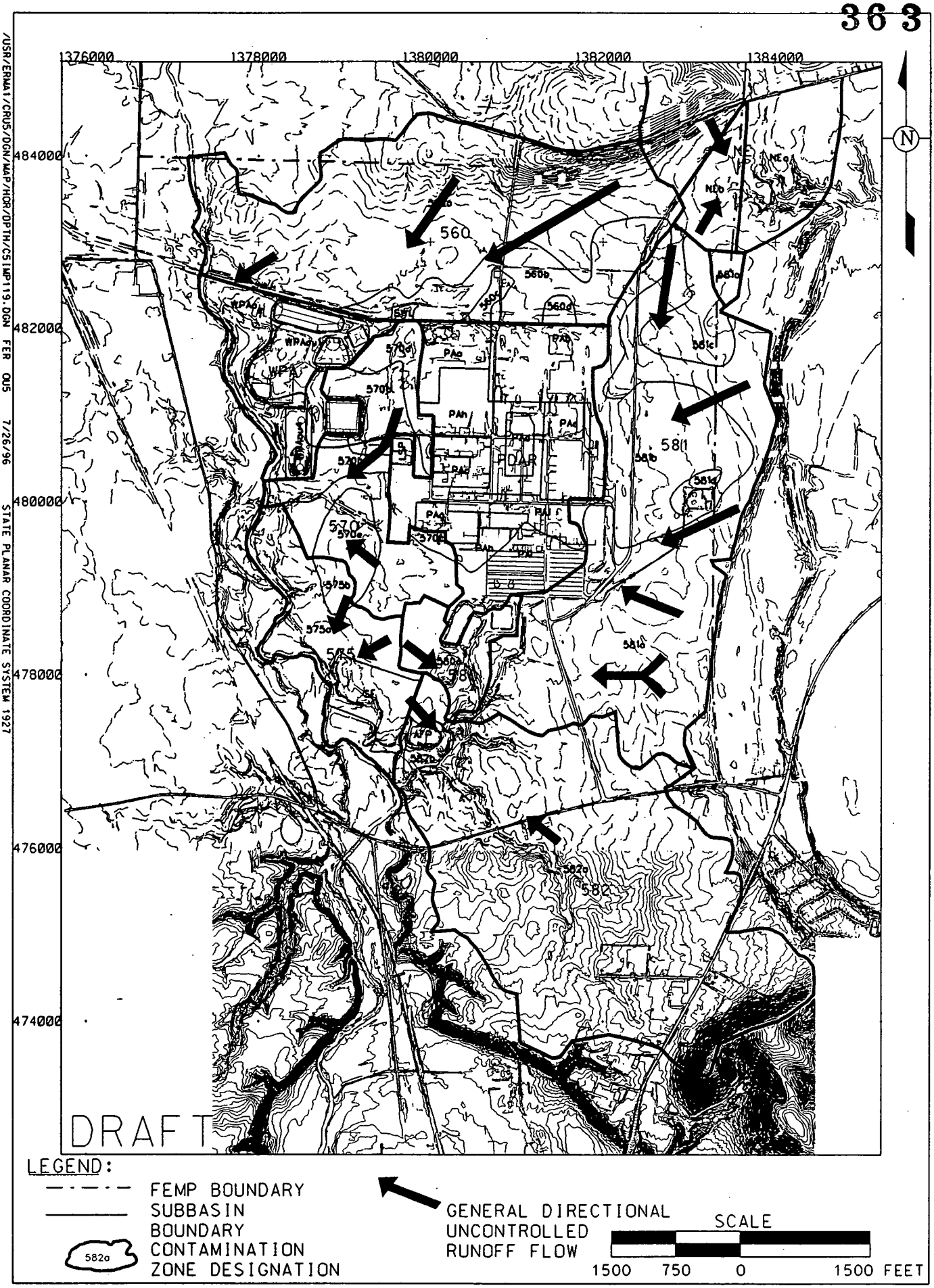


FIGURE C-1. UNCONTROLLED SURFACE WATER RUNOFF FLOW DIRECTION

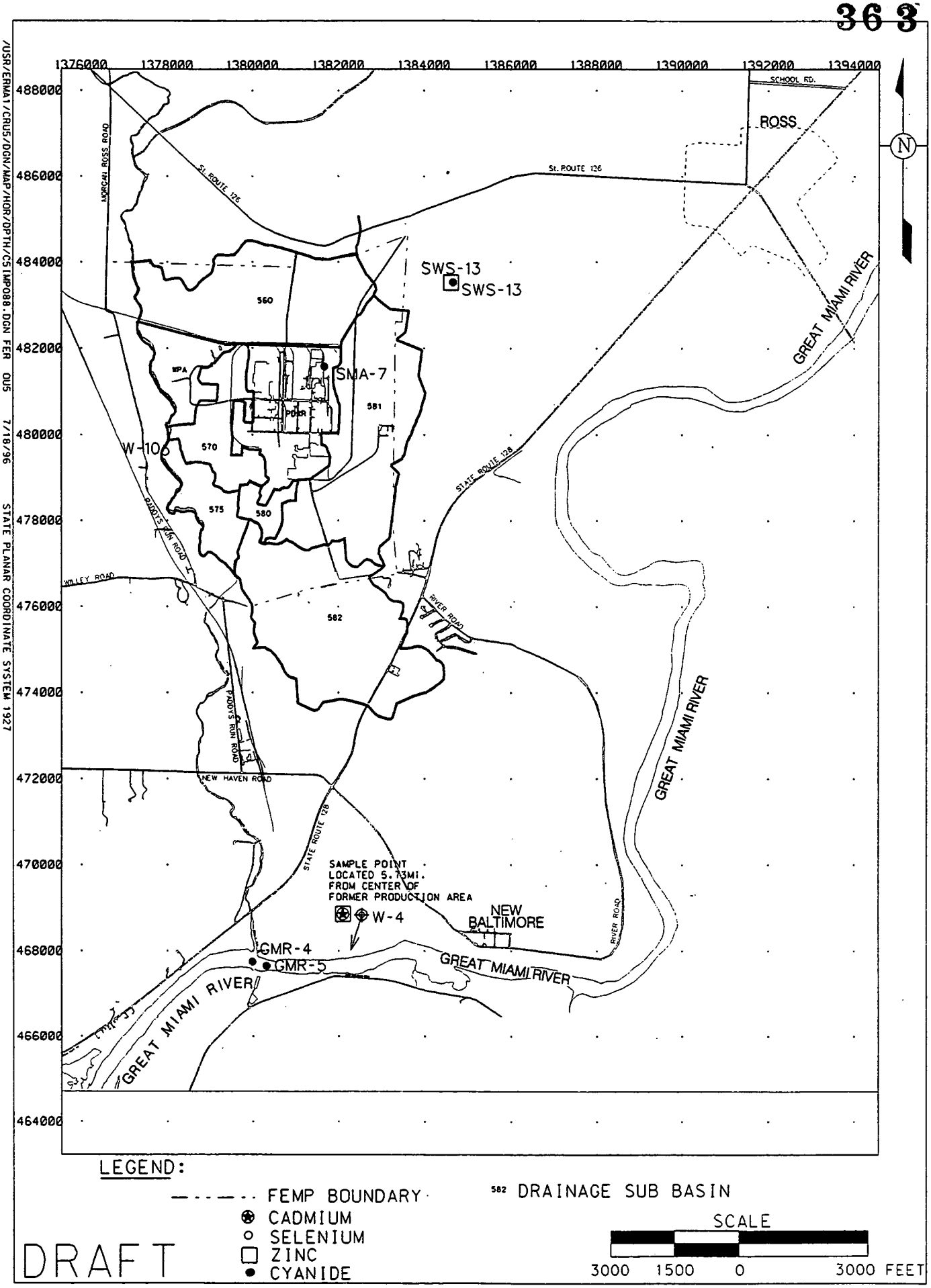
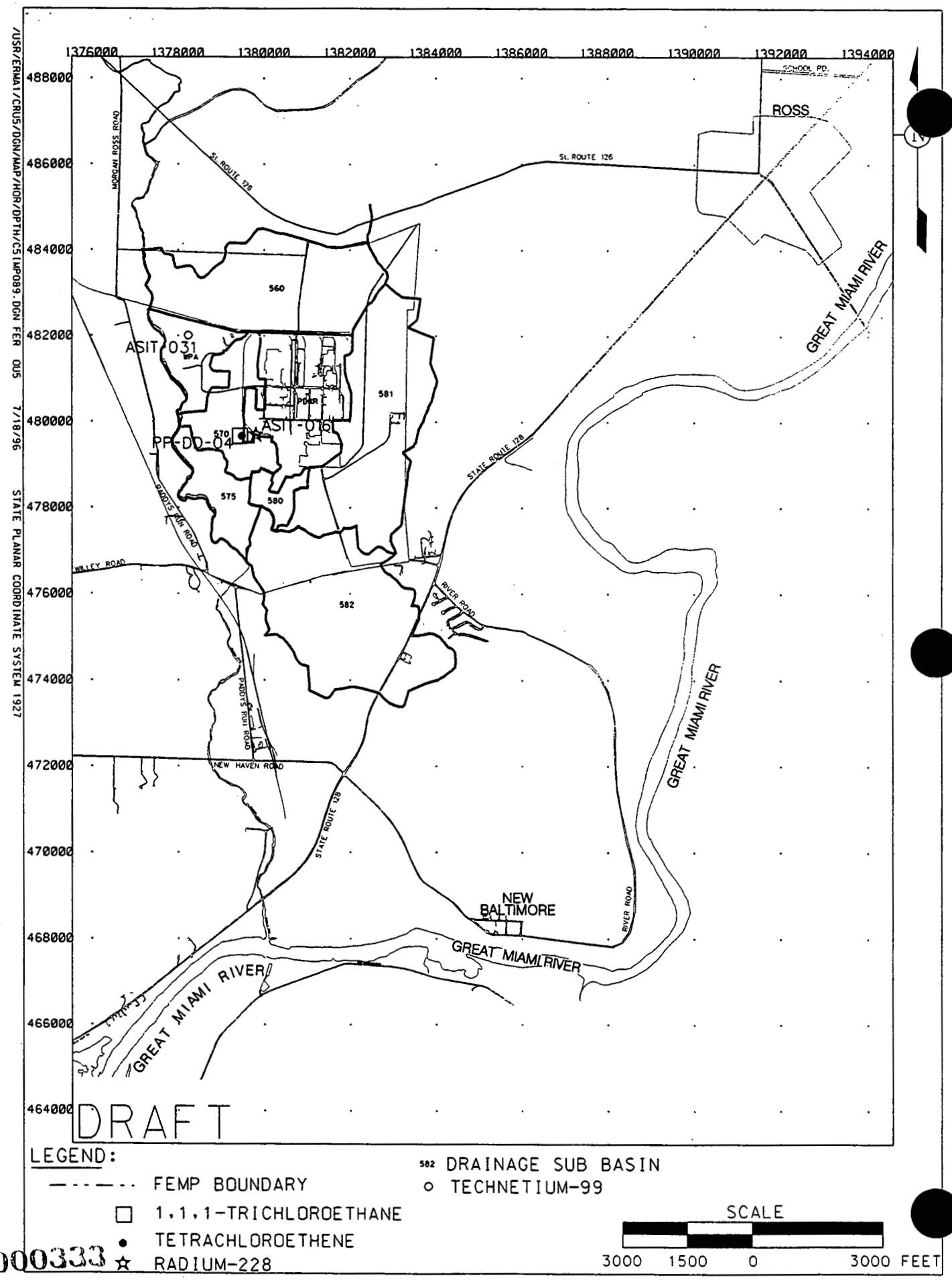


FIGURE C-2. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR CADMIUM, SELENIUM, ZINC AND CYANIDE



LEGEND:

- FEMP BOUNDARY
- 1,1,1-TRICHLOROETHANE
- TETRACHLOROETHENE
- RADIUM-228
- 582 DRAINAGE SUB BASIN
- TECHNETIUM-99

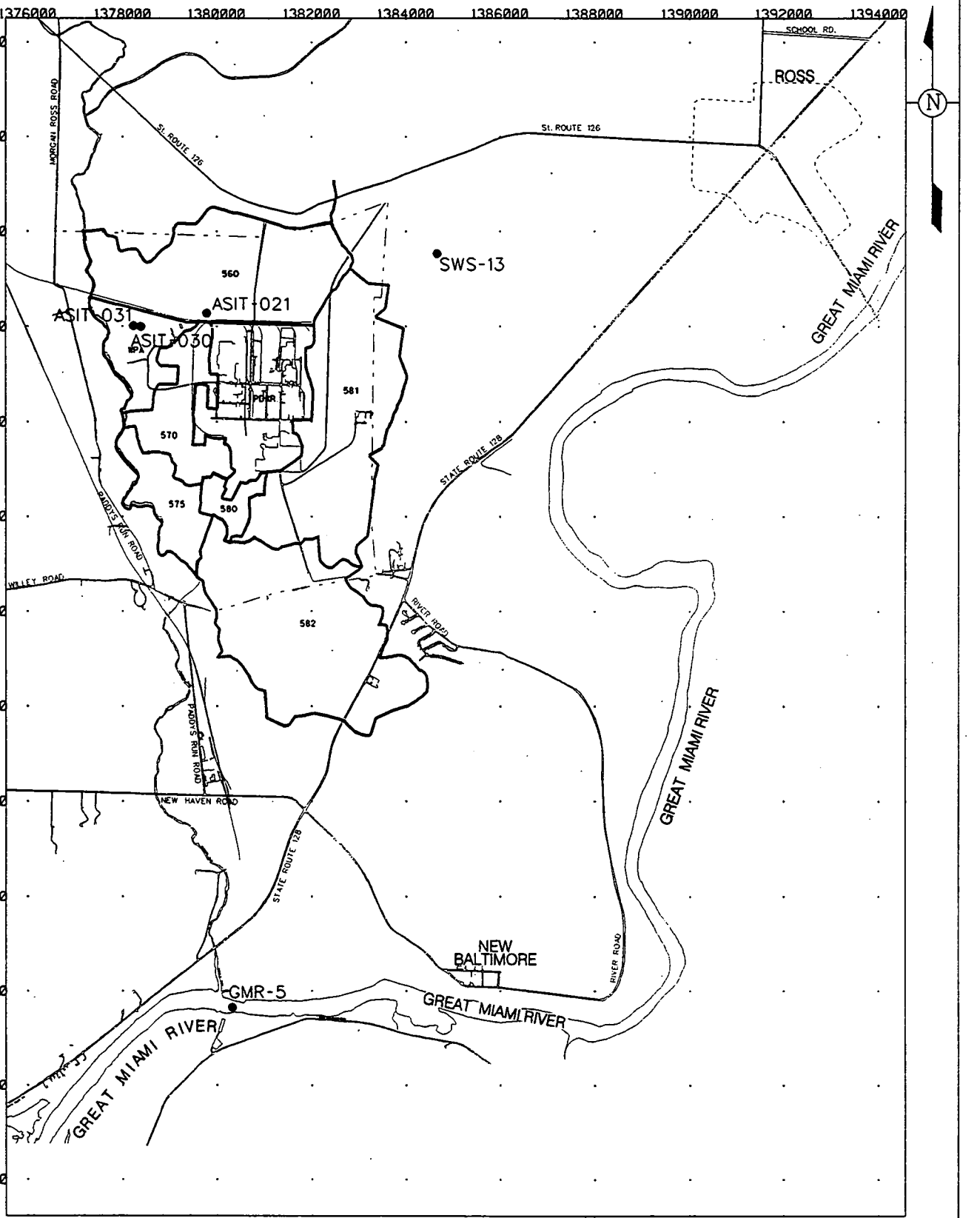
SCALE

3000 1500 0 3000 FEET

000333

FIGURE C-3. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR 1,1,1-TRICHLOROETHANE, TETRACHLOROETHENE, TECHNETIUM-99 AND RADIUM-228

/USR/ERMA1/CRUS/DGN/MAP/HOR/DPTH/C5[MP090.DGN FER OU5 7/18/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

BERYLLIUM

582 DRAINAGE SUB BASIN

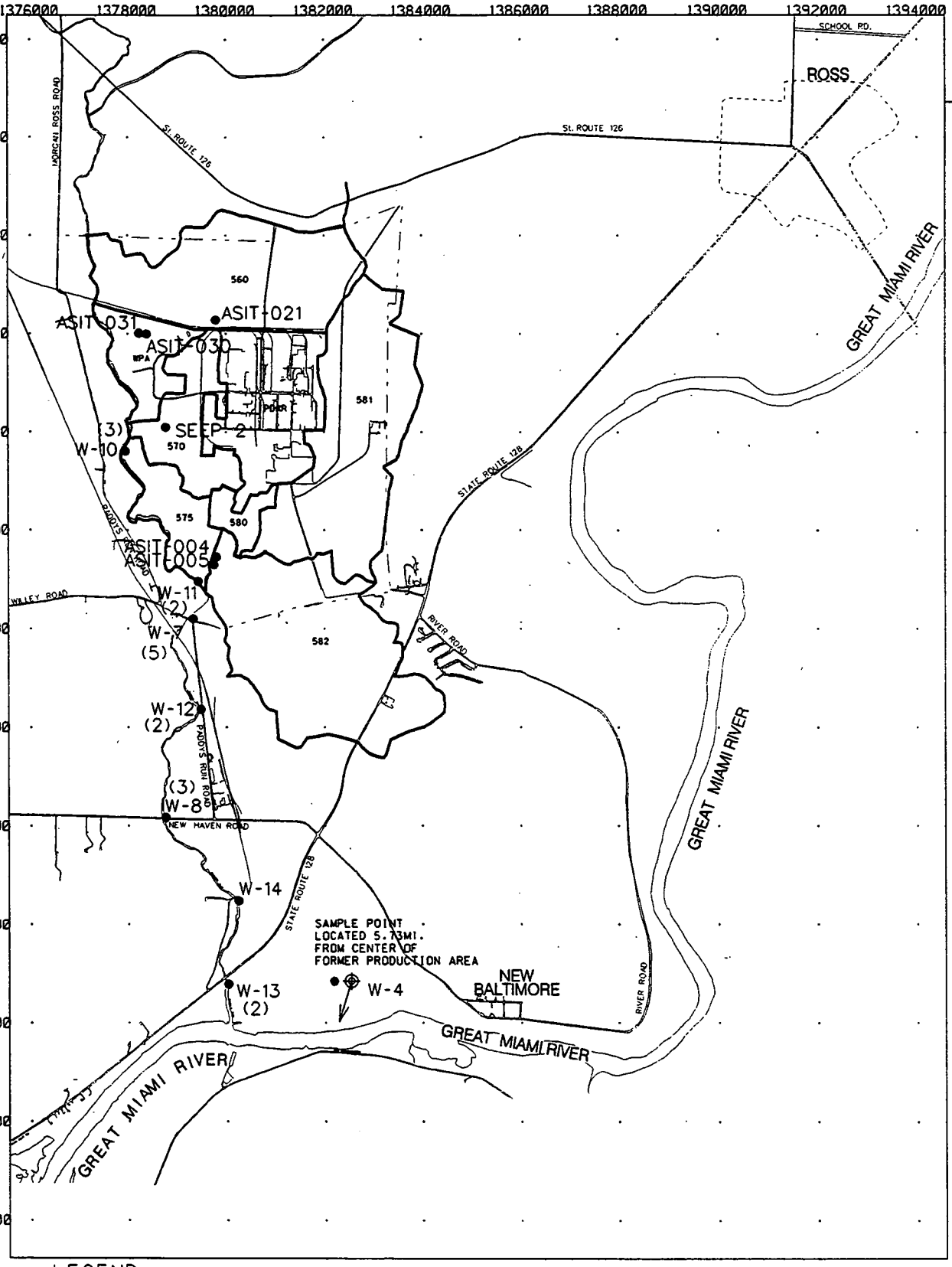
SCALE

3000 1500 0 3000 FEET

DRAFT

FIGURE C-4. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR BERYLLIUM

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMPO91.DGN FER OU5 7/18/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

- FEMP BOUNDARY
- CHROMIUM
- 582 DRAINAGE SUB BASIN
- (2) NUMBER OF EXCEEDANCES

SCALE

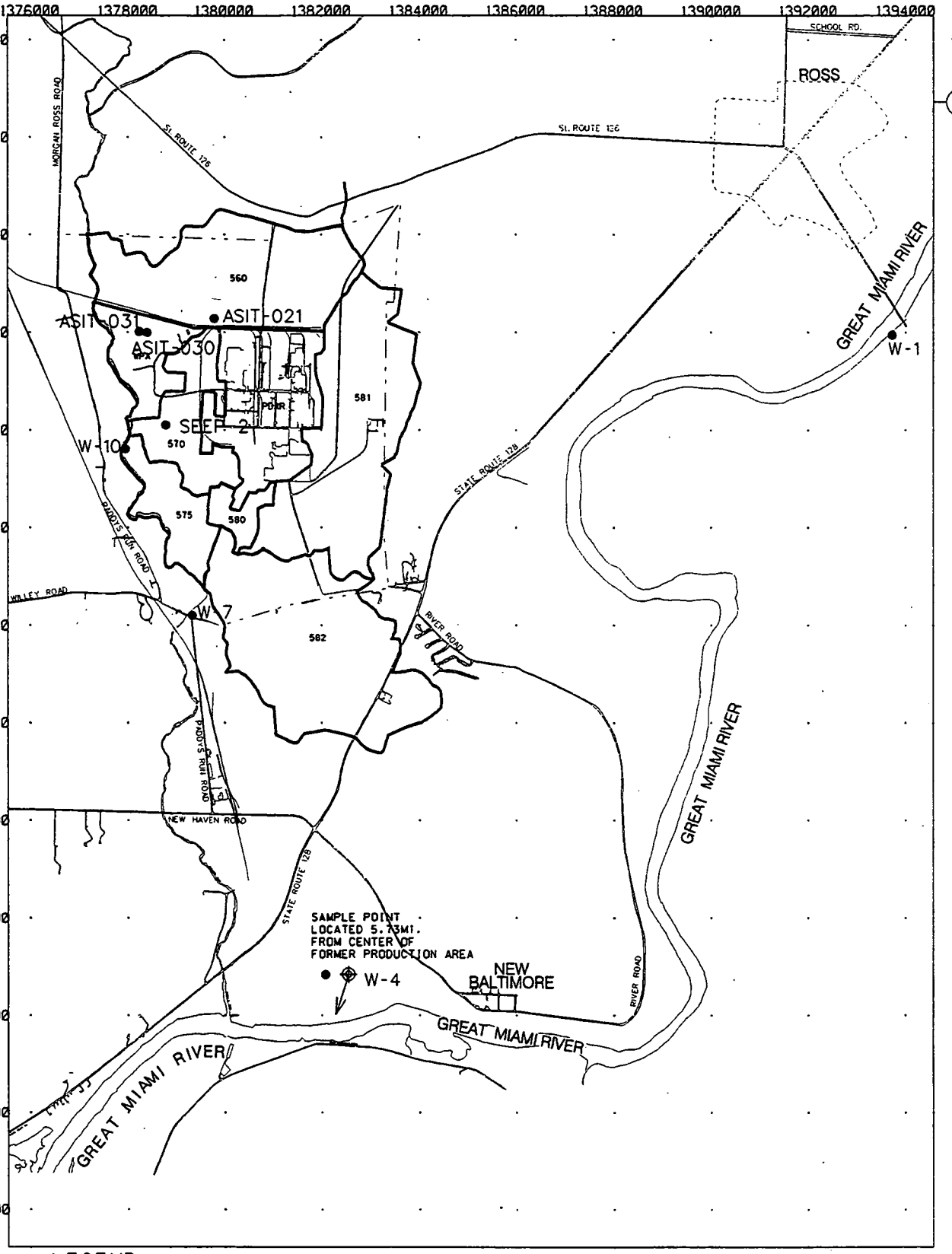
3000 1500 0 3000 FEET

DRAFT

FIGURE C-5. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR CHROMIUM

000335

/USR/ERMA1/CRU5/DGN/MAP/HOR/OPTH/C5IMP092.DGN FER 005 7/18/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

COPPER

582 DRAINAGE SUB BASIN

SCALE

3000 1500 0 3000 FEET

DRAFT

FIGURE C-6. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR COPPER

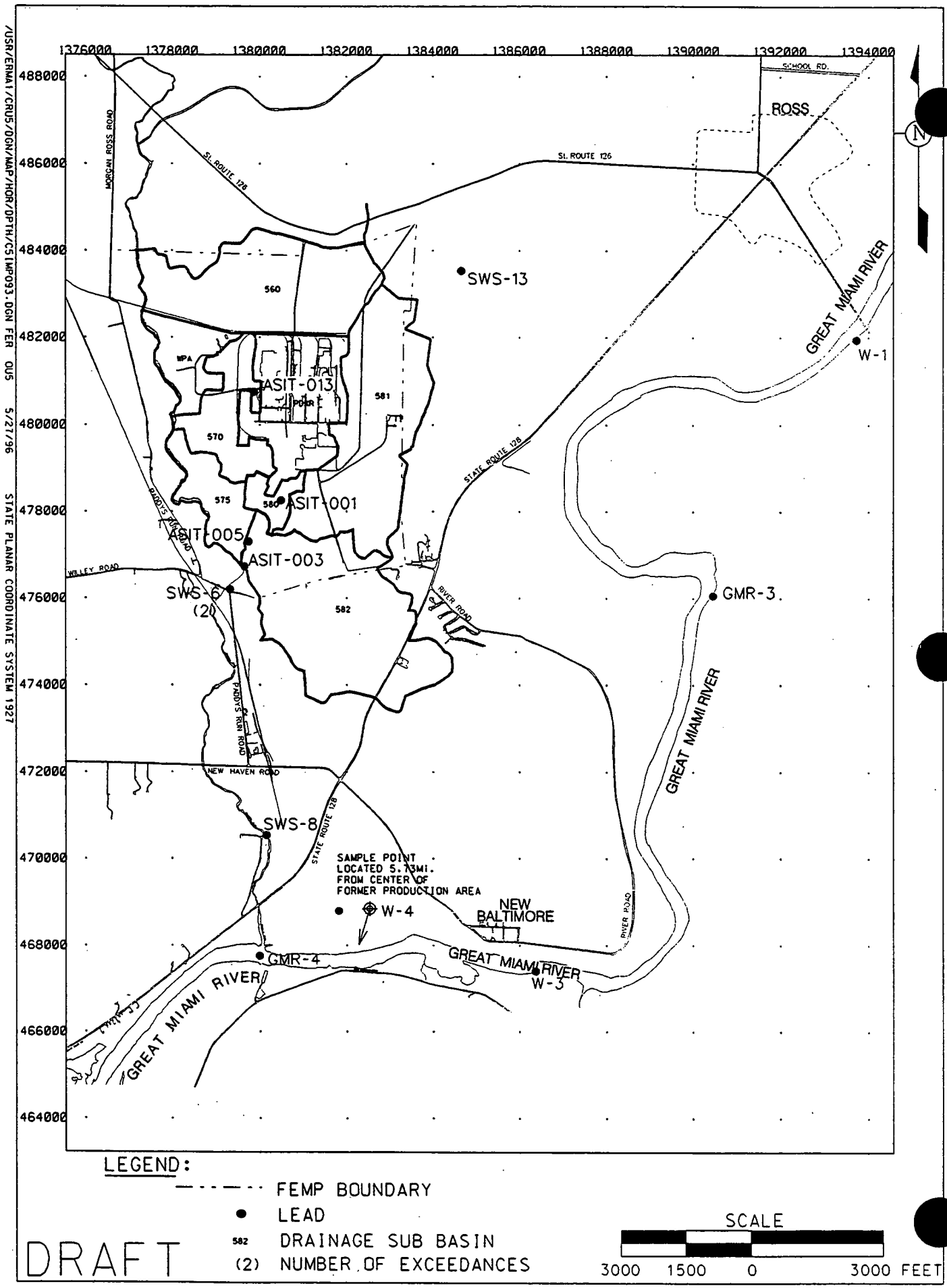


FIGURE C-7. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR LEAD

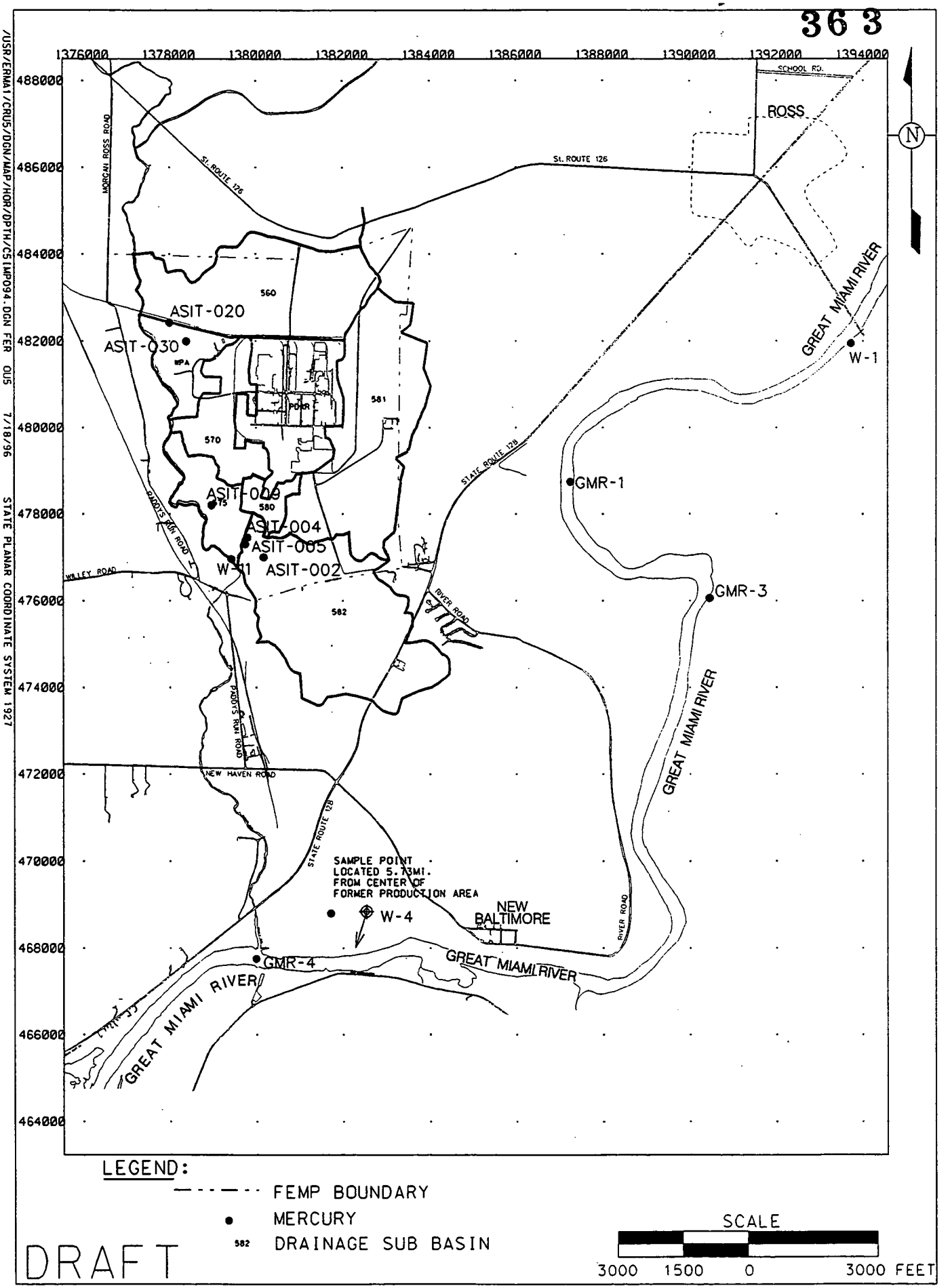


FIGURE C-8. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR MERCURY

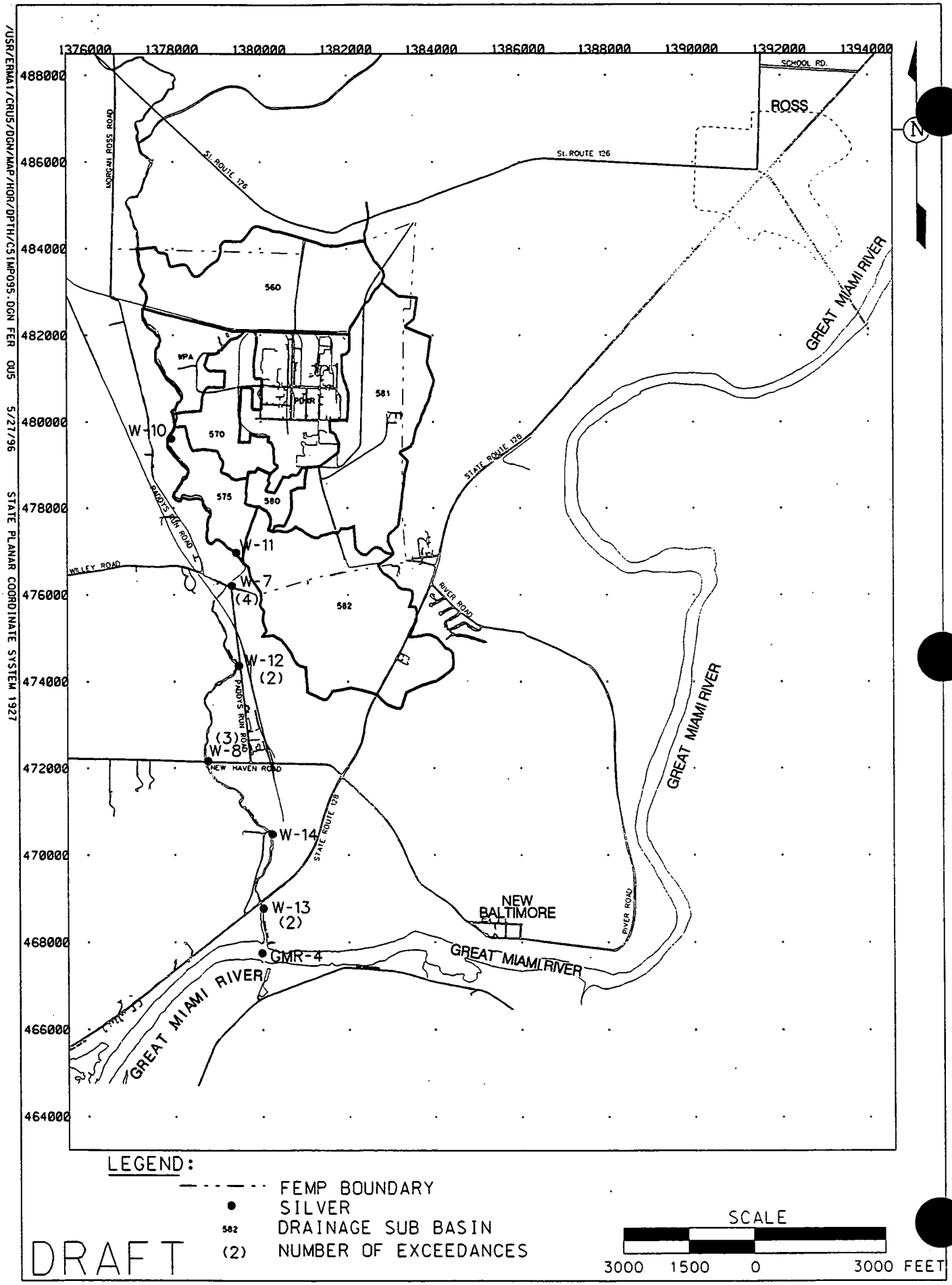


FIGURE C-9. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR SILVER

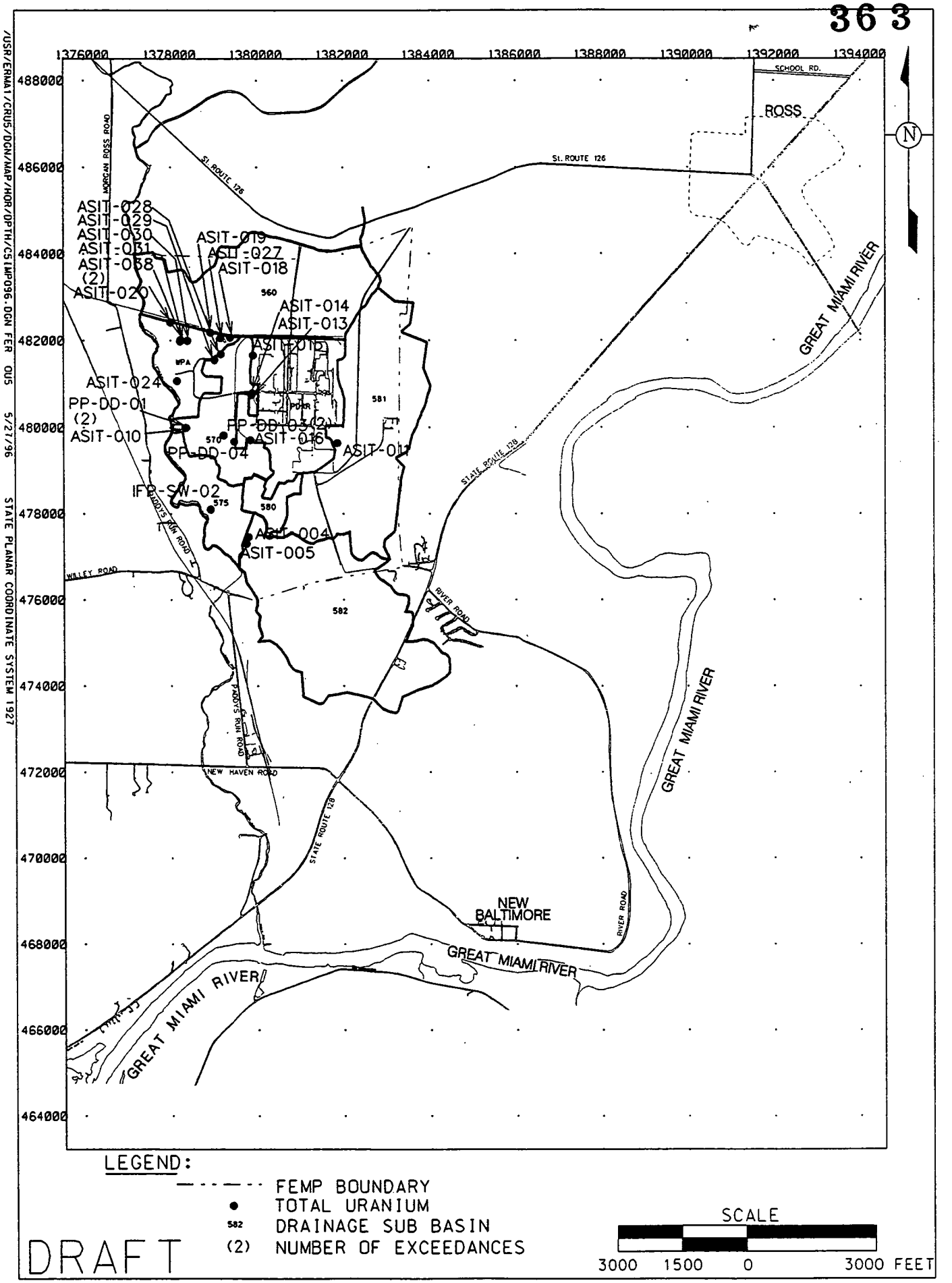


FIGURE C-10. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR TOTAL URANIUM

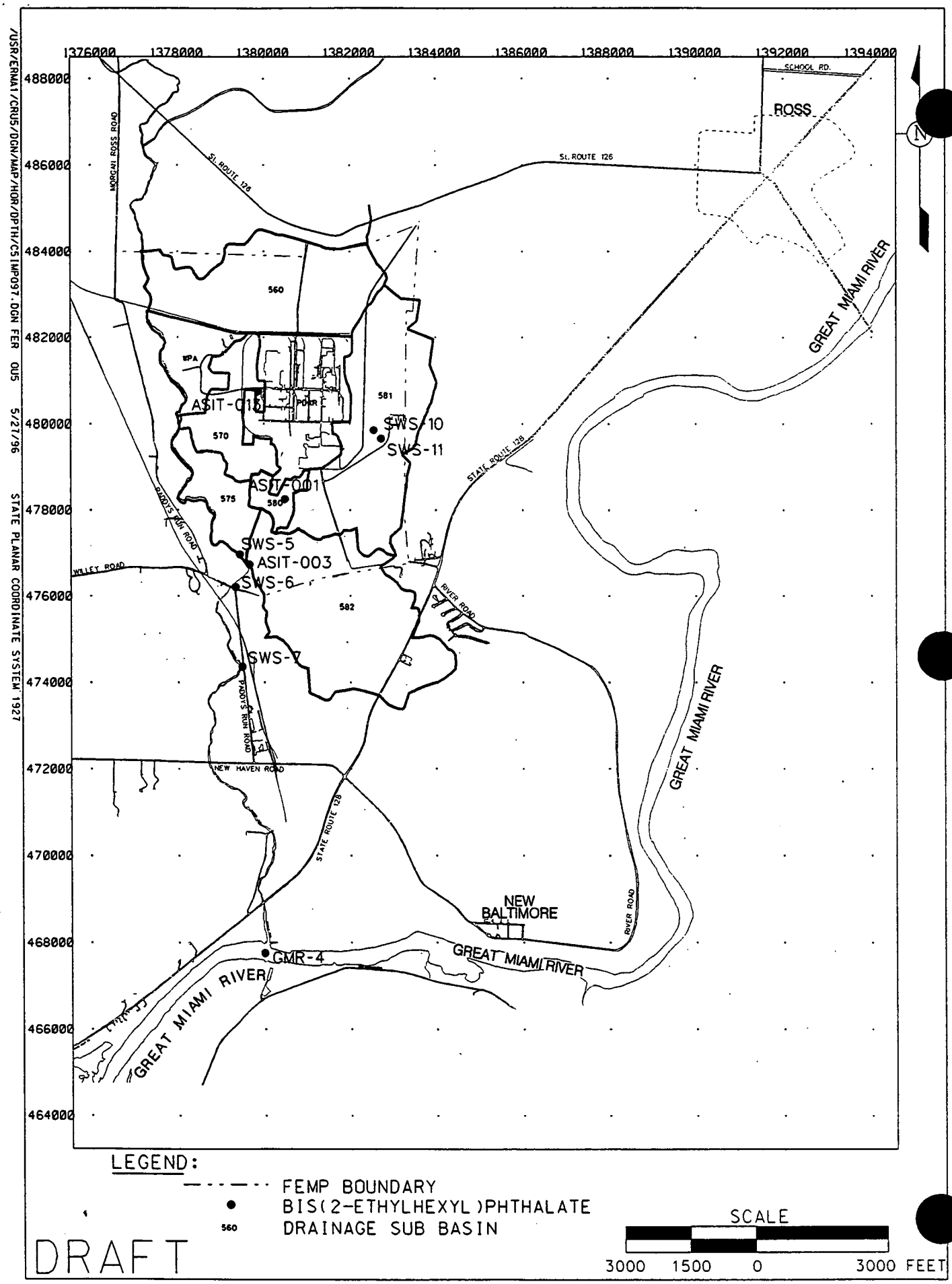
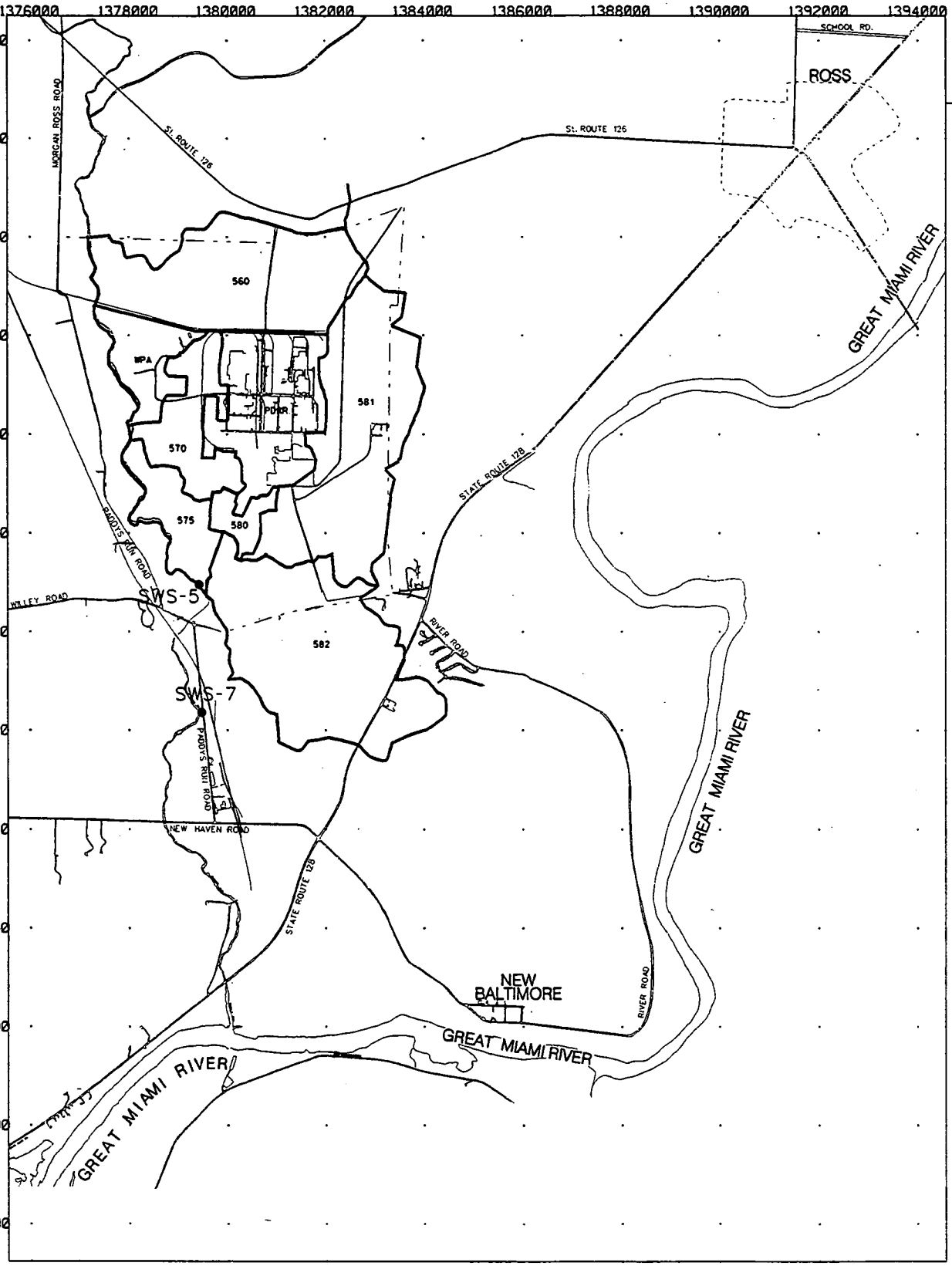


FIGURE C-11. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR BIS(2-ETHYLHEXYL)PHTHALATE

000341

/USR/ERMAT/CRU5/DGN/MAP/HOR/OPTH/C5IMP121.DGN FER OU5 5/29/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

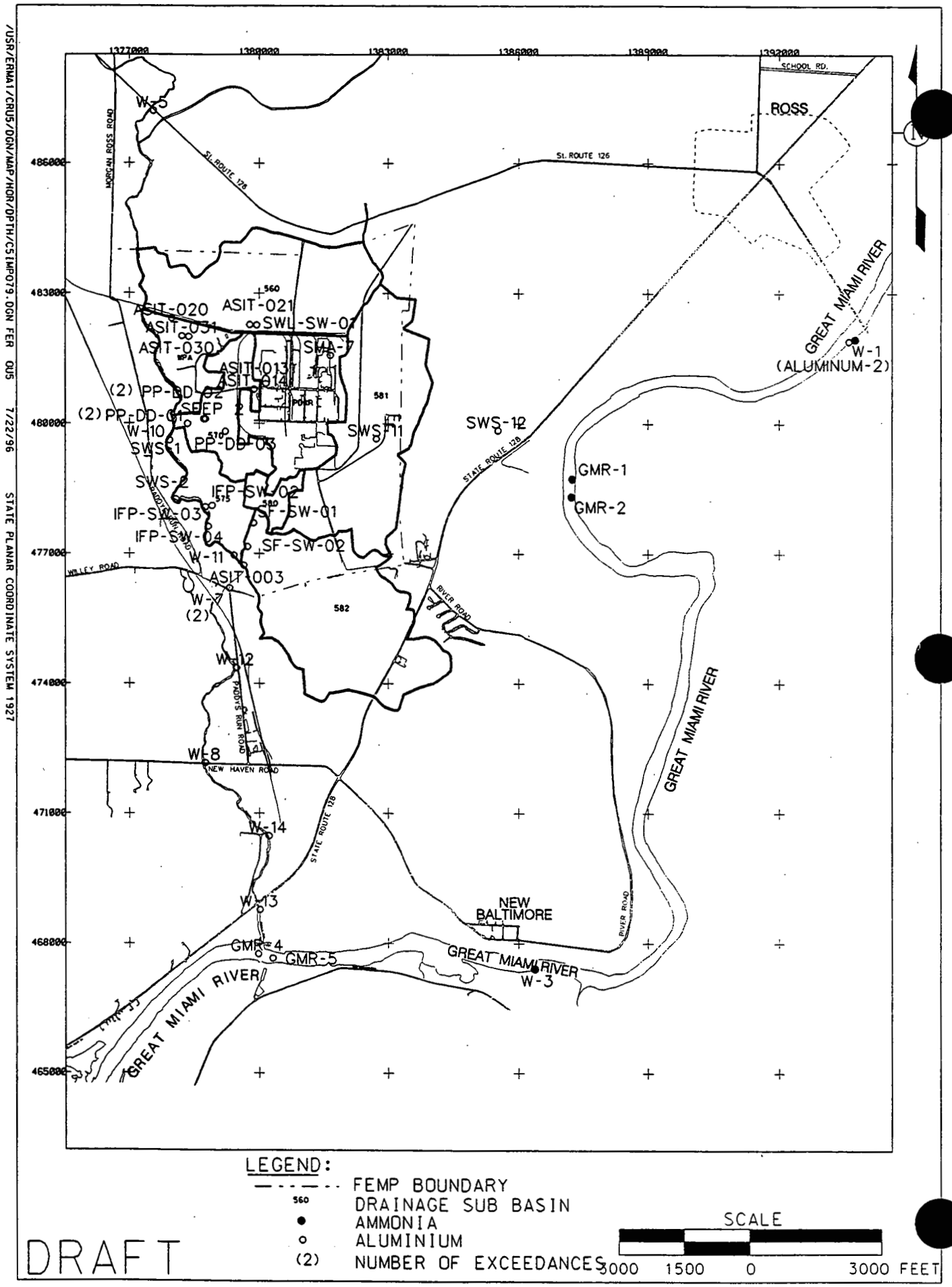
- FEMP BOUNDARY
- ● DI-N-OCTYLPHTHALATE
- 560 DRAINAGE SUB BASIN

SCALE

3000 1500 0 3000 FEET

DRAFT

FIGURE C-12. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE FRL FOR DI-N-OCTYLPHTHALATE



LEGEND:

- FEMP BOUNDARY
- 560 DRAINAGE SUB BASIN
- ● AMMONIA
- ○ ALUMINIUM
- (2) NUMBER OF EXCEEDANCES

SCALE

3000 1500 0 3000 FEET

DRAFT

FIGURE C-13. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR ALUMINIUM AND AMMONIA

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMP080.DGN FER OU5 7/18/96 STATE PLANAR COORDINATE SYSTEM 1927

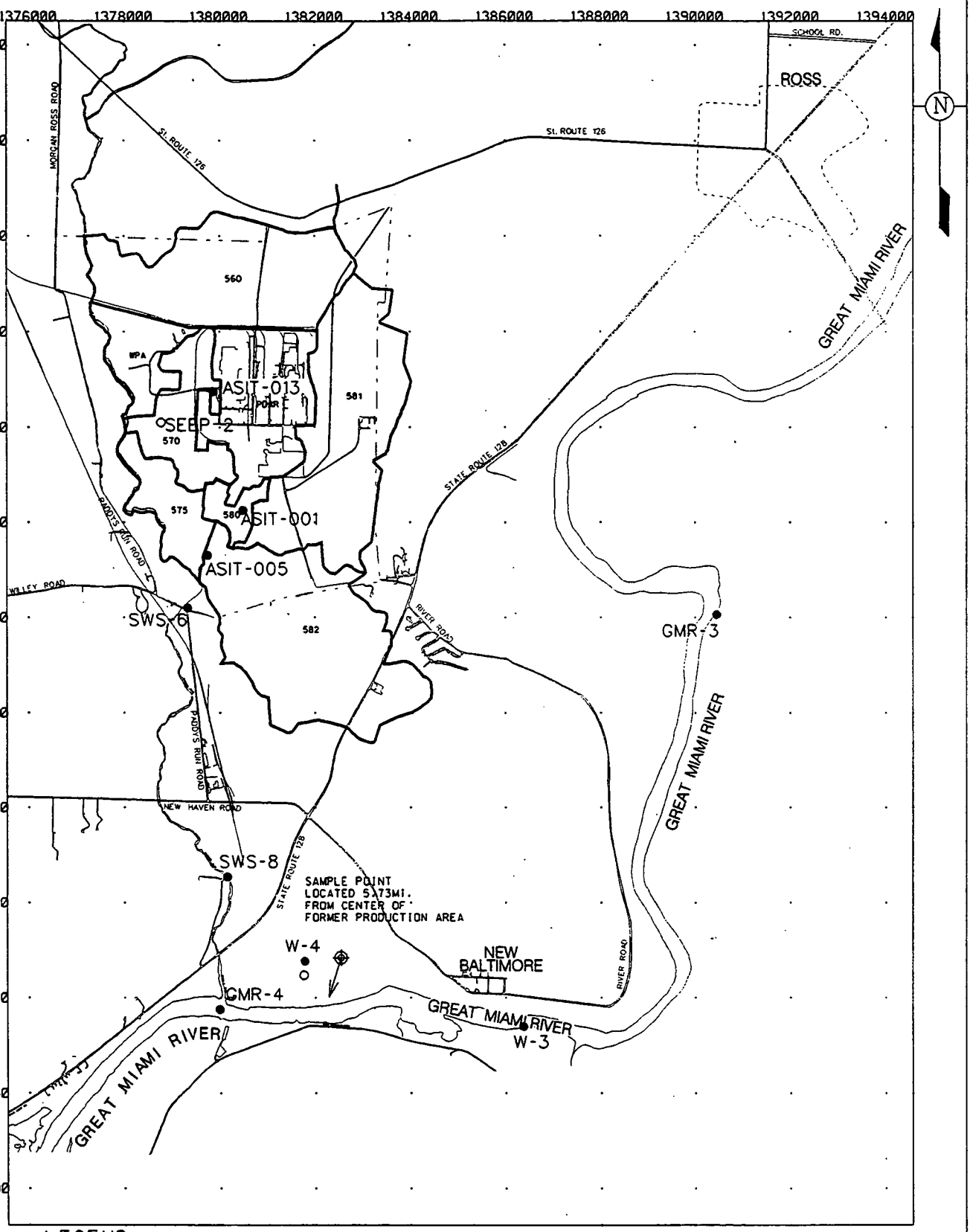


FIGURE C-14. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR LEAD AND BARIUM

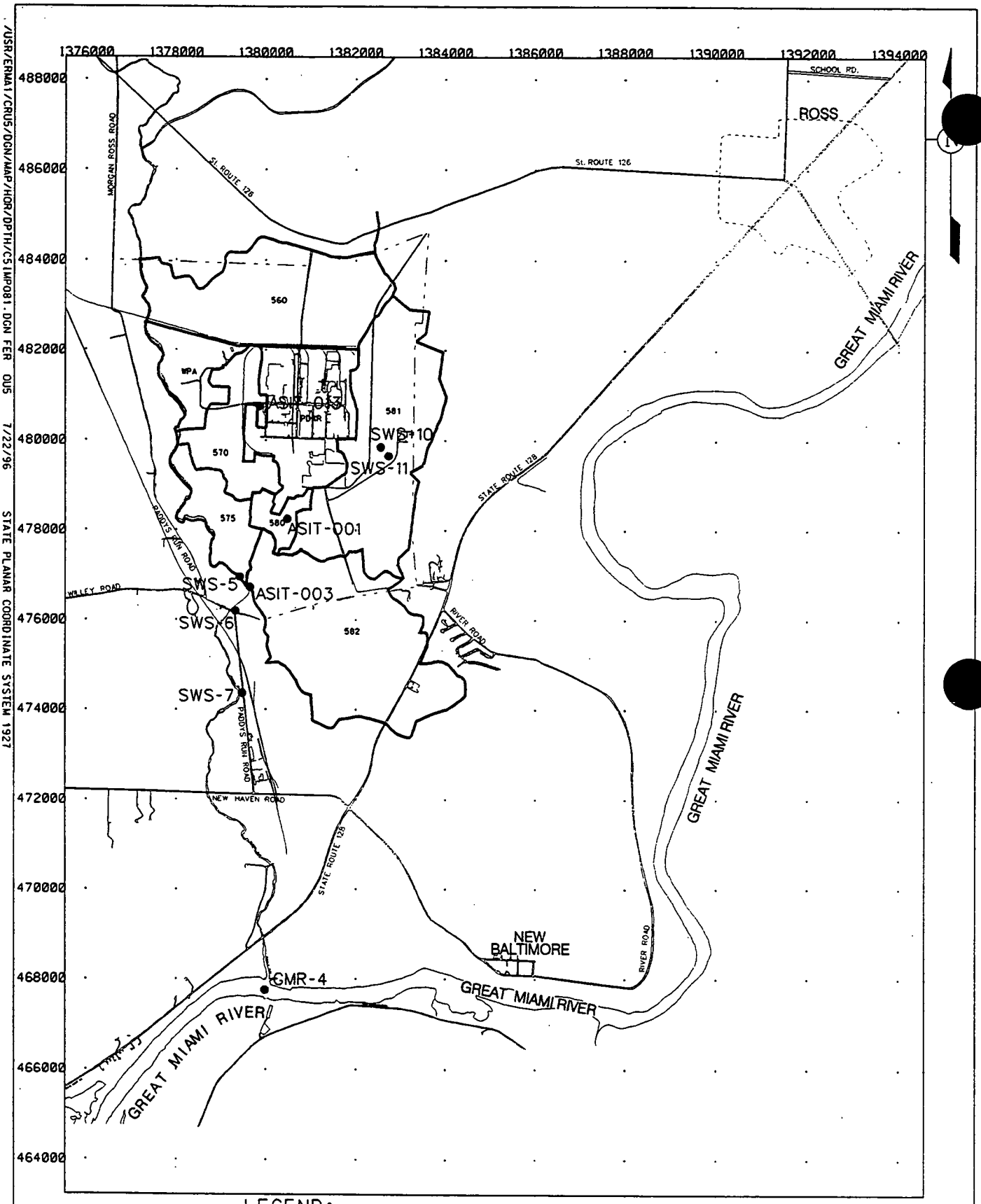


FIGURE C-15. SURFACE WATER LOCATION WITH CONCENTRATIONS ABOVE THE BTV FOR BIS (2-ETHYLHEXYL)PHTHALATE

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMP081.DGN FER OU5 7/22/96 STATE PLANAR COORDINATE SYSTEM 1927

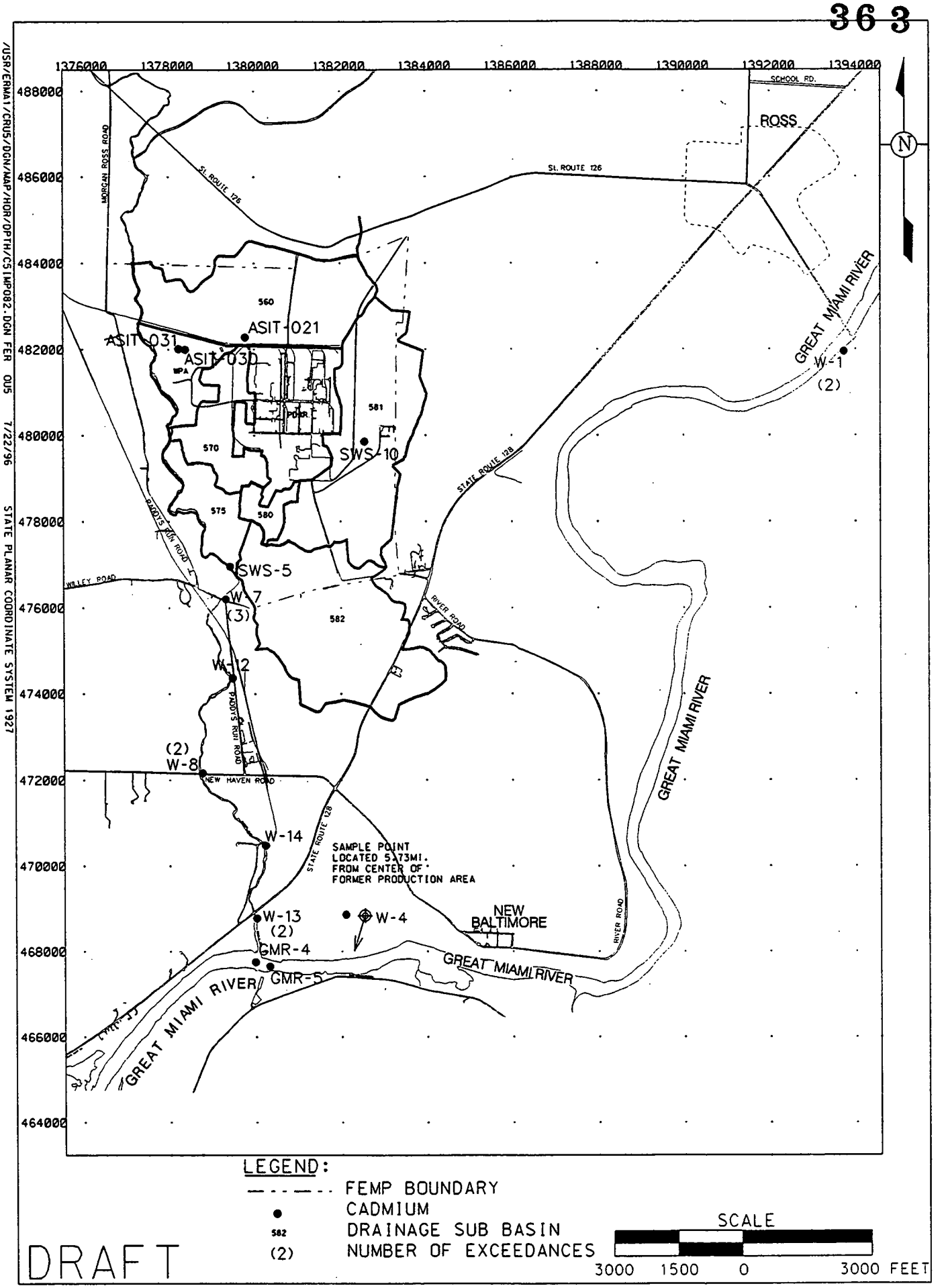


FIGURE C-16. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR CADMIUM

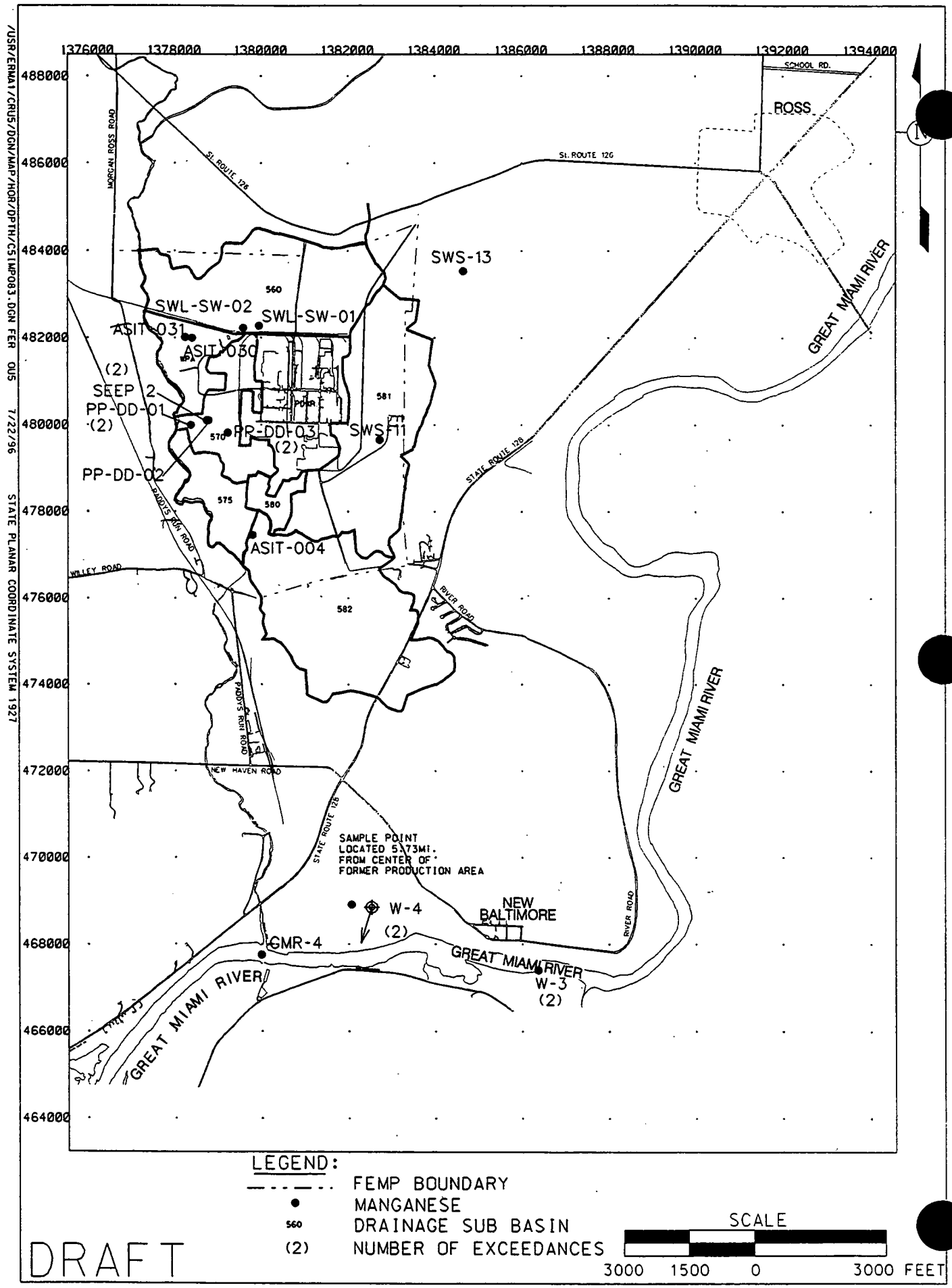
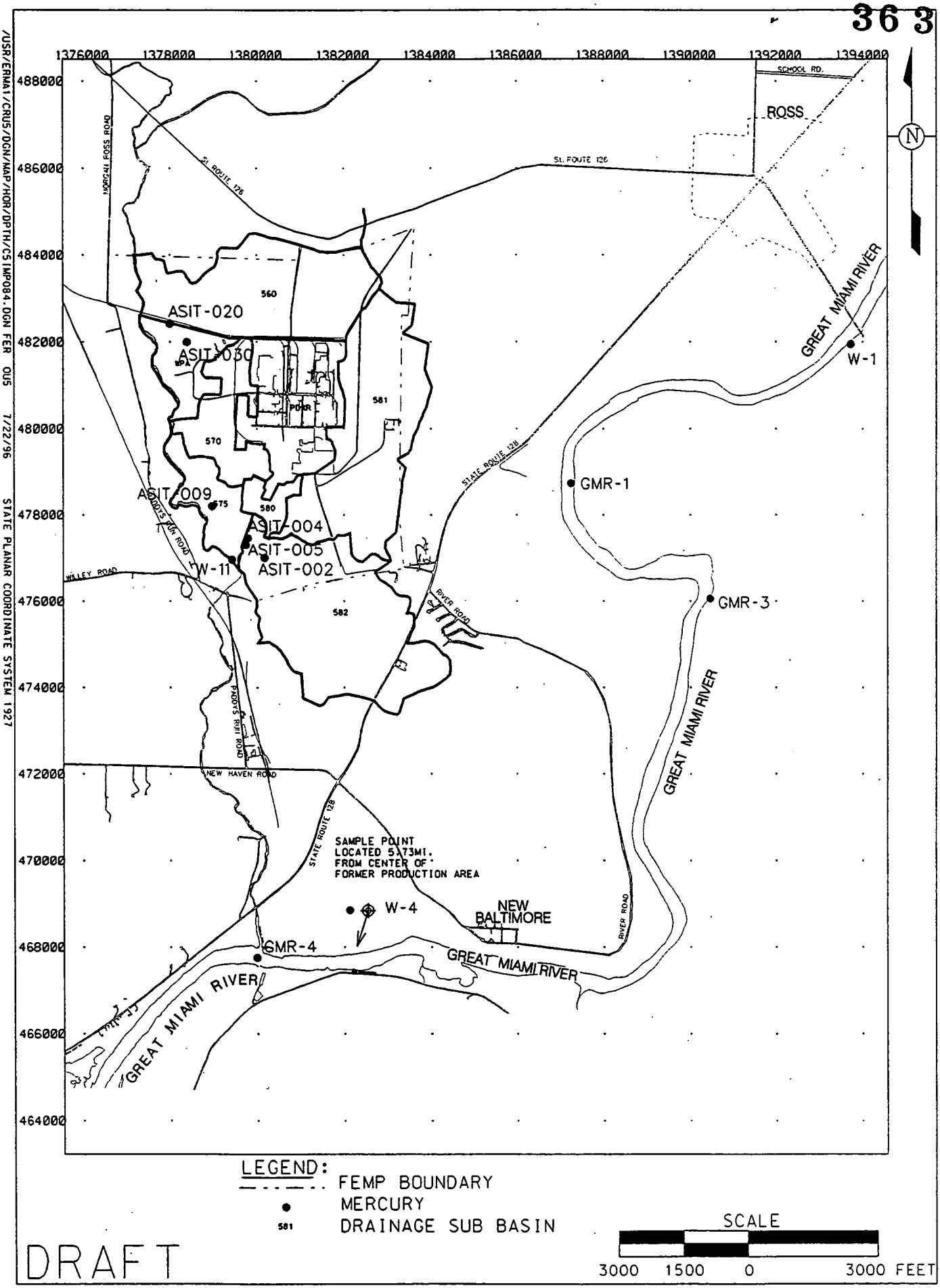


FIGURE C-17. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR MANGANESE

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMP084.DGN FER OU5 7/22/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

MERCURY

581 DRAINAGE SUB BASIN

SCALE

3000 1500 0 3000 FEET

DRAFT

FIGURE C-18. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR MERCURY

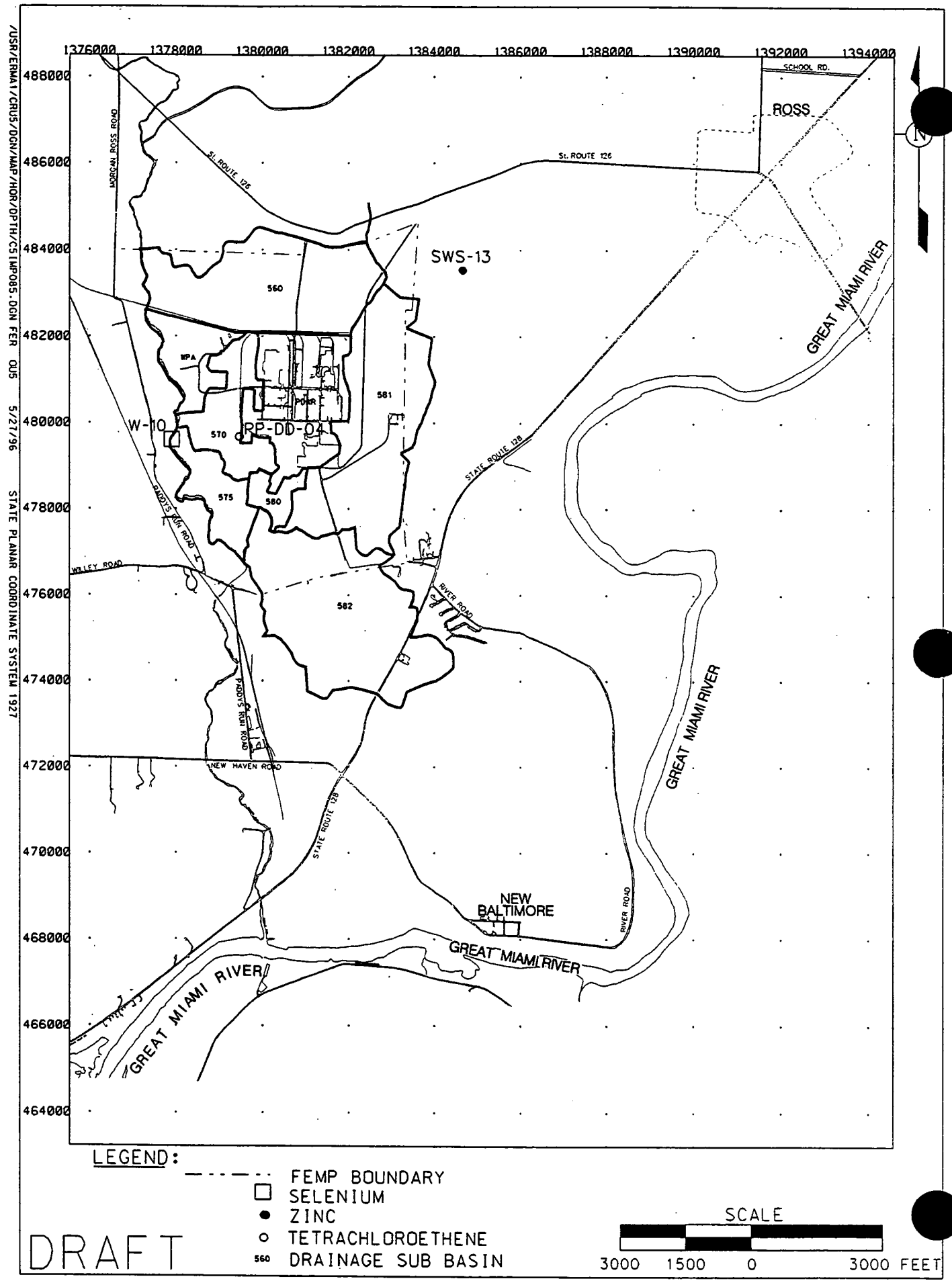


FIGURE C-19. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR SELENIUM, ZINC, AND TETRACHLOROETHENE

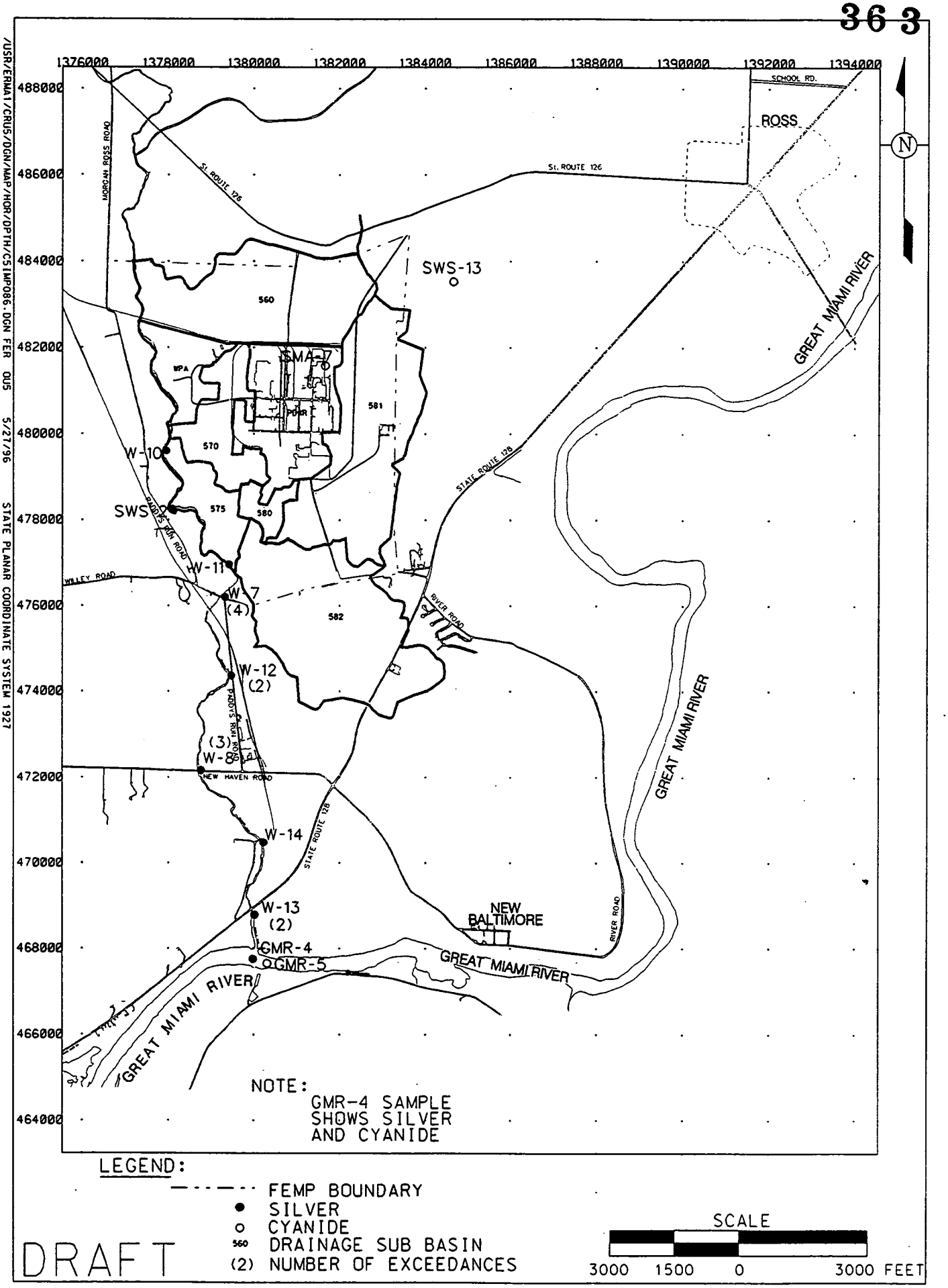
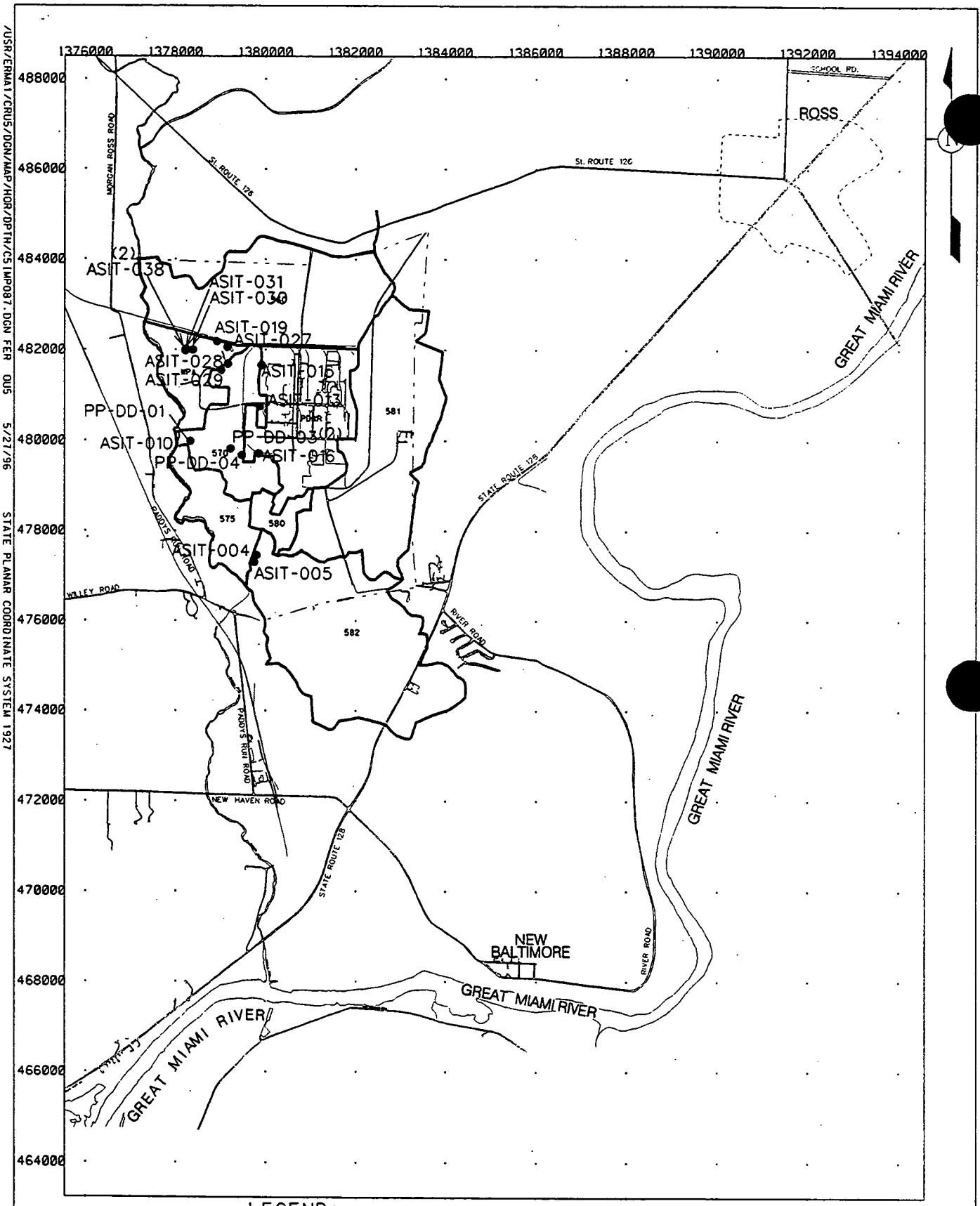


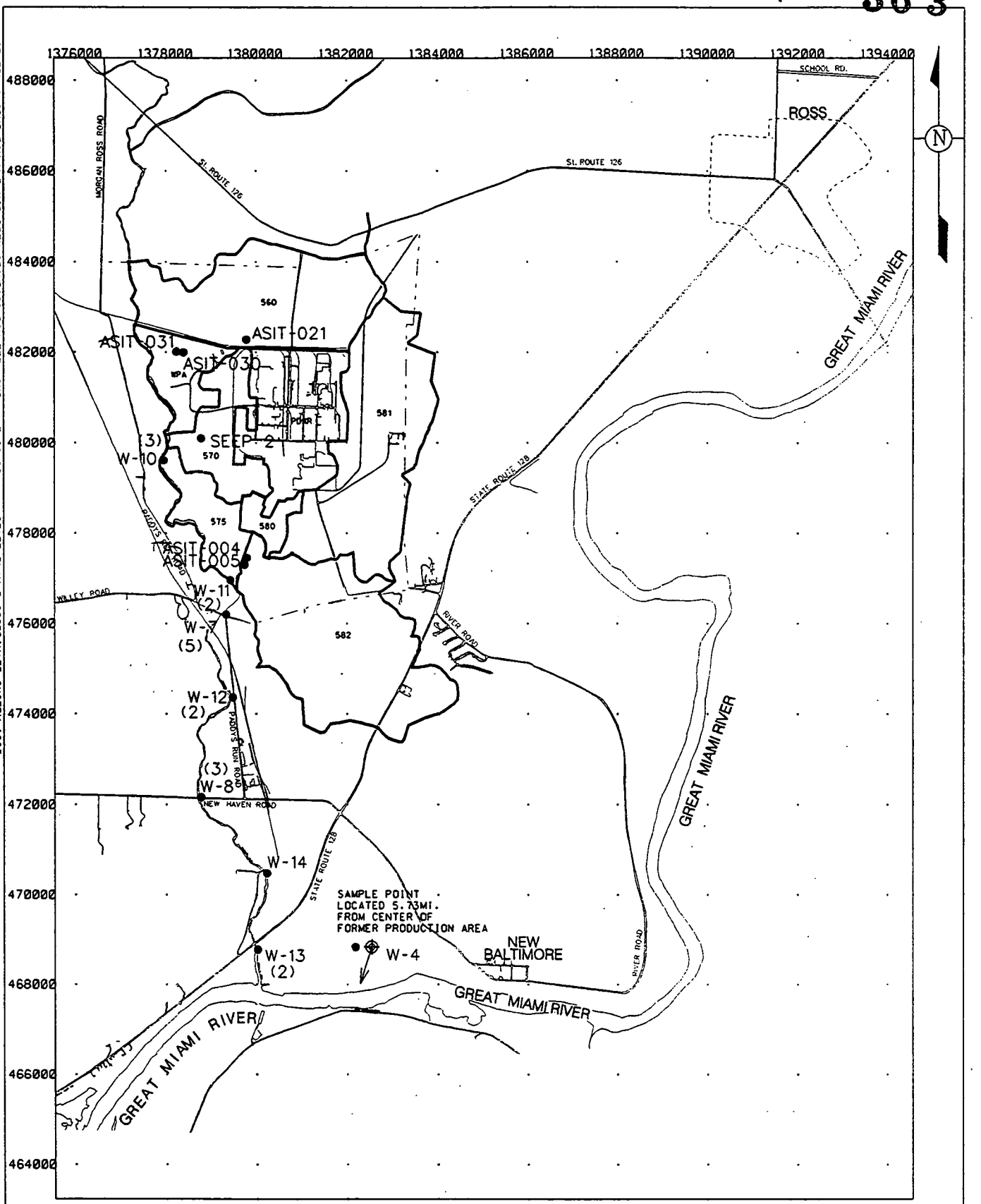
FIGURE C-20. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR SILVER AND CYANIDE



/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5IMP087.DGN FER OU5 5/27/96 STATE PLANAR COORDINATE SYSTEM 1927

FIGURE C-21. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR TOTAL URANIUM

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C51MP120.DGN FER OU5 7/29/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

- FEMP BOUNDARY
- CHROMIUM
- 582 DRAINAGE SUB BASIN
- (2) NUMBER OF EXCEEDANCES

SCALE

3000 1500 0 3000 FEET

DRAFT

FIGURE C-22. SURFACE WATER LOCATIONS WITH CONCENTRATIONS ABOVE THE BTV FOR CHROMIUM

Appendix D

APPENDIX D

DOSE ASSESSMENT

APPENDIX D

This appendix describes the technical approach for conducting the annual radiological dose assessment (to meet the intentions of DOE Order 5400.5 and the air pathway compliance reporting for 40 CFR 61 NESHAP Subpart H) during the active remediation of the Fernald Environmental Management Project (FEMP). The Integrated Environmental Monitoring Plan (IEMP) will be the vehicle for conducting and reporting the annual sitewide radiological dose assessment and assuring that the modeling simulations accompanying the dose assessment closely align with the categories of remedial activities contemplated each year at the FEMP.

The application of effective source and emission control measures, coupled with appropriate "early warning" release monitoring, form the cornerstone of the FEMP's environmental safeguards during remediation. The objective of the dose assessment under the IEMP is to support these safeguards during remediation and to provide appropriate feedback, where necessary. The FEMP's current compliance-based method for conducting the site's annual dose assessment (which, by definition is performed at the end of the calendar year to report the results of past activities) will be supplemented with an air pathway dose projection model that can be used at the beginning of the year (or at desired intervals throughout the year) to provide "early warning" projections of the estimated cumulative dose effects of the various mix of remedial activities proposed or underway at any given time.

The new dose projection model will be developed to support the annual dose. The dose projection model will incorporate revised source emission rate calculations that more accurately reflect the actual remediation activities that are required by the FEMP's Records of Decision and that have been sequenced under the FEMP's accelerated remediation plan. These revised emission rates will be incorporated into the FEMP's existing CAP88-PC model required for determining compliance with 40 CFR 61 the National Emissions Standards Hazardous Air Pollutants, or (NESHAP), Subpart H. A summary of the dose projection model is provided in Section D.4.

D.1 REGULATORY DRIVERS AND REQUIREMENTS

Radiological dose assessments are prepared annually at the FEMP to establish that doses to members of the public from routine operations and emissions are in compliance with the dose limits set in U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) regulations and orders. The various radiological dose limits and guidelines defined in the Applicable or Relevant and Appropriate Requirements (ARARs) and other regulatory requirements accompanying the FEMP's remediation activities are described in this section.

In addition to the regulatory-based drivers for the FEMP's annual dose assessment, the need for a dose projection procedure that can be utilized as a planning tool has been identified. Dose projections are needed to help prevent exceedence of the annual radiological dose limits and to identify the expected significant contributors for each year's combination of remedial activities. Based on the dose projections, any additional source control measures or adjustment in project-specific activities can be made as necessary to ensure that the FEMP's contributions to annual dose remain within prescribed limits.

D.1.1 ARARs and Other Regulatory Drivers

This subsection summarizes the ARARs and other regulatory drivers for the dose assessment and associated dose limits. A sitewide radiological dose assessment is needed to show compliance with the following limits and guidelines from DOE Order 5400.5, which incorporates dose assessment standards in 40 CFR 61 (NESHAP), Subpart H.

- *The exposure of members of the public to radiation sources as a consequence of all routine activities at a DOE site shall not cause, in a year, an effective dose equivalent greater than 100 millirem (mrem).* This annual effective dose equivalent is defined as the sum of penetrating external exposure for the year, plus the committed effective dose equivalent for intakes experienced during the year.

  The guideline includes doses from remedial actions and naturally occurring radionuclides released by DOE processes, but not radon and its decay products. All pathways that could contribute significantly to the exposure are to be included in the calculations. Significant exposures are considered to be one percent of the 100 mrem (1 mrem) dose limit or greater.

- *The exposure of members of the public to radioactive materials released to the atmosphere as a consequence of all activities at a DOE site shall not cause, in a year, an effective dose equivalent greater than 10 mrem.* Because this guideline implements the EPA regulations of 40 CFR 61 Subpart H, Radon-222 is excepted. The same annual effective dose equivalent definition applies as above.

  Note: The radon effluent guidelines of DOE Order 5400.5 also implement the EPA flux regulations of 40 CFR 61, Subpart Q, which apply to radon-producing wastes during storage or disposal. These guidelines are expressed in terms of radon concentrations in air and radon flux at the surface of radon-producing wastes, not in terms of dose to humans or other organisms.

- *The liquid effluents from DOE activities shall not cause private or public drinking water systems to exceed the drinking water radiological limits in 40 CFR 141.* That is, effluents must not cause the drinking water to exceed any of the following independent limits: man-made beta/gamma-emitting radionuclides at an annual average concentration that would cause an annual dose equivalent of 4 mrem to the total body or any internal organ; combined radium-226 and radium-228 at any time totaling 5 picoCurieo/liter (pCi/L); or gross alpha activity (including radium but excluding radon and uranium) of 15 pCi/L at any time.

- *The absorbed dose to native aquatic animal organisms shall not exceed one rad per day from exposure to the radioactive material in liquid wastes discharged to natural waterways.* For the purposes of satisfying this requirement, the term "native aquatic animal organisms" (which is not otherwise defined by DOE) is interpreted to mean insects, macroinvertebrates (crayfish, shellfish, etc.), fin fish, or mammals.

D.1.2 Remediation Support Requirements

During the FEMP remediation, routine dose assessments using monitoring data and modeling projections will also be conducted more frequently to verify the effectiveness of the source control measures implemented by individual remediation projects and to prevent exceedence of the annual dose limits.

Before the end of the year, the dose assessment will be conducted first on a sitewide basis, using all the available monitoring data collected to date and estimates of source emission rates to predict the potential cumulative annual maximum dose. When the projected sitewide cumulative dose is unacceptable, significant contributors will be identified by performing source-specific analyses. Based on the analyses, the source/emission control measures of specific projects will be adjusted as needed to reduce sufficiently the expected emissions.

D.2 GENERAL TECHNICAL APPROACH

This section presents a discussion of the general technical approach to be followed for performing the dose projection and the annual dose assessment. The discussion includes an explanation of exposure pathways and media important to the dose assessment, surveillance and characterization of these pathways, and the dose calculation procedure. In general, the technical approach for the future dose assessment will be similar to the approach conducted under the FEMP's EMP except that the monitoring activities will follow the IEMP scope described in the main text of this plan. Other additions (i.e., dose projection and confirmation of source control measures) will also be incorporated to support the remediation.

D.2.1 Exposure Pathways During Remediation

Establishment of representative exposure pathways is important for performing the dose assessment. A typical exposure pathway consists of a specific source, medium of transport, and defined receptor. During the course of remediation, conditions at the FEMP's contaminant sources may be altered both temporarily (during the action) and permanently (as a result of the action). Therefore, representative definitions of remediation-specific exposure pathways are needed to support accurate projections of radiological dose. Because contaminant source conditions can vary each year due to the mix of remedial activities in a given year, representative definitions of remediation-specific exposure pathways will be reevaluated each year.

D.2.1.1 Remedial Project Specific Sources

Specific remedial operations will be conducted at the FEMP to achieve the final cleanup goals. These remedial operations will present new potential emissions sources in addition to the traditional sources evaluated for NESHAPS compliance. Following is a list of the major types of remedial operations:

- Building D&D
- Soil and waste material excavation
- Waste treatment
- Construction of the disposal facility
- Waste transportation.

It is important to characterize the source emission potential of these activities during the planning stage of remediation. From such characterization, sufficient source control measures and monitoring strategies can be implemented for each action, as appropriate. The source-specific emission rates accompanying these actions are important factors in identifying the significant contributors to the total annual radiological dose.

It is important to emphasize that the scope of the IEMP does not include the real-time, project-specific emission control monitoring that will be performed by the individual projects. The individual projects will also be responsible for applying the appropriate emission controls within a remediation activity to achieve compliance with project-specific regulatory requirements for environmental emissions. As a feedback mechanism for the projects, in the event that the IEMP dose projection indicates a pending unacceptable annual cumulative impact, follow-up project-specific analyses will be conducted to determine the possible causes. Results of the analysis then will be provided to the specific remedial projects, who will be responsible for adjusting their control measures or activities further to bring cumulative projections within acceptable limits.

D.2.1.2 Media-Specific Pathways

Effective source control measures for each remedial action will be implemented and maintained during the FEMP remediation. (The IEMP monitoring and dose projection activities are designed to appraise the cumulative effectiveness of these control measures.) As a result of the FEMP's obligation to apply such measures, the potential impacts resulting from remedial activities are not expected to increase appreciably in any of the media-specific pathways from those levels observed historically. Therefore, the historical monitoring results summarized in the FEMP's annual Site Environmental Reports (SER) can be used to select the FEMP's significant exposure pathways (i.e., those pathways with the potential to contribute one percent or more of regulatory-based dose limits, as prescribed by DOE guidelines) to be routinely monitored and included in the annual dose projection procedure under the scope of the IEMP.

According to the previous annual dose assessments and remedial investigation/feasibility studies (RI/FS) performed at FEMP, the potential exposure pathways to human receptors are through the air

pathway (inhalation and ingestion), surface water pathway, groundwater pathway, and direct radiation pathway. These potential media-specific pathways are summarized below:

Air Pathway

Potentially significant exposure (i.e., above one percent of the air pathway dose limit of 10 mrem) to humans through the air pathway during remediation may result from:

- Inhalation of contaminated fugitive dust from soil excavation, building decontamination and dismantlement (D&D), temporary storage piles, and waste pits,
- Inhalation of stack and vent releases,
- Ingestion of foodstuff contaminated by direct deposition onto crops, and
- Ingestion of foodstuff contaminated indirectly by deposition onto soil where crops are grown.

Note: Exposure through consumption of meats and milk from animals that consumed contaminated feed has been shown to be consistently insignificant (i.e., less than 0.2 mrem which was the total 1995 dose in the foodstuffs ingestion pathway), according to existing monitoring data.

Surface Water Pathway

Potentially significant exposures (i.e., above one percent of the all-pathway combined dose limit of 100 mrem) via surface water pathways during remediation may include:

- Consumption of foodstuff contaminated through irrigation with contaminated surface water
- Contamination of groundwater due to infiltration through the storm sewer outfall ditch and Paddys Run into the Great Miami Aquifer.

Note: Direct consumption of surface water and consumption of fish from Greater Miami River are not considered significant pathways since surface water is not used as a source of drinking water and there is no commercial fishing in the Great Miami River in the FEMP vicinity. Furthermore, the estimated dose due to an assumed 4.5 kilograms (kg) per year consumption of fish in the Great Miami River is only 0.04 mrem in 1995. Exposure through consumption of meats and milk contaminated through animal consumption of foodstuffs irrigated with contaminated surface water (i.e., Great Miami River) has been shown to be consistently insignificant (i.e., less than 0.2 mrem, which was the total 1995 dose in the foodstuffs ingestion pathway), according to existing monitoring data.

Groundwater Pathway

Potentially significant exposure (i.e., above one percent of the drinking water dose limit of 4 mrem and the all-pathway combined dose limit of 100 mrem) via the groundwater pathways during remediation may result from:

- Consumption of foodstuff contaminated through irrigation with contaminated groundwater
- Consumption of drinking water from off-site wells.

Note: Consumption of meats and milk contaminated though animal consumption of foodstuff irrigated with groundwater has been shown to be consistently insignificant (e.g., less than 0.2 mrem which was the total 1995 vdose in the foodstuffs ingestion pathway) according to existing monitoring data.

Direct Radiation Pathway

Exposure from direct radiation may result from:

- Direct radiation from materials stored at the FEMP, especially materials in the K-65 silos
- Direct radiation from contaminated soil and sediment.

D.2.1.3 Potential Receptors

Potential receptors to be considered in the radiological dose assessment during FEMP remediation will include actual and hypothetical off-property residents. The hypothetical receptors are usually selected to demonstrate the worst possible dose at locations of the measured or calculated maximum groundwater and/or air concentrations even when there is no actual receptor at those locations. The exposure scenarios and parameters (i.e., duration of exposure and potential food sources) will be generally conservative as used in the previous dose assessments.

D.2.2 Routine Surveillance of Pathways

The environmental media that have the potential to lead to a significant annual dose (greater than one percent of applicable dose limit) at the site boundary will be routinely sampled and analyzed for the analytes contributing to dose. Sections 3 to 7 of the main text describe the media-specific monitoring programs under the IEMP. All the significant pathways listed in Section D.2.1.2 will be monitored under the IEMP.

In general, the routine surveillance under IEMP will include both environmental sampling/analysis and air emission/dispersion modeling. Frequencies of the monitoring and evaluation will be selected to satisfy the regulatory drivers as well as remediation support requirements.

D.2.2.1 Basis for Environmental Sampling and Analysis

Most data for the dose assessment will be based on measurements of radionuclide concentrations in environmental media at on-property and boundary monitoring locations (as presented in Sections 3.0 through 7.0), rather than in effluent samples obtained at specific sources (e.g. stacks), for the following reasons:

- *Dose assessments based on measured radionuclide concentrations in environmental media are less uncertain than those based on effluent measurements.* Assessments based on environmental monitoring avoid the use of the transport and bioaccumulation models required by effluent-based calculations, reducing the overall uncertainty in the results.

- *The potential exists for unmonitored releases from the FEMP, and the impact of all releases must be accounted for.* Examples of potential unmonitored releases are: releases from open waste pits, fugitive releases from remediation activities, and any releases from demolition projects in the former production area. In an effluent-based method, releases from such pathways must be estimated conservatively, adding to the uncertainty of the results and over-estimating the impact.

- *Calculations based on environmental measurements directly account for impact from multiple sources.* Using environmental monitoring results as input for the dose assessment accounts for all sources of environmental contaminants, without the need for assumptions regarding the impacts of multiple facilities.

- *Despite the lower concentrations in environmental media compared to effluent samples, adequate dose sensitivity can be achieved.* Environmental sampling frequencies, sample sizes, and analytical methods have been selected to obtain sufficient sensitivity to support the required dose calculations.

D.2.2.2 Basis for Emission and Dispersion Modeling

The air pathway dose calculation, which is required to demonstrate compliance with EPA's NESHAP Subpart H standards, is based on estimates of effluent activities and subsequent air dispersion modeling. An effluent-based calculation is required in this case for demonstration of compliance with 40 CFR 61.

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Air emission and dispersion modeling has been applied at the FEMP for routine annual regulatory compliance analysis, remedial investigation/feasibility study, and system safety analysis processes. Various modeling procedures were used to estimate annual or potential future life-time impacts to the public from on-site airborne contaminant emissions. The past annual air modeling analyses, which were summarized in the Annual NESHAP Subpart H Reports and SER, focused on emission of radioactive contamination from the former production area and the waste pit area. These areas were considered the only major air-emission sources of radionuclides when the FEMP was still in production.

During the remedial investigation/feasibility study process, various air modeling tasks were conducted to determine potential life-time impacts to the public caused by airborne fugitive dust emission from the FEMP before, during, and after remediation. Results of the modeling were used to support estimation of the baseline risk, development of soil remediation goals, and determination of the conservative short-term and life-time impacts during and after remediation. An air modeling procedure also was developed and applied to estimate the unmitigated worst-case wind-generated 24-hour fugitive dust emission as the result of a site-specific 100-year wind storm. Other smaller air modeling tasks also were conducted at the FEMP to support site management decisions. For example, air modeling was used to determine the amounts of materials that can be temporarily stored in particular buildings.

As part of its integration responsibilities, the IEMP will serve to consolidate the FEMP's remediation-based air modeling functions and reporting requirements required to assess the air exposure pathway. A new dose projection simulation model will be developed under the IEMP for use in estimating remediation-based annual doses. This new simulation model is described in Section D.4.

D.2.3 Dose Calculation Procedure

Except for the air inhalation exposure pathway (which is estimated via air modeling calculations to comply with EPA NESHAP requirements), estimates of annual dose are based on the measured, background-corrected concentration of a contaminant in each environmental media (e.g., groundwater and foodstuff). Ingestion rates for standard man are used for the consumption of air and water. A

modified reference diet (NRC Reg. Guide 1.109) is used for the consumption of food. Dose conversion factors (DCF) [which are radionuclide specific factors used to convert a unit of ingested radioactivity (pCi) to dose (mrem)] are taken from DOE publications (Internal/External Dose Conversion Factors for Calculation of Dose to the Public DOE/EH-0070 and DOE/EH-0071).

The general form of the dose assessment equation is

$$D = C_{i,m} * I_m * DCF_i$$

where,

D = Dose (mrem/yr)

$\mathbf{C_{i,m}}$ = Background corrected concentration of radionuclide i in media m

$\mathbf{I_m}$ = Intake (ingestion or inhalation) rate for media (kg/yr, L/yr, or m3/yr)

$\mathbf{DCF_i}$= Dose conversion factor for radionuclide i (mrem/yr*pCi)

The detailed calculation of doses from the various environmental media was governed by FEMP procedure EP-REM-008, Estimating Radiological Pathway Dose. Doses from all the media monitored under the IEMP also will be calculated according to relevant sections in this procedure. In general, air inhalation dose (from the CAP88-PC calculation), drinking water ingestion dose, foodstuff ingestion dose, and direct radiation dose will be calculated separately and then combined into the DOE all-pathway annual dose.

D.3 REPORTING

The types, frequency, and procedure of dose assessment reporting during FEMP remediation are summarized in this section. Based on the expanded objective of the dose assessment described in Section D.1, there will be three interfacing and reporting mechanisms in which the dose assessment results will need to be presented. Each of these three reporting processes is described in the following subsections.

D.3.1 Project-Specific Interfaces

Remedial project-specific emission monitoring results collected by remediation projects will be used to project sitewide annual radiological dose and to determine significant contributors among the on-going remedial actions. Therefore, an interface between the IEMP and ongoing remediation projects will be maintained to gather project-specific data and to provide feedback for adjusting/implementing source control measures. Frequency of data collection of evaluation will generally follow the procedure described in Section D.4 unless project-specific considerations warrant special modifications.

D.3.2 Regulatory Interfaces

When the projected radiological doses indicate a need for adjusting/implementing the project-specific source control measures, the regulatory agencies will be notified by the specific remediation projects. The modifications and the effectiveness of the improved source control measures will also be documented.

D.3.3 Annual Reporting

The NESHAP Subpart H Annual Report and the SER will be issued annually, according to reporting schedule in Section 8.0 of the IEMP. Annual summaries of the monitoring results, estimated doses from airborne emissions, directly calculated dose from eating foodstuffs produced near the site, directly calculated direct radiation dose, and estimated dose from drinking well water will be included in these reports. Comparisons of the pathway-specific and the combined annual radiological doses to the regulatory dose limits will be also be presented.

D.4 DEVELOPING THE PREDICTIVE AIR PATHWAY MODEL

As part of the IEMP, a new air pathway simulation model will be developed that can be used to estimate radiological doses through the air pathway based on specific remedial activities contemplated at any point in time for the FEMP. The model will be based on the FEMP's current NESHAP Subpart H dose calculation procedure but with necessary revisions which can more reasonably reflect the expected site conditions during remediation. Appropriate modeling-support tools to determine quantitative estimates of remediation-related source emission rates also will be developed.

The development of this new predictive dose projection model is provided below. Because this model will be based on CAP88-PC, a brief summary of CAP88-PC methodology is first provided, followed by revisions to be made to CAP88-PC only for the predictive model, and finally the summary of developing and using the new model.

D.4.1 Methodology for CAP88-PC

The general procedure for air pathway radiation dose calculation is briefly summarized in this section. This general procedure can be divided into six steps: source identification, emission rate estimation, dispersion modeling, comparison with ambient air monitoring results, dose calculation, and reporting.

The FEMP uses CAP88-PC, a set of air dispersion and dose calculation computer models prescribed by EPA, to determine compliance with the radionuclide NESHAP requirements of the Clean Air Act. The dose calculation is based on both measured and estimated on-site airborne radionuclide emission and the site-specific meteorological data during each one-year period.

D.4.1.1 Source Identification

As part of the general procedure, the FEMP evaluates all airborne emission sources at the end of the year to identify significant sources of emissions that occurred during the year. The evaluation is based on monitoring data and/or qualitative assessments of the effectiveness of source control measures. Usually the former production area and the Waste Pit Area are identified as the two major source areas. Examples of the emission sources inside the former production area include stacks, building vents, laboratory hoods, and the cooling tower. Releases from the waste pit area are primarily fugitive dust emissions. Major radionuclides in each of the significant source areas are also identified.

D.4.1.2 Emission Rate Estimation

After identifying the significant sources, airborne radioactive material release quantities from each significant source area and for each major radionuclide are calculated. Both routine and nonroutine releases are accounted for in the annual emission rate calculation. Although some of the data used in the calculation are obtained through measurements and sampling, most inputs are obtained through

specific estimating calculations. Very conservative estimates are made for emission sources which are not measured directly. The measured and estimated data are used in simple equations to determine the annual emission rate for each source. The annual precipitation pattern is considered in the estimation of fugitive dust emissions.

D.4.1.3 Dispersion Modeling

The AIRDOS program (a steady-state, Gaussian plume, atmosphere dispersion model) in CAP88-PC is used to calculate the concentrations of radionuclides in the air, on the ground, and in food based on estimates of the amount of airborne radioactive material released. The CAP88-PC programs also require a large amount of other data to estimate dose, which includes the number, height, and location of release points; wind speed and direction; and population distribution in the Fernald area.

Based on the actual size of a source area, each source can be modeled as a point or an areal emission source by CAP88-PC. Separate model runs are first conducted to determine impacts due to each of the identified sources. These intermediate results are superimposed to determine the final cumulative results.

D.4.1.4 Dose Calculation

Using the modeled concentrations and the population distribution data, the CAP88-PC computer programs (e.g., DARTAB) calculates both individual and collective doses due to the estimated annual airborne radioactive material released. Estimates are made of the effective dose equivalent (EDE) from each of the locations of 40 off-site receptors surrounding the FEMP. The maximally exposed individual (MEI) is determined to be an individual at the receptor location with the highest collective EDE from all the emission sources. Conservative assumptions about an exposure scenario resulting in the highest estimate of a dose are used in the dose calculation. For example, a person is assumed to be outdoors at one location for 100 percent of the time during the year to estimate doses at the air monitoring stations. These conservative assumptions provide a margin of error for underestimating emissions and doses.

D.4.1.5 Reporting

The significant source areas, area- and radionuclide-specific emission rates, comparison of measured and modeled fenceline airborne concentrations, calculated value and location of the maximum EDE to the MEI from airborne emission sources, and comparison with relevant regulatory thresholds are presented in the annual NESHAP Subpart H Report and the annual SER and will be presented in the annual IEMP report. Documents on monitoring status, dose calculation, and other recordkeeping requirements (e.g., compliance status with the NESHAP effluent monitoring requirements and records of periodic confirmatory measurements) of the NESHAP regulation are also maintained at the FEMP.

D.4.2 Revisions to CAP88-PC for the Predictive Model

The FEMP remediation operations will utilize source control to minimize airborne emissions. The IEMP intends to utilize monitoring and predictive modeling to provide sitewide cumulative appraisals for the source control measures at any given point in time to ensure regulatory compliance and public protection. With this objective and the expected new emission sources, the current annual air pathway radiation dose calculation will be modified for the predictive model during the remediation. The modeling results will also be utilized to assess the overall effectiveness of emission control measures around remediation sites on a more frequent basis. This section describes the rationale for the specific modifications.

D.4.2.1 Expected New Emission Sources During Remediation

The FEMP's remediation activities will require evaluation as potential new sources of emissions for inclusion in the air pathway modeling activity. Examples of these sources may include: D&D operations, excavation operations, waste treatment operations (e.g., drying of waste pit material and vitrification of K-65 silo material), exposed excavation areas, and temporary storage piles. These operations may potentially present both diffuse and point emission sources. Although project-specific emission controls will be implemented, potential contributions from these new sources to the annual air pathway radiation dose should be evaluated.

D.4.2.2 Purpose and Frequency

In addition to the annual radiation dose calculation to determine compliance with the NESHAP, modeling will be conducted to evaluate effectiveness of the emission source control measures during a specific remediation project. When ambient monitoring data show significantly elevated total suspended particulate (TSP) and/or radionuclide concentrations, modeling will be conducted to determine the possible sources. If a remediation project is identified as the major source of the elevated monitoring data, adjustments should be made to improve the project-specific emission control measures. In order to effectively maintain the source control and to ensure protectiveness to the public, evaluation of the monitoring data and model estimation of contributions from each potential source to the accumulated fenceline impacts may need to be conducted frequently during on-going remedial operations.

D.4.2.3 Source Identification

The new sources and accompanying potential for airborne emissions (and the benefits of planned emission control measures) for all of the expected remedial operations needs to be defined for inclusion in the model. Each remedial operation needs to be characterized by determining the project-specific factors which will affect airborne emissions of radioactive material during operation. Typical factors include types of mechanical disturbance involved, duration, source dimension, source concentrations, particle diameter, moisture content, and specific weight.

D.4.2.4 Emission Rate Estimation

Emissions from all the new sources need to be estimated. However, new estimation tools and procedures need to be developed for these sources. Most of the new sources will have emission mechanisms which are significantly different from the current sources in the former production area. Therefore, appropriate new emission estimation procedures may need to be developed for these sources. In order to develop technically sound emission estimation tools and procedures, sufficient source characterization and ambient monitoring data will be required to support the development process.

D.4.2.5 Additional Dispersion Model

The CAP88-PC model will continue to be utilized for determining NESHAP compliance. However, in order to differentiate efficiently the contributions from different sources to the cumulative impacts at the fenceline and evaluation of specific source control measure, a more robust dispersion model may need to be selected for purposes other than the annual radiation dose calculation. A dispersion model with time-variable emission, multi-source, and point- and areal-source capabilities is preferred.

D.4.3 Summary of the Revised Methodology

Various remedial operations will be undertaken over a number of years at the FEMP. These operations may release measurable quantities of contaminants into the atmosphere. The primary objective of this plan is to provide the technical approach which will be followed in developing an efficient sitewide air emission/dispersion modeling tool which can assess effectiveness of emission source control measures and estimate air quality impacts during remediation. The specific procedures for each step will be developed after holding discussions with the regulatory agencies.

The approach presented in this section lists the modeling tools and processes necessary to quantify air emissions, to estimate impacts at downwind receptor locations using site-specific operations and meteorological data, and to determine contribution from each source during the FEMP remediation. In general, the modeling tools will need to be calibrated to ensure that modeling results are statistically conservative compared to monitored data. Therefore, the proposed approach will include activities in two major categories (monitoring and data collection/evaluation, and model development and application) which are summarized below:

Monitoring and Data Collection/Evaluation Activities

- Continue collecting site-specific hourly meteorological data.
- Per NESHAP Subpart H, maintain current continuous monitoring activities for all emission point sources that have the potential to emit radionuclides (other than radon) that would exceed 0.1 mrem EDE to the nearest off site individual. Currently these monitoring activities provide both monthly and composited annual results.

- Collect bi-weekly (or weekly for selected monitors) fenceline ambient air quality monitoring data (e.g., TSP and radionuclide concentrations) for at least the first two years (i.e., fiscal years 1997 and 1998) during site remediation.

- Identify and characterize remedial operations expected to occur at the site.

- Log the remedial activities that were in operation for each day during the same period that the monitoring data is collected. (Weekly logs are acceptable for activities in continuous operation for a week or more.) The log should include:

  - Specific remedial and (or the lack of) emission control activities that occurred each day;

  - Location and general description of each activity (e.g., types of mechanical disturbance involved)

  - Areal extent of each activity (e.g., number of acres and volume of material excavated during the day)

  - Time and reasons that activities were interrupted (e.g., excavation halted due to heavy rain)

  - Obtain any project-specific source material concentrations and monitored air quality data or dose data

  - If observed, any non-site related activities which might result in air quality impacts at the monitoring stations should be noted (e.g., agricultural tilling or burning).

- Review existing data from source material samples to identify important emissions model parameters. If existing data are unavailable, collect source material samples to obtain necessary input data.

- Collect representative source material samples to measure important emission model parameters in the early stage of the remediation.

- Review, on a weekly basis, the collected monitoring data, logs, and meteorological data.

  - Check remedial and (or the lack of) emission control activities and locations against the monitoring and meteorological data

  - Note time periods when monitored data appears to correspond with activity logs and meteorological data

- Attempt to identify causes which would prevent correspondence between monitored air quality and activity logs.

Model Development and Application

- Identify and characterize remedial operations expected to occur at the site in the first two years (i.e., fiscal years 1997 and 1998).

- Identify existing emission models applicable to those remedial activities and operations. Note that emission models used as input to CAP88-PC for determining NESHAP compliance may require EPA approval. Emission model sources should include, but not be limited to:

  - EPA Air/Superfund Guidance documents
  - EPA AP-42 Document and FIRE Database
  - Equipment or facility manufacturer's data
  - Texas Tech Erosion Assessment Model
  - Open literature.

- Specify emission model parameters (e.g., chemical concentrations, particle diameter, moisture content, and specific weight) which require field measurements.

- Select applicable air dispersion model(s). Models should be EPA-accepted, therefore, the source of models should be the EPA Office of Air Quality Planning and Standards (OAQPS). Preferred models may include SCREEN3, ISC3, HARM II, ALOHA, and CAMEO. A dispersion model with time-various emission, multi-source, and point- and areal-source capabilities are preferred. The selected dispersion model will also be used to evaluate accident emission. When doing so, the modeling results shall be used in accordance with the FEMP Emergency Plan to determine likely offsite impacts, and to direct field teams dispatched to verify the location and magnitudes of those impacts. However, the CAP88-PC model will continue to be utilized for determining NESHAP compliance.

- Conduct model simulations and compare modeling results with monitoring data.

  - Estimate emissions from each remedial activity using appropriate emission models.

  - Use the selected air dispersion model with site meteorological data and activity-specific emissions to estimate cumulative pollutant concentrations at the monitoring locations.

  - Compare modeled and monitored pollutant and/or TSP concentrations.

  - Determine degree of conservatism provided by the model.

  - Adjust emission models, if appropriate, to better account for site-specific conditions.

- Determine/document possible causes and reevaluate the emission control measures at major emission sources when the modeled and/or the monitored concentrations exceed certain thresholds.

- At the end of each year, determine the remediation source-specific annual emission rates by summing all the results.

- At the end of the first two years, analyze all the modeling and monitoring results using multivariate statistical techniques to verify that the selected models and parameter estimation procedures are statistically conservative when compared to monitored data.