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OPERATIONS AND MAINTENANCE MASTER PLAN FOR THE AQUIFER RESTORATION AND WASTEWATER TREATMENT PROJECT

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

SEPTEMBER 1997

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

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LIST OF ACRONYMS

ARAR	applicable or relevant and appropriate requirement
ARWWP	Aquifer Restoration and Wastewater Project
AWWT	advanced wastewater treatment [facility]
BSL	biodenitrification surge lagoon
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
D&D	decontamination & demolition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FFCA	Federal Facility Compliance Agreement
FRL	final remediation level
FS	Feasibility Study
gpm	gallons per minute
HNT	high nitrate tank
hr	hour
IAWWT	interim advanced wastewater treatment
IEMP	Integrated Environmental Monitoring Plan
kg	kilograms
ℓ	liter
lbs	pounds
MG	million gallons
mg	milligrams
mgy	million gallons per year
mg/kg	milligrams per kilogram
mg/ℓ	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan
OSDF	on-site disposal facility
PSP	project specific plan
PTI	permit to install
PTO	permit to operate
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RD/RA	remedial design/remedial action
RI	Remedial Investigation

LIST OF ACRONYMS
(Continued)

ROD	record of decision
SCEP	Soil Characterization and Excavation Project
SDF	slurry dewatering facility
SOP	standard operating procedure
SPIT	South Plume interim treatment
STP	sewage treatment plant
SWRB	Storm Water Retention Basin
VOC	volatile organic compound
WPRAP	Waste Pits Remedial Action Project

FOREWORD

The Operations and Maintenance Master Plan (OMMP) for the Aquifer Restoration and Wastewater Treatment Project has been revised to address the comments received from the U.S. Environmental Protection Agency (EPA) and Ohio EPA (OEPA) on the June, 1997 submittal of this document. This foreword assembles the commitments made to EPA and OEPA about how their comments have been addressed in the revised OMMP.

Changes to the OMMP are set apart from regular text. They are formatted as follows:

- Revised text is redlined and the DOE-assigned sequential number of the comment being addressed appears in the left margin at the beginning of the paragraph
- Text revised at DOE's initiative is also redlined and "DOE" appears in the left margin at the head of the paragraph
- When text has been deleted as a comment response or at DOE's initiative, the comment number or "DOE" appears in the margin at the head of the paragraph; strike outs are not used
- Table revisions are not redlined but the comment number or DOE appears at the left margin at the top of the table to indicate that changes have been made
- Figure revisions are not noted within the OMMP, but the changes are indicated within the comment response document
- Editing and minor revisions made by DOE are not marked.

Key revisions made at the initiative of DOE are as follows:

Section 3.0 -

- 3.3.2 - Expected throughput of IAWWT was reduced from 300 gpm to 250 gpm to better reflect actual operational experience and thereby set realistic future operational goals.
- 3.3.3 - Expected throughput of SPIT was incorrectly noted at its design capacity of 200 gpm. This was reduced to 175 gpm to better reflect actual operational experience and thereby set realistic future operational goals.
- Figure 3-1 - Date for new STP operation was corrected.

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- Figure 3-4 - Location of existing SWRB valve house was shown incorrectly and was therefore moved to the correct location..

Section 4.0 -

- Figures were revised to reflect amended IAWWT and SPIT throughput rates.
- Figure 4-5 was revised to include storm water flows from Lime Sludge Ponds and Sanitary Landfill which were inadvertently left off.
- 4.2.1 - Dates for the duration of stormwater runoff flows were revised to be consistent with current remediation schedules.

Section 5.0 -

- Figure 5-1 was revised to indicate that IAWWT will be used for groundwater treatment as primary flow and stormwater as secondary flow and that AWWT Phase I will have an alternate flow of remediation wastewater.
- The appropriate Figures and text were revised to reflect amended IAWWT and SPIT throughput rates.
- 5.4.1.1 - Title was changed to "Diversion of Remediation Wastewater" to reflect that the stream is being diverted (rerouted) to another treatment facility rather than bypassed to the Great Miami River without treatment.

App. B -

Calculations were revised to include storm water flows from Lime Sludge Ponds and Sanitary Landfill which were inadvertently omitted in the draft OMMP.

Key revisions made as a result of the comments include:

General -

Flow rates and capacity of treatment units were revised throughout the document (text and figures) to reflect projected averages in millions of gallons per year (mgy) in addition to gallons per minute (gpm).

Section 3 -

3.6.2 - Accounting of 10 allowable bypass days was revised to reflect telephone discussions with U.S. EPA and Ohio EPA on September 16, 1997 when consensus was reached that any bypass event which exceeds 12 hours should automatically be counted as a bypass day.

1.0 INTRODUCTION

This document is the Operations and Maintenance Master Plan (OMMP) for the Aquifer Restoration and Wastewater Project (ARWWP) at the U.S. Department of Energy's (DOE's) Fernald Environmental Management Project (FEMP). The scope of the ARWWP includes the design, construction, and operation of the principal (groundwater, storm water, wastewater, and sanitary wastewater) management facilities that support the FEMP's overall cleanup mission. The ARWWP encompasses all of the water-related elements within Operable Unit 5 and the FEMP's other source-control operable units (Operable Units 1 through 4) that are necessary to meet their storm water, sanitary, and wastewater treatment and discharge needs.

1.1 Scope and Objectives

3 The OMMP is a formal remedial design deliverable required to fulfill Task 2 of the Operable Unit 5 Remedial Design (RD) Work Plan (DOE, 1996b). Following review by the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (OEPA), the OMMP will allow the FEMP to commence operations for the three new aquifer restoration modules (the South Plume Optimization Module, the Injection Demonstration Module, and the South Field Extraction System Module) currently being designed and implemented in accordance with the Operable Unit 5 Record of Decision (ROD) (DOE 1996a). The plan also establishes the decision logic and priorities for the major flow and water treatment decisions needed to maintain compliance with the FEMP's NPDES permit and ROD-based surface water discharge limits.

The fundamental objectives of the OMMP are to guide and coordinate the extraction, collection, conveyance, treatment, and discharge of all groundwater, storm water, sanitary, and remediation wastewater generated sitewide over the life of the FEMP's cleanup program. Compliance with discharge limits will include a plan of the commitments, performance goals, operating schedule, treated water flow rates, direct discharge flow rates, system-by-system sequencing, and other operating priorities. This plan also allows for balanced sitewide water management and provides the approach for the management of treatment residuals (treatment sludges, retention basin sediments, and spent resins/filtration media) that are by-products of the FEMP's wastewater treatment processes.

The OMMP is expected to serve as a comprehensive statement of management policy to ensure that planned modes of operation and maintenance for the ARWWP are consistent with regulatory

requirements and satisfy the FEMP's remedy performance commitments for groundwater restoration and wastewater treatment. This document establishes a comprehensive plan that provides the overall management philosophy and decision parameters to implement the day-to-day flow routing, critical-component maintenance, and treatment priority decisions. It is not intended to provide detailed, specific operating or maintenance procedures for the ARWWP. The plan will also serve to inform EPA and OEPA of the planned operational approaches and strategies that are intended to meet the regulatory agreements made during the Operable Unit 5 Remedial Investigation/Feasibility Study (RI/FS) process (DOE 1995a, DOE 1995c).

Internally, the plan will be the focal point for coordinating and scheduling wastewater conveyance and treatment needs with other site projects throughout the duration of the remediation process at the FEMP. As such, the plan provides the basis for development of more detailed internal operating procedure documents (e.g., Standard Operating Procedures, Standing Orders, and Preventive Maintenance Plans) that are required for execution of work at the FEMP. The existing detailed procedural documents that govern the performance of water-related operations and maintenance activities at the FEMP are expected to be updated (revised, combined, or eliminated) as required to conform with the general strategies, guidelines, and decision parameters defined in this plan.

In Section 2.3 of the RD Work Plan, the FEMP committed to providing a compliance crosswalk that demonstrates the substantive, permit-related regulatory requirements associated with groundwater restoration and wastewater treatment and how overall compliance with water-related Applicable or Relevant and Appropriate Requirements (ARARs) will be achieved. The format of the compliance crosswalk is largely based on a June 12, 1995, letter (DOE - 1055-95) from DOE to EPA and OEPA that outlined the FEMP's strategy for compliance with permit-related substantive regulatory requirements at the site. The strategy outlined in the letter identified the development of compliance crosswalks for ARARs (including substantive permitting requirements) as a substitute for a formal permitting plan. These compliance crosswalks are to be supplied with the remedial design submittals to EPA and OEPA. The compliance crosswalk for all Operable Unit 5 groundwater and wastewater treatment activities is to be submitted with this OMMP. Several design submittals have already been supplied with their accompanying permit information summaries. In addition, many of the key

wastewater facilities are already in place, having been installed under OEPA-approved Permit to Install (PTI) or Permit to Operate (PTO) documents. Future design submittals will include permit information summaries as appropriate.

1.2 Basis and Need

The need for the OMMP arose as DOE and regulators realized that the various water and wastewater flows that originate from FEMP remediation activities are in direct competition with one another for treatment resources. The wastewater treatment capacities at the FEMP must, therefore, be prioritized so that 1) discharge limits can be maintained; 2) a range of flow conditions at various time intervals can be accommodated, and 3) the detrimental affects of exceptional operating circumstances can be effectively managed. The need for treatment (and the accompanying hierarchy of treatment priorities) will vary over the span of the site remedy as new projects come on line, others are completed, and aquifer restoration activities come up to full system configurations.

It was recognized during the development of the Operable Unit 5 ROD, that the 20 parts-per-billion (ppb) discharge limit for total uranium could probably be met under average operating conditions, but that consistency within this limit may not be attained during periods of exceptional operating conditions. It was further recognized that the application of the discharge limit was not considered as a required component of the remedy to ensure protectiveness, but rather as an appropriate performance-based objective that appeared reasonably attainable through the application of an appropriate level of water treatment. It was recognized that the performance-based discharge limit, must be able to accommodate exceptional operating conditions anticipated to occur over the duration of the remedy. Two exceptional operating conditions were actually cited in the Operable Unit 5 ROD that would permit relief allowances from the 20 ppb total uranium discharge limit, when necessary, for:

- Storm water bypasses during high precipitation events
- Periodic reductions in treatment plant operating capacity that are necessary to accommodate scheduled maintenance activities.

It was agreed, at the time the ROD was signed, that the OMMP would define the operating philosophy for: 1) the extraction/injection and treatment systems, 2) establishment of operational constraints and conditions for given systems, and 3) establishment of the process for reporting and instituting corrective measures to address accedences of discharge limits. The OMMP also contains details the manner in

which exceptional operating conditions would be accommodated and reported in the demonstration of discharge limit compliance.

The OMMP will be modified during the course of the remedy to accommodate expansions of the system or the retirement of individual restoration modules from service, once area-specific cleanup levels are achieved. The plan is intended to serve as a living guidance document to instruct operations staff in implementing required adjustments to the system over time. The OMMP will thus be evaluated periodically to ensure the most recent instructions regarding treatment priorities and flow routing decisions are available to system operators. Proper notifications for reporting bypasses and maintenance shutdowns of the system, and the reporting and application of corrective measures to address accedences of discharge limits also are identified in the OMMP.

1.3 Relationship to Other Documents

The OMMP is expected to function in tandem with several other major design support plans being prepared to support the ARWWP. The environmental monitoring activities conducted in support of aquifer restoration performance decisions will be conducted and reported through the Integrated Environmental Monitoring Plan (IEMP) (DOE 1997b), submitted to EPA and OEPA as Task 9 of the Operable Unit 5 RD Work Plan. Information obtained through the IEMP will be used to: 1) appraise groundwater restoration progress; 2) assess the need for changing groundwater extraction or injection flow rates, and 3) assess the durations of groundwater extraction and/or injection activities over the life of the remedy.

The design flow rates, planned installation sequence, detailed design basis, and overall restoration strategy for the aquifer restoration modules comprising the groundwater remedy were developed in the Baseline Remedial Strategy Report for Aquifer Restoration (DOE 1997a) (submitted to EPA and OEPA as Task 1 of the Operable Unit 5 RD Work Plan [DOE 1996b]). The IEMP and the Baseline Strategy Report identified the need to conduct start-up monitoring activities for the new aquifer restoration modules prior to formal long-term operations under the terms of the OMMP. A start-up monitoring project specific plan (PSP) will be developed for each new module to define start-up monitoring activities and necessary adjustments in flow rates based on initial in-the-ground field performance.

Once start-up monitoring activities and adjustments have been completed, the long-term operations and remedy performance monitoring activities for any new modules will be based on the OMMP and IEMP, respectively.

The first of these start-up monitoring plans, the Injection Demonstration Test Plan, was submitted to EPA and OEPA in the summer of 1997. This plan will define the overall start-up monitoring activities for the Injection Demonstration Module, along with the criteria and decisions for determining whether to proceed with full-scale incorporation of injection into the groundwater remedy. Until the injection demonstration testing and decision-making activities have been completed, the Injection Demonstration Test Plan will continue to serve as the controlling document for the operation of the injection system. If full-scale injection is deemed appropriate, following completion of the Injection Demonstration Test Plan activities, necessary operating refinements gained from the testing program will be incorporated into appropriate revisions of this OMMP. Ensuing start-up monitoring PSPs also will be prepared for each of the new extraction and injection modules (or combinations of modules), as they approach completion of construction.

The Remedial Action (RA) Work Plan (DOE 1997c) for Aquifer Restoration (submitted to EPA and OEPA as Task 10 of the Operable Unit 5 RD Work Plan) conveys the enforceable RA construction schedule for the initial restoration modules to be brought on-line in Fiscal Year 1998 (the Injection Demonstration Module, the South Field Extraction System Module, and the South Plume Optimization Module). It also contains the planning-level RA construction schedule for the remaining modules to be brought online in the years beyond 1998 (the South Field Extraction System Phase II Module, the South Field Injection Module, the Plant 6 Area Extraction Module, and the Waste Storage Area Extraction Module). These schedules will determine when new modules can be expected to be brought online for operations planning, and when the start-up monitoring PSPs need to be prepared.

The OMMP will function in tandem with several other RD or design support plans being prepared by other project organizations outside the ARWWP. The Soils Characterization and Excavation Project (SCEP) submitted a draft Sitewide Excavation Plan (DOE 1997) and a series of area-specific detailed design plans, (termed Integrated Remedial Design Packages, or IRDPs), that will define the approach and commitments for management of storm water, intercepted perched groundwater, and sediment during soil remediation activities. The Waste Pits Remedial Action Project (WPRAP) will be

developing design documents that define the management of storm water and remedial wastewater within that project's boundaries, and the plan for coordinating the treatment of the streams by the ARWWP. The On-site Disposal Facility (OSDF) Project has developed design documents that define the management of storm water and leachate within the boundaries of that project, and the planned handoffs for delivering these streams for treatment to the ARWWP. The Silos Project (SP) will produce similar design documentation to coordinate the management and delivery of their process remedial wastewater for treatment by the ARWWP. Lastly, the facility-specific implementation plans developed by the Facilities Decontamination and Demolition (D&D) Project will discuss the coordination strategy for wastewater generated by D&D activities for treatment by the ARWWP. Each of these project organizations will be responsible for ensuring that their respective regulatory requirements and commitments for effective management of storm water and remedial wastewater within their project boundaries are met and integrated with ARWWP.

1.4 Plan Organization

The plan is generally organized around the major wastewater streams being managed by the ARWWP: groundwater, storm water, remedial wastewater, and sanitary wastewater. The sections and their contents are as follows:

Section 1.0 Introduction: presents an overview of the plan, its objectives, and its relationship to other documents, and its organization.

Section 2.0 Summary of Regulatory Drivers and Commitments: discusses the ARARs compliance crosswalk and provides a summary of the other commitments and guidelines that have been activated for the ARWWP by the Operable Unit 5 ROD.

Section 3.0 Description of ARWWP Major Components: identifies the major collection, conveyance, and treatment components comprising the FEMP's system for managing the major wastewater streams, the treatment capacities that will be available once the full system is fully on-line, and a schedule of major ARWWP activities throughout the aquifer restoration process.

Section 4.0 Projected Flows: provides an estimate of flow generation rates and durations for each of the major wastewater streams. Estimates of the summary yearly flows developed are used in Section 5 to evaluate the treatment systems discussed in Section 3.

Section 5.0 Operations Plan: establishes the operations philosophy, treatment priorities, management, and flow of operations information, and organizational roles and responsibilities necessary to successfully operate the groundwater and wastewater systems to achieve regulatory requirements and commitments.

Section 6.0 Operations and Maintenance Methods: addresses the general methods, guidelines, and practices used in managing equipment operation and maintenance; discusses some of the dedicated organization resources and management systems that will help to assure meeting the requirements in the ROD, describes the key parameters used to monitor the performance of the groundwater and wastewater facilities, and describes the principal features and maintenance needs for the overall operation.

Section 7.0 Organizational Roles, Responsibilities, and Communications: this section presents the organizational roles and responsibilities with respect to implementation of this OMMP. Also presented are information needs and communications protocol for coordination with other FEMP project organizations outside the ARWWP and interaction with the EPA and OEPA.

Appendix A South Plume Performance Monitoring and Maintenance Plan

Appendix B Calculation of Projected Annual Average Storm Water Flows

Appendix C List of ARWWP Standard Operating Procedures

1.5 Program Modifications and Revisions

Following approval, the OMMP will remain in place for the duration of the FEMP's remediation activities. Periodic reviews of the OMMP will be conducted to respond to needed changes in program emphasis or the addition of new components, as appropriate. It is envisioned that an annual strategy meeting will be held with EPA and OEPA to review overall operational performance, aquifer restoration progress, upcoming technical or operational issues, and any necessary revisions to the OMMP or its objectives. This meeting would likely be scheduled to occur as part of one of the IEMP quarterly meetings.

2.0 SUMMARY OF REGULATORY DRIVERS AND COMMITMENTS

Section 2.1 summarizes the FEMP's pertinent regulatory-based requirements, commitments, and operating constraints that have a bearing on either the implementation of or the reporting obligations for the OMMP activities. A review and listing of pertinent requirements was conducted to help ensure that the scope of the OMMP 1) satisfies the regulatory obligations for operations and maintenance activities that have been activated by the CERCLA process, and 2) meets the expectations of other pertinent criteria that have been developed through the remedial design (RD) process.

Section 2.2 provides the formal permit crosswalk required for inclusion in the OMMP by the RD Work Plan (DOE 1996b), and discusses additional ARARs and To Be Considered requirements. The suite of ARARs and To Be Considered requirements in the FEMP's approved CERCLA Operable Unit 5 ROD (DOE 1996a) was examined to identify the subset with specific operations and maintenance requirements or permitting issues affecting the OMMP. The FEMP's existing compliance agreements issued outside the CERCLA process, such as the National Pollutant Discharge Elimination System (NPDES) permit and existing Air and Wastewater Permits to Install (PTI), Permits to Operate (PTO), and Permit Information Summaries also were reviewed.

2.1. GENERAL COMMITMENTS AND CONSTRAINTS FOR THE ARWWP

General commitments and constraints for the ARWWP can be divided into those applicable to aquifer restoration, storm water management, and wastewater treatment. The general commitments, operating constraints, and performance goals that have originated as part of the post-ROD remedial design process were identified for inclusion in this section.

2.1.1 Aquifer Restoration

The general remedy performance commitments and constraints which have been agreed to with EPA and OEPA regarding aquifer restoration are summarized in the following list. These commitments and constraints were derived from the Operable Unit 5 ROD and subsequent remedial design remedial action (RD/RA) documentation as noted:

- Aquifer Restoration Approach - The FEMP has received EPA and OEPA approval for the accelerated aquifer restoration approach contained in the Baseline Remedial Strategy Report for Aquifer Restoration (DOE 1997a). This approved approach initiates the commitments for well locations, installation sequence, and projected

pumping and injection schedules needed over the life of the groundwater remedy. The approach represents the controlling vision for when the various groundwater flow streams are expected to come on line, and the life-of-remedy groundwater treatment and injection water demands that have been estimated through computer modeling.

4 • Aquifer Cleanup Levels - Targeted groundwater final remediation levels (FRLs) were presented in the Operable Unit 5 ROD. In general, the FRLs were based on maximum contaminant levels (MCLs) for drinking water (or 10^{-5} incremental lifetime cancer risk or 0.2 hazard index when no MCL was available). For example, uranium had a proposed MCL of 20 μg/L (ppb), therefore 20 ppb was selected as the FRL for uranium. Groundwater remediation is expected to continue until all the constituent-specific FRLs have been achieved or, if necessary, until a technical impracticability (TI) waiver is justified in the event the FRLs cannot be achieved. Alternative best available technologies existing at that time will be considered prior to requesting a TI waiver.

5 • Discharge Limits - During site remediation, significant amounts of both treated and untreated water will be discharged to the Great Miami River. Treatment will be applied to storm water, remediation wastewater, and recovered groundwater to the extent necessary to limit the total mass of uranium discharged through the FEMP outfall to the Great Miami River to no more than 600 pounds per year. This mass-based discharge limit became effective upon issuance of the Operable Unit 5 ROD. Additionally, the necessary treatment will be applied to these streams to limit the concentration of total uranium in the blended effluent to the Great Miami River to no greater than 20 ppb. The 20 ppb discharge limit for uranium will be based on a monthly average and will become effective January 1, 1998.

Up to 10 days per year are allowed by the ROD for emergency bypass due to storm events. Uranium contained in these bypass events will only be counted in the annually discharged mass, but not in the monthly average concentration calculations. Needed relief from the discharge limits is also provided by the ROD to accommodate scheduled treatment plant maintenance activities. Approval by the EPA must be obtained in advance by notification of these planned maintenance periods. The notification must be accompanied by a request for the uranium concentrations in the discharge not to be considered in the monthly averaging performed to demonstrate compliance with the 20 ppb total uranium limit. The FEMP will make every reasonable effort to prevent bypass of storm water during treatment plant shutdowns for maintenance including scheduling maintenance shutdowns during the times when dry weather is expected. The NPDES permit will govern all remaining nonradionuclide conventional discharges to the Great Miami River.

• Groundwater Treatment Capacity - A committed or reserved groundwater treatment capacity of at least 2000 gpm (including existing and new treatment capacities) will be provided, The major portion of this capacity will be achieved by adding additional equipment within the existing Advanced Wastewater Treatment (AWWT) treatment facility. The remaining treatment capacity will be available from existing facilities, particularly during dry seasons or when the other site remediation-related wastewater flows decrease.

6 • Groundwater Treatment Decisions - The piping networks that convey extracted groundwater will be designed to connect all the new on-property extraction wells to double headers, one connected to the main line to treatment and the other to the main discharge line. This requirement is not applicable to the existing South Plume Recovery Well System or South Plume Optimization System. The extracted groundwater can then be sent to either the treatment facilities or directly to the discharge outfall; thus, the treatment or discharge decision will be made on a well-by-well basis. The combined South Plume Recovery Well System and South Plume Optimization System discharge will be routed for treatment as a whole, or in part, based on the combined concentration. As identified in the Final Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (DOE1997a), when the extracted groundwater exceeds the treatment capacity, groundwater from wells which have relatively higher uranium concentrations will be treated preferentially. The remaining extracted groundwater will bypass treatment and be directly discharged. The combined treated and untreated discharge will comply with the 20 ppb discharge limit and the 600 pound per year mass-based limit as described above under Discharge Limits.

• Extraction Rate - The net groundwater extraction rate should not exceed the recharge rate of the regional aquifer or cause excessive water table drawdown. Therefore, 4000-gpm was established as the limit for the net extraction rate in the Operable Unit 5 FS Report (DOE 1995a). The maximum pumping rate for each individual well should not exceed 400 gpm in order to prevent excessive local drawdown and improve uranium mass removal efficiencies. Hydraulic impacts to the groundwater contamination under the Paddys Run Road Site south of the existing South Plume recovery wells should also be minimized; reversing groundwater flow from the Paddys Run Road Site into the South Plume Recovery System needs to be prevented.

• Injection Rate and Quality - Injection technology has been incorporated into the approved approach (if proven to be successful at the field scale) to reduce groundwater drawdown and to increase the groundwater flushing rate through the plume. Based on results of a short-term field injection test, an injection rate as high as 450 gpm per well is achievable in the Great Miami Aquifer. However, due to areas of high iron concentrations in the Great Miami Aquifer and the existence of iron bacteria, the issue of geochemical compatibility between water types when injecting water into the aquifer needs to be considered in order to maintain long-term efficiency of groundwater injection in any well. The first short-term injection test conducted in October 1995, used untreated (not treated for iron) groundwater from the South Plume area and rapidly resulted in a significant well-plugging problem (DOE 1995d). Results of the second short-term injection test, conducted in March 1996 (DOE 1996c), indicate that when groundwater treated by the South Plume Interim Treatment system (Section 3.3.3) was used, plugging did not occur after five days of continuous injection at 200 gpm. This resulted in a significant drop in iron content. A longer-term, full-scale injection demonstration evaluation is planned for 1998, once the five wells comprising the Injection Demonstration Module are installed and operational. This test will be conducted in accordance with the ARWWP's Re-Injection Demonstration Test Plan, currently in development.

In calculating the overall groundwater flow balance for the Baseline Remedial Strategy Report, it was assumed that all water used for injection will consist of treated groundwater, and no treated process wastewater or storm water (or untreated groundwater) would be utilized as an injection water source. The treatment decision logic contained in this OMMP will employ this assumption as a general operating constraint.

2.1.2 Storm Water Management

The requirements for controlling storm water runoff (and associated sediment loads) at the point of origin are beyond the scope and intent of this document and are the specific responsibility of the source-control projects at the FEMP. The decision to provide pretreatment must be made in concert with ARWWP recognizing surface water FRLs, NPDES limits, and hydraulic capacity.

The ARWWP will be responsible for providing the treatment for:

- Designated streams, upon delivery at the ARWWP treatment headworks
- Sediment clean out of the treatment headworks
- Coordination and review to ensure similar strategies and criteria for source control in other projects.

In general, all storm water management activities conducted sitewide need to adhere to the commitments and design criteria contained in the FEMP Storm Water Pollution Prevention Plan.

2.1.3 Wastewater Treatment

The ARWWP is responsible for the following commitments for wastewater treatment:

Minimize the Outfall Uranium Concentration and Uranium Mass Loading

- Coordinate the accurate projection of influent quantity, quality, and timing for all the remedial wastewater sources to be received from other generator projects
- Strive to maintain high mass removal efficiency of the treatment facilities through regularly scheduled maintenance activities
- Strive to minimize the bypass volume of contaminated runoff during high or sequential rain fall events

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- Help coordinate the identification of cost-effective pretreatment at sources of wastewater when appropriate.

Minimize the System Downtime

- Incorporate preventive considerations into the system design
- Operate within the design envelope
- Establish effective preventive maintenance procedures
- Prepare for potential corrective maintenance needs.

Manage Treatment Residuals within the terms of the Operable Unit 5 ROD

- Characterize residuals for compliance with OSDF waste acceptance criteria
- Transport residuals not attaining onsite waste acceptance criteria off the site for disposal
- Pursue treatment techniques to treat the residuals to attain waste acceptance criteria in the event offsite disposal capacity becomes unavailable or cost prohibitive.

2.2 ANALYSIS OF REGULATORY DRIVERS & EXISTING PERMIT REQUIREMENTS

The following section provides a summary of the regulatory drivers governing activities initiated under this OMMP, including applicable ARAR/To Be Considered criteria, DOE Orders, FEMP legal agreements, and existing environmental permits. This section has been organized based on criteria related to: 1) point source air emissions; 2) surface water and treated effluent discharges; 3) groundwater restoration activities; 4) hazardous waste management requirements; and 5) substantive permitting requirements mandated by existing environmental permits and permit information summaries.

The information provided fulfils the commitment made in Section 2.3 of the RD Work Plan to provide a compliance crosswalk that demonstrates how these requirements will be met. The format of the compliance crosswalk is based on mutually agreed format described in the June 12, 1995, letter from DOE to EPA (DOE-1055-95).

2.2.1 Point Source Air Emissions

Currently, no emission sources associated with ARWWP wastewater treatment units are required to comply with the regulatory requirements described below. Any emissions from sources associated with

future modifications or expansions to AWWT facilities or other wastewater treatment units will be compared to these requirements to make sure that activities are conducted in compliance with applicable requirements. Any continuous emission monitoring that may be required for National Emissions Standards for Hazardous Air Pollutants (NESHAP) Subpart H point sources will be described in future compliance crosswalks submitted in the appropriate plans. Future point source air emissions associated with activities within the scope of the OMMP will be evaluated against the following regulatory drivers:

- 40 Code of Federal Regulations (CFR) Part 61, NESHAP Subpart H, which specifies that all radiological emissions (except radon) from the FEMP site must not cause any member of the general public to receive a dose equivalent in excess of 10 mrem/year. In addition to the 10 mrem/year site-wide standard, NESHAP Subpart H requires that an application for approval be filed with EPA for those sources that exceed a 0.1 mrem/year dose equivalent to members of the public. Continuous emission monitoring is required for stacks or vents that have the potential, under normal operating conditions but without emission control devices, to cause a member of the public to receive a dose equivalent in excess of 0.1 mrem/year. Demonstration of source-specific compliance with the 0.1 mrem/year dose standards is achieved through computer modeling. Site-wide radiological emissions from the entire site are reported annually in the Annual FEMP NESHAP Subpart H Report.

- Ohio Administrative Code (OAC) 3745-31 and OAC 3745-35, Permits to Install and Permits to Operate, require the installation of Best Available Technology (BAT) when installing, modifying, and operating air contaminant sources. Such requirements associated with any future expansions or modifications to the AWWT or other wastewater treatment units will be included in the project specific design submittals for these projects.

2.2.2 Surface Water and Treated Effluent

The FEMP's wastewater treatment systems are subject to substantive permitting requirements for wastewater treatment units. Treated wastewater effluent is discharged through the Parshall Flume to the Great Miami River. The site discharge is fully subject to discharge permitting requirements. The following regulatory drivers govern these surface water and treated effluent discharges associated with FEMP site-wide wastewater treatment units:

- FEMP NPDES Permit (OEPA Permit No. 1IO00004*ED) triggers a variety of operational and maintenance requirements designed to ensure discharges of treated effluent are conducted in compliance with the terms and conditions of the permit. These requirements include process control sampling and maintenance activities at sampling stations and treatment units.

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- OAC 3745-31, Wastewater Permits to Install (PTI) are required for new installations or modifications to existing wastewater treatment units. Wastewater Permits to Install are issued provided the newly installed/modified treatment unit will not adversely impair water quality or cause a violation of applicable effluent standards. Relocation of the FEMP Sewage Treatment Plant (STP) is the only current ARWWP activity that is anticipated to require a PTI. Compliance with the substantive PTI requirements associated with relocation of the FEMP STP or other future projects will be demonstrated in their corresponding project-specific design packages.

2.2.3 Groundwater Restoration

The regulatory drivers governing groundwater-related operation and maintenance activities include only those required as part of the Underground Injection Control (UIC) Program. The injection wells installed under the Injection Demonstration, and under subsequent aquifer restoration modules, must comply with the substantive requirements of this program. This policy is also cited as a To Be Considered requirement in the Operable Unit 5 ROD. The OEPA has primacy for this program, and has put out a Policy for those Class V injection wells installed for purposes of groundwater remediation, as described below:

- OEPA Policy 5X26 Aquifer Remediation Projects states that such wells do not need a PTI/PTO if the owner/operator complies with the policy. Many of the elements in this policy will fall under the Injection Demonstration Test Plan and subsequent start-up plan for later modules. Long-term operation of the injection wells for the later modules, however, will fall under this OMMP. The requirements that fall under the OMMP Plan (for long-term injection) include submittal of monthly operating reports including the analysis of the injectate, the volume and rate of the injected fluids, and a description of any well maintenance and rehabilitation procedures. The policy also requires all Class V injection wells to be permanently plugged and abandoned within 120 days of ceasing operations, in a manner that will prevent migration of fluids into an underground source of drinking water. The use of this policy is allowed so long as injectate does not exceed Safe Drinking Water Act MCLs or Health Advisory Limits (HALs). If these limits were to be exceeded in our injectate, then full compliance with all additional substantive requirements for UIC permits would be necessary.

2.2.4 Hazardous Waste Management

Small quantities of Investigative Derived Waste (IDW) that are known to contain one or more Resource Conservation and Recovery Act (RCRA) listed hazardous waste constituents will be treated in on-site wastewater treatment systems. These wastewaters will be pretreated for Volatile Organic Compounds (VOCs) prior to discharge to the site's AWWT facility. Treatment for VOCs will render the resulting waste stream non-hazardous by removing the hazardous constituent concentration to nondetectable levels. Although Clean Water Act regulated wastewater treatment units are excepted from RCRA

permitting requirements, the waste handled is still regulated as a RCRA-hazardous waste. The appropriate requirements under the interim-status Ohio Hazardous Waste regulations, therefore, must be met with relation to the scope of the OMMP. The hazardous waste requirements fall under the following general categories: storage of hazardous wastewaters and treatment residuals, treatment of RCRA-listed wastewaters to meet non-RCRA statues (nondetectable), determination of RCRA status of treatment residuals, and management and transport of hazardous treatment residuals to an off-site disposal facility (if necessary):

- OAC 3745-52-34, 40 CFR 262.34, Accumulation Time of Hazardous Waste, which requires that containers of hazardous waste can be accumulated for up to 90 days provided they are labeled and managed in accordance with the applicable provisions for these regulations

- The FEMP Investigative Derived Waste Policy, which requires that RCRA F-listed wastewaters generated during remedial activities be pretreated to nondetectable levels of the hazardous waste constituents through the Plant 8 VOC Treatment System, prior to subsequent treatment in the AWWT Facility. This Policy, outlined in DOE letter dated March 23, 1995, has been approved by both EPA and OEPA

- OAC 3745-51-07, 40 CFR 261.7, Residues of Hazardous Waste in Empty Containers, which specifies requirements that must be considered when determining if hazardous waste containers are empty

- OAC 3745-52-11, 40 CFR 262.11, Hazardous Waste Determinations, which requires newly generated wastes to be evaluated and characterized to determine their regulatory status under the applicable provisions of these regulations

- OAC 3745-52-20 through 31, 40 CFR 262.20 through 31, Preparing and Transporting Hazardous Waste Off-site, which requires that off-site shipments of hazardous waste generated from this project will be managed in accordance with applicable provisions of these regulations.

2.2.5 Existing Environmental Permits and Permit Information Summaries

Tables 2-1 and 2-2 list the environmental permits and permit information summaries, respectively, that are applicable to ARWWP activities initiated under this plan. These tables identify the status of the permits for various wastewater treatment operations and list their corresponding substantive requirements. Cross references to the appropriate Standard Operating Procedures or site documents that describe the manner in which these requirements are addressed in detail are also provided in the tables.

TABLE 2-1
ACTIVE PERMITS TO INSTALL & OPERATE

Permit No.	Description of Source	Effective Date	Substantive OMMP Requirements	Cross Reference[a]
Wastewater Permits to Install				
05-0944	Sewage Treatment Plant Ultraviolet Disinfection Unit	June 28, 1984	• Lamps will be cleaned periodically using a chemical dosing system of sodium hydrosulfite and food grade citric acid.	SOP 43-C-501
05-1043	Storm Water Retention Basin	November 18, 1987	• Periodic assessment of sediment depths and sediment clean out once six inches of deposition has occurred. • Water collected in basin chambers will be removed by means of floating outlet structures.	Inspection/removal status documented through separate correspondence with EPA.
05-2872	Changes to Biosurge Lagoon	December 16, 1987	• Periodic assessment of sediment depths and sediment clean out once 500,000 gallons of sediment has occurred. • Sediment removal schedule will be extended if measured sediment is less than 500,000 gallons.	Inspection /removal status is documented through separate correspondence with EPA.
05-3368	New Equipment and Renovate Equipment of the General Sump	November 8, 1988	• All General Sump Tanks shall be equipped with high/low level alarms.	SOP 43-C-701
05-5722	FEMP Advanced Wastewater Treatment Facility	December 3, 1992	• PTI has been withdrawn. AWWT is currently considered part of a CERCLA Response Action. Substantive permit requirements include the following bulletized items. • AWWT must be equipped with the control equipment listed in the PTI application including a Cyclonic Scrubber, Bubble Cap Tray Scrubber, and Packing Tower. • Maximum process rate for the AWWT will be 557,118 pounds per hour (lbs/hr). The allowable limit for particulate is 0.894 lbs/hr and from uranium the rate is 1.34E-08 lbs/hr.	SOP 43-C-340
Air Permits to Install & Operate				
46-003	Methanol Storage Tank (T127)	September 23, 1993	• Tank no longer in operation. Requirements applicable until residual methanol is removed from tank system. • Tank is equipped with submerged fill and an internal floating pontoon roof with double seals. • The roof seals, man hole, piping seals, and secondary containment will be inspected on an annual basis.	Internal Regulatory Compliance oversight directs annual inspection

[a] See Section 6.0 for a discussion of ARWWP Standard Operating Procedures (SOPs).

TABLE 2-2
PERMIT INFORMATION SUMMARIES[a]

Description of Source	Submittal Date	Substantive Requirements	Cross Reference[b]
Permit Information Summaries			
AWWT Slurry Dewatering Facility	December 7, 1995	• Filter cake will be drummed and managed as low-level waste. • All chemical storage tanks (caustic, acid, sludge conditioners) must be equipped with submerged fill devices. • Residual particulate and radiological emissions must be controlled via high energy particulate air (HEPA) filtration devices.	SOP 43-C-358
AWWT Multi-Media Filter Project	November 12, 1996	• Backwash from the carbon and multi-media filters will be collected and discharged to the headworks of the AWWT Facility.	SOP 43-C-340
AWWT Expansion Project	December 20, 1996	• Tanks associated with the multimedia filtration and ion exchange columns operate under pressure in a closed system.	Procedures currently under development by ARWWP personnel

[a] Previously submitted to fulfill substantive permitting requirements for various CERCLA response/removal action pursuant to the requirements of CERCLA 121(e), 40 CFR 300--National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Paragraph XIII.A of the Amended Consent Agreement.
[b] See Section 6.0 for a discussion of ARWWP Standard Operating Procedures (SOPs).

3.0 DESCRIPTIONS OF MAJOR ARWWP COMPONENTS

Major operating system components of Operable Unit 5 aquifer restoration and wastewater treatment required to accomplish the associated Operable Unit 5 remedy commitments and goals are described in this section. Identified are the existing and currently proposed FEMP conveyance and treatment system components for managing the major wastewater streams. This section also provides treatment capacities that are available now and in the future, once the full system is on line. This section also describes key linkages between the components. Figure 3-1 provides a schedule of major ARWWP activities throughout the aquifer restoration process.

3.1 GROUNDWATER COMPONENT

In accordance with the approved Remedial Design/Remedial Action (RD/RA) Work Plans (DOE 1996b and 1997c) for Operable Unit 5 and the Baseline Remedial Strategy Report for Aquifer Restoration (DOE 1997a), the remediation of the Great Miami Aquifer will be achieved by completing area-specific groundwater restoration modules. This section describes currently proposed modules. These modules will consist of either extraction wells or injection wells as described in the following subsections. The modules are discussed in two categories: 1) current/near-term modules (Section 3.1.1) and 2) long-term modules (Section 3.1.2).

3.1.1 Current/Near-Term Groundwater Restoration Modules

Current/near-term restoration modules consist of those modules that are currently in operation or are scheduled to begin operations in 1998. These modules are:

- South Plume Removal Action
- South Plume Optimization
- South Field Extraction System Phase I
- Injection Demonstration.

The geographical locations of each of these modules are provided in Figure 3-2. The RA Work Plan established a remedial action schedule for each of these near-term modules, which is provided in Table 3-1 and 3-2. A description of each of the modules is provided in the following subsections.

3.1.1.1 South Plume Recovery System

Five extraction wells were installed in 1993 at the leading edge of the off-property South Plume as part of the South Plume removal action to gain an early start on groundwater restoration. The South Plume removal action well system began pumping in August 1993.

The primary intent of this well system is to prevent further off-property migration of contamination within the groundwater plume. Additional measures for the active restoration of the off-property plume will be conducted under the South Plume Optimization Module (Section 3.1.1.2).

2 Four of the five original wells are targeted to pump a summed total of 736 million gallons per year (mgy) [1400 gallons per minute (gpm)]. The eastern fifth well has been abandoned in place at the current time per agreement with EPA and OEPA. Each well is equipped with a submersible pump and flow rate controls. Each well has a maximum pumping capacity of about 500 gpm. The combined flow is routed to Storm Water Retention Basin (SWRB) valve house, where a portion of the flow is typically diverted to treatment, while the remainder of the flow is routed to the Great Miami River.

3.1.1.2 South Plume Optimization System

This module was so named during the regulator review of the April 1995 South Plume Removal Action report (DOE 1995b). Its implementation reflects the commitment of EPA, OEPA, and DOE to restore the off-property portion of the plume quickly and cost effectively. In order to accelerate the recovery of contaminants in the off-property area, additional extraction wells will be installed to supplement the plume containment wells of the South Plume Removal Action Module.

The South Plume Optimization Module consists of two recovery wells (RW-6 and RW-7) located on private property adjacent to the FEMP (Figure 3-2). Each well will be equipped with a submersible pump and flow rate controls. Each well is being designed to have a maximum capacity of about 400 gpm, but is intended to be operated at approximately 250 gpm. A common discharge header will convey the combined recovered groundwater from these wells to the existing South Plume System discharge header.

A third well location (3N) (also located on private property) has been identified as a contingency, should additional pumping be necessary in the future. The Baseline Remedial Strategy Report provides

the criteria for determining if and when this contingency well location will be installed. If Well 3N is necessary, an addendum to the RA Work Plan will be submitted to include milestone activities and dates for its construction and operation.

After site access easements have been obtained, construction activities will begin for the two extraction wells and the associated infrastructure. The module construction includes drilling two extraction wells, approximately 800 feet of trenching, placement of 1800 feet of high-density polyethylene piping, submersible pumps, electrical service, controls and instrumentation, and a valve house. Once construction is completed, inspected, and accepted, systems testing will be conducted. Following successful testing and a standard start-up review of all procedures and maintenance plans, the module will be brought on-line.

The RA Work Plan established a schedule for this module (Table 3-1) that includes the award of subcontracts for well installation and construction of the associated infrastructure, the completion of well installation and construction, and initiation of operations (start-up).

3.1.1.3 South Field Extraction System - Phase I

The South Field Extraction System Module consists of Phase I and Phase II. South Field Extraction System Phase I Module includes 10 extraction wells. In 1996, nine of the 10 extraction wells were installed on FEMP property in the vicinity of the south field/storm sewer outfall ditch as part of an EPA-approved early start initiative. These wells are designed to remove groundwater contamination in an on-property area where uranium contamination levels are highest (Figure 3-2). Each well will be equipped with a submersible pump and flow rate controls. Each well will have a maximum capacity of about 300 gpm. Two discharge headers will be provided to convey recovered groundwater from each well; one header will convey flow to treatment systems and the other header will convey flow to untreated discharge. Each well discharge will have valving to direct its flow to one of the selected headers.

The remaining work to be completed as part of Phase I includes construction and installation of the tenth extraction well, new electrical high-voltage power service, approximately 6000 feet of trenching for placement of 12,000 feet of high density polyethylene piping, variable speed submersible pumps, new access roadways, instrumentation and controls, 10 well houses, and one valve house. After

construction is completed, inspected, and accepted, systems testing will be conducted. Once the systems testing is complete and a standard start-up review is completed, full implementation of the Phase I module will begin.

The schedule for this module are provided in Table 3-1. It includes the award of subcontracts for well installation and construction of the associated infrastructure, the completion of well installation and construction, and initiation of operations (start-up).

3.1.1.4 Injection Demonstration Module

Groundwater injection was determined to be a potentially viable strategy for enhancing aquifer restoration in the Baseline Remedial Strategy Report. To test this technology at the field scale, a five-well injection demonstration module (Task 4 in the RD Work Plan) is being constructed. If successful, then injection wells may be added to other aquifer restoration modules. The five injection wells will be located along Willey Road on the southern boundary of the FEMP (Figure 3-2). An injection rate of approximately 200 gpm per well is planned.

27 During the demonstration period (first year of operation), the operation and maintenance of this module including monitoring will be governed by the Injection Demonstration Test Plan. If, at the close of the demonstration period, re-injection is proven to be a viable enhancement to the aquifer remedy, operation and maintenance of this module will be incorporated into a revision of this OMMP. It will be necessary to separate the operation and maintenance costs and scope for this module, during the demonstration period, to distinguish it from the remainder of the groundwater remedy. This will allow comprehensive assessment of its viability as part of the long-term groundwater remedy. The decision criteria for evaluating the viability of re-injection technology at the FEMP on a field scale focus on:

- Maintenance and operational costs of re-injection
- Vertical and horizontal expansion of the 20 μg/L total uranium plume
- Effectiveness in shortening the remedy
- Creation of a hydraulic barrier at the southern FEMP property boundary

Section 1.3 of the Re-injection Demonstration Test Plan (DOE 1997d) provides further details on these criteria.

The installation and construction of this module includes five injection wells (completed in the spring of 1997), a 50,000-gallon surge tank, two pumps, individually rated at 1000 gpm @ 200 feet of Total Dynamic Head (TDH), electrical service, approximately 5000 feet of trenching and placement of high density polyethylene piping, fabrication of injection well downcomers, and instrumentation and controls. Once completed, the construction will be inspected and accepted, and systems testing will be conducted. After successful testing and standard start-up review, operation of the module will begin.

The RA work plan established a schedule for this module (Table 3-1) that includes the award of subcontracts for well installation and construction of the associated infrastructure, the completion of construction, and initiation of operations (start-up).

3.1.2 Long-Term Groundwater Restoration Modules

Long-term modules are those modules that are scheduled to be installed after 1998. These modules are:

- South Field Injection System
- South Field Extraction System Phase II
- Waste Pit Area Extraction System
- Plant 6 Area Extraction System.

The geographical locations of each of these modules is provided in Figure 3-3. The RA Work Plan established Remedial Action Schedule for each of these long-term modules (Table 3-2). The RA Work Plan schedules are contingent upon completion of various other operable unit remediation activities, which, if delayed, may necessitate revised schedules for the long-term modules. Any such revised schedules would be submitted as addenda to the RA Work Plan. Descriptions of all long-term modules are provided in the following subsections.

3.1.2.1 South Field Injection System

If the Injection Demonstration Module (Section 3.1.1.4) results indicate that re-injection is a viable aquifer restoration enhancement technology, then the Aquifer Restoration Project will implement the South Field Injection System Module. This module includes all injection wells from the geographical areas of Phases I and II of the South Field Extraction System Module, installation of five injection wells, and the conversion of three existing extraction wells to injection wells. The South Field Injection System Module was not described in the Operable Unit 5 RD Work Plan because it is based

on further development of the Draft Baseline Remedial Strategy Report, which was submitted after the Operable Unit 5 RD Work Plan.

8 The South Field Injection Module is located in the south-central portion of the FEMP within the South Field area (Figure 3-3). Construction of this module also includes the installation of one additional pump rated at 1000 gpm @ 200 feet TDH at the previously installed injection water surge tank, approximately 4000 feet of trenching and placement of high density polyethylene piping, instrumentation, and controls. Once completed, the construction will be inspected and accepted, and systems testing will be conducted. After successful testing and standard start-up review, operation of the module will begin.

The schedule dates for this module are provided in Table 3-2, and include the award of subcontracts for well installation and construction of the associated infrastructure, the completion of well installation and construction, and initiation of operations (start-up). If these dates must be revised in the future, due to schedule changes with the Operable Unit 2 Southern Waste Unit and associated soil remediation activities, an addendum to the RA work plan will be submitted to provide the new schedule.

3.1.2.2 South Field Extraction System - Phase II

29 The nine-well, early-start South Field Extraction System-Phase I was designed to support the initial 27-year base case system presented in the Operable Unit 5 FS and ROD (DOE 1995a). As presented in the Baseline Remedial Strategy Report, the proposed well field for the 10 year aquifer restoration includes additional extraction wells in the south field area. These additional extraction wells will comprise Phase II of the South Field Extraction System Module and will be located in the area depicted in Figure 3-3. Table 4-1 presents extraction/injection rates for the planned aquifer restoration. The Phase II extraction wells will be installed after Operable Unit 2 remedial activities for contaminated soils and source areas have been completed. Phase II includes installation and construction of nine extraction wells, approximately 1500 feet of trenching and placement of 3500 feet of high density polyethylene piping, electrical service to each well, submersible well pumps, instrumentation and controls, and nine well houses. Once completed, the construction will be inspected and accepted, and systems testing will be conducted. After successful testing and standard start-up review, operation of the module will begin.

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The schedule dates for this module (Table 3-2) include the award of subcontracts for well installation and construction of the associated infrastructure, the completion of well installation and construction, and initiation of operations (start-up). Schedule dates are contingent on the completion of the source operable unit and soil remedial activities in this area. If these dates must change in the future due to changes in the remedial action schedule for Operable Unit 2 waste unit and soil remedial activities in this area, then an addendum to the RA Work Plan will be submitted to provide the revised schedule.

3.1.2.3 Waste Pit Area Extraction System

The Waste Storage Area Extraction System Module will recover contaminants from the portion of the Great Miami Aquifer that underlies the waste storage area (Operable Unit 1 and Operable Unit 4). The current plan is for the module to consist of 10 recovery wells located in and near the FEMP waste pit area. Each well will be equipped with a submersible pump and with flow rate controls. Each well will be designed to operate at a rate up to 200 gpm. Two discharge headers shall be provided to convey recovered groundwater from the wells — one header will convey flow to treatment systems and the other header will convey flow to untreated discharge. Each well discharge will have valves to direct flow to the selected header.

Once this area is accessible (i.e., after the waste pit material and contaminated soil have been excavated), construction of the module can be initiated within this area (Figure 3-3). The construction includes installation of the ten extraction wells, 7000 feet of trenching and placement of 14,800 feet of high-density polyethylene piping, submersible pumps, new electrical high-voltage power service to the area, instrumentation and controls, and 10 well houses. Once completed, the construction will be inspected and accepted, and systems testing will be conducted. After successful testing and standard start-up review, operation of the module will begin.

The schedule dates for this module are provided in Table 3-2, and include the award of subcontracts for well installation and construction of the associated infrastructure, the completion of well installation and construction, and initiation of operations (start-up). These dates are contingent on the completion of the source operable unit and soil remedial activities in this area. If these dates must be revised, due to schedule changes during Operable Unit 1, Operable Unit 2, or Operable Unit 5 soil remediation activities, then an addendum to the RA Work Plan will be submitted to provide the new schedule.

3.1.2.4 Plant 6 Area Extraction System

The Plant 6 Area Extraction System Module will recover contaminants in the portion of the Great Miami Aquifer located beneath and east of Plant 6, which is located in the southeastern portion of the FEMP's former production area. The current plan is for the module to consist of two extraction wells located in this area (Figure 3-3). Each well will be designed to operate at approximately 400 gpm or less. Two discharge headers will be provided to convey recovered groundwater from the wells — one header will convey flow to treatment systems and the other header will convey flow to untreated discharge. Each well discharge will have valves to direct flow to the selected header.

After D&D of Plant 6 and excavation of underlying contaminated soil, the area will be accessible and construction of this module can begin. Construction of the Plant 6 Area Extraction System Module includes installation of the two extraction wells, 3300 feet of trenching and placement of high density polyethylene piping, electrical service, submersible pumps, instrumentation and controls, one valve house, and two well houses. Once completed, the construction will be inspected and accepted, and systems testing will be conducted. After successful testing and standard start-up review, operation of the module will begin.

The schedule for this module (Table 3-2) includes the award of subcontracts for well installation and construction of the associated infrastructure, the completion of well installation and construction, and initiation of operations (start-up). These dates are contingent on the completion of the source operable unit and soil remedial activities in this area. If these dates must be revised in the future, due to schedule changes with the Operable Unit 3 Plant 6 area D&D activities or related soil excavation, then an addendum to the RA Work Plan will be submitted to provide the new dates.

3.1.3 Groundwater Collection and Conveyance

An extensive system of collection and conveyance piping systems will be required for the remediation of the Great Miami Aquifer. A major portion of that piping was installed as a part of Removal Action 3 in the early 1990s (Figure 3-4). This included: 1) a major collection header and force main from the South Plume Recovery System back to the site SWRB valve house, 2) a continuing force main from the SWRB valve house across the site to the eastern edge of the site where the Parshall Flume is located, and 3) a gravity main from the eastern edge of the site to the Great Miami River.

This piping forms the infrastructure for the new piping systems described herein. A design package for each of these new systems will be sent to the EPA and Ohio EPA for review prior to their construction.

New collection and conveyance systems for the remediation of portions of the aquifer under other portions of the FEMP (i.e., Phase II of South Field Extraction System waste storage area, and Plant 6 area systems) will not be installed until the soil remediation activities in those areas have been completed. This will avoid the need to maintain additional corridors of soil contamination. This is particularly important as it may be necessary to maintain these pipelines in service for years after anticipated termination dates based on bounce-back phenomena which has occurred at other remediation sites. Construction of these systems prior to soil remediation in these areas would delay the end of soil cleanup unnecessarily. Based on funding constraints, this may delay a cleanup of groundwater within a 10-year time frame.

3.1.4 Great Miami Aquifer Remedy Performance Monitoring

Section 3 of the Integrated Environmental Monitoring Plan (IEMP) (DOE 1997b) provides for the routine remedy performance monitoring of the Great Miami Aquifer. The details of how this remedy performance data will be evaluated and the associated decision making process are located in Section 3.7 of the IEMP. Figure 3-5 illustrates the overall framework for the groundwater remedy performance decision-making process for 1997 and 1998. If it is determined that aquifer restoration program expectations for 1997 and 1998 (as identified in the IEMP) are not being met, then the design and operation of the aquifer restoration system will be evaluated to determine if a change needs to be implemented. A change to the operation of the aquifer restoration system would be implemented by a modification to this OMMP. A groundwater monitoring change, if found to be necessary, would be implemented through the yearly reviews and two-year revisions of the IEMP, after approval. If additional characterization data is needed (e.g., to determine the nature of a newly detected FRL exceedance) a modification to the IEMP would be implemented, or a new sampling plan would be prepared depending upon the anticipated size of the activity.

Individual module start-up plans will provide specifics on the frequency of water level and water quality data collection activities during each module start-up. These detailed project specific plans are being/will be developed for each module and will be presented to the EPA and Ohio EPA for review and comment so that approval for system start-up is obtained prior to the scheduled start-up date. The

site-wide groundwater data will be utilized to to assess the performance of the site-wide groundwater remedy which is comprised of several individual modules. The module-specific start-up monitoring data (water levels and water quality) will be collected at the same time as the site-wide groundwater monitoring data. The start-up monitoring will be integrated with the IEMP groundwater monitoring such that area-wide interpretations can be made. Changes to the scope of the routine monitoring identified in the IEMP may be necessary based on the findings of the sampling specified in the start-up monitoring plans. These changes would be accommodated as necessary in the annual updates or biennial revisions.

The details of the quarterly and annual reporting of groundwater remedy performance information is also provided for in the IEMP, Section 3.7. The reporting subsection provides the specific information to be reported at the quarterly meetings/reports and in the comprehensive annual report. It is recognized that the data evaluation and reporting for IEMP and the OMMP will evolve over the first few quarterly meetings/reports as consensus is reached on the desired content of the meetings/reports.

3.1.5 Perched Groundwater

As specified in the Operable Unit 5 ROD, the remediation of perched groundwater will be accomplished by the excavation and dewatering of soil containing the contaminated water. These remediation activities will be completed by the Soils Characterization and Excavation Project (SCEP) and are therefore not within the scope of this document. The ARWWP will, however, receive water from the SCEP as a result of the excavation dewatering efforts and from storm water runoff collection, as discussed in Section 4.0. Therefore, unless otherwise identified, the term "groundwater" will be used throughout the remainder of this document to mean groundwater from the Great Miami Aquifer.

3.2 OTHER SITE WASTEWATER SOURCES/SYSTEMS

3.2.1 Storm Water Component

3.2.1.1 Storm Water Collection and Conveyance

The existing storm water collection system for the former production area drains from north to south to the existing SWRB (see Section 3.4.1.1). Figure 3-6 shows the underground piping network for the existing storm water system. It is planned that soil remediation will occur from north to south as explained in the draft Sitewide Excavation Plan and discussed further in Section 4.2 of this plan. It is anticipated that, for the most part, the existing storm water collection system will be used to transfer

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runoff from the active soil remediation areas to the SWRB. As erosion control at the point of excavation will be utilized, a significant increase of the current accumulation rate of solids in the conveyance system is not anticipated.

Areas which are remediated outside of the former production area such as areas 1 and 2 (see Figure 4-3) and construction of the OSDF will require the construction of new storm water collection and conveyance systems. These systems will be designed and constructed by either the SCEP or OSDF project. The ARWWP is actively involved in design review of these facilities. Their design flows have been included in this OMMP, as described further in Section 4.0.

3.2.1.2 Storm Water Monitoring

All projects that require pre-treatment for storm water must monitor discharges sent to the headworks of the ARWWP wastewater treatment facilities. Data will be collected and reviewed to verify that adequate erosion control is being provided. Analysis of the discharge from the SWRB will provide data to observe trends in overall influent contamination. Unusual or unanticipated trends will result in further review of influent streams.

All uncontrolled runoff (that not requiring treatment for uranium removal) will flow to Paddys Run via four existing drainage pathways. Monitoring of the four uncontrolled drainage pathways currently exists and will continue. Information collected will be reported semi-annually as part of the IEMP quarterly meetings/reports.

3.2.2 Remediation Wastewater Component

3.2.2.1 Remediation Wastewater Collection and Conveyance

The former production area wastewater collection and conveyance system will form the infrastructure of remedial wastewater collection and conveyance. All remedial wastewaters will be directed to either the existing Biodenitrification Surge Lagoon (BSL) or the existing high nitrate tank (HNT), the headworks for existing wastewater treatment, as described in Section 3.4.1.

Each of the source projects will be responsible for constructing new collection or conveyance systems or coordinating with ARWWP to utilize existing systems to transfer their wastewaters, or transporting flows by tanker truck or dumpster to these headworks.

Because of the increased quantity of flow which will be required from the BSL/HNT to the existing AWWT Phase II Facility (where this wastewater will be treated as discussed in Section 5), new pumps and transfer pipeline are being installed between these facilities. The increased pumping capability will also allow water to be sent to AWWT Phase I during abnormal conditions discussed in Section 5.4.1.1.

3.2.2.2 Remediation Wastewater Monitoring

All projects that require pre-treatment for remediation wastewater will require personnel to monitor discharges sent to the headworks of the ARWWP wastewater treatment facilities. For example, as discussed in Section 4, the Waste Pits Remediation Project (WPRAP), will require pretreatment of some streams to address heavy metals which are not specifically targeted for treatment at the AWWT. Monitoring of their pretreatment will be preformed by WPRAP. The ARWWP will periodically review their monitoring to verify adequacy of their pretreatment. Each contributing project will be required to monitor the flow of wastewater from their project(s) to the existing headworks so that actual flows can be checked for consistency against anticipated flows. This information will be used to determine if flows are greater than anticipated and if adjustments to wastewater treatment facilities will be necessary. Also, equipment will be installed to monitor the flow rate in the new BSL to AWWT transfer line.

3.2.3 Sanitary Wastewater Component

3.2.3.1 Sanitary Wastewater Collection and Conveyance

An extensive system of sanitary sewers currently exists at the FEMP. Figure 3-7 shows the underground piping network for the sanitary sewer system. The sanitary sewers in the former production area flow from north to south, to a main collector sewer located at the south end of the area, which runs west to east, to an existing lift station. Additional sewers from the administrative area run north and tie-in to the main collector sewer.

Soil remediation will be accomplished north to south preceded by D&D of existing facilities. As the existing facilities are removed, the need for the sanitary sewers decreases, so new sewers will not be required. Minor modifications (such as addition of new D&D changeout facilities) will require a minimal quantity of new sanitary wastewater collection and conveyance systems.

Because of the need to construct a new Sewage Treatment Plant (STP) to allow for the D&D of the existing STP and soil remediation of the underlying area, a new force main will be constructed from the existing sewage lift station to the new STP. The new STP will be located adjacent to the AWWT facility. A new force main from the new STP to the existing AWWT discharge header also shall be constructed.

3.2.3.2 Sanitary Wastewater Monitoring

Since the flow of sanitary wastewater will decrease as D&D progresses, monitoring the flow in collection sewers is not required. No future discharges should contain contaminants outside of those normally expected, so no monitoring of contaminants in the collection sewers is required. Total flow and influent contaminant levels to the STP will continue to be monitored for overall trends and STP operational management.

3.3 TREATMENT SYSTEMS

Treatment will be applied to recovered groundwater, storm water, remediation wastewater, and sanitary sewage to the extent necessary to limit the concentration and total mass of uranium discharged through the FEMP outfall to the Great Miami River (limits detailed in the Operable Unit 5 ROD) and to meet NPDES permit limitations. To attain these mass- and concentration-based uranium discharge limits, DOE has committed to expanding the existing AWWT facility by installing an additional groundwater treatment capacity of 946 mgy (1800 gpm) [788 mgy (1500 gpm) nominal throughput rate] to achieve a total groundwater treatment capacity (combined existing and new treatment capacity of at least 1051 mgy [2000 gpm]). Figure 3-8 shows general locations of the existing and planned facilities. The following information summarizes the existing and planned wastewater treatment systems and their expected throughput rates.

3.3.1 Advanced Wastewater Treatment (AWWT) Facility

The existing AWWT, currently consisting of Phases I and II, is located in the southwest corner of the former production area. The AWWT is currently being expanded to incorporate an additional capacity dedicated to groundwater treatment. The two existing AWWT systems are installed as parallel treatment systems and are operated from a central control room. The expansion will also be operated from the same central control room.

3.3.1.1 AWWT Phase I

Figure 3-9 shows a simplified process flow diagram of the AWWT Phases I and II treatment processes. The Phase I system consists of the following unit processes:

- Flow equalization and pH adjustment with caustic (when required) in preparation for the downstream coagulation process
- Coagulation with alum and polymer, followed by clarification for reduction of suspended solids, uranium, and some unspecified assumed reduction in other radionuclides and heavy metals. Other coagulant chemicals may be tested as part of process optimization efforts
- Filtration using multimedia filters to remove suspended solids from the clarifier overflow. The filters are cleaned by backwashing
- pH adjustment with sulfuric acid if required (not used presently)
- Two trains of three ion-exchange resin vessels (each train) to remove uranium. The wastewater flows through two ion exchange resin vessels in lead/lag series with the third vessel available for regeneration
- Final pH adjustment (if required - not presently used), filtration, and discharge. Both the Phase I and Phase II treated streams are combined in the pH mixing/recycle tank, filtered using multi-tubular filters, and discharged.

The Phase I operation is currently prioritized to the treatment of the storm water collected in the SWRB. On an average annual basis, approximately 158-210 mgy (300 to 400 gpm) of storm water has been treated through the Phase I system. During periods of low rainfall and low levels in the SWRB, the AWWT Phase I system is used to treat groundwater.

The current sources to this system are contaminated storm water runoff and extracted groundwater. The storm water discharged to the SWRB contains an average of approximately 500 ppb uranium, while the South Plume groundwater currently being pumped contains around 20 ppb. This differential in concentration illustrates the basis of the current treatment philosophy to preferential treatment of storm water over groundwater.

The recently completed installation of multimedia filters to replace previously used multi-tubular filters is expected to allow for an average annual treatment capacity of approximately 315 million gallons per year. This is based on an anticipated throughput of 600 gallons per minute.

3.3.1.2 AWWT Phase II

The AWWT Phase II was installed for treatment of previous production wastewaters and site-contaminated remediation wastewater. The AWWT Phase II system is currently configured to allow concurrent treatment of site remediation wastewater, storm water, and groundwater. This system consists of the same unit treatment as the Phase I system, except that adsorption with activated carbon for organic contaminant removal is present prior to the ion exchanges vessels. Carbon filtration is included in the Phase II system to provide treatment of VOCs that may be present in the remediation wastewaters. Only one train of three ion exchange vessels is present in AWWT Phase II.

Recycled streams within the wastewater complex are sent to the headworks of the Phase II system. Some of the major recycled streams include filter and ion exchange backwash water, return water from the adjacent Slurry Dewatering Facility (SDF), rainfall onto the AWWT complex, and floor washdowns. The inflow to the Phase II system flows through two 80,000 gallon equalization tanks to accommodate fluctuating incoming flow streams. The Phase II operation is currently prioritized to the treatment of site wastewater collected in the BSL or HNT.

As with the Phase I system, the Phase II system treats the most contaminated stream as the first priority. The uranium concentration of the wastewater stored in the surge lagoon has averaged around 1500 ppb, making it the first priority. Any excess system capacity, which is dependent on the level in the BSL, has normally been used to treat storm water or groundwater.

13 The recently completed installation of multimedia filters to replace previously used multi-tubular filters is expected to allow for an average annual treatment capacity of approximately 158 million gallons per year. This is based on an anticipated throughput of 300 gallons per minute.

3.3.1.3 AWWT Expansion

As discussed in the Operable Unit 5 ROD, the existing capacity of the AWWT facility will be expanded to the maximum achievable within the confines of Building 51, thus enhancing the FEMP's ability to treat groundwater. The design and initiation of construction of the expansion have been accomplished as described by Task 8 in the RA Work Plan.

1 This treatment system is in the early stages of construction. The unit processes of the AWWT expansion system include aeration, granular multimedia filtration, and ion exchange. The treated effluent from this facility will be the source of water for aquifer re-injection. The aeration step is included to help remove iron, thereby reducing biofouling of the re-injection well screen. This treatment system will be able to process approximately 788 mgy (1500 gpm) on an annual average basis. The operating capacity takes into account downtime for scheduled maintenance and unplanned interruptions of flow. This new system is somewhat similar in design to the South Plume Interim Treatment (SPIT) system (described in Section 3.3.3) and is expected to perform in a similar manner.

3.3.2 Interim Advanced Wastewater Treatment (IAWWT) System

The IAWWT is located just north of the SWRB. Either SWRB water or South Plume groundwater may be treated by the IAWWT system before it is discharged to the Great Miami River. The IAWWT system consists of two trailer-mounted treatment systems. Before the SWRB discharge enters these two trailer systems, it is pumped through granular multimedia filters for suspended solids removal. Each trailer unit has two feed pumps, two bag filters, two cartridge filters, and three ion exchange vessels in series (two operating, one standby). The treated effluent is discharged through the FEMP outfall line to the Great Miami River. Backwash from the multimedia filters is routed to the general sump for subsequent treatment in the AWWT Phase II system.

DOE 1 The IAWWT treatment system was sized as a 158 mgy (300 gpm) treatment system to treat uranium-contaminated storm water before the installation of the AWWT Phase I system. Since that time, the system has been used to treat mostly groundwater. However, the IAWWT is used to treat SWRB waters during periods of heavy rainfall. Current plans are to maintain this system primarily for groundwater treatment. As a groundwater treatment system, the IAWWT throughput is expected to be approximately 131 mgy (250 gpm).

3.3.3 South Plume Interim Treatment (SPIT) System

14 The SPIT system was installed to provide treatment of approximately 92 million gallons per year of South Plume Groundwater. This is based on an anticipated throughput of 175 gallons per minute. The system is housed in a building located just north of the SWRB. The system consists of filtration for particulate removal and ion exchange for uranium removal. The SPIT system consists of granular multimedia filters followed by a bag filter. The SPIT system uses three ion exchangers in series (two

operating, one standby). The treated groundwater is discharged through the FEMP outfall line to the Great Miami River. Multimedia filter backwash is pumped to the general sump for subsequent treatment in the AWWT Phase II system. The SPIT system will remain dedicated to the treatment of extracted groundwater at the above stated capacity.

A future project will provide aeration of influent groundwater and a new discharge pipeline to the treated groundwater re-injection holding tank. This project will occur prior to the expansion of the planned re-injection system.

3.3.4 Volatile Organic Compound (VOC) Wastewater Treatment System

A 10 gpm treatment system at Plant 8 was constructed in 1991 for treatment of VOC-contaminated perched water collected from wells in and around Plants 2/3, 6, 8, and 9 (FEMP Removal Action 1). The system includes a 6,000-gallon storage tank, pumps, bag and cartridge filters, activated carbon drums, and a post-treatment collection tank.

Removal Action 1 ceased in December 1995, but some pumping operations remain in Plant 6 for maintenance purposes. Water with VOC contamination is being treated by activated carbon adsorption at the AWWT Phase II. Current plans call for operation of the Plant 8 VOC system only for treatment of future wastewaters containing RCRA-listed hazardous constituents. In 1999, the existing VOC plant will be relocated/modified to allow D&D of Plant 8 to proceed.

3.3.5 Sewage Treatment Plant (STP)

Sanitary sewage and laundry wastewater is currently treated at the FEMP sewage treatment plant, located southeast of the former production area. The sewage treatment plant consists of a lift station, primary settling basins, trickling filters, secondary settling basins, an anaerobic digester, and ultraviolet disinfection units. The plant is scheduled to be decommissioned in FY 1998 and replaced by a new sewage treatment facility located near the AWWT Facility. The new sewage treatment facility will use relocated equipment from the out-of-service biodenitrification (activated sludge) effluent treatment system and the existing STP. The main components of the new sewage treatment plant will include an aeration tank, a clarifier, sludge thickener, and an ultraviolet disinfection system.

3.4 ANCILLARY FACILITIES

A number of facilities exist that are supplementary to the operation of the various treatment systems. These include system headworks for equalizing the flows to these systems, groundwater flow routing facilities, wastewater collection and transfer facilities, sludge processing facilities, and discharge monitoring facilities. These facilities are described below.

3.4.1 System Headworks

Headwork facilities exist for support of the various wastewater treatment facilities. In general, these facilities provide for flow equalization prior to discharging to the various treatment systems. Details of the headworks follow.

3.4.1.1 Storm Water Retention Basin (SWRB)

The SWRB, located south of the former production area, currently receives storm water runoff from the former production area. The SWRB allows for the settling of suspended solids and flow equalization. It has a retention capacity of about 10 million gallons. The basin consists of an east chamber and a west chamber, which allow collection of water in one chamber while "settled" water is discharged from the other chamber. Valves at the SWRB chamber inlets and at the SWRB discharge pumping station accommodate this operation. The basin consists of a primary bottom bentonite liner and an upper flexible synthetic membrane liner. An underdrain system beneath the synthetic liner is used to monitor and collect leakage through the synthetic liner. The discharge valves (SWRB valve house, described below) allow water to be pumped to the AWWT Phases I and II, IAWWT, or directly to the FEMP outfall line to the Great Miami River.

3.4.1.2 Biodenitrification Surge Lagoon (BSL)

The BSL is located in the southeast section of the waste storage area. It is used to collect wastewater flows from the site and provide a relatively consistent flow rate to wastewater treatment. It is an 8-million-gallon, man-made lagoon that receives contaminated wastewater from the general sump as well as controlled storm water runoff from the clearwell, waste pit area perimeter, and Waste Pit 6. The discharge from the lagoon is pumped to the AWWT Phase II facility. The lagoon will serve as the primary headwork for AWWT Phase II treatment of future remediation wastewater. Therefore, it is intended to be the primary discharge point for other remediation projects. In the event of an

emergency situation, such as potential overflow of the lagoon, valves at the AWWT facility will also allow a portion of the flow to be directed to the Phase I treatment system.

The lagoon has two synthetic membrane liners and a leachate collection system underneath each membrane liner. The bottom of the lagoon is lined with a 12-inch thick layer of bentonite. Wastewater is pumped from the lagoon to the AWWT Facility from a pump station located at the southeast corner of the lagoon.

3.4.1.3 High Nitrate Tank (HNT)

The HNT is located southeast of the surge lagoon. It has a 500,000 gallon capacity that was previously used for storing high nitrate-concentration wastewater from the general sump. Concrete secondary containment surrounds the HNT. Discharged wastewaters from the HNT are combined with discharged wastewater from the BSL by means of two 60-gpm pumps. The HNT will be used as a holding tank for wastewater from the Silos Project and may be used for other flows in the future.

3.4.1.4 Headworks Sludge Removal Systems

The procedures now used for removal of sediment from the SWRB and the BSL are very cumbersome and they require taking the basin/lagoon out of service for extended time periods. A new project will install three remotely operated solids removal systems (dredges) to address anticipated future increased levels of sediment accumulation in these basins. One dredge will service the BSL. Because the SWRB consists of two chambers (east and west), two dredges will be used to avoid continuously moving a dredge from one chamber to the other.

The scope of the project also includes the purchase and installation of local off-loading, or decanting systems necessary to allow the sludges and treated waters to be separated. The separated water will be discharged into the basins. The separated sludge will be transported by truck to the slurry dewatering facility for dewatering and packaging for ultimate disposal. This project will also process the backwash from the existing SPIT and IAWWT systems. It is not anticipated at this time that solids buildup in the HNT is a concern, so no specific sludge-removal measures are planned for that facility.

3.4.1.5 Sanitary Lift Station

All sanitary flow is collected in the Sanitary Lift Station, which has a limited storage volume. Pumps automatically transfer accumulated wastewater to the STP when a certain storage level is reached. Therefore, most flow surges are transferred to the STP without equalization.

3.4.1.6 Great Miami Aquifer

No specific headworks exist for groundwater. However, because this flow can be adjusted by regulating the extraction wells, the aquifer itself serves as a headworks for groundwater.

3.4.2 SWRB Valve House

34 The SWRB valve house is located just north of the SWRB west chamber. The valve house contains an extensive array of valves to allow diversion of storm water flow from the SWRB and groundwater flow from the South Plume Recovery System to the various interim and future treatment facilities. This facility also serves as the point of convergence for the treatment systems effluents prior to discharge through the FEMP outfall pipeline. The valves also allow for untreated water from the SWRB to be discharged directly to the Great Miami River to prevent the SWRB from overflowing to the Storm Sewer Outfall Ditch and Paddys Run, due to heavy rainfall or other operational difficulties. Flow monitoring and sampling equipment are also provided in the valve house.

3.4.3 South Field Valve House

As part of the South Field Extraction System Phase I construction, a new south field valve house is planned, upstream of the SWRB Valve House, that will receive the combined South Plume Recovery System and South Plume Optimization System groundwater. It is to direct the combined flow toward treatment and/or to untreated discharge prior to combining with other groundwater flows.

3.4.4 General Sump

The general sump is just northeast of Plant 8 in the former production area. The general sump is a tank farm (13 tanks with 5,000 -50,000 gallon capacity) that is primarily a wastewater transfer facility. Historically it has provided limited treatment consisting of neutralization, precipitation, pH adjustment, and decantation. The general sump receives wastewater from various plant sources for diversion to the surge lagoon. The general sump will remain in service for a period of time but will be phased out of service as soon as feasible.

3.4.5 AWWT Slurry Dewatering Facility (SDF)

The AWWT slurry dewatering facility is adjacent to the AWWT facility. The primary purpose of the SDF is the processing (dewatering) of waste slurries and sludges from the AWWT facilities. The dewatering of miscellaneous site waste sludges (i.e., those from the SWRB, BSL, STP, etc.) will also be performed at this facility.

The slurry dewatering facility has a design treatment capacity of 30,000 gallons per day of slurry. The process consists of slurry conditioning (pH adjustment, coagulation/flocculation, filter aid addition), thickening, and pressure filtration. The dewatered waste material will be packaged for on- or off-site disposal.

3.4.6 Resin Regeneration Facility

As described above, the primary process used at the FEMP for removing uranium from wastewater is ion exchange. The resin used to perform the ion exchange can be regenerated, to restore its chloride ion exchange form. A resin regeneration system, using sulfuric acid regenerant, was designed and installed for AWWT Phases I and II. A review of the originally installed AWWT regeneration process identified some safety and technical concerns, and some opportunities for improvement. A project to reconfigure the original process and retrofit the original equipment is being implemented. A brine (sodium chloride) regeneration system is being installed.

3.4.7 Effluent Aeration Facility

The effluent aeration facility adds dissolved oxygen to the groundwater/wastewater effluent as necessary to meet NPDES permit minimum requirements of 5 parts per million (ppm) of dissolved oxygen. All treatment system effluents discharged (except for the existing STP) are conveyed to the effluent aeration facility. The effluent aeration facility consists of a 60,000 gallon stainless steel aeration tank and an adjacent building that houses two 30-horsepower (hp) water recycle pumps and two 75-hp compressed air blowers. There is additional building space to double the system size, if required.

3.4.8 Parshall Flume

Downstream of the effluent aeration facility, the effluent is currently combined at Manhole 176B with existing Sewage Treatment Plant effluent from Manhole 175. These combined flows pass through a

Parshall flume and associated outfall monitoring station for FEMP discharge flow measurement and monitoring. The new sewage treatment plant effluent will be combined with the other effluents and routed through the effluent aeration facility. Manhole 175 will be decommissioned.

3.5 CURRENT TREATMENT PERFORMANCE

As described above, a number of treatment systems have been used at the FEMP to treat groundwater, storm water, and process-generated remediation wastewater. A description of the uranium removal performance of these systems, as well as a description of uranium contamination within sanitary sewage, are provided below.

3.5.1 Groundwater

The SPIT system was installed in 1994 to remove uranium from groundwater recovered by the South Plume extraction well system. AWWT Phase I and II have also been used occasionally to treat groundwater when capacity was available. The SPIT system has consistently reduced the uranium concentration from about 20 ppb to less than 5 ppb. Based on this information, future groundwater treatment modeling used 5 ppb as the performance value.

3.5.2 Storm Water

The IAWWT and AWWT Phase I systems have been used to remove uranium from storm water collected in the SWRB. The IAWWT has consistently reduced the uranium concentration from about 500 ppb to 5 ppb. AWWT Phase I has been used for both groundwater and storm water and has required some troubleshooting and modification since its startup in 1995; consequently, its performance had not been consistent. With the recent addition of multi-media filters, its performance consistently has provided an effluent of 10 ppb or less. Based on these performances, future storm water treatment modeling has used 10 ppb as the performance value.

3.5.3 Remediation Wastewater

AWWT Phase II has been used to treat the more variable remediation-generated wastewater and, on occasion, groundwater. It also has required some troubleshooting and modification since 1995. With the recent addition of multi-media filters, its performance has consistently provided an effluent of 20 ppb or less. Based on this performance, future remediation wastewater treatment modeling has used 20 ppb as the performance value.

3.5.4 Sanitary Sewage

The treatment of FEMP sanitary sewage is important with respect to compliance with the Clean Water Act and, more specifically, with the site NPDES permit requirements. It would not be significantly important to the remediation aspects of Operable Unit 5, except for the presence of uranium contamination in the collected sewage.

The uranium concentration of the STP effluent over the course of the last several years has fluctuated between 20 and 550 ppb. Levels greater than 20 ppb will cause the STP effluent to affect the potential to meet the monthly average of 20 ppb in FEMP wastewater discharge to the Great Miami River and is a concern to the overall success of adherence to the goals and commitments outlined in this plan.

Preliminary investigation (sampling) of the sanitary sewer system has identified pipeline sections where the uranium concentration in sewage is elevated. Infiltration of contaminated water into the sewer pipeline is suspected as the source of the elevated uranium concentrations.

Between mid-1991 and mid-1994, the average monthly STP effluent uranium concentrations were normally less than 20 ppb (see Figure 3-10). This was attributed to the elimination of the Biodenitrification facility effluent from the STP. Since 1994, the uranium concentrations in the STP effluent have been increasing. This appears to correlate with the Plant 7 demolition implosion. It is theorized that the implosion may have loosened the underground piping joints, resulting in a greater potential for uranium-contaminated perched groundwater infiltration.

The contaminated perched water areas will be remediated by excavation and dewatering, soil disposition, and contaminated water treatment as described in the Operable Unit 5 ROD. The need and remedy for reducing the uranium concentration in the STP effluent, prior to perched water area remediation, to support the 20 ppb discharge criteria is currently being investigated. If interim corrective actions are determined to be necessary, the remedy will likely include one or more of the following actions:

- Installation and operation of a simple dedicated wastewater treatment unit (likely incorporating filtration and ion exchange) for the STP discharge

- Isolation of the contaminated sections of sanitary sewer piping and rerouting to accommodate the necessary site sanitary services
- Rehabilitation of the sanitary sewer piping in the areas of contamination.

3.6 CURRENT AND PLANNED DISCHARGE MONITORING

Currently, discharge monitoring is completed under two sampling programs. Conventional pollutants are monitored under the NPDES. Radionuclides and total uranium are monitored under the Federal Facilities Compliance Agreement (FFCA). These two programs are being incorporated into the IEMP sampling program as described in Section 4 of the IEMP. These monitoring programs are described briefly in the subsections below.

3.6.1 NPDES Monitoring

There are six permitted FEMP wastewater discharge outfalls to State of Ohio waters that are regulated by the NPDES Permit Program (see Figure 3-11). There are also two internal monitoring points. The permit (Ohio EPA Permit No. 1IO00004*ED) is administered by the Ohio EPA and granted to the DOE at the FEMP. The effluent pollutant limitations, monitoring requirements, and reporting requirements are specified in the permit for each outfall and internal monitoring point.

Discharges through Outfall 4001 enter the Great Miami River at River Mile 24.73. The sampling and monitoring location for this outfall is the Parshall flume chamber near Manhole 176B. This outfall is the primary FEMP wastewater discharge outfall consisting of discharges from the AWWT facilities, IAWWT, SPIT, STP, untreated groundwater, and untreated storm water.

Discharge through Outfall 4002 enters Paddys Run at River Mile 2.50. The sampling and monitoring location for this outfall is the SWRB overflow spillway. Discharge at this outfall only occurs when the accumulation of storm water in the SWRB exceeds the capacity of the SWRB. Overflow of the SWRB to Paddys Run results in further contamination of the Great Miami Aquifer and, therefore, operating guidelines are provided in this plan to minimize the frequency of this occurrence. Accordingly, eliminating SWRB overflow is considered one of the most important parameters driving this OMMP.

Discharges through Outfalls 4003, 4004, 4005, and 4006 are untreated storm water runoff drainage from site areas into Paddys Run. Runoff from eastern and southern areas of the site drains through

Outfall 4003, which is just north of Willey Road. Runoff from the inactive flyash pile area drains through Outfall 4004, which is just west of the flyash pile. Runoff from the western area of the site drains through Outfall 4005, which is just south of the K-65 Silos. Runoff from areas north of the site drains through Outfall 4006, which is north of Waste Pit 5.

Internal sampling station 4589 is the sampling of dewatered sludge from the STP. Internal sampling station 4601 is the sampling of final effluent from the STP at the Ultraviolet Disinfection Building.

3.6.2 Radionuclide and Uranium Monitoring

30 The FEMP site conducts a surface water sampling and analytical program for certain specific radionuclides which are potentially present in the regulated liquid effluent and in the uncontrolled stormwater runoff from the site. Details of this program are provided in Section 4 of the IEMP. The program consists of uranium analysis of a daily flow-proportional composite sample of the site effluent and grab sampling at monthly and quarterly intervals. The monthly samples are analyzed for total uranium, radium-228 and technetium-99, while the quarterly samples are analyzed for lead-210 radium-226 and strontium-90.

The daily total uranium analysis of the site effluent to the Great Miami River is used to track compliance with Operable Unit 5 ROD established limits. Since the issuance of the Operable Unit 5 ROD in January 1996, the FEMP is obligated to limit the total mass of uranium discharged through the FEMP outfall to the Great Miami River to 600 pounds per year.

31 This daily effluent uranium analysis is also used to forecast the FEMP's ability to achieve a future requirement for a monthly average uranium concentration of 20 ppb uranium in the site discharge to the river. This future requirement becomes effective January 1, 1998, as established in the Operable Unit 5 ROD. The Operable Unit 5 ROD does allow relief from this 20 ppb requirement during periods of excessive precipitation and for scheduled maintenance. (Excessive precipitation is an amount of precipitation combined with the projected weather forecast, that causes water levels in the basin to threaten the limit of the holding capacity of the basin.) The uranium concentration in the effluent to the river on up to 10 storm water bypass days a year may be deleted when calculating the monthly average. Section 9.1.5 of the Operable Unit 5 ROD stipulates that notification will be provided to EPA and

OEPA within seven days of the implementation of such a direct bypass. The purpose of the bypass is to minimize the possibility of SWRB overflow to Paddys Run.

35 The average monthly uranium concentration is calculated by multiplying each daily flow by the uranium concentration of the flow-weighted composite sample for that respective day. The sum of the values obtained by multiplying the flow times the concentration is then divided by the sum of the flows for the month. The result is a flow-weighted average monthly uranium concentration. The daily flow-weighted concentrations are then multiplied by 8.34 (lb/gal) to obtain the daily pounds of uranium discharged. The sum of the daily masses for the year is used to compare against the 600-pound-per-year limit.

36 After the average monthly uranium concentration has been calculated, the 10 allowable bypass concentrations will be accounted for as follows: If any by-pass days occur during a particular month which equal or exceed 12 hours in duration, the flow-weighted concentration for that day will be dropped and the average will be recalculated. If additional bypass days of less than 12 hours occur during a month, the highest flow-weighted concentration will be dropped and the average will be recalculated. This method will be repeated until the 20 ppb limit is achieved or all of the allowable bypass days have been expended.

EXAMPLE: Stormwater bypasses occurred on March 2, 3, and 4, 1997. The bypassing started at 12:00 AM on March 2 and ended at 9:30 AM on March 4. Therefore two days of equal to or greater than 12 hours of bypassing occurred. The flow-weighted average for the month was 33 ppb. By dropping the daily flow-weighted concentration of the two days when 12 or more hours of bypassing occurred, the average was reduced to 18 ppb. Thus, although there were three bypass days reported to the agencies, only two of the 10 allowable bypass days were expended to meet the 20 ppb limit.

If the adjusted average monthly uranium concentration exceeds the 20 ppb limit after the flow-weighted concentrations for all allowable by-pass days have been removed, the excursion will be reported to the agencies.

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36 If a sequence of months (i.e., not a random occurrence) indicate an exceedance of the 20 ppb monthly average, or if the sum of well pumping has been reduced below that expected in order to achieve compliance with the 20 ppb monthly average and there has not been above average rainfall, then corrective measures will need to be evaluated. Depending on the reason for the sequence of exceedances, or if less than targeted recovery well pumping rates are required to maintain compliance with the 20 ppb limit, corrective actions could include: modifications to parts of the FEMP wastewater system as discussed in Section 3.5.4 or 5.4.1.2; continued reduction of groundwater extraction pumping rates until additional treatment can be installed; segregation of the South Plume Optimization wells discharge from the combined SPO/South Plume Recovery System header to reduce the concentration of uranium in flow bypassing treatment; or other such actions.

The need for corrective measures will be discussed with the U.S. EPA and Ohio EPA as part of the IEMP quarterly meetings/reports. (Summary reporting of how the FEMP is doing with respect to compliance with the 20 ppb uranium discharge limit and the use of bypass days will be included in the IEMP quarterly meetings/reports.) In the event that corrective measures are deemed necessary, the situation will be outlined to the EPAs in order to reach consensus regarding what action (if any) is required.

3.6.3 IEMP Surface Water and Treated Effluent Monitoring Program

Significant portions of these current programs (NPDES and FFCA) are being incorporated into the IEMP which is scheduled to be implemented in 1997. Section 4 of the IEMP describes these two programs in more detail and also how these two programs are being integrated into the IEMP surface water and treated effluent sampling program. The IEMP also provides for additional monitoring above that required by the NPDES permit and the FFCA. This additional monitoring is planned in order to monitor surface water and treated effluent for potential site impacts to various receptors during remediation. Figure 3-11 shows the current NPDES, FFCA, and the new IEMP treated-effluent and surface-water sampling locations. In addition to identifying the sampling program requirements, the IEMP provides a comprehensive data evaluation, and associated decision-making and reporting strategy for surface-water and treated-effluent. Figure 3-12 depicts the IEMP treated-effluent and surface-water data evaluation strategy and associated actions.

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TABLE 3-1

AQUIFER RESTORATION REMEDIAL ACTION SCHEDULE FOR NEAR-TERM ACTIONS

Module	Well Installation Contract Award	Infrastructure Contract Award[a]	Complete Construction	Commence Operations
Injection Demonstration	Complete	September 5, 1997	June 1, 1998	**August 1, 1998[c]**
South Plume Optimization	November 1, 1997	January 2, 1998	July 1, 1998	**September 1, 1998[c]**
South Field Extraction System Phase I	NA[b]	February 1, 1998	August 1, 1998	**September 30, 1998[c]**

[a]The infrastructure contract for the groundwater extraction modules includes all construction activities other than well drilling (e.g., installation of electrical, instrumentation, pipelines, pumps and associated equipment).
[b]Nine of the 10 Phase I South Field Extraction System Module wells were installed previously under the 1995 Project-Specific Plan for the Installation of the South Field Extraction System (DOE 1995e).
[c]The dates provided for commencing operations (start-up) are the enforceable milestones for the aquifer restoration remedial action. All other dates are provided for information purposes to demonstrate their relationship to the enforceable (commence operations) milestones.

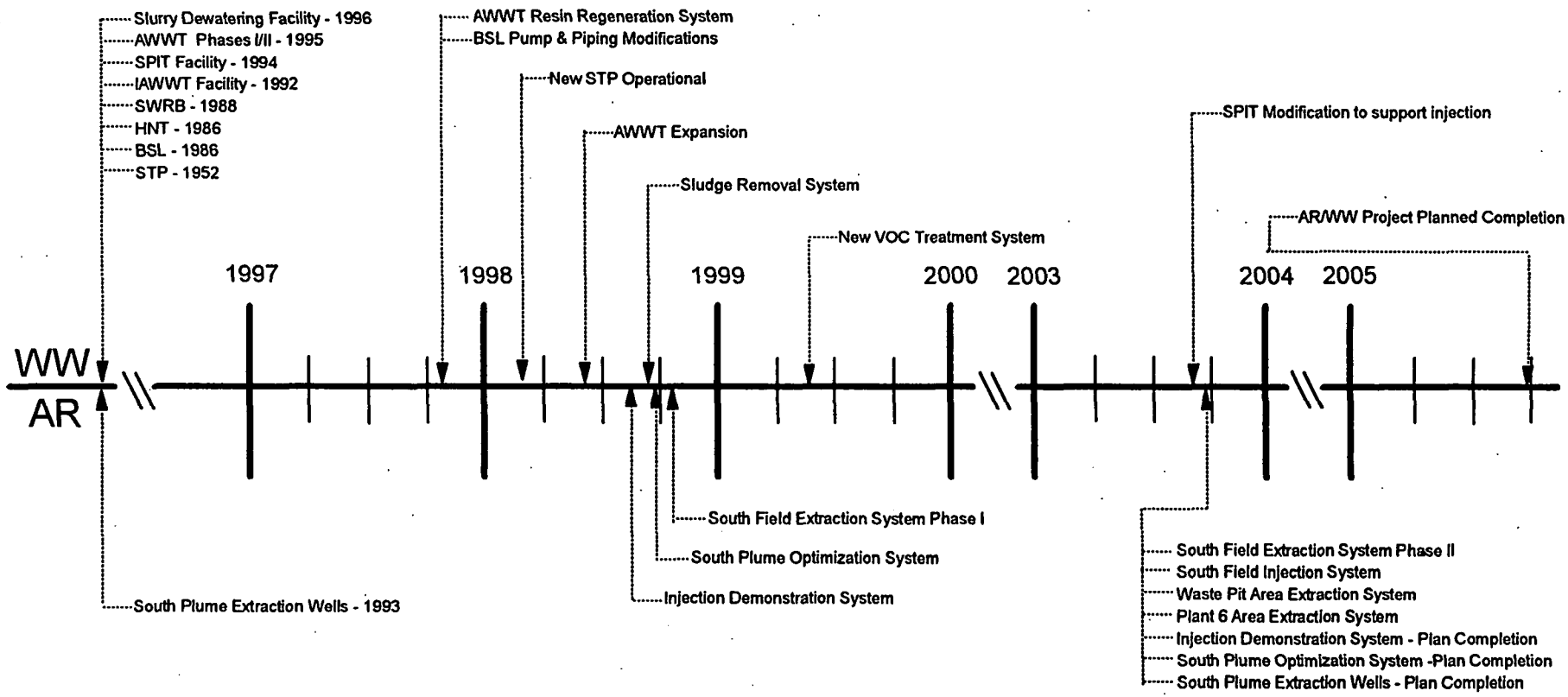
TABLE 3-2

AQUIFER RESTORATION REMEDIAL ACTION SCHEDULE FOR LONG-TERM ACTIONS[a]

Module	Well Installation Contract Award	Infrastructure Contract Award[b]	Complete Construction	Commence Operations
South Field Injection System	October 1, 2002	December 31, 2002	August 1, 2003	October 1, 2003
South Field Extraction System Phase II	November 30, 2002	December 31, 2002	August 1, 2003	October 1, 2003
Waste Pit Area Extraction System	October 31, 2002	December 1, 2002	August 1, 2003	October 1, 2003
Plant 6 Area Extraction System	February 1, 2003	March 1, 2003	August 1, 2003	October 1, 2003

[a]The long-term projected dates are contingent upon completion of OU1, OU3, and/or OU2/OU5 remedial activities in the module areas. If these projects are delayed, then revised schedules will be submitted as addenda to the RA Work Plan for Aquifer Restoration.
[b]The infrastructure contract for the groundwater extraction modules includes all construction activities other than well drilling (e.g., installation of electrical, instrumentation, pipelines, pumps and associated equipment).

Figure 3-1
ARWWP Timeline



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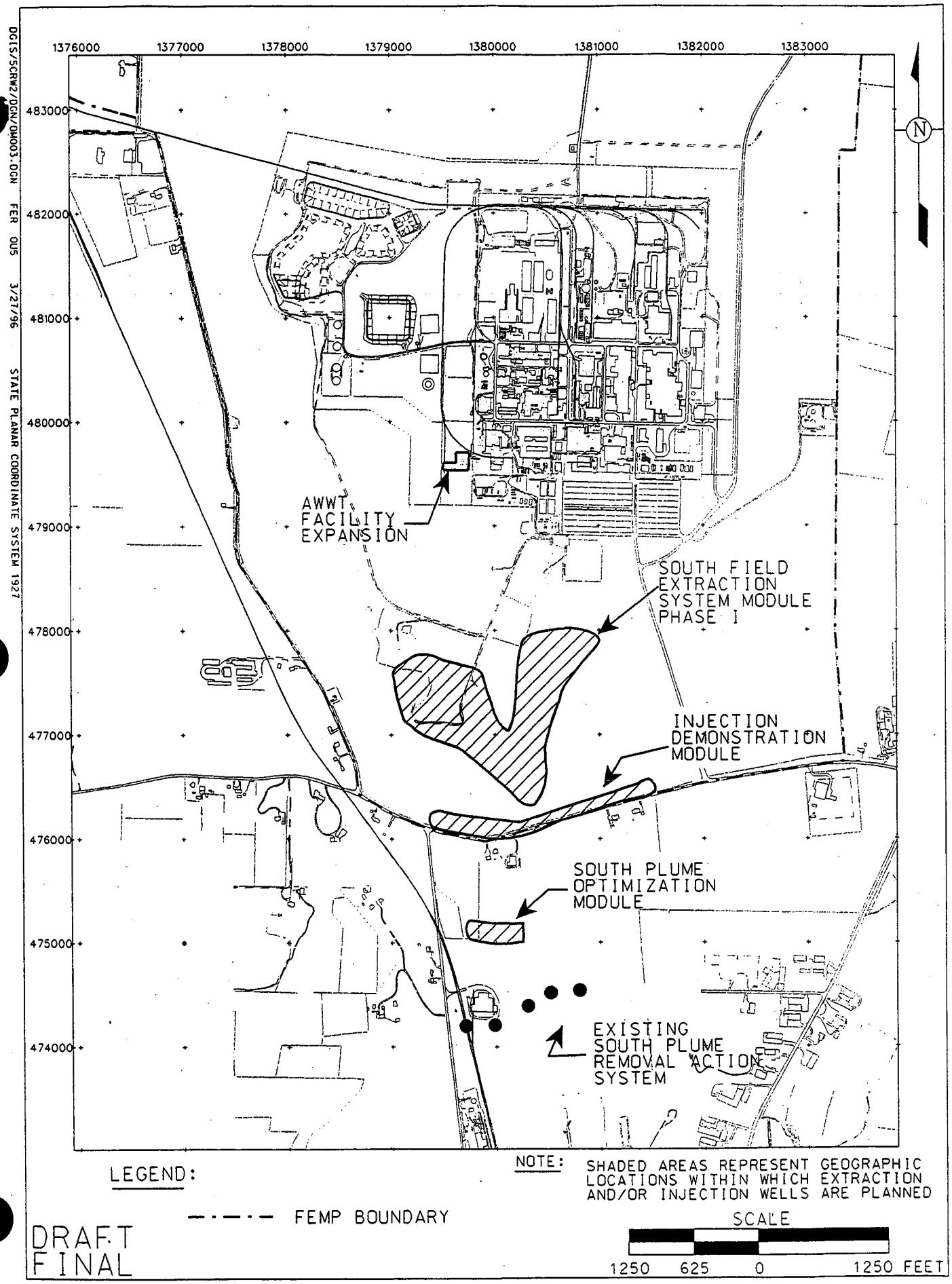


FIGURE 3-2. LOCATION OF NEAR-TERM AQUIFER RESTORATION MODULES

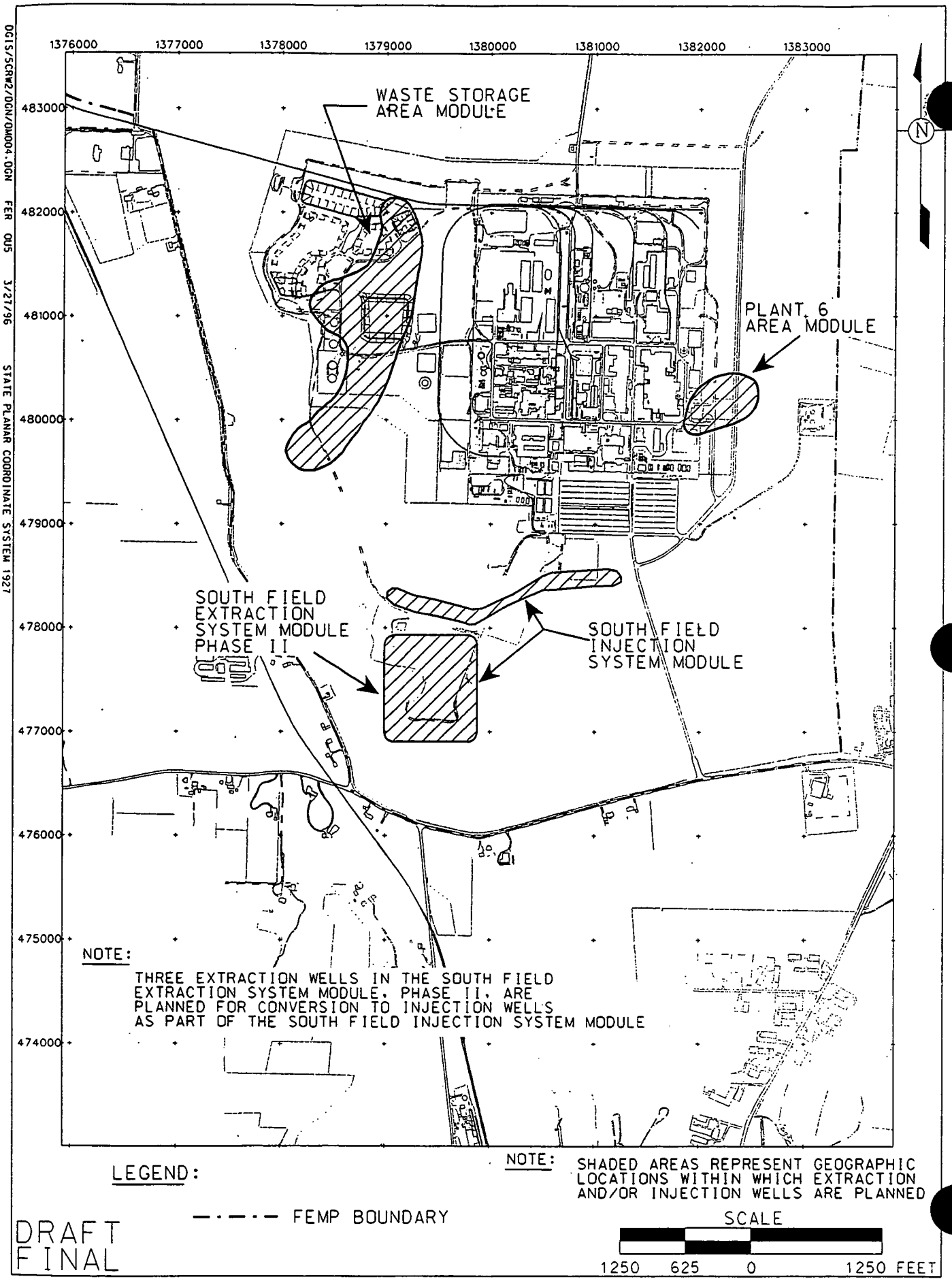


FIGURE 3-3. LOCATION OF LONG-TERM AQUIFER RESTORATION MODULES

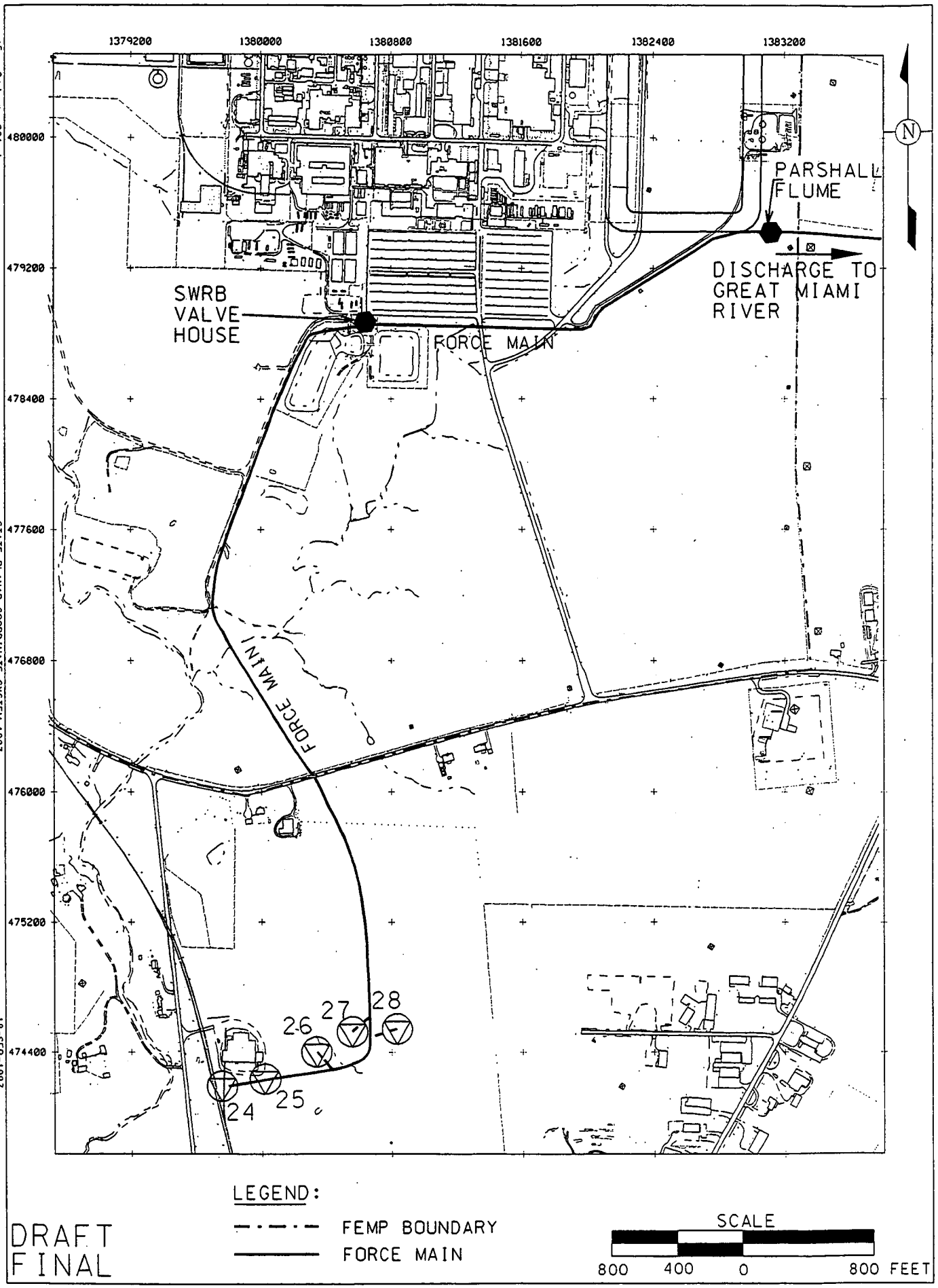
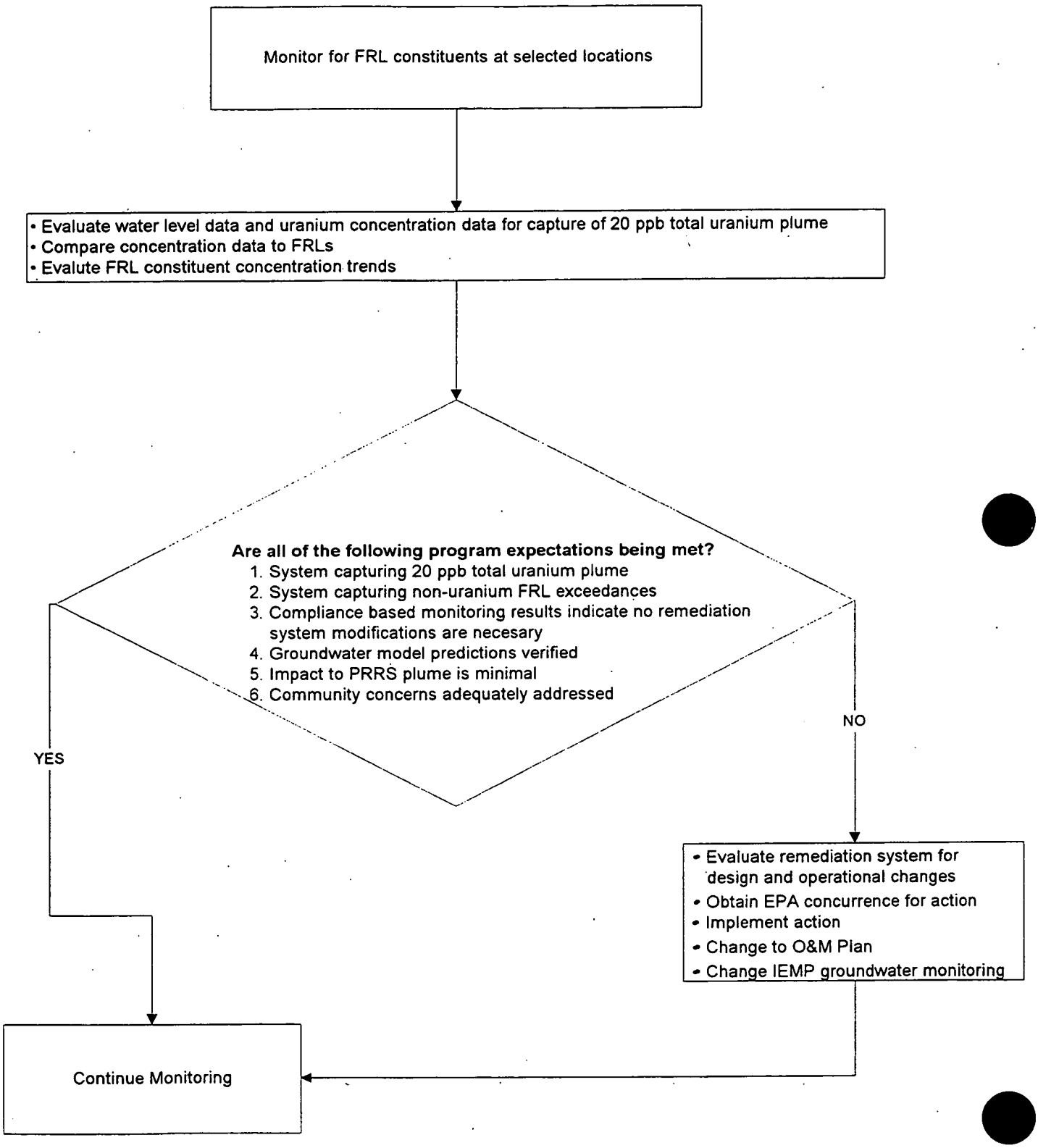
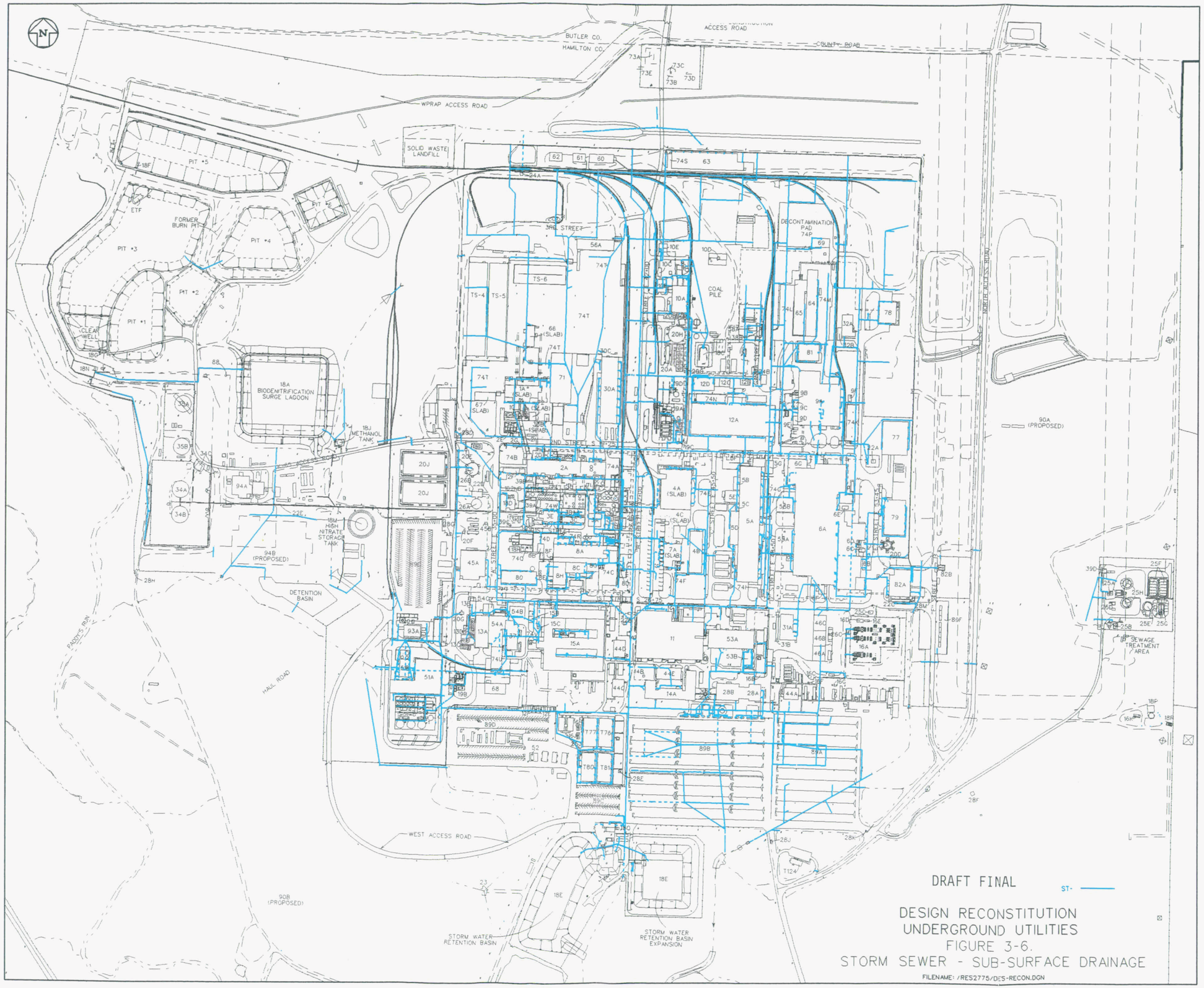


FIGURE 3-4. REMOVAL ACTION 3 GROUNDWATER CONVEYANCE SYSTEM

FIGURE 3-5
GROUNDWATER MONITORING DECISION MAKING PROCESS FOR 1997 AND 1998




BUTLER CO.
HAMILTON CO.
ACCESS ROAD
COUNTY ROAD
WPRAP ACCESS ROAD
SOLID WASTE LANDFILL
PIT #5
PIT #6
PIT #4
PIT #3
PIT #2
PIT #1
ETF
FORMER BURN PIT
CLEAR WELL
BIODENITRIFICATION SURGE LAGOON
METHANOL TANK
HIGH NITRATE STORAGE TANK
DETENTION BASIN
PADDY'S RUN
HAUL ROAD
3RD STREET
2ND STREET
STREET
TS-4
TS-5
TS-6
COAL PILE
DECONTAMINATION PAD
NORTH ACCESS ROAD
90A (PROPOSED)
94A
94B (PROPOSED)
90B (PROPOSED)
SEWAGE TREATMENT AREA
WEST ACCESS ROAD
STORM WATER RETENTION BASIN
STORM WATER RETENTION BASIN EXPANSION
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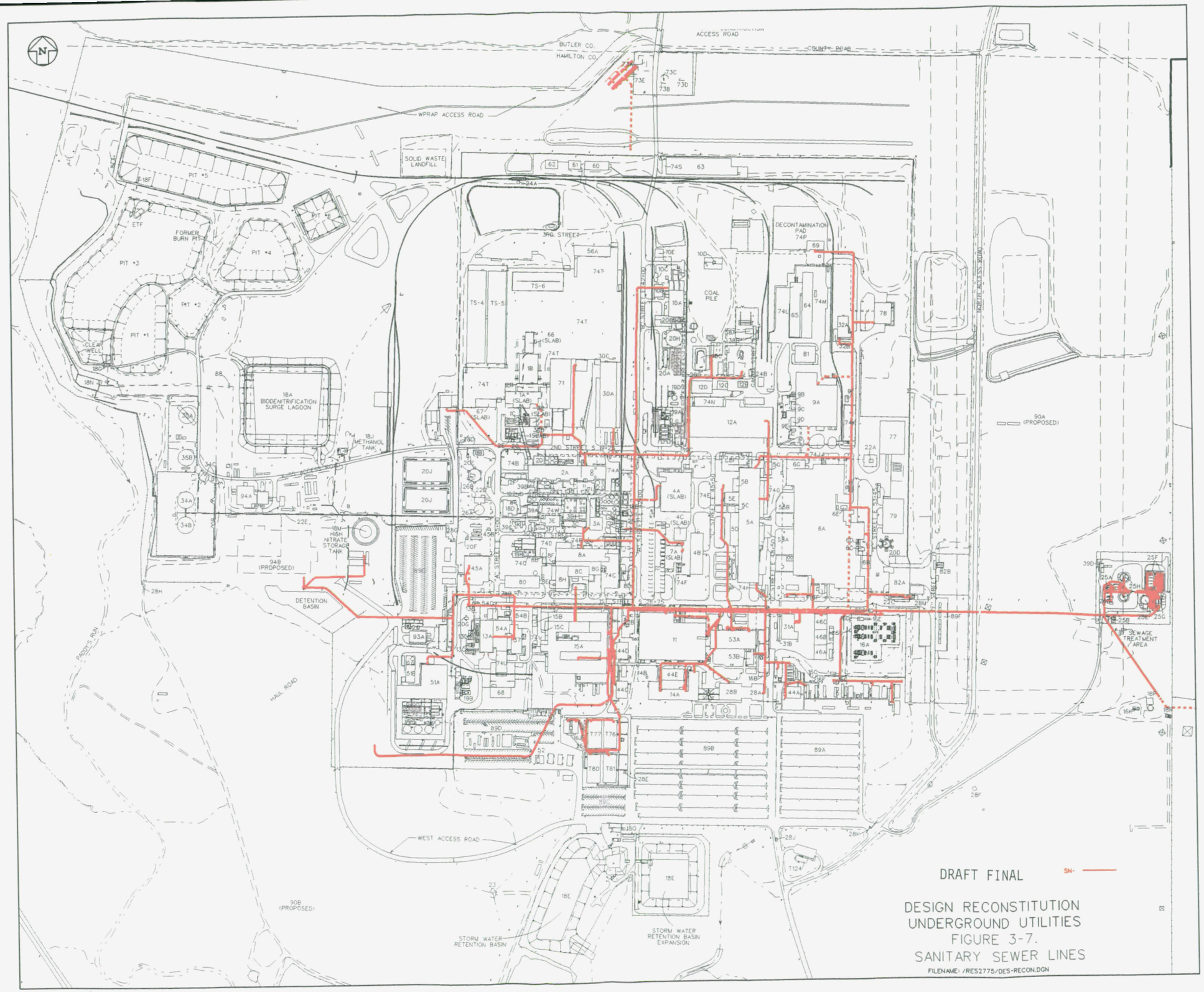
ST-
DESIGN RECONSTITUTION
UNDERGROUND UTILITIES
FIGURE 3-6.
STORM SEWER - SUB-SURFACE DRAINAGE
FILENAME: /RES2775/DES-RECON.DGN


BUTLER CO.
HAMILTON CO.
ACCESS ROAD
COUNTY ROAD
WPRAP ACCESS ROAD
SOLID WASTE LANDFILL
PIT #5
PIT #4
PIT #3
PIT #2
PIT #1
ETF
FORMER BURN PIT
CLEAR WELL
18A BIODENITRIFICATION SURGE LAGOON
18J METHANOL TANK
18M HIGH NITRATE STORAGE TANK
94B (PROPOSED)
DETENTION BASIN
PADDYS RUN
HAUL ROAD
3RD STREET
2ND STREET
1ST STREET
COAL PILE
DECONTAMINATION PAD
NORTH ACCESS ROAD
90A (PROPOSED)
SEWAGE TREATMENT AREA
WEST ACCESS ROAD
90B (PROPOSED)
STORM WATER RETENTION BASIN
STORM WATER RETENTION BASIN EXPANSION
DRAFT FINAL
SN-
DESIGN RECONSTITUTION
UNDERGROUND UTILITIES
FIGURE 3-7.
SANITARY SEWER LINES
FILENAME: /RES2775/DES-RECON.DGN

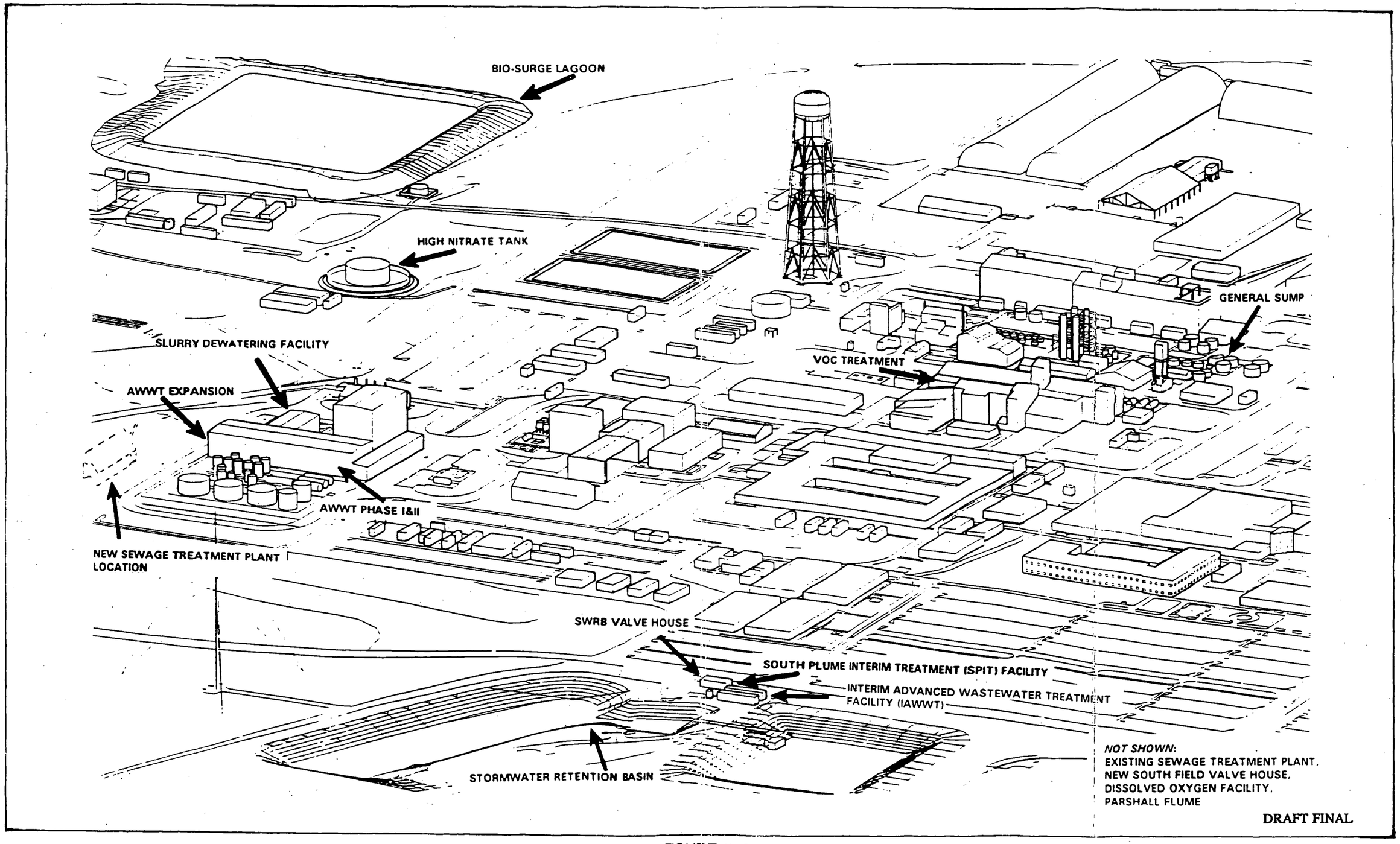
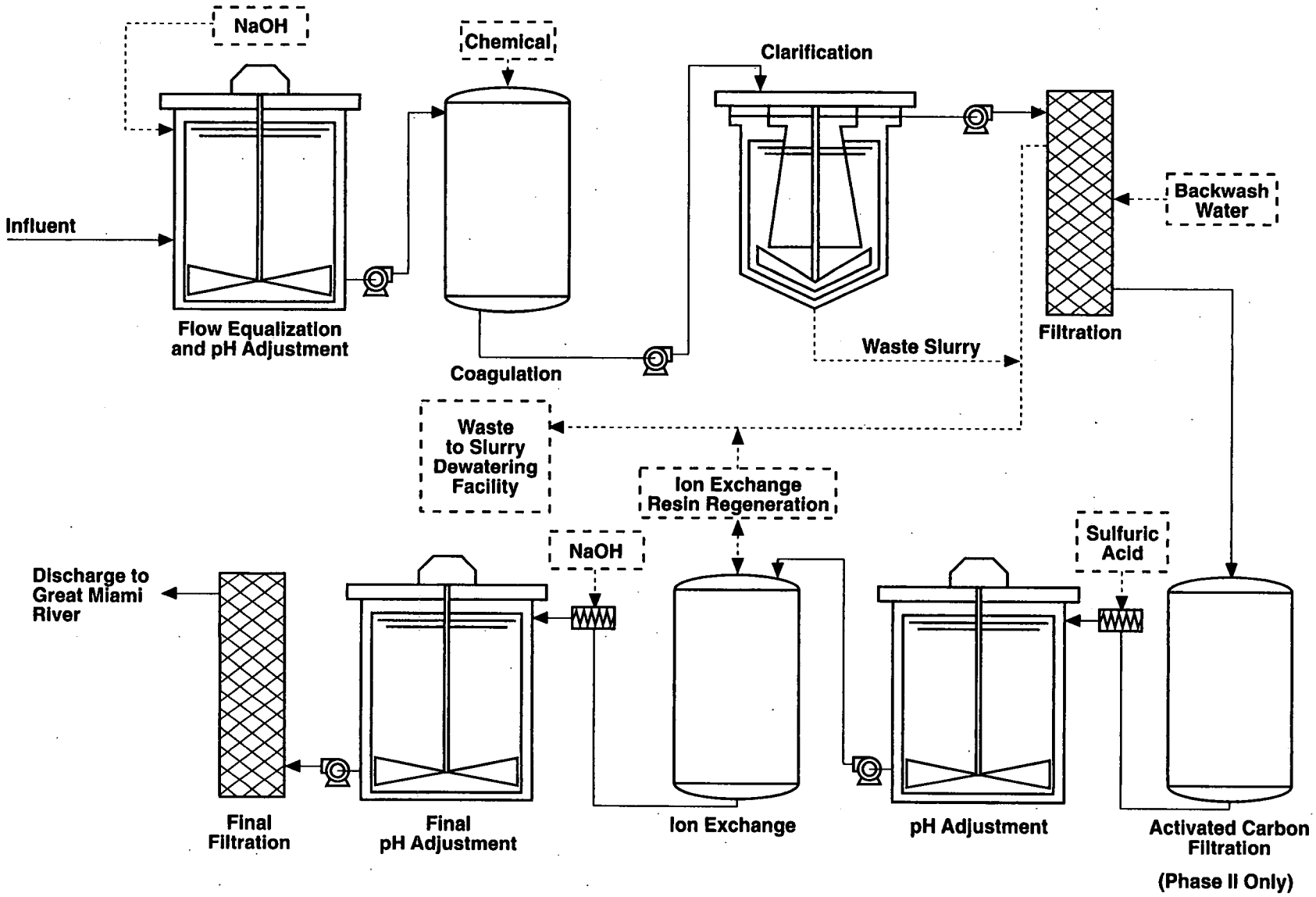


FIGURE 3-8

ARWWP FACILITIES LOCATION MAP



ADVANCED WASTEWATER TREATMENT PLANT (AWWT) SIMPLIFIED PROCESS DIAGRAM

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FIGURE 3-9

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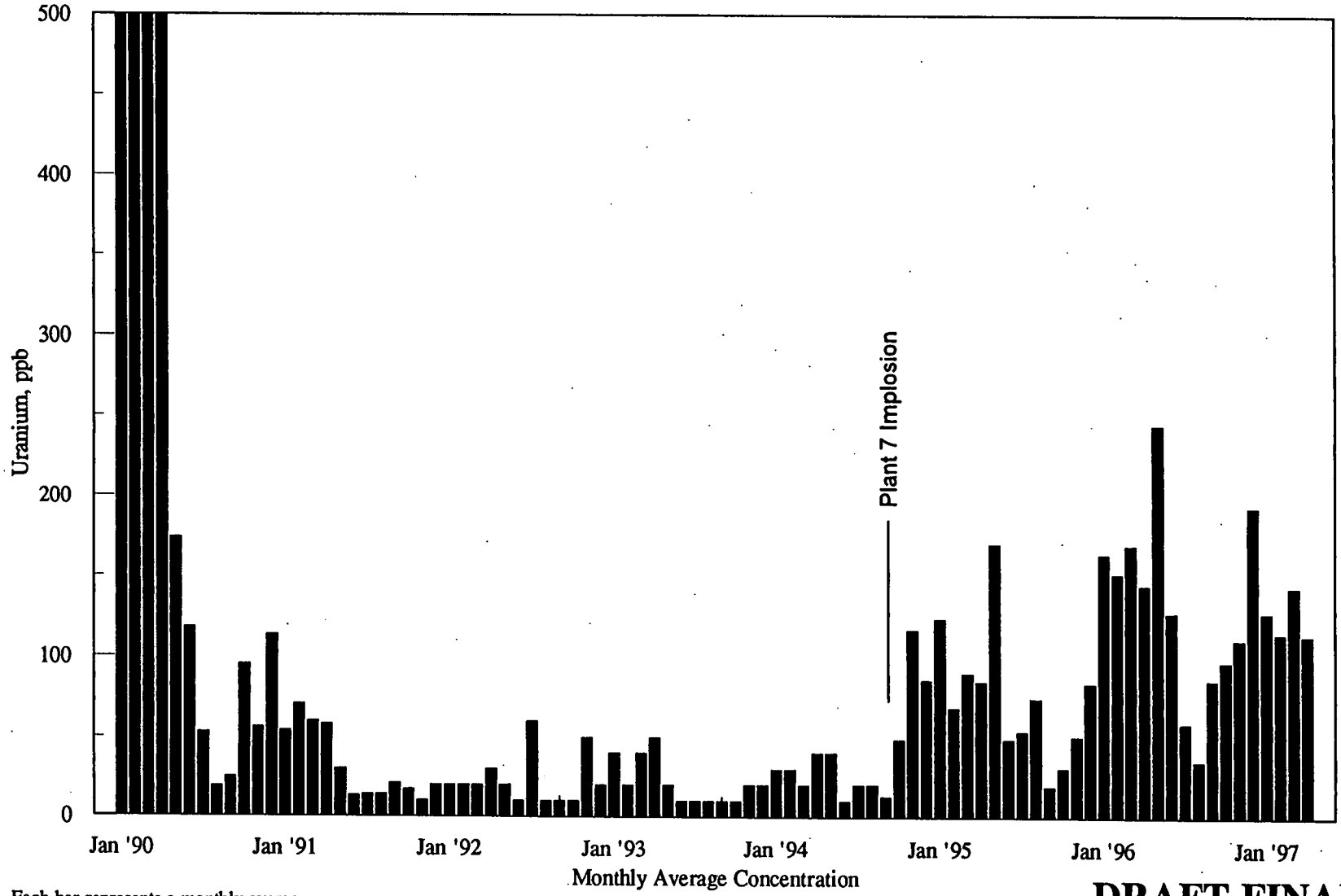
Figure 3-10

STP Discharge Average Uranium Concentration

1990-1997



Each bar represents a monthly average

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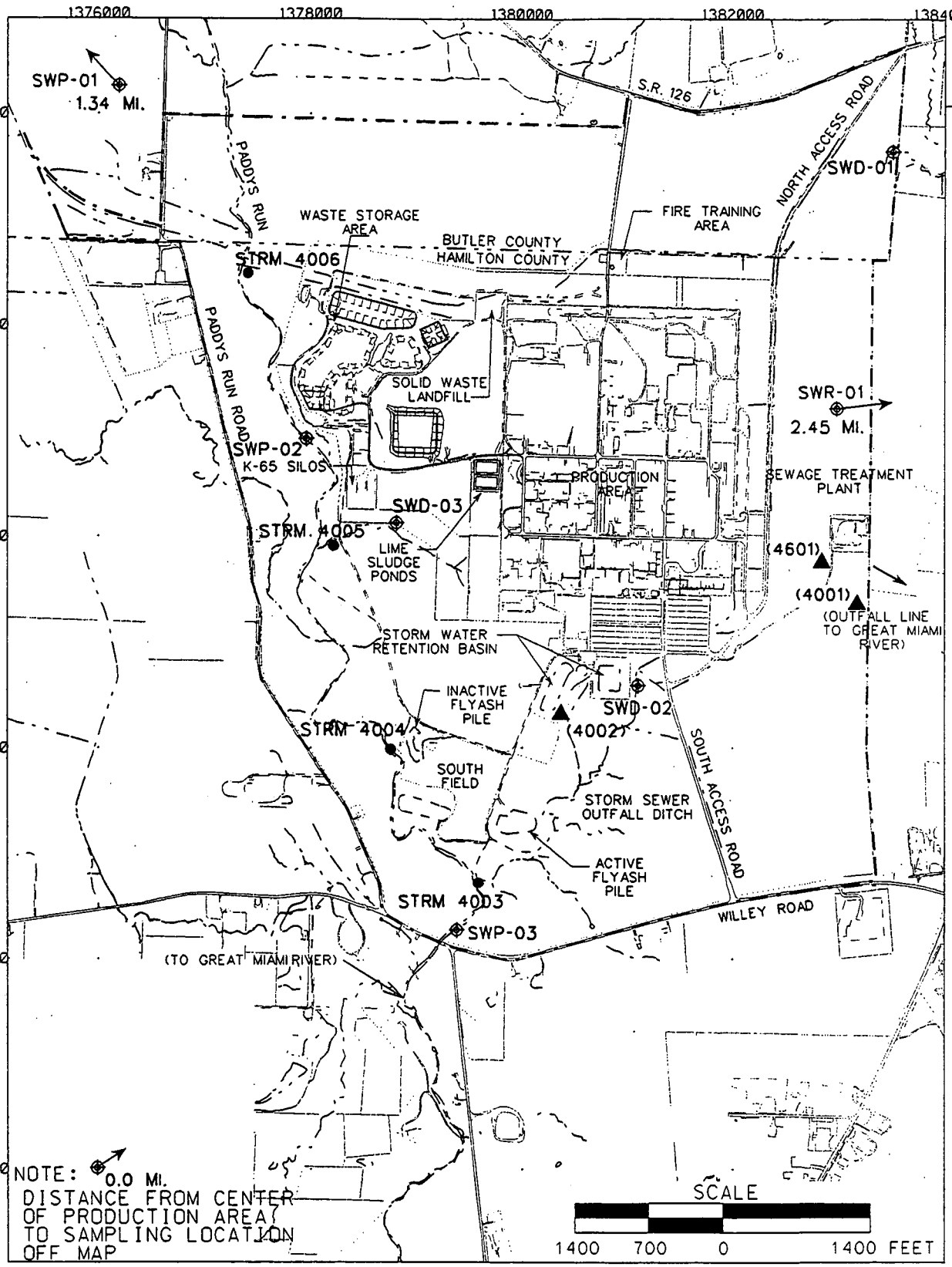
/USR/ERMA5/5CDW2/DGN/OM005.DGN FER OU5 5/23/96 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

- FEMP BOUNDARY
- SWD-02 SURFACE WATER SAMPLING LOCATION
- STRM 4003 NPDES MONITORING POINT
- ▲ PERMITED NPDES OUTFALLS
- (4001) PARSHALL FLUME
- (4002) EMERGENCY SPILLWAY
- (4601) SEWAGE TREATMENT PLANT EFFLUENT

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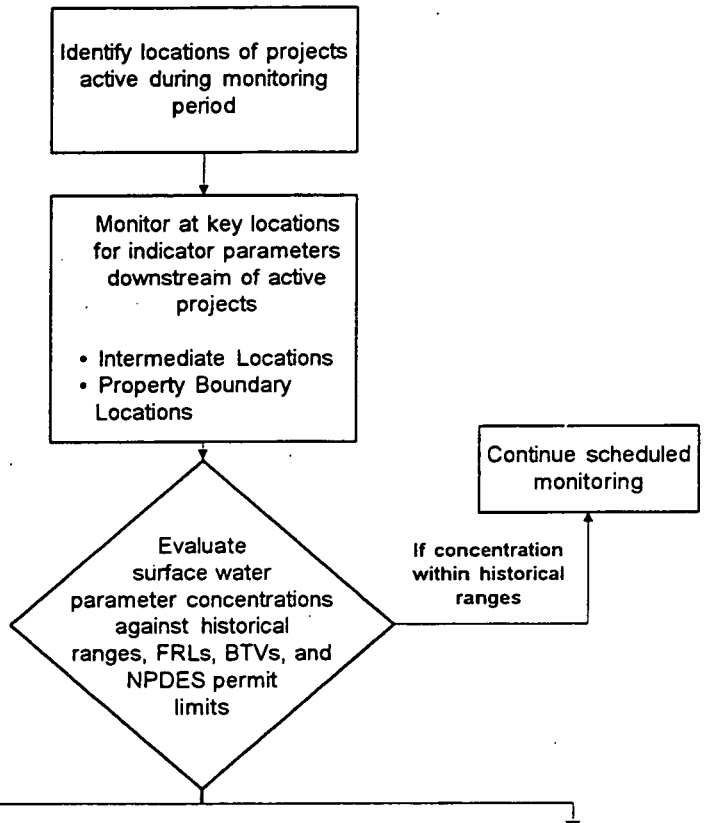
FIGURE 3-11. IEMP SURFACE WATER SAMPLE LOCATIONS

FIGURE 3-12
IEMP SURFACE WATER DATA EVALUATION AND ASSOCIATED ACTIONS



If concentration > historical ranges, but < FRLs, BTVs and NPDES permit limits[a]	
IEMP Actions	Potential Project Actions
• Identify probable sources and alert associated projects • Continue scheduled monitoring • Trend data to determine potential for unacceptable future conditions • Report information to EPA/ OEPA in next quarterly and in the annual report • Notify ARWWP of potential cross-media impacts	• Review performance/ inspection data for engineered controls • Determine if engineered controls meet design specifications • Repair engineered controls, if necessary

If concentration > FRL, BTVs, or NPDES permit limit	
IEMP Action	Potential Project Action
• Identify probable source areas and alert associated projects • Conduct confirmatory sampling to determine persistence • Continue scheduled monitoring • Report information to EPA/ OEPA in next quarterly and in the annual report. • Report NPDES noncompliance to OEPA immediately. • Notify ARP of potential cross-media impacts.	• Review performance/ inspection data for engineered controls • Determine if engineered controls meet design specifications • Repair engineered controls, if necessary • Estimate duration of source activities • Field modification of controls • Quantify release

[a] For those parameters/locations with limited historical data, IEMP data will be compared to background concentrations.

FER\OMMP\FIGURES\FIG3-12.VSD

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4.0 PROJECTED FLOWS

Projected flows are classified as extracted groundwater storm water runoff, remediation wastewater or sanitary wastewater. Projected generation rates, duration, and projected headworks discharge locations related to treatment requirements are presented in this section. Estimates of the summary yearly flows developed are used in Section 5.0 to evaluate the treatment systems discussed in Section 3.0.

4.1 GROUNDWATER

Extracted groundwater will be the largest wastewater flow during remediation. However, unlike storm water and remediation wastewater, groundwater extraction rates can be fully planned and controlled during the remediation.

DOE

4.1.1 Current Groundwater Extraction Rate

The FEMP presently has an extraction well network located at the leading edge of the South Plume, installed as part of Removal Action No. 3, to prevent further migration of the off-property portion of this uranium plume. These wells are an integral part of the required recovery well system for the Operable Unit 5 groundwater remedy. The South Plume well field currently consists of four operating recovery wells (Recovery Wells 1, 2, 3, and 4 or [3924, 3925, 3926, and 3927, respectively]). The current optimum pumping rate for these four wells combined is 1400 gpm. This flow rate is expected to continue through Fiscal Year 2003.

DOE

4.1.2 Projected Groundwater Extraction/Re-Injection Rates

This section provides the projected groundwater extraction/re-injection rates planned over the life of the groundwater remedy as presented in the Baseline Remedial Strategy Report. The rates provided are for the newly adopted baseline strategy for groundwater remediation which anticipates that 10 years (10-year scenario) will be required to complete the restoration of the aquifer. The individual groundwater remediation modules comprising this newly adopted strategy were discussed in Section 3.1. Figure 4-1 depicts the locations of all existing and planned extraction/re-injection wells, along with their associated numbers. Table 4-1 provides the extraction/re-injection rate schedule for each of the wells throughout the planned duration of the groundwater remedy. The success of the 10-year scenario is highly dependent upon the successful operation of the injection wells; geochemical

conditions in the acquifer, and timely accessibility of areas where acquifer restoration infrastructure is required.

4.1.3 Projected Groundwater Yearly Average Extraction Flow Summary

Figure 4-2 presents a graphic summary of the projected yearly extraction rates that will result from the individual well fields discussed in Section 4.1.1 and presented in Table 4-1. This flow will be available for treatment, or directly discharge into the Great Miami River, as discussed further in Section 5.0.

4.2 STORM WATER

This section addresses storm water runoff collected from all areas other than the waste pit area. (See WPRAP Section 4.3.2.) Storm water from the waste pit area is currently sent to the BSL for commingling with remediation wastewater as discussed in Section 4.3.

Figure 4-3 is a map of the FEMP which indicates the seven general remediation areas planned for soil cleanup. Contaminated storm water runoff requiring treatment will be collected from the former production area, the waste pit area, and from minor portions of remediation of areas beyond the boundaries of the production and waste pit areas (site perimeter areas).

4.2.1 Collection

2 The runoff volume collected in the SWRB is not expected to increase during the course of future site remediation. The SWRB, when originally constructed, was sized to contain a 10-year, 24-hour storm water runoff event from a 165-acre collection area. Drainage to the SWRB came from the storm sewer system in existence at that time. Removal Action No. 16 (completed in 1993) added additional collection areas on the north, east, and west sides of the original drainage area to complete the 165-acre collection area. These areas of controlled surface water runoff are shown in Figure 4-4. Area 1, Phase I remediation activities, currently in progress in the site perimeter area, caused a slight increase in storm water runoff to treatment with construction of controlled contaminated soil stockpiles. Further increases would be expected from the SCEP during the course of remediation of the southern waste units (Area 2, Phase I, as shown in Figure 4-3) lime sludge pond, and solid waste land fill. Each of these flows is detailed below:

Southern Waste Unit Storm Water Runoff

Storm water runoff will be collected from the excavation activities at South Field area. Three storm water management ponds will be constructed to collect runoff. Collected water will be pumped to the SWRB.

Flow:	Anticipated to average 7.9 mgy (15 gpm) with an intermitent combined pumping rate of 600 gpm.
Duration:	March 1998 through September 1999.

Lime Sludge Pond Storm Water Runoff

Storm water runoff from the lime sludge pond remediation is anticipated to be sent to the SWRB for treatment in AWWT Phase I (not shown on Figure 4-6). Detailed design of this remediation effort is not complete at this time, but flows are anticipated to be insignificant because of the lime sludge pond's relatively small area.

Flow:	Anticipated to average 2.6 mgy (5 gpm)
Duration:	2002 through 2003

Solid Waste Landfill Storm Water Runoff

Storm water runoff from the solid waste landfill remediation is anticipated to be sent to SWRB for treatment in AWWT Phase I (not shown on Figure 4-6). Flows from this facility are anticipated to be insignificant because of its relatively small area:

Flow:	Anticipated to average 2.6 mgy (5 gpm)
Duration:	2002 through 2003

To compensate for this increase, a project to divert approximately 11 acres of uncontaminated parking lot runoff from the SWRB was implemented (see Figure 4-4). The decrease in runoff to the SWRB from the parking lot (see Appendix B calculations) will more than compensate for the increased runoff from these and other foreseeable perimeter remediation activities.

Completion of soil remediation of the former production area is planned in segments. Soil remediation will start in Area 3 and progress southward to Area 5. As each segment of the former production area is remediated, storm water runoff influents will diminish, and the associated storm water collection systems will be progressively decommissioned and removed.

DOE The estimated average yearly quantities of storm water runoff (including perched groundwater infiltration to the storm sewers) from existing and planned changes are detailed in Appendix B and summarized as follows:

15 **SUMMARY OF ESTIMATED AVERAGE YEARLY QUANTITIES OF STORM WATER RUNOFF**

	Projected Average Annual Flow	
Area	Million Gallons	GPM
SWRB 165 acre collection area	142	270
- Removal of Parking Lot	11	20
- Net collection area remaining	131	100
• Sub-Area 4	32	60
• Sub-Area 5	47	90
A1PI stockpiles area	5	10
Southern Waste Units	8	15

4.2.2 Impacts on Treatment Operations

It is projected that contamination in storm water will be dependent upon the contamination levels of the area(s) being remediated. The operation of treatment facilities could be significantly affected by increased solids in the SWRB and increased colloidal loading to treatment. Additional clean out of sediment collected in the SWRB will be addressed by the sludge removal systems described in detail in Section 3.4.1.4. Increased process control testing will assure proper chemical dosage in primary clarification, thereby addressing the increase of colloids being sent to treatment facilities. Measures will be taken by the SCEP to minimize these solid loadings in runoff.

4.2.3 Projected Storm Water Yearly Average Flow Summary

Figure 4-5 presents a graphic presentation of the projected yearly average storm water flow discharged from the SWRB, which is anticipated from the information presented above and calculations presented in Appendix B. The flow of water to treatment will decrease as remediated areas are cleaned up. It should be noted that this figure is not intended to show the short-term peak flows that will be encountered as a result of excessive stormwater flow but is intended to show the annual average flows from the SWRB headworks to treatment.

4.3 REMEDIATION WASTEWATER

Remediation wastewater includes existing or planned flows collected in the BSL or sent directly to AWWT Phase II. Many of these flows contain VOC's or are not classified as storm water runoff and therefore cannot be sent to the SWRB. Other flows, which could be classified as storm water runoff, are sent to the BSL because of relatively higher uranium concentrations or for convenience. Each of these flows along with the responsible project, is described in the following sections and depicted in Figure 4-6.

4.3.1 Aquifer Restoration and Wastewater Project (ARWWP)

General Sump

2 The FEMP currently generates approximately 26.3 mgy (50 gpm) of contaminated wastewater from sitewide remediation activities and are collected at the General Sump. This baseline wastewater is generated from sources such as:

- FEMP laboratory
- Controlled storage pad storm water runoff
- Garage floor washing
- General decontamination
- Incidental plant usage (i.e., condensate, cleaning, etc.)
- Multi-media Filter backwash from the SPIT and IAWWT systems
- Plant 8 VOC treatment system.

2 These baseline flows are expected to decrease as the Operable Unit 3 remedial actions progress, buildings are shut down, and existing operations cease. Because most controlled storage pads are no longer required, these flows will be diverted to the SWRB.

Flow:	Anticipated to average 26 mgy (50 gpm)
Duration:	Present through June 2001.

Clearwell Discharge

The FEMP currently generates contaminated storm water runoff from the waste pit perimeter areas (Removal Action No. 3) and from the surface of several waste pits. This water flows to the Clearwell and is pumped to the BSL. In the case of Waste Pit 6, it is intermittently pumped to the BSL. Currently, the Clearwell discharge averages approximately 25 gpm on an annual basis. This water will be combined, however, with other WPRAP flows and is included in Section 4.3.2.

AWWT Backwash and AWWT Sumps

The ARWWP is currently responsible for handling existing wastewaters collected at the general sump and BSL, and for treatment of backwash and storm water collection at the AWWT sumps.

Backwash from all existing wastewater treatment systems are sent either directly to AWWT Phase II or to the BSL. Current plans call for this to continue in the future. The AWWT expansion backwashes will be added to this flow. In addition, storm water runoff collected at the pad areas around the AWWT are sent to Phase II for processing.

Flow:	Anticipated to average 15.8 mgy (30 gpm)
Duration:	Existing through end of remediation.

4.3.2 Waste Pit Remedial Action Project (WPRAP)

Generation of significant quantities of wastewater associated with the following remedial activities are expected: (1) initial removal of waste pit water, (2) removal and processing of pit wastes and (3) excavation dewatering activities. Wastewater will be recycled to the projects for use as remediation process water to the maximum extent possible. Bleed streams will be discharged to the BSL for final wastewater treatment in AWWT Phase II. Storm water will also be generated and runoff will be controlled and discharged as clean or pumped to the ARWWP for treatment. The current plan calls for the WPRAP project to provide a pretreatment system for wastewaters containing excessive concentrations of heavy metals prior to discharge to the BSL.

Waste Pit Perimeter Area Runoff Control

This existing system collects runoff from the perimeter of the waste pit area and will serve as secondary containment for runoff collection from the waste pits and the K-65 Silos during remediation. The flow is directed to a concrete pond (sump) and is transferred directly to the BSL via a series of sequentially operated (level controlled) pumps.

Flow:	Anticipated to average 15.8 mgy (30 gpm). Intermittent peak pumping from this source during excessive rainfall events can be as high as 2,000 gpm.
Duration:	Present through April 2004

Storm Water Management Pond

16 Potentially contaminated runoff will be directed to a storm water management pond sized to accommodate the 25-year, 24-hour storm event for the controlled area surrounding the specific waste pit remediation.

Flow:	Storm water flow to this sump is anticipated to average approximately 7 million gallons per year. Averaged over the year, this is approximately 13 gpm. The sump transfer pumps will pump intermittently at a rate of 250 gpm.
Duration:	August 1998 through April 2004

Process Wastewater from Solidification

2 This flow consists of waste solidification facility effluent and contains dewatering, drying, and exhaust gas scrubber flows. Specific characteristics of this wastewater stream will not have been completely defined until the WPRAP subcontract has been awarded. The WPRAP subcontractor (WPRAP) will coordinate design efforts with the ARWWP. Pretreatment of this stream is likely to be required by the WPRAP subcontractor and upgrades to the Clearwell pumping system will likely be required.

Flow:	Anticipated to average 18.4 mgy (35 gpm). This flow is intended to be discharged to the BSL via the existing Clearwell.
Duration:	March 1999 through April 2004

Waste Pit Dewatering Flows

2 In preparation for the excavation of the waste pits, significant dewatering flows are anticipated to be discharged to the BSL through the existing Clearwell. This wastewater stream has the potential for concentrations of heavy metals. Pretreatment of this flow by the WPRAP subcontractor is anticipated.

Flow:	The dewatering of the waste pits during their excavation is anticipated to produce nearly 26.3 mgy (50 gpm) that will require treatment. Initial pumping rates may be as high as 300 gpm.
Duration:	March 1999 through April 2004

4.3.3. On-Site Disposal Facility (OSDF) Project

Wastewater from the OSDF Project will consist of OSDF leachate and active well runoff.

Leachate

Leachate from the OSDF will result from leakage of storm water through and out the bottom of the cells, which will be at a maximum when a cell is first constructed and not capped. The flow will steadily decrease after the cell is capped, until it stabilizes at a steady small flow. This flow pattern will repeat for each cell constructed. A leachate transfer system directs this flow across the site to the BSL.

Flow:	Anticipated to average 5.3 mgy (10 gpm) pumped intermittantly @ 200 gpm.
Duration:	March 1998 and continuing for an undetermined period

Active Cell Runoff

During the period when a cell is being filled with contaminated soil and debree, storm-water runoff from the cell will be collected, combined with the leachate flow, and pumped to the BSL. 20 gpm annual average flow pumped intermittantly with leachate flow discussed above.

4.3.4 Soil Characterization and Excavation Project (SCEP)

The SCEP will produce wastewater from collection of storm water runoff in the active remediation areas and from wellfields installed to dewater areas scheduled for stable deep excavation conditions.

Seepage Collection

An existing seepage flow from the Inactive Flyash Pile is transferred by 50-gpm pumps directly to the influent equalization tank at the AWWT Phase II. This flow has been very small in the past, but will be increased by truck wash water during excavation activities.

Flow:	Flow from this sump is anticipated to average approximately 2.6 million gallons per year. Averaged over the year, this is approximately 5 gpm. The sump transfer pumps will pump intermittently at a rate of 50 gpm.
Duration:	Present through October 1999

Soil Remediation of STP and FTA

Dewatering activities and storm water runoff within the existing Sewage Treatment Plant (STP) and Fire Training Area (FTA) during soil remediation will require pretreatment for VOC/RCRA-listed constituents. After pretreatment, these flows are anticipated to be discharged to the BSL. Because of

the scheduled remediation of Plant 8, the existing VOC Treatment System will be relocated and modified, as necessary.

Flow:	Anticipated to average 5.3 mgy (10 gpm)
Duration:	January 2000 through March 2001

Dewatering Activities

2 Dewatering activities within the areas of soil remediation will be required to provide for slope stability
DOE in deep excavations (below perched groundwater levels). Flows from areas which indicate detectable levels of VOCs must be treated in AWWT Phase II. Areas with VOC levels less than detectable will be sent to the SWRB. This section only addresses flow anticipated to be sent to the BSL.

Flow:	Anticipated to average 26.3 mgy (50 gpm)
Duration:	Area 3; March 2001 through December 2002
	Area 4; January 2003 through December 2005
	Area 5; January 2006 through completion

4.3.5 Silos Project

Vitrification Pilot Plant Effluent

2 The effluent from the previously planned Vitrification Pilot Plant was to be discharged directly to the existing High Nitrate Tank. Pretreatment of this wastewater was to be performed for radon and radium. A decision on a revised path forward is in progress. A nominal allowance has been made for discharges from the eventual technology deployed for the remediation of the silos.

Flow:	Anticipated to average 5.3 mgy (10 gpm)
Duration:	Undetermined

K-65 Decant Sump Tank Effluent

2 The Decant Sump Tank was originally used as the collection point for the decanted liquid remaining
18 from the slurrying operations at the K-65 silos. Although this sump is no longer operational, seepage accumulates within the tank over time and must be removed. This water historically has been treated through Plant 8 and then sent to the BSL for treatment at the Phase II AWWT. This water will be pretreated in the Slurry Dewatering Facility prior to treatment in AWWT Phase II.

Flow:	Batches. Anticipated to average 0.5 mgy (1 gpm)
Duration:	Present and continuing for undetermined period

4.3.6 Facilities Decontamination and Demolition D&D Project

The decontamination activities for each of the major facilities in the former production area is expected to produce small batches of wash water that will require treatment. This minimal source of wastewater will be containerized and characterized prior to treatment.

Flow:	Batches. Anticipated to average 0.5 mgy (1 gpm)
Duration:	Present through 2005.

4.3.7 Projected Remediation Wastewater Annual Average Flow Summary

Figure 4-7 presents a graphic summary of the projected remediation wastewater yearly average flows that will result from the BSL, based on the individual flows discussed in Section 4.3.1 and presented graphically on Figure 4-6. Many of these remediation wastewater inflows are mandated to receive treatment for VOC contaminants or are not storm water flows and are therefore restricted from discharge to the SWRB. Accordingly, they are planned to be treated through the AWWT Phase II treatment system. These sources are all competing for limited treatment capacity within this treatment system. It should be noted that neither figure is intended to show the short-term peak flows that will be encountered as a result of excessive stormflow. Rather, this figure is intended to show the annual average flows from the BSL/HNT headworks.

4.4. SANITARY WASTEWATER

The existing sanitary flow averages 53-105 mgy (100-200 gpm). This includes some infiltration of contaminated perched water, as discussed in Section 3.2.3. Existing flows are expected to decrease as the Operable Unit 3 remedial actions progress, buildings are shut down, and existing operations cease. Because most controlled storage pads are no longer required, these flows are targeted for diversion (gravity flow) to the SWRB.

TABLE 4-1

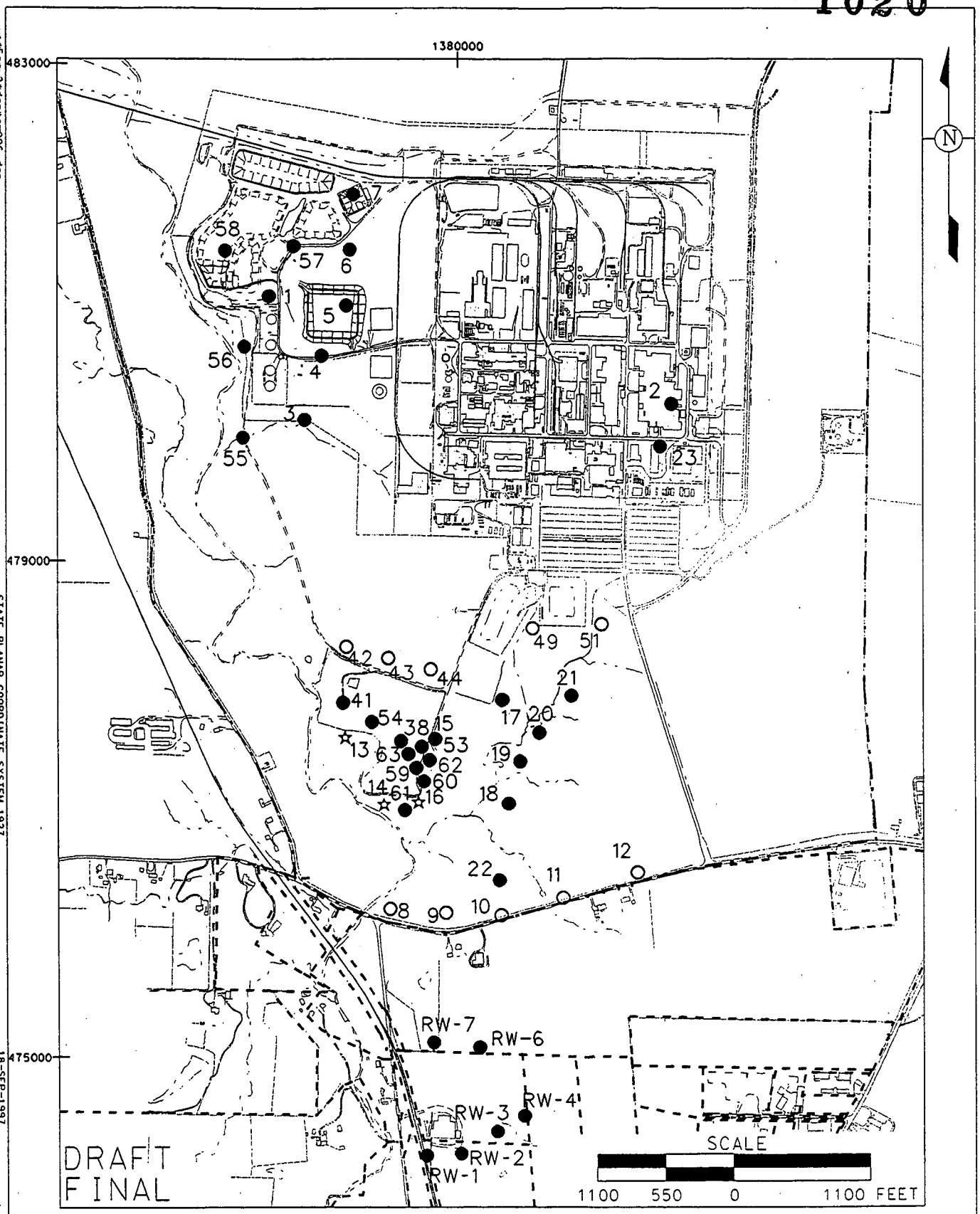
EXTRACTION/RE-INJECTION RATE SCHEDULE

System ID	Location	Well ID	Fiscal Year Pumping Rates[a] (+) = Pumping (-) = Injecting					
			1997-1998		1999-2003		2004-2005	
			(mgy)	(gpm)	(mgy)	(gpm)	(mgy)	(gpm)
I	Waste Pits	1	0.0	0	0.0	0	52.6	100
I	Waste Pits	3	0.0	0	0.0	0	52.6	100
I	Waste Pits	4	0.0	0	0.0	0	52.6	100
I	Waste Pits	5	0.0	0	0.0	0	52.6	100
I	Waste Pits	6	0.0	0	0.0	0	52.6	100
I	Waste Pits	7	0.0	0	0.0	0	52.6	100
I	Waste Pits	55	0.0	0	0.0	0	52.6	100
I	Waste Pits	56	0.0	0	0.0	0	52.6	100
I	Waste Pits	57	0.0	0	0.0	0	52.6	100
I	Waste Pits	58	0.0	0	0.0	0	52.6	100
	System Totals	Pumped	0.0	0	0.0	0	526.0	1000
		Injected	0.0	0	0.0	0	0.0	0
			0.0		0.0		0.0	
III	Plant 6	2	0.0	0	0.0	0	131.5	250
III	Plant 6	23	0.0	0	0.0	0	131.5	250
	System Totals	Pumped	0.0		0.0	0	263.0	500
		Injected	0.0		0.0	0	0.0	0
			0.0		0.0		0.0	
II	Fence Line Injectors	8	0.0	0	-105.2	-200	0.0	0
II	Fence Line Injectors	9	0.0	0	-105.2	-200	0.0	0
II	Fence Line Injectors	10	0.0	0	-105.2	-200	0.0	0
II	Fence Line Injectors	11	0.0	0	-105.2	-200	0.0	0
II	Fence Line Injectors	12	0.0	0	-105.2	-200	0.0	0
	System Totals	Pumped	0.0		0.0	0	0.0	0
		Injected	0.0		-526.0	-1000	0.0	0
			0.0		0.0		0.0	
II	South Field Phase I	13	0.0	0	105.2	200	-105.2	-200
II	South Field Phase I	14	0.0	0	105.2	200	-105.2	-200
II	South Field Phase I	15	0.0	0	105.2	200	52.6	100
II	South Field Phase I	16	0.0	0	105.2	200	-105.2	-200
II	South Field Phase I	17	0.0	0	52.6	100	52.6	100
II	South Field Phase I	18	0.0	0	52.6	100	0.0	0
II	South Field Phase I	19	0.0	0	52.6	100	105.2	200
II	South Field Phase I	20	0.0	0	52.6	100	105.2	200
II	South Field Phase I	21	0.0	0	52.6	100	0.0	0
II	South Field Phase I	22	0.0	0	105.2	200	105.2	200
	System Totals	Pumped	0.0		788.9	1500	420.8	800
		Injected			0.0	0	-315.6	-600
			0.0		0.0		0.0	
II	South Field Phase II	38	0.0	0	0.0	0	157.8	300
II	South Field Phase II	41	0.0	0	0.0	0	210.4	400

TABLE 4-1
(Continued)

System ID	Location	Well ID	Fiscal Year Pumping Rates[a] (+) = Pumping (-) = Injecting 1997-1998 (mgy)	1997-1998 (gpm)	1999-2003 (mgy)	1999-2003 (gpm)	2004-2005 (mgy)	2004-2005 (gpm)
II	South Field Phase II	53	0.0	0	0.0	0	157.8	300
II	South Field Phase II	54	0.0	0	0.0	0	210.4	400
II	South Field Phase II	59	0.0	0	0.0	0	157.8	300
II	South Field Phase II	60	0.0	0	0.0	0	157.8	300
II	South Field Phase II	61	0.0	0	0.0	0	105.2	200
II	South Field Phase II	62	0.0	0	0.0	0	105.2	200
II	South Field Phase II	63	0.0	0	0.0	0	157.8	300
	System Totals	Pumped	0.0		0.0	0	1420.1	2700
		Injected	0.0		0.0	0	0.0	0
			0.0		0.0		0.0	
II	North line of injectors	42	0.0	0	0.0	0	-105.2	-200
II	North line of injectors	43	0.0	0	0.0	0	-105.2	-200
II	North line of injectors	44	0.0	0	0.0	0	-105.2	-200
II	North line of injectors	49	0.0	0	0.0	0	-105.2	-200
II	North line of injectors	51	0.0	0	0.0	0	-105.2	-200
	System Totals	Pumped	0.0	0	0.0	0	0.0	0
		Injected	0.0	0	0.0	0	-526.0	-1000
			0.0		0.0		0.0	
IV	South Plume	RW-1	157.8	300	157.8	300	0.0	0
IV	South Plume	RW-2	157.8	300	157.8	300	0.0	0
IV	South Plume	RW-3	210.4	400	210.4	400	0.0	0
IV	South Plume	RW-4	210.4	400	210.4	400	0.0	0
IV	South Plume Optimization	RW-6	0.0	0	131.5	250	0.0	0
IV	South Plume Optimization	RW-7	0.0	0	131.5	250	0.0	0
	System Totals	Pumped	736.3	1400	999.3	1900	0.0	0
		Injected	0.0	0	0.0	0	0.0	0
			0.0		0.0		0.0	
	Total Pumping		736.3	1400	1788.3	3400	2629.8	5000
	Total Injecting		0.0	0	-526.0	-1000	-841.5	-1600
	Net Aquifer Extraction		736.3	1400	1262.3	2400	1788.3	3400

[a]Fiscal Year is from October 1 through September 30.



LEGEND:

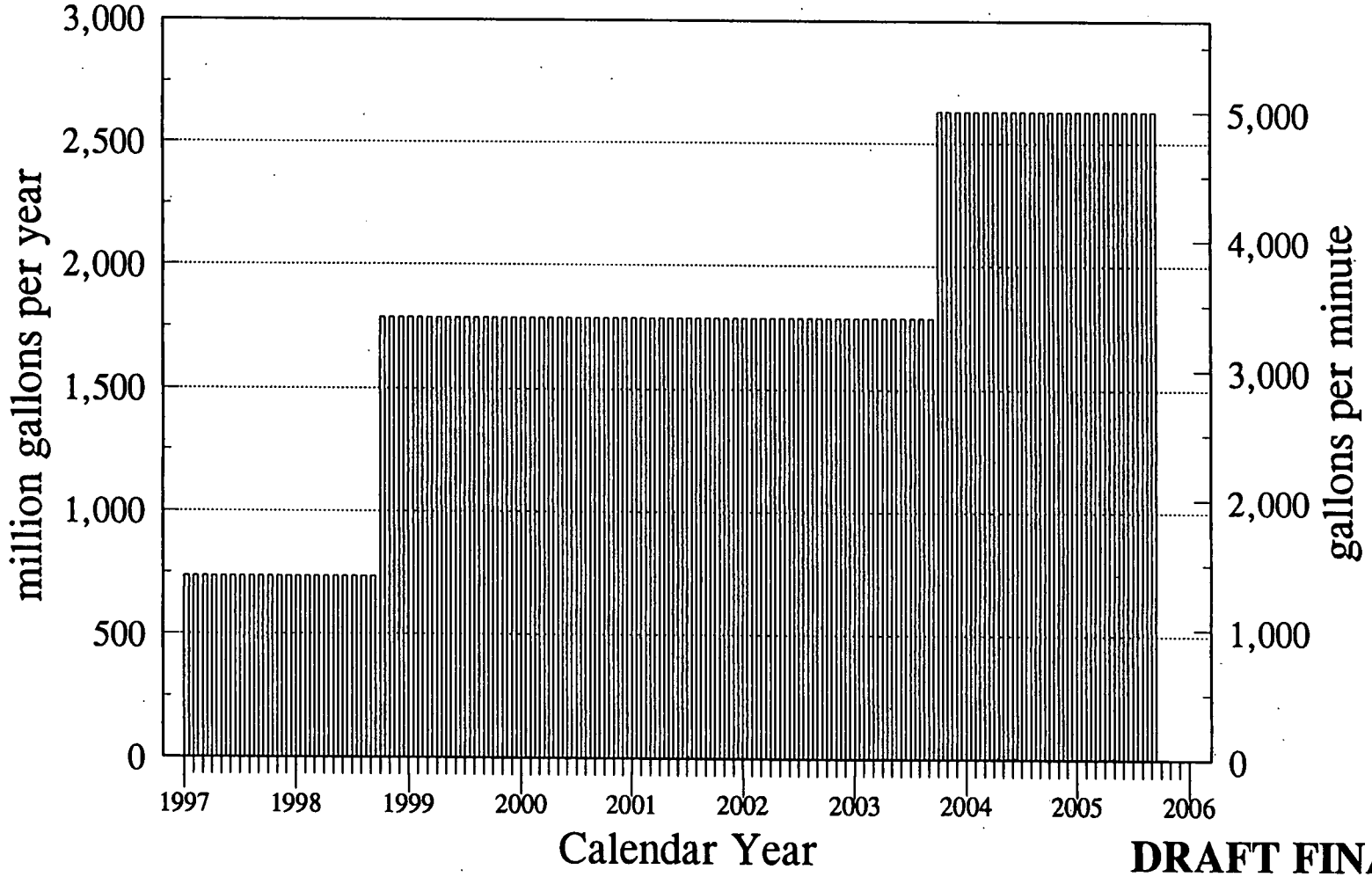
- FEMP BOUNDARY
- HOMEOWNER PROPERTY BOUNDARIES
- ○ INJECTION WELL
- ● EXTRACTION WELL
- ☆ EXTRACTION/INJECTION WELL

FIGURE 4-1. WELL LOCATIONS FOR THE BASELINE GROUNDWATER REMEDIAL STRATEGY

v:\5cr\w2\cgn\cm006.dgn
STATE PLANAR COORDINATE SYSTEM 1927
18-SEP-1997

Figure 4-2

Summary Groundwater Flow Timeline
Projected Yearly Average Total Groundwater Extraction Rate



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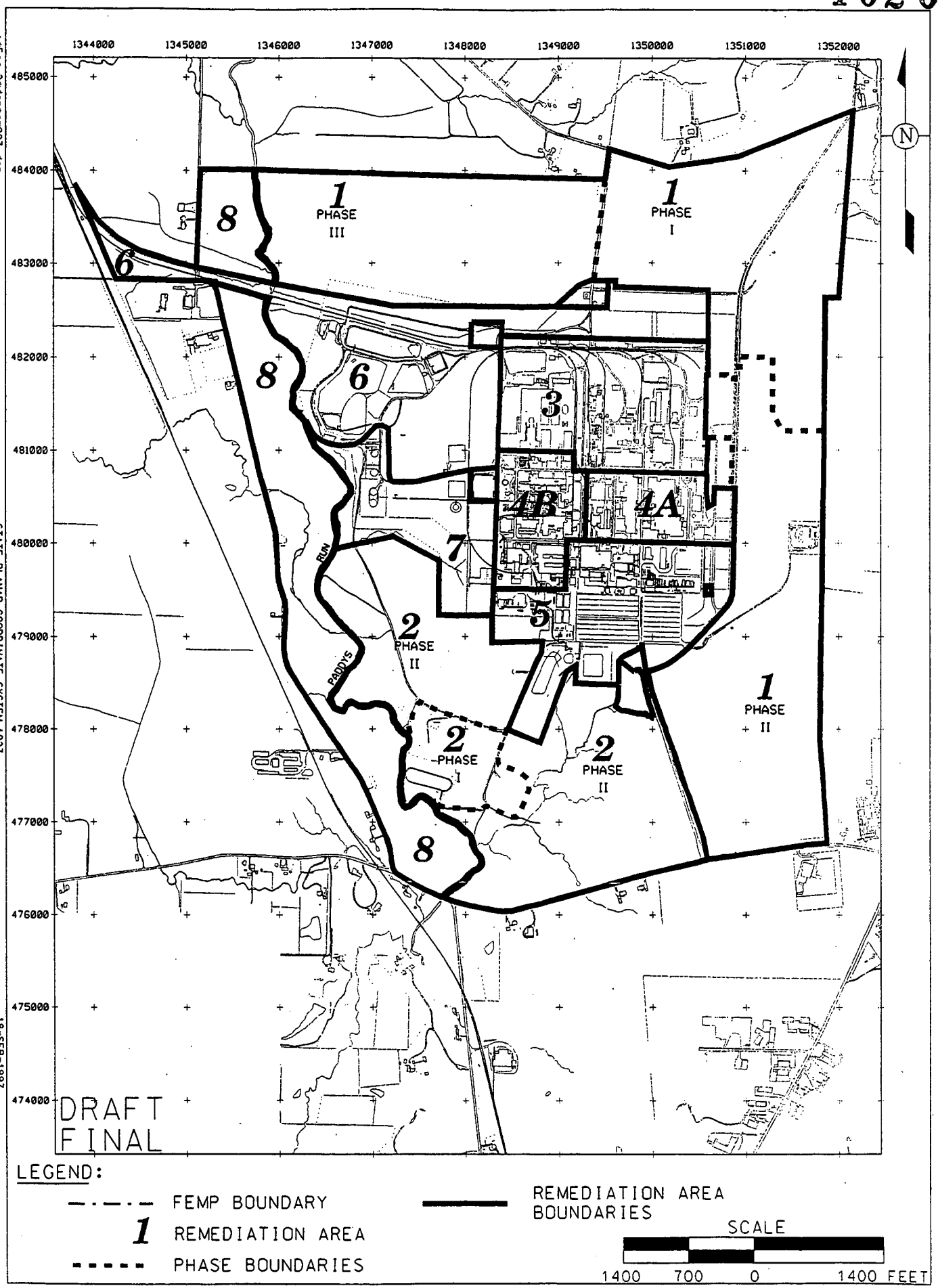
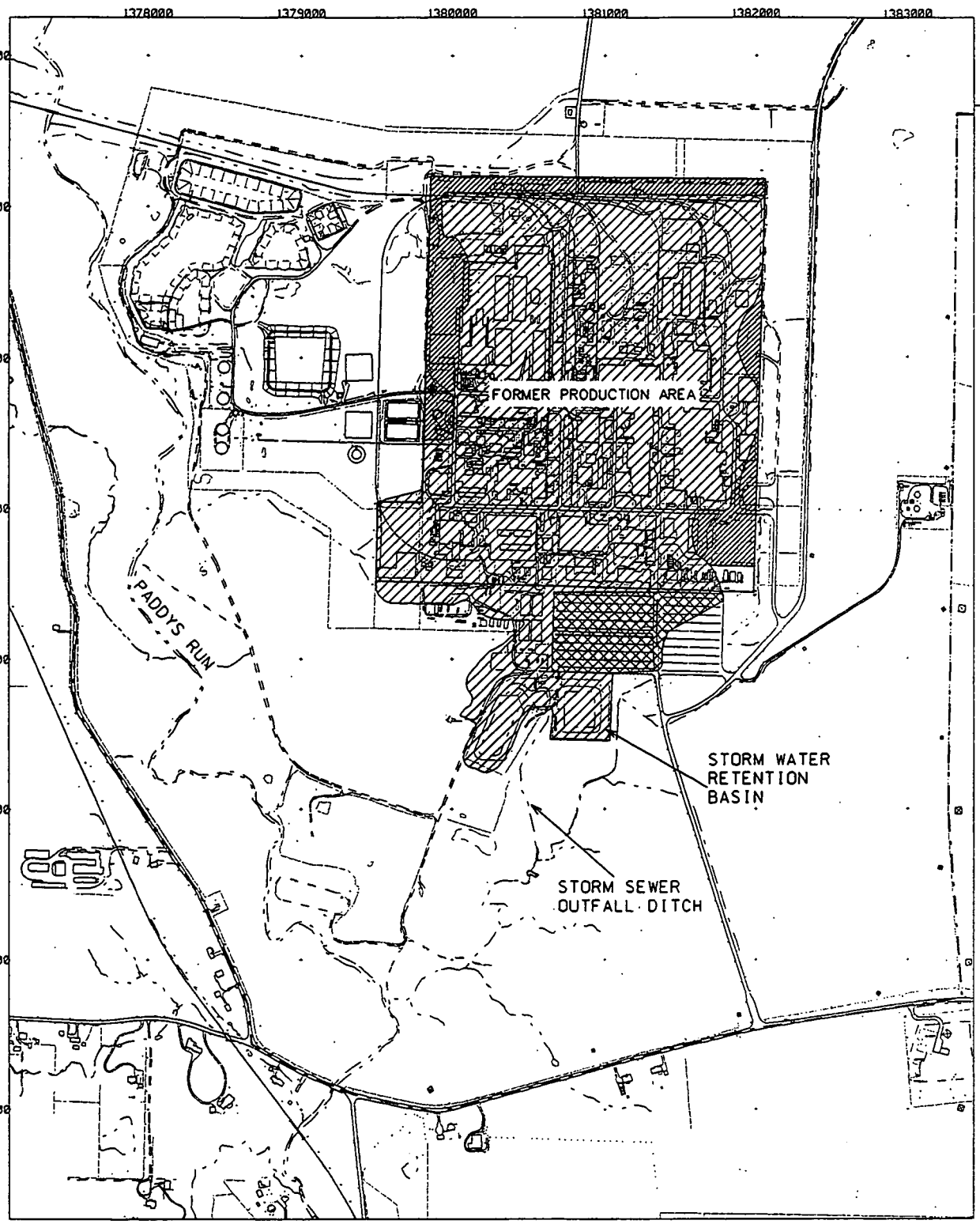


FIGURE 4-3. SITEWIDE REMEDIATION AREAS

/USR/ERMA5/5CRW2/DGN/OW002.DGN FER 6/24/97 STATE PLANAR COORDINATE SYSTEM 1927



LEGEND:

FEMP BOUNDARY

REMOVAL ACTION 16

ORIGINAL SWRB DRAINAGE AREA

DIVERTED PARKING LOT RUNOFF

NOTE:

DRAWING IS BASED ON 1992 AERIAL PHOTOGRAPHS.

SCALE

1000 555 0 1000 FEET

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FIGURE 4-4. SWRB CONTROLLED AREA SURFACE WATER RUNOFF

Figure 4-5

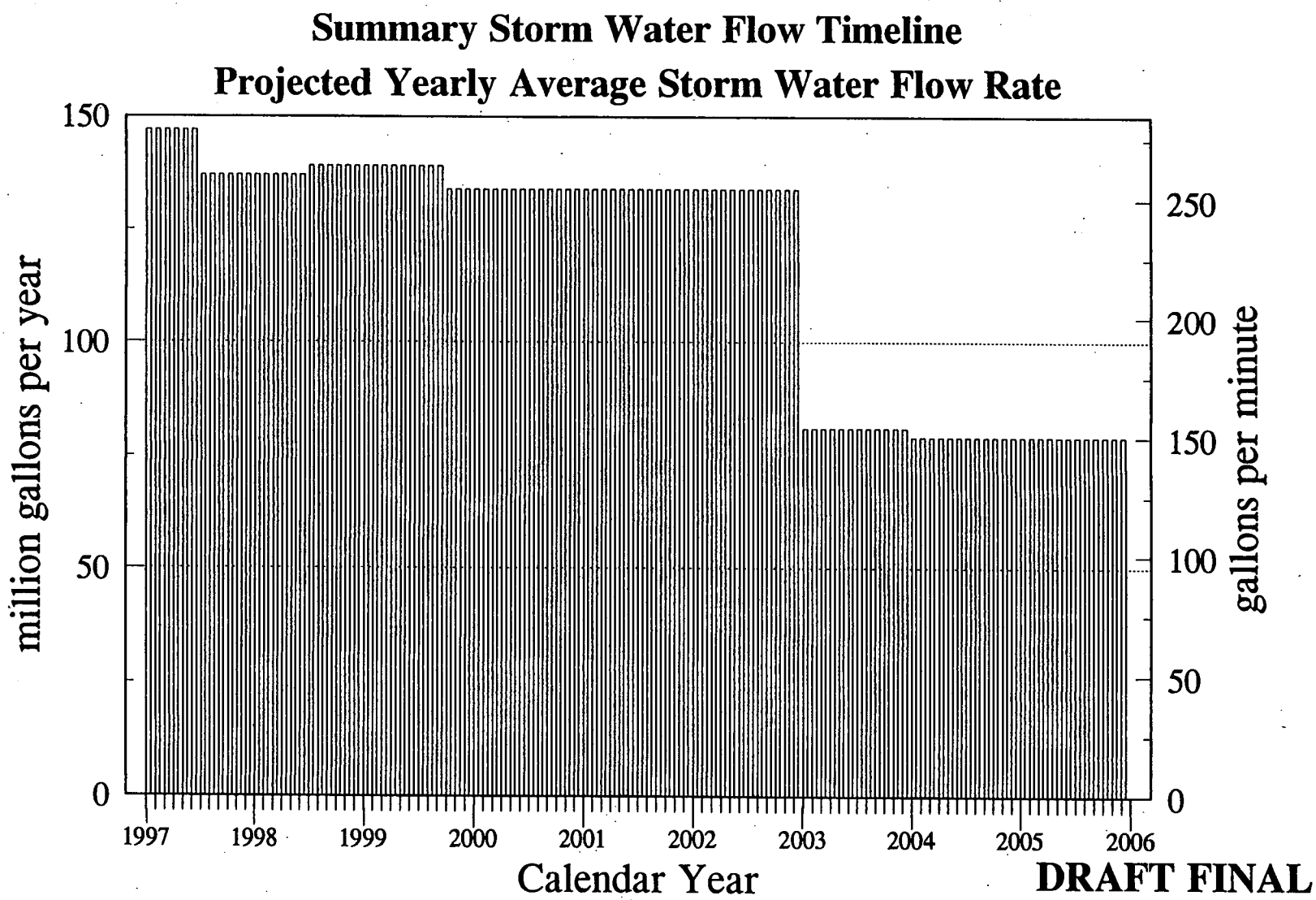
Summary Storm Water Flow Timeline
Projected Yearly Average Storm Water Flow Rate
million gallons per year
150
100
50
0
gallons per minute
250
200
150
100
50
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Calendar Year
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Figure 4-6
Remediation Wastewaters Flow Timeline

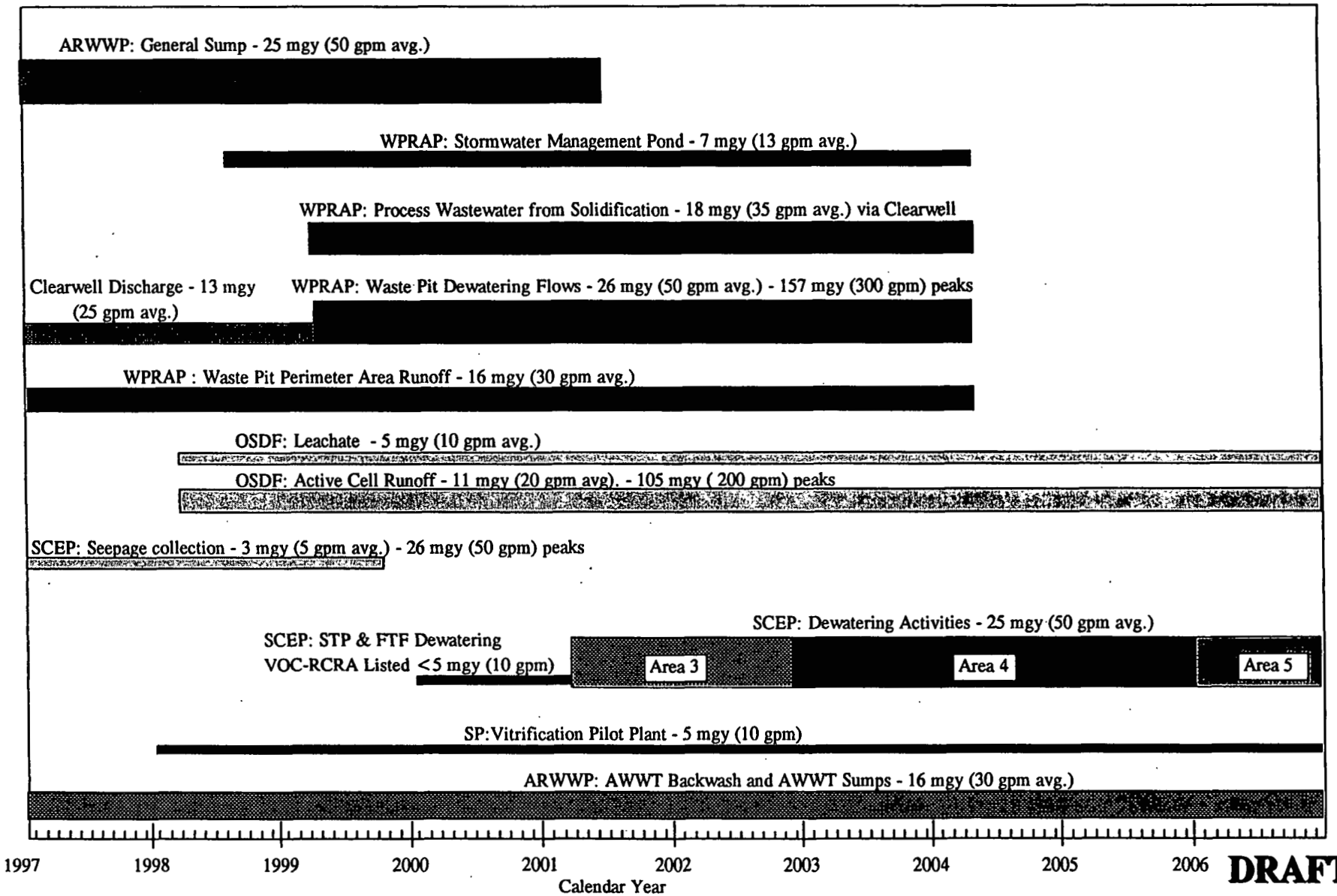

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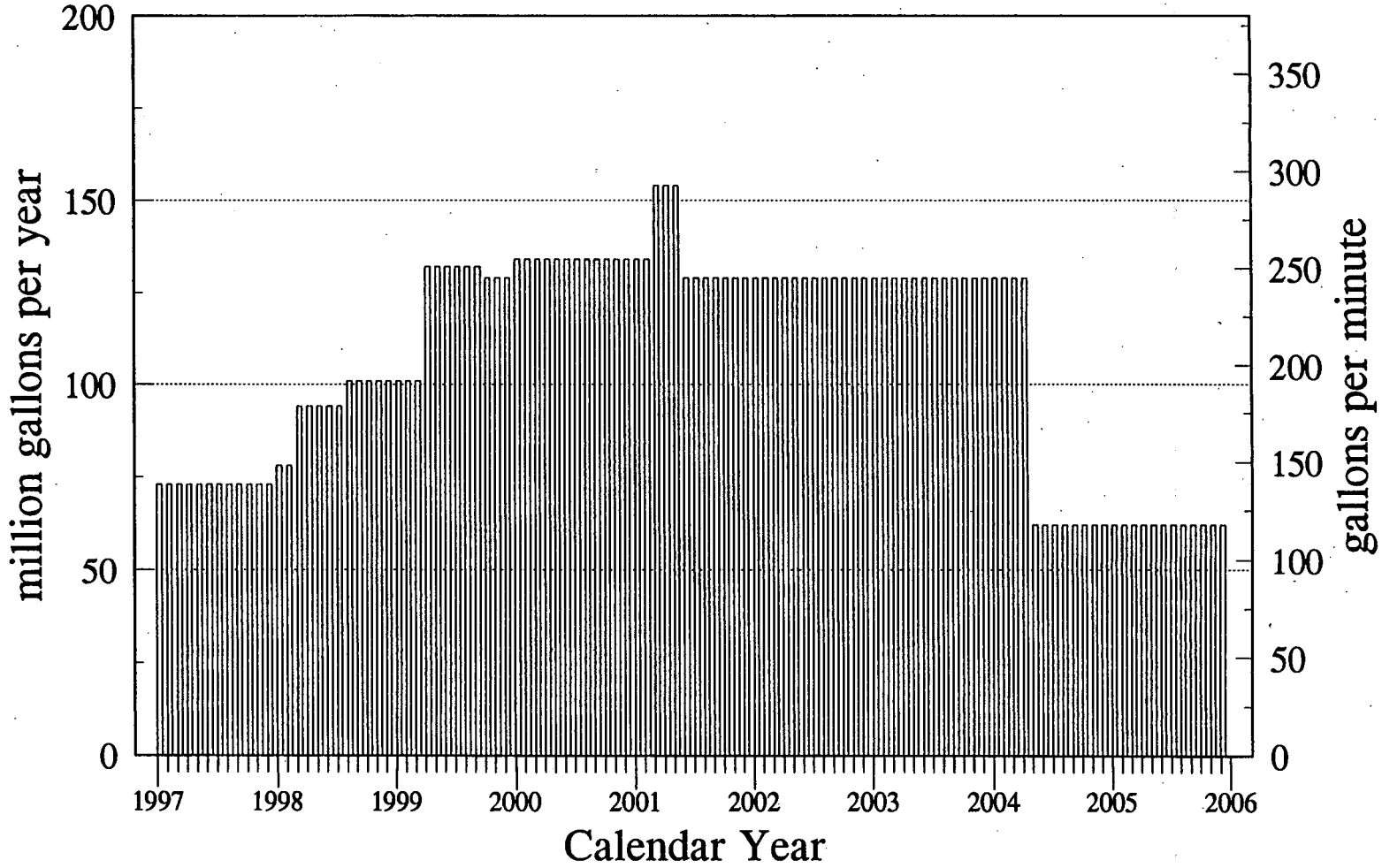
Figure 4-7

Summary Remedial Wastewater Flow Timeline
Average Annual Flow



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5.0 OPERATIONS PLAN

This section contains the operations philosophy, treatment priorities, hierarchy of decisions, management and flow of operations information, and management of treatment residuals necessary to successfully operate the groundwater extraction and wastewater systems to achieve regulatory requirements and commitments. Included are detailed flow charts of: 1) day to day wastewater treatment operational decisions, 2) the logic for determining which groundwater wells will receive treatment and which will be bypassed and 3) operational guidelines for well field abnormalities. This section also contains a discussion of the relationship of the operations plan to other FEMP documents.

5.1 WASTEWATER TREATMENT OPERATIONS PHILOSOPHY

The primary goals of wastewater treatment operations and maintenance are to: 1) meet effluent discharge requirements, 2) minimize bypassing of untreated groundwater and storm water, and 3) maintain treatment headwork capacities. This requires making the correct decisions in applying treatment to maximize the quantity of uranium removed from wastewater prior to its discharge to the Great Miami River. Maximizing uranium removal will result in compliance with the objectives as outlined in Section 2. Other regulatory discharge requirements, such as NPDES, must also be met. Influent streams to treatment and effluent streams from treatment are sampled for uranium concentration to provide information needed to ensure that the objectives are met. Sampling is also performed to ensure all requirements of the NPDES permit are met.

5.2 TREATMENT PRIORITIES

During FEMP remediation, wastewater treatment systems will include the AWWT system (Phases I and II, and the planned AWWT expansion), the IAWWT system, the SPIT system, the planned VOC treatment system, and the planned STP. The effluents from these systems, along with bypassed (untreated) groundwater and storm water, will combine at the Parshall Flume to form the FEMP site's regulated discharge of uranium to the Great Miami River.

1 The expected effective treatment capacity of each uranium-removal treatment system is listed below:

DOE

- AWWT Phase I — 315 mgy — 600 gpm
- AWWT Phase II — 159 mgy — 300 gpm
- AWWT Expansion — 788 mgy — 1500 gpm
- IAWWT — 131 mgy — 250 gpm
- SPIT — 92 mgy — 175 gpm

The effective treatment capacity represents the flow being treated through each of the treatment systems (except AWWT Expansion) at the time of the writing of this OMMP. Figure 5-1 shows the currently projected treatment modules and simplified general wastewater flows in the overall FEMP centralized wastewater treatment system during remediation.

The priority for water treatment through the wastewater treatment facilities shown on Figure 5-1 is the water containing the greatest uranium concentration. At this time, the source of water containing the greatest amount of uranium is the remediation wastewater collected in the BSL. The water in the BSL contains about 1500 ppb uranium in a typical analysis. The BSL also collects all VOC-contaminated wastewater and process wastewater effluents. As a result, the AWWT Phase II treatment system will be dedicated to treating water from the BSL until the level in the BSL drops to the intake position of the discharge pumps.

The source containing the second highest concentration of uranium is the storm water in the SWRB. The SWRB typically contains water with a uranium concentration of approximately 500 ppb. The AWWT Phase I system will be dedicated to treating storm water until the level in the SWRB drops to the level of the pump intake (or slightly above the intake to prevent freezing in winter).

19 Groundwater from the South Plume recovery system contains the lowest concentration of uranium of all the wastewater streams. As more remediation wells are installed, uranium in groundwater sent to treatment will be higher than that currently received, but is still expected to be less than that in the SWRB discharge. In order to provide water for re-injection and treating a reasonable quantity of groundwater necessary to clean up the aquifer in the most expedient manner while meeting the discharge goals, two treatment systems will be dedicated to groundwater treatment -- the AWWT Expansion and the SPIT system. In addition, groundwater will be sent to the other systems as treatment capacity is available and as discussed further below. All groundwater flows exceeding treatment system's capacity will be discharged without treatment.

Water discharged from the STP also contains uranium. Uranium treatment for this discharge is currently not provided. However, as discussed in Section 3.5.4 the STP discharge contributes to the total uranium concentration at the Parshall Flume and is of concern to achieving the discharge limits.

5.3 HIERARCHY OF TREATMENT DECISIONS

Figure 5-2 provides a logic flow chart listing the frequent decisions that must be made for wastewater treatment facilities. These decisions are typically made using guidance provided by ARWWP management and engineering support staff. The shift supervisor is responsible for operations and direction of maintenance activities at all of the groundwater extraction facilities, all uranium treatment and ancillary facilities, the STP, and the Parshall Flume. The purpose of Figure 5-2 is to provide a consistent logic for operation of all wastewater treatment facilities and a tool for the shift supervisors to ensure that they are operating the facilities in accordance with all regulatory requirements.

32 Shift supervision is provided 24 hours per day, 7 days per week, 365 days per year, by licensed wastewater operators with considerable experience in operating and supervising wastewater treatment plants. As the supervisor of all operations and maintenance activities that occur on a particular shift, the shift supervisors are responsible for ensuring that treatment equipment is operated, maintained, and repaired as necessary so that maximum prioritized treatment capacity is available at all times. The operations activities are performed in accordance with the pertinent site standard operating procedures (SOPs) listed in Appendix C. Maintenance is performed in accordance with the operations and maintenance specifications provided by the manufacturer. After EPA and OEPA approval of this document, the supervisors will be trained to follow the decision flow chart. They are also expected to use their best judgment and experience to respond to situations where the flow chart cannot be applied. An example of a situation in which the flow chart could not be followed would occur if the IAWWT were down at the time when a heavy rainfall occurs. The supervisor would not be able to send storm water to IAWWT to minimize the amount of storm water sent to the river without treatment.

Not all decisions are listed on Figure 5-2; some are implied. For example, when the flow chart indicates that storm water should be pumped to IAWWT, it is implied that IAWWT is operational. The shift supervisor is responsible for knowing the operational status of each facility and sending water only to operational facilities.

Another implied decision that exists on the treatment portion of the flow chart concerns flow rates through treatment systems. The question, "Is the flow rate through each treatment facility at or near its effective system capacity?" is asked. If the answer is no, the question, "Is additional water available?" is asked. The supervisor is directed to increase flow through the system by adding groundwater to any

system which can handle additional capacity. This step implies that any maintenance actions that will help restore flow capacity should be performed.

Some of the decisions to be made during periods of heavy precipitation depend on the experience of the shift supervisor to minimize the quantity of water that is bypassed around treatment and sent directly to the Parshall Flume. The shift supervisor uses the logic chart, along with his experience and understanding of the treatment facilities and weather forecast, to determine when to resume normal treatment operations.

Events such as equipment downtime may occasionally occur that make it impossible to exactly follow the logic chart in Figure 5-2. The circumstances in which the shift supervisor finds it necessary to deviate from the chart shall be documented in the shift supervisor's logbook and communicated to the manager of ARWWP.

5.4 WASTEWATER TREATMENT OPERATIONS DECISIONS

Below is a detailed discussion of the flow chart introduced in Section 5.3. Each major type of water to be treated is discussed to provide a better understanding of the flow chart.

5.4.1 Remediation Wastewater

During normal operations, water from the BSL and a small amount of groundwater will be pumped to the AWWT Phase II treatment system. The level in the BSL is measured as inches freeboard (the distance between the liquid level and top of the lagoon). When the level in the BSL exceeds 110 inches of freeboard, additional quantities of groundwater may be treated through the AWWT Phase II system. However, as discussed in Section 5.4.3.1, once the WPRAP, the OSDF, and the former process area cleanup and dewatering project are fully operational, it is expected that the AWWT Phase II system will rarely be available for groundwater treatment.

During periods of heavy precipitation, control of the BSL level becomes more important. During excessive storms, or during periods of sequential storms, the water in the BSL may rise to a level where additional influent control actions may be necessary. Figure 5-2 illustrates the decisions that must be made to reduce inflow to the BSL. These actions are required to prevent the BSL from overflowing to Paddys Run and eroding the banks of the BSL, and to ensure that sufficient capacity exists for continued inflow of contaminated runoff from the waste storage area. Processes that send

water to the BSL are requested to stop pumping in an order based on either the ability of each process to hold its discharge water until the period of heavy precipitation is complete or the relative importance of each influent to the overall FEMP project.

The first inflows stopped are processes that have significant capacity to store water. These include the general sump and the 500,000 gallon HNT, which are maintained at low levels under normal operating conditions. The next inflow to be stopped will be the WPRAP storm water management pond. Since the pond has a capacity to hold a 25-year, 24-hour storm water volume runoff, its specific capacity exceeds the regulatory requirements to contain a 10-year 24-hour storm water runoff volume. As the level in the BSL continues to increase, other processes will be stopped from pumping into the BSL in the order indicated on the flow chart until all process flows have been halted.

DOE 5.4.1.1 Diversion of Remediation Wastewater

If all process flows to the BSL have been halted and the level in the BSL continues to increase, approximately 200 gpm of additional discharge flow from the BSL will be diverted to the AWWT Phase I treatment system. Note that as discussed in Section 3.2.2.1, the process line required to accomplish this increased pumping will be installed in 1998. This action will only be used if an emergency condition is deemed to exist, since wastewater treated through the AWWT Phase I system will not be treated for VOC contaminant removal.

The clearwell will receive water that is anticipated to contain relatively high amounts of uranium from WPRAP. Overflow of the Clearwell will cause erosion and possible structural failure of the banks and is therefore deemed unacceptable. The Clearwell will be pumped to the BSL until it becomes evident that continued pumping will cause the BSL to overflow. In that extreme event, portable pumps and hoses will be used to pump the Clearwell to the Waste Pit Perimeter Runoff Concrete Pond.

The Waste Pit Perimeter Runoff Concrete Pond overflows to a swale to the west of the pond. The swale can be pumped back into the Concrete Pond when the heavy rainfall is over and the level in the BSL has dropped low enough to allow additional inflow. The flow chart tells the supervisor to continue pumping this pond into the BSL until it becomes evident that continuing to pump will cause the BSL to overflow. Overflow of the BSL will cause erosion of the banks and possible structural failure and is therefore deemed unacceptable. After the level in the BSL begins to drop, any water in the swale can be pumped to the Concrete Pond and the BSL.

Normal operation of the BSL and all processes that pump water to the BSL will be resumed when the level in the BSL drops to 35 inches of freeboard or when the period of heavy precipitation is complete.

5.4.1.2 Potential Reductions to Remediation Wastewater Flows

In the event that the remediation wastewater flows consistently exceed the capacity of the BSL, two potential inflow reductions are available to relieve the situation. These may be accomplished in the WPRAP and OSDF project, as described below.

OSDF

As part of the OSDF project (see Section 4.1.3.3), storm water runoff from the active cell will be sent through the leachate collection system to the BSL. With revisions to OSDF individual cell construction, this water could be pumped to existing process area storm sewers and sent to the SWRB for subsequent treatment in AWWT Phase I. This could occur until remediation of Area 5 removes the existing storm sewers, making this alternative unfeasible.

WPRAP Storm Water Management Pond

As part of the WPRAP (see Section 4.1.3.3), a storm water management pond was constructed to control contaminated runoff from that facility. Under normal conditions, it is anticipated that the runoff collected will not significantly exceed the 20 ppb discharge goal. Accordingly, this water may, in the future, be normally discharged either to the SWRB or directly to the Parshall Flume and Great Miami River. Several cross ties of existing pipelines could be used to accomplish this action.

5.4.2 Storm Water

Storm water runoff from the former production area will continue to be collected in the SWRB and processed through the AWWT Phase I treatment system. Treatment of storm water through the AWWT Phase I system continues until the level in both chambers of the SWRB drops to approximately one to four feet and then the AWWT Phase I system will be switched to treating contaminated groundwater. The switchback from groundwater to storm water is made when the level in one chamber of the SWRB is up to the influent gate and the level in the other chamber rises to 3 to 5 feet. The switch from groundwater to storm water can be made sooner if heavy rainfall is predicted. During the winter, when runoff potential is at its lowest, the level in the SWRB will be maintained at a slightly higher minimum level to prevent the intake pipes from freezing.

The primary goal governing operation of the SWRB is to prevent overflow to Paddys Run. During periods of precipitation, the level in the SWRB will normally continue to increase even when the AWWT Phase I treatment system is treating water at its full capacity. During heavy precipitation, when the level in the SWRB increases to seven to eight feet with more precipitation expected, the shift supervisor will direct that the IAWWT system begin treating storm water.

If the level continues to increase, the shift supervisor will determine if the AWWT Phase II system has the capacity to treat any storm water. AWWT Phase II will only be used to treat storm water in the event the BSL level is very low before the precipitation begins.

5.4.2.1 Bypassing of Storm Water

If the level in the SWRB rises to between 8½ to 10½ feet, storm water from the SWRB will be bypassed around treatment to the Parshall Flume and the Great Miami River. The exact level at which bypassing will begin depends on the availability of additional treatment through the AWWT Phase II system and on the weather forecast. Bypassing will continue until the level in the SWRB drops below eight feet and the precipitation event is over.

As discussed in the previous section for remediation flows, if the level in the BSL increases to the point that an emergency condition exists and it is necessary to divert water from the BSL to the AWWT Phase I treatment system, storm water treatment capacity will be reduced and the amount of storm water to be bypassed will increase.

5.4.3 Groundwater

Groundwater treatment capability is required to provide re-injection water and meet aquifer cleanup schedules. Because of system design and the need to keep system discharges of highest quality to provide for the re-injection water, the AWWT expansion facility and the SPIT facility will be dedicated to treating groundwater. Groundwater will be treated at the IAWWT unless, as discussed in the previous section, additional storm water treatment capacity is needed to minimize storm water bypass. Under no conditions will the IAWWT, AWWT Phase I, or AWWT Phase II discharges be used for re-injection. The AWWT Phase I system will be used to treat groundwater when the level in the SWRB is low. The AWWT Phase II system may be used to treat groundwater if the level in the BSL is very low and the weather forecast does not predict rainfall for the upcoming period.

5.4.3.1 Bypassing of Groundwater

Using the flow information previously presented in Section 4.0, and the expected effective treatment capacity presented in Section 5.2, it is possible to project the additional groundwater flows that can be treated in AWWT Phases I and II. The shaded areas of Figure 5-3 and 5-4 depict the capacities in AWWT Phase I and II, respectively, that are projected to be available for groundwater treatment. Figure 5-4 indicates very limited excess capacity in AWWT Phase II for groundwater treatment during the years 1999-2004. Combined with the uncertainties in remedial wastewater flows, it is expected that Phase II will not play a significant role in groundwater treatment. Figure 5-5 presents a graphic summary of the expected groundwater flow that will be bypassed when all projected reliable treatment capacity is utilized.

Treatment of groundwater well discharges will be prioritized in order of uranium concentration, with the highest uranium concentration wells routed to treatment until all available treatment capacity is utilized. Remaining well discharges will be bypassed around treatment to the Parshall Flume. The existing four South Plume off-property, leading-edge wells and the additional two wells being installed in the South Plume Optimization Project will be routed as a group either for treatment, full bypass, or partial bypass since piping does not exist for well-by-well decision-making.

As treatment capacity is exceeded, wells will be diverted from treatment to bypass in order of lowest uranium concentration as shown on Figure 5-6. The wells with the lowest uranium concentration will be bypassed first until the needed amount of treatment capacity has been made available. Note that the treatment projections will meet or exceed the 2000 gpm of committed or reserved groundwater treatment capacity as described in the Baseline Remedial Strategy Report.

22 5.4.3.2 Re-Injection of Treated Groundwater

The water for the re-injection demonstration will be obtained from the discharge of the AWWT Expansion System as shown on Figure 5-2. In the future, if the Injection Demonstration Project is successful, effluent from the SPLT system will be piped to allow routing to the 50,000 gallon surge tank (see Section 3.1.1.4). The quantity of flow which is transferred to the surge tank is controlled automatically by level control at the surge tank.

The specific details for operating of the individual injection wells will be addressed in future SOP's. However, it should be noted that the injection demonstration system is designed such that each injection well has it's own flow control system that allows the flow of injectate to be varied individually. The nominal flow of 1000 gpm to the Injection Demonstration Wells will be supplied by a single pump (with backup spare provided). Additionally, controls are being provided that allow less than a total of 1000 gpm to be injected. These controls will allow the fixed speed pumps discharge to be split between injection and recycled to the injection supply tank. Therefore, the discharge from the pumps remains relatively constant while the flow to the injection wells can be varied.

Similarly, in the future, when the re-injection flow increases above 1000 gpm, a third pump will be added as discussed in Section 3.1.2.1. The third pump will provide standby and the two operating pumps will be controlled in the same manner as described above to provide a varying demand.

In addition, instrumentation on the individual injection wells is being provided such that the water levels within each injection well can be monitored. Clogging of the injection wells will be indicated by rising waters levels at constant flows. The injection wells are also being instrumented such that flow to the well is automatically stopped if excessively high levels are reached.

5.4.4 Ion Exchange Vessel Rotation/Regeneration

The Baseline Remedial Strategy Report contains a sequence of aquifer well extraction based on the projected treatment capability of the various facilities. Meeting the overall 20 ppb total uranium discharge level to the Great Miami River was based on the assumption that the uranium concentration in the system discharges were:

- AWWT Phase II - below 20 ppb
- AWWT Phase I - below 10 ppb
- AWWT Expansion facility, SPIT IAWWT - below 5 ppb.

In order to effectively balance operating costs while meeting regulatory commitments, the overall 20-ppb-discharge goal at the Parshall Flume will be used to determine when changes must be made in the ion exchange (IX) operation. As the 20-ppb limit is reached, the IX vessels in the treatment train that are causing the Parshall Flume uranium concentration to exceed 20 ppb will be rotated from standby to lag (if a standby unit is available), lag to lead, and lead to standby, followed by regeneration, to maintain compliance.

5.4.5 Sanitary Sewage

Sanitary sewage, including the laundry sump, is treated through the STP. No uranium removal capability is provided in this system; its purpose is to treat sanitary sewage to meet NPDES requirements. The STP discharges directly to the Parshall Flume. The concern for the level of uranium in the discharge from the STP is for meeting the 20 ppb discharge goal. The level of uranium has risen from an average of 20 ppb to levels which, at times, exceed 200 ppb. Potential corrective measures to address this situation are discussed in Section 3.5.4.

5.5 EXTRACTION AND RE-INJECTION WELL OPERATION DECISIONS

Figure 5-7 lists decisions that must be made based on changes in operation in any of the leading edge extraction wells (South Plume), the re-injection wells, or the treatment capacity supplying injection water. When any of the conditions of Figure 5-7 are met, the shift supervisor will initiate the listed action. Performance of the listed actions will ensure that the leading edge of the plume does not move beyond the leading edge extraction wells. Notification to the manager of ARWWP will be made whenever any of the conditions on Figure 5-7 occur. Any changes in well pumping set points will be transmitted to shift supervisors by the Operations Manager.

5.6 OPERATIONAL MAINTENANCE PRIORITIES

Maintaining the treatment facilities on line includes ensuring that all equipment is operating properly, that adequate personnel are assigned to operate the treatment systems safely, and that the combined treatment and bypassing systems are removing uranium to below 20 ppb as measured at the Parshall Flume. Below is a list of operational maintenance priorities in their order of importance:

- Keep the Parshall Flume discharge point and sampling system on line. If the discharge monitoring system were to become nonoperational, discharge monitoring of effluent to the river from the FEMP would be jeopardized. The sampling system must be operational so that accurate reports of uranium and NPDES contaminant levels can be made.
- Keep the sewage treatment plant on line and operating correctly. This will prevent NPDES permit violations by STP discharge.
- Keep the AWWT Phase II treatment system on line at maximum capability. This will also allow the BSL to be maintained at a low level so that a heavy precipitation event will not quickly create the potential for bypassing or overflow. Keeping AWWT Phase II on line includes keeping the AWWT Slurry Dewatering Facility available to process clarifier slurries and provide treatment of resin regeneration waste streams.

- Keep AWWT Phase I on line to prevent the SWRB from overflowing and to minimize the amount of untreated storm water that must be bypassed around treatment.

The next two priorities after these will vary based on weather conditions and the level in the SWRB:

- In periods of heavy precipitation or high level in the SWRB, the priority is to keep IAWWT on line. IAWWT, which normally provides additional treatment capacity for groundwater, also provides backup capacity for storm water.

- If the SWRB level is not high and large quantities of precipitation are not expected, the priority will be to keep the South Plume Extraction Wells on line to maintain capture of the South Plume of uranium contamination in the aquifer. These wells are located at the leading edge of the plume and prevent the plume from spreading further south into the aquifer.

- Keep the AWWT expansion facility, the south field extraction wells, and the re-injection demonstration wells on line. The re-injection wells receive discharge from the AWWT Expansion facility and re-inject that water into the aquifer to speed the cleanup process.

- Keep SPIT on line. SPIT provides additional groundwater treatment.

- Keep the ion exchange resin regeneration system on line and available to regenerate resin for reuse.

- Keep the South Field Extraction and future systems operating.

More specific details of managing equipment operation and maintenance are contained in Section 6.

5.7 OPERATIONS CONTROLLING DOCUMENTS

Operations at the wastewater treatment facilities are controlled directly by standing orders and standard operating procedures (SOPs). Standing orders translate the DOE Orders and conduct of operations principles, guidelines, and procedures into performance requirements for personnel involved in operating the wastewater treatment facilities. The standing orders were written to ensure that all operations are conducted in full conformance with DOE conduct of operations requirements.

A more extensive discussion of SOPs and Standing Orders is contained in Section 6.1.2.

This OMMP provides an overview of operations and maintenance. Standing Orders and SOPs implement the requirements of this plan. The OMMP is not intended to replace Standing Orders or SOPs; its purpose is to:

- Prioritize waters to be treated
- Prioritize the shutdown sequence of remediation wastewater streams
- Determine which wastewater streams are to be bypassed without treatment
- Determine when and which the ion exchange vessels within the various treatment units need to be rotated and/or regenerated
- Describe what additional measures will be taken under the direction of the ARWWP Manager in the event that the day-to-day logic is adhered to and the average monthly discharge uranium level is consistently greater than 20 ppb.

5.8 MANAGEMENT AND FLOW OF OPERATIONS INFORMATION

Samples are taken from each of the treatment systems at locations indicated on Figure 5-2. The results of the sample analysis are reviewed daily by the shift supervisors, the process engineer, and the operations manager to review system performance and determine if any of the treatment system ion exchange vessels need to be removed from service for resin replacement or regeneration.

20 The operations manager issues daily and monthly operations reports that summarize flow rates and flow totals as well as uranium concentrations form each wastewater treatment system. The operations manager communicates process information from the operations personnel to ARWWP personnel involved in modeling the aquifer cleanup. Information on required well pumping rates and treatment system flow rates is communicated from ARWWP modeling personnel to operations personnel via the operations manager's monthly performance goals.

5.9 MANAGEMENT OF TREATMENT RESIDUALS

The AWWT Slurry Dewatering Facility (SDF) began routine operations in September 1996. It has been used primarily to dewater AWWT clarifier settled solids. The SDF will be used in the future to dewater sludges dredged from the SWRB and BSL, to dewater sewage treatment plant waste activated sludge, and to precipitate and dewater sludges from AWWT ion exchange regeneration solutions.

21 The filter cake produced by the SDF filter press is unloaded in metal boxes of about 50 cubic foot capacity. Representative samples from each box have been analyzed for total uranium, to characterize the waste and to help assess the possibility of eventual disposal at the FEMP's OSDF. The average SDF filter cake uranium concentration (from AWWT clarifier bottom dewatering) has been

approximataely 1200 milligrams per kilograms (mg/kg), with a range of 600 mg/kg to 1900 mg/kg. This compares to the Waste Acceptance Criteria of 1030 mg/kg total uranium for the OSDF.

Variations in the incoming wastewater and in-treatment operations result in variations in the filter cake uranium concentration. Many individual boxes have tested below 1030 mg/kg total uranium and could be considered acceptable for disposal on site. Personnel who make decisions regarding the ultimate practices for disposal of SDF filter cakes will need to consider various factors. Some factors would be:

- The costs of continued sampling and analysis for each box
- The cost of shipping and handling for off-site disposal compared to on-site disposal
- The possibility of improved economies of scale in off-site disposal by collaboration with the WPRAP
- Changes in the AWWT incoming wastewater or treatment
- Differences in the sources of other incoming waste sludges and slurries
- Stakeholder concerns and preferences.

A Waste Acceptance Criteria (WAC) plan is being developed to clearly define the requirements and conditions for material disposition into the OSDF. No materials will be placed in the OSDF unless they can meet the WAC plan criteria. Specific decisions regarding the disposal of sludges and treatment residuals will be made after the implementation of the OSDF WAC plan.

These factors may also differ in the future. Decisions regarding SDF filter cake disposal will need to be made to best fit the situation. Current plans are to ship those boxes not meeting the on-site WAC to the Nevada Test Site. Future conditions may dictate other actions.

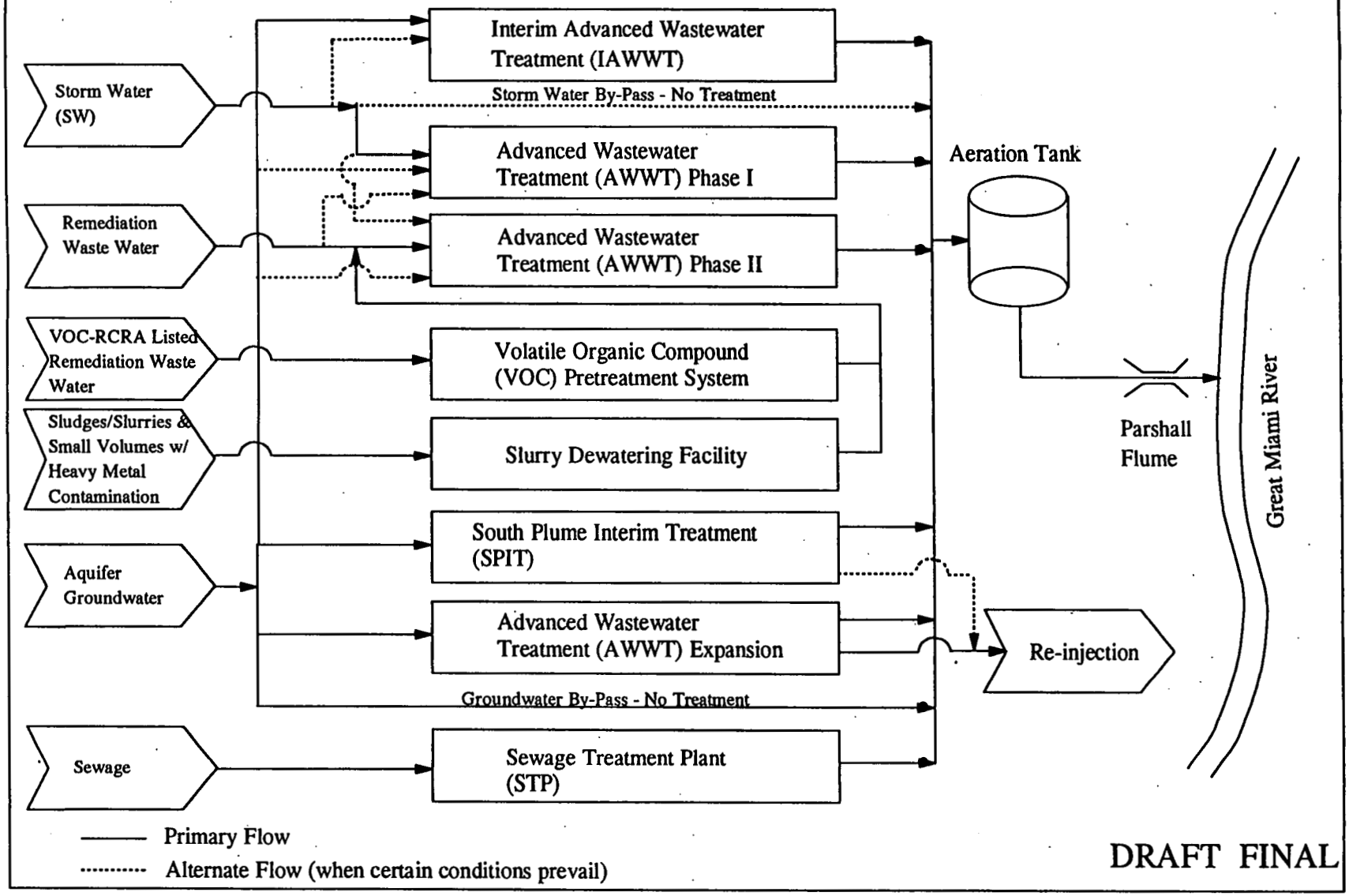

FIGURE 5-1. PROJECTED TREATMENT MODULE EFFLUENT FLOW DIAGRAM

Figure 5-2 Wastewater Operations Flow Chart

This figure is provided as an 28" x 42" full size drawing in a pocket holder at the back of this binder.

Figure 5-3

Summary Storm Water Flow Timeline with Projected Treatment Average Annual Flow

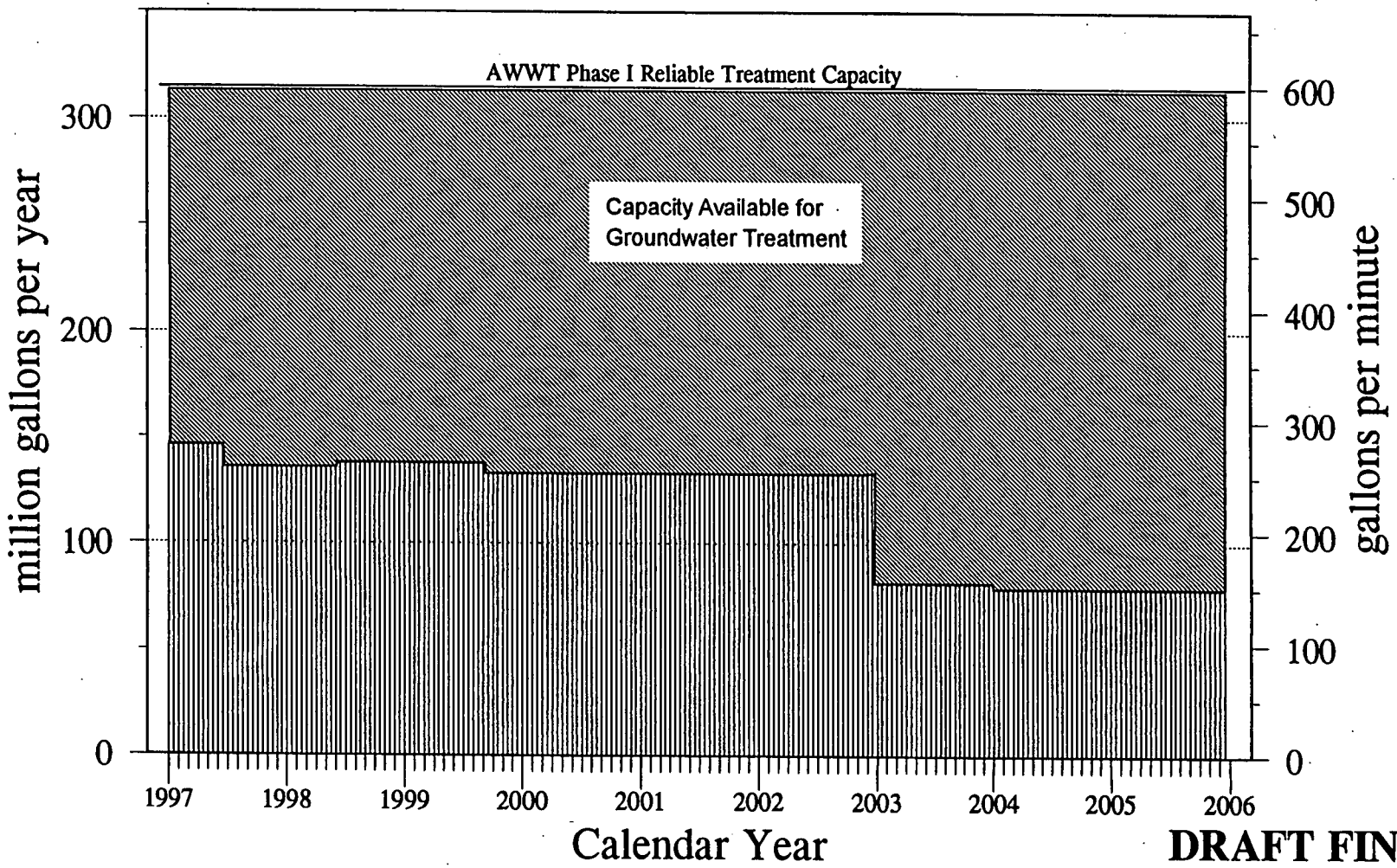

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Figure 5-4

Summary Remedial Wastewater Flow Timeline with Projected Treatment Average Annual Flow

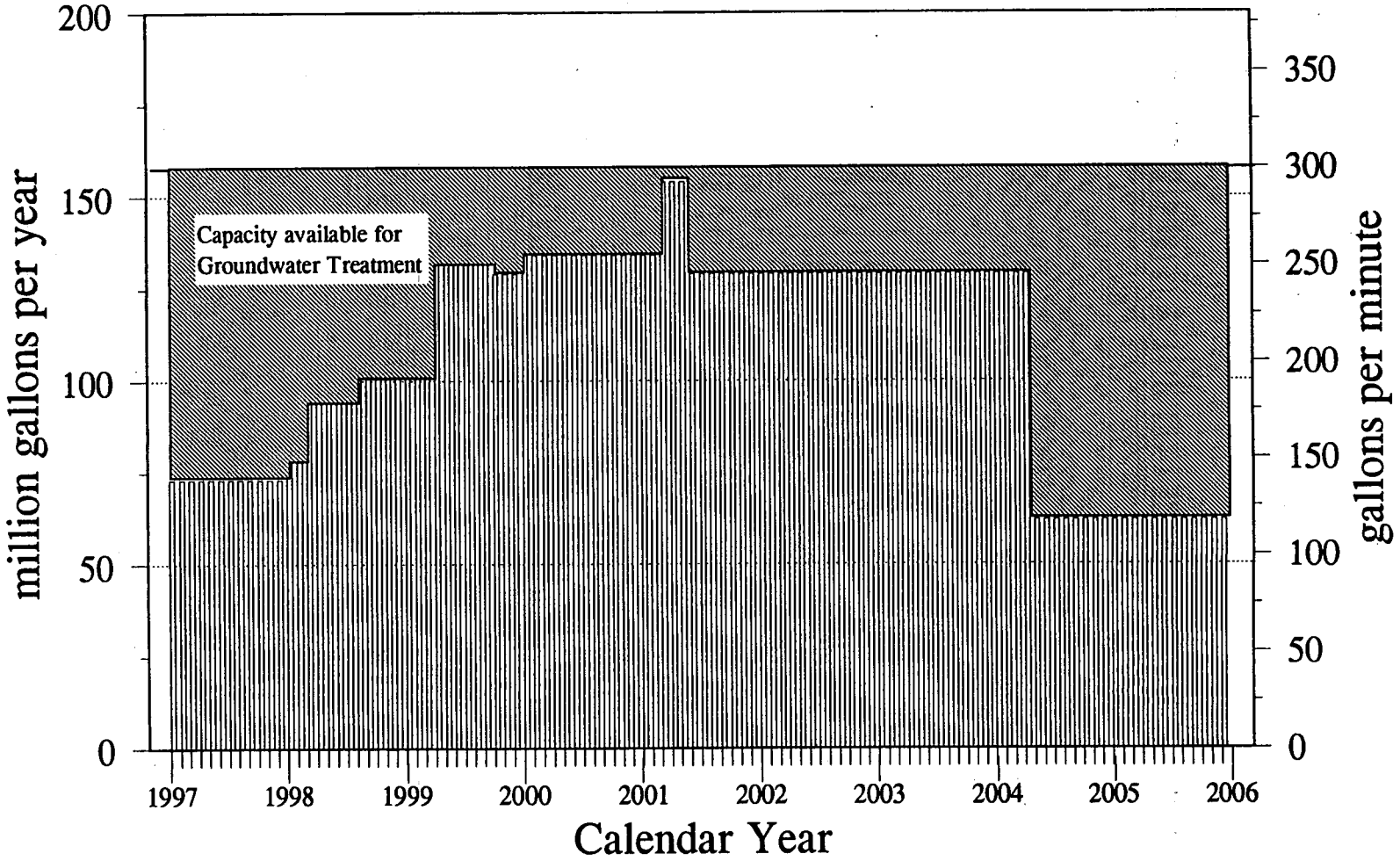

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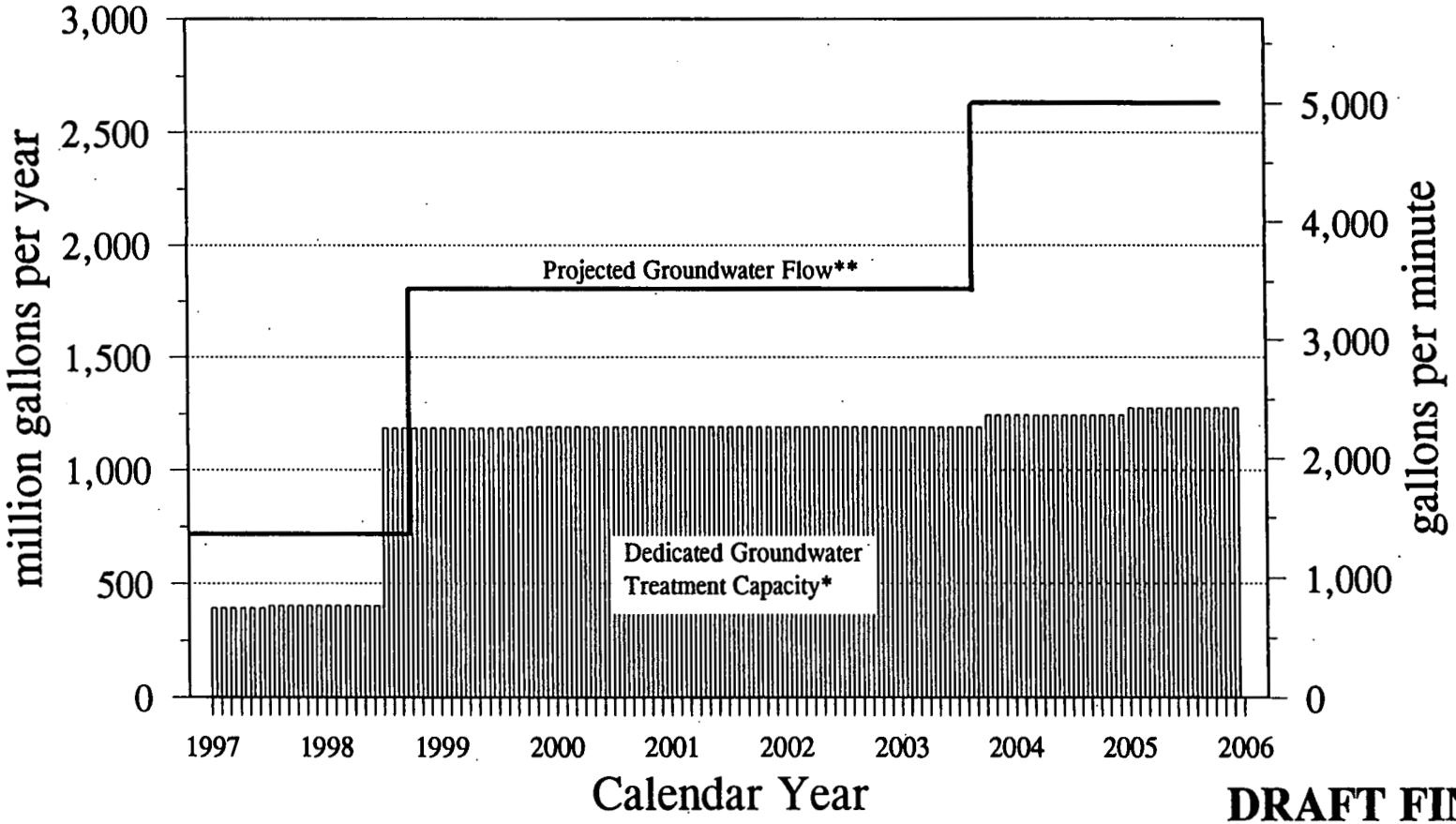
Figure 5-5

Summary Groundwater Flow Timeline with Projected Treatment Average Annual Flow



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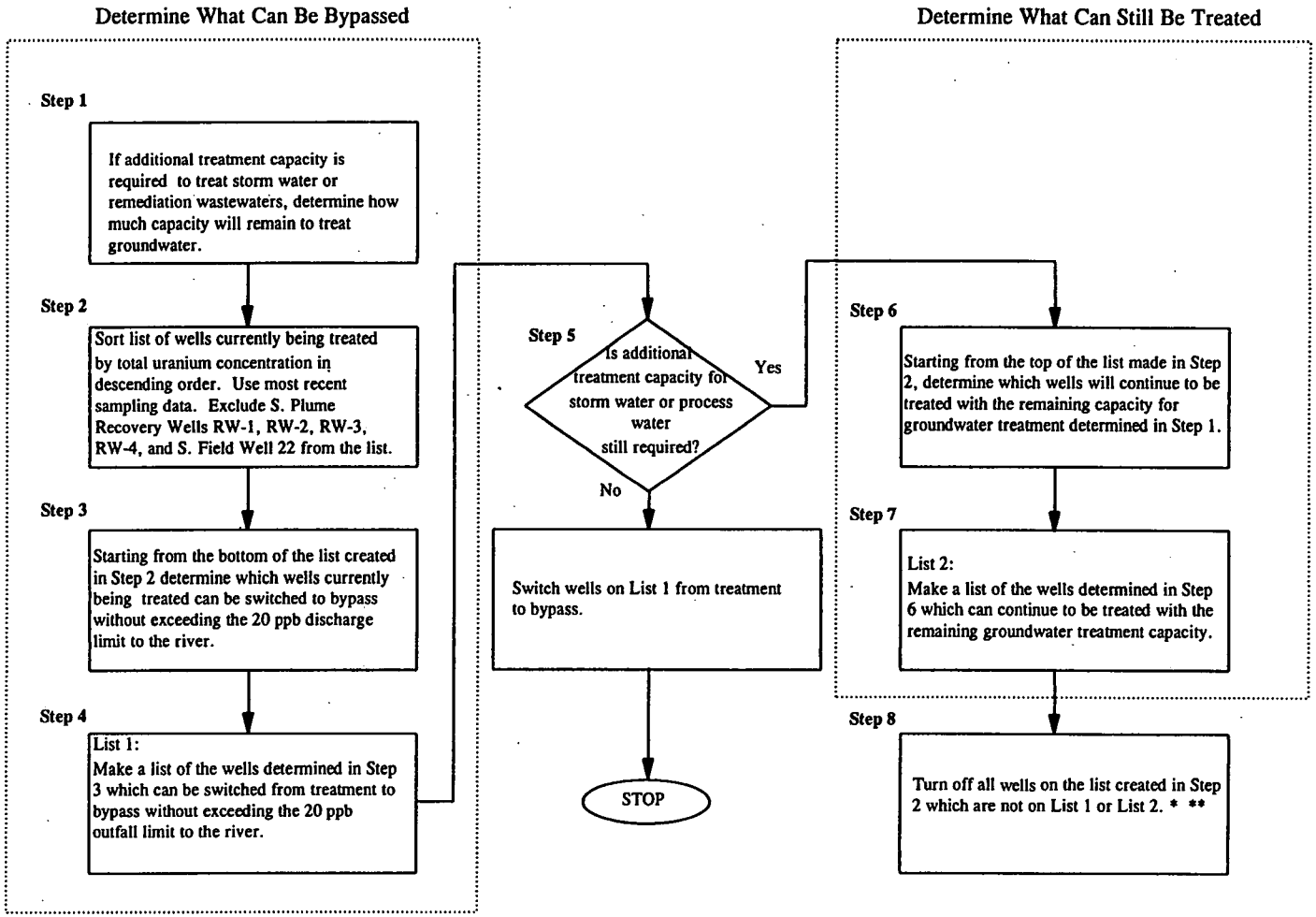
*Treatment capacity is a combination of AWWT Expansion, SPIT, IAWWT, & AWWT Phase I.

** Excess groundwater will require direct discharge to GMR.



* Priority should be given to keep off-site wells operating when deciding which wells to turn off (i.e. South Plume Recovery Wells RW-1, RW-2, RW-3, RW-4 and South Plume Optimization Wells
RW-6 and RW-7 should take precedence over on-site wells). If it becomes necessary to turn off South Plume or South Plume Optimization wells, turn them off in the following order until the required capacity is available: RW-7 (250 gpm); RW-6 (250 gpm); RW-4(400 gpm); RW-3(400 gpm); RW-2 (300 gpm); RW-1(300 gpm)

** If it becomes necessary to shut down South Field Recovery Well 22, then the Injection Demonstration Wells 8, 9, 10, 11, and 12 should be shut down at the same time.

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Figure 5-6. Logic for Determining Groundwater Extraction Wells to Treat

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CONDITION	ACTION
South Plume Well Outages	
One well down for less than one week	No Action
One well down for one week or more, or more than one well down	Increase pumping rate in other South Plume wells to compensate. New well set points will be provided by Aquifer Restoration Team
Injection Demonstration Well Outages	
One well down for four weeks or less	No Action
Two wells down for four weeks or less	Shut down South Plume Optimization Wells (RW-6 and RW-7)
One or two wells down for four weeks or more, or three or more injection wells down	Shut down South Plume Optimization Wells (RW-6 and RW-7) and increase pumping from South Field Well 22
Reduced Groundwater Volume for Injection	
Injectate volume greater than or equal to 800 gpm	No Action
Injectate volume less than 800 gpm and greater than or equal to 600 gpm	Shut down South Plume Optimization Wells (RW-6 and RW-7)
Injectate volume less than 600 gpm	Shut down South Plume Optimization Wells (RW-6 and RW-7) and increase pumping from South Field Well 22

Figure 5-7. Operational Guidelines for Well Field Abnormalities

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6.0 OPERATIONS AND MAINTENANCE METHODS

This section describes the general methods, guidelines, and practices used in managing equipment operation and maintenance. Managing equipment operation and maintenance in the context of this document includes not only routine control panel monitoring and repair work, but also the preventive, predictive, and proactive actions used to maximize equipment operating efficiency and capacities. This section discusses some of the management systems that will help to assure that meeting the Operable Unit 5 ROD (DOE 1996a) requirements are met, describes the key parameters used to monitor the performance of the groundwater and wastewater facilities, and describes the principal features and maintenance needs of the overall operation.

The treatment and well system performance parameters and maintenance requirements have unique differences. The treatment systems are designed and built with many redundant features and equipment to reduce potential downtime (for example, installed spare pumps and ion exchange units). Those features are not economically practical for the well systems. The equipment in the treatment systems has more easily discernible indicators of equipment condition and are more easily accessed for monitoring by operator walk-through than the underground well system. The methods used to measure the equipment condition and the specific measurable goals for the two systems also are different.

6.1 MANAGEMENT SYSTEMS

6.1.1 Maintenance and Support

The ARWWP is responsible for routine repairs, preventive maintenance, and minor modifications and improvements needed for maintaining the operational capability of FEMP wastewater treatment facilities. Full-time maintenance supervision and skilled, qualified craftsmen (pipe fitters, welders, millwrights, electricians, instrumentation technicians, and asset preservation specialists) are headquartered in a combination shop/storage/office facility inside of Building 51. The operations and maintenance groups work together closely on a day-to-day basis, promoting a sense of ownership and cooperation between the operators and maintainers of this system.

The ARWWP technical staff directly supports facility operation and maintenance, and includes chemical and civil engineers, geologists and hydrogeologists, quality assurance, health, safety, and environmental compliance personnel. The technical staff works together to resolve issues and improve operations.

They also provide troubleshooting and technical assistance to the day-to-day operations and maintenance groups.

Key responsibilities of the central maintenance group include developing preventive maintenance schedules, developing spare parts inventories, developing maintenance work instructions, and administering the sitewide Computerized Maintenance Management System (CMMS). Specific engineering discipline skills may be utilized from the sitewide facilities engineering group for specific maintenance needs (for example, structural analysis, electrical power distribution design, and instrumentation system configuration). All work involving a modification is reviewed by knowledgeable, technical staff members to ensure that it is appropriate. All maintenance work is formally planned and scheduled, except for emergency repairs, which are handled in a safe, expeditious manner. Major system maintenance turnarounds are planned in detail to help minimize the duration of system outages.

The CMMS is used as a powerful maintenance management tool. Each specific piece of equipment (for example, every tank, pump, motor, flow meter, control valve, etc.) is assigned a unique, specific, identification number. All maintenance work performed by the skilled crafts (repairs, preventive maintenance, and minor modifications) is initiated by a work order request, written to the specific equipment number. Work order information is maintained in a database in the CMMS. Work orders may be initiated for a specific, one-time task or on an automated scheduled basis for routine repetitive work. For example, the CMMS is used to regularly schedule and document all instrumentation calibrations. Calibration/preventative maintenance schedules, maintenance work instructions and procedures, spare parts information (including inventory), and repair history information are documented in the CMMS database. The information inputs into the CMMS are provided by maintenance, operations, and engineering personnel. The data collected in the CMMS provides for the creation of equipment histories, which assists in the analysis of maintenance trends and costs.

The facilities consist of standard gravel-packed water wells and conventional water and wastewater treatment unit processes that are typical for the industry. It may be expected to have good reliability and has well-documented maintenance guidelines. Routine maintenance practices, as documented by the original equipment manufacturer's maintenance manuals, have been used to provide the basis for FEMP

maintenance procedures and practices. A spare parts inventory (developed from original equipment manufacturer's recommendations) is maintained to expedite the completion of equipment repairs.

6.1.2 Operations

Operating personnel play an important role in maximizing equipment operating efficiency and capacity. One significant duty of the facility operators is to identify and report existing and potential future equipment problems. Operators perform routine scheduled checks, inspections, and walk-throughs of the facilities and systems. Potential problems and maintenance needs are reported to supervision and maintenance work orders are initiated. Operators and Shift Supervisors maintain shift logbooks that document activities and specific actions taken during each shift. Information in the logbooks is used as the basis for transfer of duty from one shift to the next. The logbooks are kept as an historical record of operational activities. Management and technical staff periodically review the logbooks and roundsheets as additional assurance that the systems are being effectively operated.

6.1.2.1 Process Control

Facilities are staffed by operators and shift supervisors around the clock (24 hours per day, 7 days per week, 365 days per year). The operators at AWWT and the SDF monitor the process using a distributed control system (DCS) located in control rooms. The DCS receives input from process meters (e.g., tank level and process flow meters) and from devices that indicate equipment status (e.g., valve position limit switches and motor run relays). The DCS outputs control signals to regulate the process (e.g., control valve positioning and motor start/stop control). The DCS uses desktop-style computer equipment (monitors, keyboards, and pointing devices) to provide a graphic operator-machine interface for the process monitoring and control. The DCS operator interface includes various process graphics screens depicting portions of the treatment system in piping and instrumentation diagram format and providing real time process measurements and information. The DCS system has graphic process trending capabilities, process alert and alarm management, and an historical database of all operator inputs and process alert/alarms. Plans are to use the DCS to interface with new and existing well systems to provide enhanced real time monitoring and remote controls. The operators at AWWT and SDF also access process and equipment information by making "walking rounds" of all equipment in the process.

The other facilities have more traditional control panels or local control boards at the equipment. Operators at all the other facilities perform walking rounds to ensure correct operation of all equipment.

Information collected during the walking rounds is documented on rounds sheets which are reviewed each shift by the Shift Supervisor. If any unusual conditions are observed during the walking round, the operator immediately notifies the Shift Supervisor and appropriate corrective actions are taken.

6.1.2.2 Standard Operating Procedures

Each operation is performed in accordance with approved SOPs that are developed by the technical staff with the assistance of operations personnel. The SOPs are living documents that are reviewed periodically, revised, as necessary for the safe and consistent operation of treatment processes. A list of current SOPs used is contained in Appendix C.

SOPs provide step-by-step instructions for performing wastewater treatment operations activities. They also contain health and safety precautions that must be followed while performing the steps contained in the procedure. SOPs are written from the perspective of the operator who will be performing the steps.

SOPs also contain instructions as to when management must be notified of nonroutine operating conditions or events and to whom in ARWWP management these conditions must be reported. Reporting of these conditions or events to management beyond ARWWP and to outside agencies is discussed in Section 7.0 of this OMMP.

6.1.2.3 Conduct of Operations

The DOE Conduct of Operations standards (DOE Order 5480.19) are implemented for operations and maintenance through Standing Orders. The Standing Orders spell out the specific methods used by the project for the implementation of all eighteen chapters of DOE 5480.19. The chapter titles (which are indicative of the important operational protocol) are Operations Organization and Administration, Shift Routines and Operating Practices, Control Area Activities, Communications, Control of On-Shift Training, Investigation of Abnormal Events, Notifications, Control of Equipment and System Status, Lockouts and Tagouts, Independent Verification, Logkeeping, Operations Turnover, Operations Aspects of Facility Chemistry and Unique Processes, Required Reading, Timely Orders to Operators, Operations Procedures, Operator Aid Postings and Equipment and Piping Labeling. Implementation of the Standing Orders helps to assure clarity, consistency, and a common purpose in the day-to-day activities.

6.1.2.4 Training

A training and qualification program exists to ensure that all operating personnel involved in treating wastewater are qualified and competent for their positions. The goal of the training and qualification program is to prepare personnel for the operations team and to continually improve the team's knowledge and capabilities. The program consists of two major elements. An initial training program leads to operator qualification in wastewater treatment facilities. A continuing training program provides a means to update team members on changes to regulations, equipment, and procedures as well as information and exercises to improve understanding and performance. Along with the in-house training programs, the operators and supervisors of the wastewater systems affirm their competence through the requirement that they possess a Class I (or higher) Wastewater Operator's license.

6.1.2.5 Self-Assessments

Verification that personnel are operating according to the SOPs is accomplished through self-assessments and audits. Self-assessments are performed on a regular basis to ensure that the SOPs accurately reflect current operating conditions and to ensure that operations personnel are following the SOPs. Independent audits are performed to ensure that all activities in the wastewater treatment facilities are performed in accordance with internal and external requirements. The results of the self-assessments and audits are used to revise and update procedures and to improve performance of activities involved in wastewater treatment.

6.1.2.6 Oversight

In general, a much greater level of controls and oversight exists in government work than that found in the private sector. In-depth safety review and analysis, job-specific health-and-safety plans and procedures, execution of internally generated permits, and careful reliance on personal protective equipment are used to help reduce employee exposures to risks, to levels as low as reasonably achievable. This level of control requires formal, written documentation, analysis, and justification, lengthier authorization and approval chains, and a greater need to create and to ensure strict adherence to fixed rules and procedures.

6.2 WELL PERFORMANCE MONITORING AND MAINTENANCE

This section describes the key performance monitoring and maintenance guidelines for the recovery well systems. To complete the aquifer restoration within the accelerated schedule, a high level of onstream

time at the modeled pumping rates, is needed for each individual well. Some well downtime is expected and can be accommodated (see Figure 5-7). However, lengthy outages can adversely impact the planned goals. An upgraded well maintenance program was recently developed to address this issue. More frequent component preventive maintenance checks along with periodic formal performance testing and well chlorination were identified as major program elements to improve well operating efficiency. The following sections provide a description of the highlights of the planned well maintenance program that is detailed in Appendix A.

6.2.1 Operational Monitoring and Performance Testing

The main system performance indicators for the wells will be gathered and summarized using formal performance tests monitor the recovery well specific capacity and the pump/motor assembly performance. The test results will be used to determine the need for well redevelopment or pump/motor rebuilding. The information will help to minimize unscheduled, unplanned emergency maintenance and will help to shorten the duration of well outages. System operating parameters that will be routinely monitored include: 1) water level - static and pumping, 2) flow, 3) discharge pressure, and 4) motor amperage draw.

Water level, both static and pumping, will be measured daily to detect significant changes. The drawdown from static water level to the pumping water level, compared to historical drawdown for an individual well, is an indication of the degree of fouling of the well screen and the surrounding formation. The vertical placement of the recovery well pump/motor assemblies is fixed, based upon an anticipated worst-case drawdown that is below the seasonal low-static water levels. While each pump setting has some added submergence to be conservative, pumping levels need to be routinely monitored in order to ensure that adequate pump/motor submergence is maintained and to prevent severe component damage. Each recovery well has an installed pressure transducer that can be linked to an automated data logger. These pressure transducers are located approximately one foot above the pump bowl assembly, well above the required minimum submergence for the pump intake. As long as the pumping water level is maintained above the transducer, adequate pump intake submergence is assured. If the pumping water level above the pressure transducer approaches zero head (i.e., begins to approach the still acceptable level of one foot above the bowl assembly), well/screen maintenance actions will be taken.

Performance testing of the wells is anticipated to require an outage of approximately eight hours each. Until an adequate historical database is developed, the testing is planned to be conducted for each well on a quarterly basis. It is planned to measure static water level, then pump flow, discharge pressure, pumping water level, and motor amperage for at least five different flow rates for each performance test of a well.

23 The results of the performance measurements will be used to determine the condition of the pump/motor and of the well. The flow and discharge head will be plotted and compared to the manufacturer's pump curve and to previously developed head/flow curves. The amperage draw of the well's pump motor at various flows will also be compared to previous readings and pump/motor manufacturer published information. The static water level and pumping levels will be used to calculate drawdown and specific capacity (flow rate divided by drawdown) within the recovery well at various flows. As fouling and encrustation of the well progresses, drawdown within the well will increase for a given flow rate (the specific capacity will decrease). The need for well screen maintenance activities will be triggered by excessive drawdown. Maintenance work will be planned, scheduled, and performed to avoid costly damage to equipment such as the recovery well pump/motor assembly and to avoid lengthy unplanned outages.

6.2.2 Routine Well/Screen Maintenance

Well/screen routine maintenance is required to maximize system overall onstream time and to minimize recovery well drawdown and the need for major rehabilitation. The recovery wells will be superchlorinated by the addition of sodium hypochlorite (an industrial strength bleach with 12½ percent available chlorine is planned to be used). This is a common practice in the well water supply industry. The chlorination will serve to deter bacteria growth and buildup on the screen and in the local formation and will serve to increase long term well production. The procedure will be performed on each well on a scheduled basis or when pumping drawdown exceeds eight feet. It is anticipated to require an outage of 24 to 48 hours for each recovery well. Until a baseline is established, routine well superchlorination will be performed on a quarterly basis. It is anticipated that periodic, major rehabilitation efforts will be required every few years, when the drawdown within the well becomes excessive and the superchlorination procedure is not adequately effective.

24 The basic procedure includes well shutdown, removal of the pitless adapter cover, feed of a calculated quantity of sodium hypochlorite, well surging by pump stop and start, and a hold time to allow the sodium hypochlorite to react and dissipate. The hypochlorite quantity will be calculated to yield about 2000 to 3000 milligrams per liter (mg/l) available chlorine in the volume of water within the well screen assembly (between the static water level and bottom of the well screen). The reaction/dissipation time will be 24 to 48 hours during which the free chlorine residual is expected to fall to acceptable limits. It is anticipated that the water initially pumped from a superchlorinated well will contain turbidity and scale. The water quality of this discharge will be documented and controlled through the internal procedure for discharge of miscellaneous wastewater sources to treatment systems. Sampling and analysis of this water will be performed in order to document its turbidity and chlorine content. Adequate dilution of this stream is anticipated by other water sources so that turbidity should not affect outfall limits for Total Suspended Solids. If after superchlorination, the drawdown remains excessive, more extensive rehabilitation efforts will be required.

6.3 TREATMENT FACILITIES PERFORMANCE MONITORING AND MAINTENANCE

This section describes the key performance monitoring parameters and maintenance needs for the wastewater treatment systems and their ancillary facilities. Meeting the FEMP effluent discharge uranium limit of 20 ppb on a monthly average basis, within the accelerated schedule, is an ambitious undertaking. The experience that has been gained in operating the various FEMP systems provides an increased confidence level that the limit may routinely be met. Round-the-clock vigilance and wise decision-making will be needed to ensure compliance.

6.3.1 Treatment Facilities Performance Monitoring

All of the FEMP's wastewater treatment systems use strong base-anion exchange as the final unit process for uranium removal. The strong base-anion exchange resins have a very strong affinity for the uranyl carbonates in the FEMP's wastewater. The technology is reliable; however, treatment to the effluent levels required at the FEMP (i.e., < 20 ppb) is not widely practiced in wastewater systems. An expected performance of the various FEMP treatment systems has been used in this plan to demonstrate the ability to meet the ROD effluent requirements. The performance expectations are, for the most part, based on historical FEMP operating experience, as opposed to vendor performance guarantees or widely published data.

The commissioning of the AWWT Phases I and II in January 1995 provided treatment for the wastewaters most highly contaminated with uranium. Each FEMP treatment system has routinely reduced uranium concentrations by more than 90 percent and has reduced the total mass of uranium discharged to the Great Miami River. The total uranium discharged to the Great Miami River for the past five calendar years is as follows:

YEAR	URANIUM LBS. DISCHARGED
1992	975
1993	1044
1994	773
1995	393
1996	275

Treatment system operating records from 1996 showed uranium removal of almost 94 percent with a total of 1483 pounds of uranium removed. The 275 pounds discharged in 1996 includes about 175 pounds of untreated South Plume Groundwater, Sewage Treatment Plant outlet, and SWRB wastewater pumped to the Great Miami River during periods of heavy rainfall. The ROD limitation of 600 pounds uranium per year was met in 1996 with only 275 pounds being discharged to the river.

The treatment system data shows a gradual improvement in limiting uranium discharge. The most significant improvements to the AWWT operation were redesign and installation of the ion exchange outlet strainers and the replacement of multi-tubular filters with multi-media filters. The effluent discharge goal of a monthly average of 20 ppb total uranium was first met in August 1996 (with an average of 16 ppb). The limit was also met in October and November 1996 with an average of 14 ppb for each month. Using treatment bypass days, as described in the Operable Unit 5 ROD and as further detailed in Section 3.6.2, the limit was met in the first five months of 1997. There were six calendar days in those months when some of the water stored in the SWRB had to be pumped directly to the river, bypassing the treatment systems, due to heavy rainfall quantities that would have led to an overflow of the SWRB. Five of the six calendar days were used in calculating the monthly averages. The results for 1997 (with the quantities from "bypass days" deleted from the calculations) are shown below:

1997 (MONTH)	AVG URANIUM DISCHARGED (ppb)	
January	19	(One treatment bypass day)
February	15	
March	20	(Two treatment bypass days)
April	15	
May	18	(Three bypass days, two days used

The Operable Unit 5 ROD limitation of a 20 ppb monthly average effluent uranium will become effective in 1998. The FEMP has been able to routinely comply with that requirement, except under unusual operating conditions.

Measurable parameters for the FEMP treatment systems are the total volume of water treated, the influent and effluent uranium concentrations and mass, and the total mass of uranium removed by treatment. The FEMP total effluent flow rate is metered. Flow weighted composite samples of the effluent are analyzed daily for total uranium. Those two parameters are used to measure compliance with the Operable Unit 5 ROD requirements for uranium discharge in the FEMP's effluent. Additionally, each individual wastewater treatment train has flow measurement and control. The individual AWWT treatment systems are also routinely sampled at strategic process locations, including the inlet and outlet of each ion exchange vessel. Those samples are analyzed for total uranium three times per day (on each operating shift). The sample results and treatment flow rates are reported, tracked, and used to determine the need for troubleshooting, process adjustments, and corrective actions. A daily summary sheet of all aquifer restoration and wastewater process data, including individual well and treatment system total flows and treatment train uranium inlet and outlet concentrations, is published and distributed to the project's management and technical staff. All of the routine uranium analytical work is conducted in a laboratory located within the AWWT area in Building 51.

The most significant historical operating problem with the FEMP treatment systems has been fouling of the ion-exchange resin with particulate materials. To achieve the required ion-exchange performance, good flow distribution and adequate contact time between the resins and wastewater is needed. Plug flow (equal flow velocities) throughout the resin bed with enough (normally at least two minutes) empty bed contact time is the ideal. Resin fouling with various suspended materials can lead to flow channeling

(varying localized flow zones) and inadequate resin contact. The result is an increased leakage of the contaminant (a greater concentration in the exchanger outlet). The pressure drop across an ion-exchange unit provides some indication of the degree of gross fouling. Inlet and outlet pressures are monitored and differential pressure is used as a benchmark to determine the need to take a unit off-line and to clean the resin by backwashing. Troubleshooting an inadequately performing ion-exchange unit requires some judgment. The FEMP system operating deficiencies due to fouling were initially identified through operating experience and ion-exchange unit inspection and sampling. The use of multimedia filters upstream of the ion-exchange units has provided much more consistent performance and longer service cycles. The recent installation of multimedia filters at AWWT Phases I and II has led to improved bottom line uranium discharge performance and a greatly increased throughput capability.

Although there have been overall improvements and the recent performance has been favorable, the long-term ability to meet the 20 ppb monthly average limit remains unproven. There is no real-time uranium analysis in this system, nor are there proven, commercially available, cost-effective units. The ion-exchange unit performance has been slightly erratic and somewhat unpredictable, most likely due to varying degrees of resin bed fouling. The available indicator of fouling (ion-exchange unit pressure drop) does not directly mathematically correlate with uranium removal capability. A management system involving timely sampling, analysis, and response has been implemented as a primary means of ensuring compliance.

6.3.2 Treatment Facilities Maintenance Practices

The treatment systems have been constructed with adequate installed spare equipment (e.g., spare pumps, multimedia filters, and ion exchangers) and with some alternate piping and valving configurations to minimize unscheduled outages. This redundancy helps to allow a treatment system to remain on line, even when a major component requires maintenance work. There are installed spare pumps to move the wastewater through each of the treatment systems. If an individual pump needs to be shut down (due a failure or to investigate unusual conditions), the installed spare pump may be started and the treatment system kept on line. All of the existing ion-exchange trains include three vessels (two are operated in series while the third is an installed spare). If an individual ion-exchange unit needs to go off line (for maintenance, resin replacement, backwash, regeneration, inspection, etc.), the spare unit may be brought on line. The multimedia filter systems also include an additional filter allowing for off-line activities (similar to those of the ion-exchange vessels) enabling the treatment systems to stay on line

at no loss in processing rate. The filtration systems (multi-media and activated carbon) are operated with multiple units in parallel flow. Even when a spare unit is unavailable, a filter shutdown leads to a reduction in throughput (not a complete system shutdown). The treatment systems also have piping bypasses around flow meters and control valves allowing for continued system operations, using manual means, during maintenance activities.

The AWWT expansion project has been designed with only two ion exchange units per train. Normally, both units in a train would operate in series. For short duration shutdowns of a single vessel (for example, backwashing, resin regeneration, minor maintenance, etc.) flow will be routed through one ion exchanger only. Longer duration outages of a single vessel may necessitate specific well shutdowns, depending on the overall system performance and on the performance of the affected train. The two vessel per train configuration was selected during the project's design to provide a higher total system capacity and better equipment utilization within the remaining serviceable space in Building 51.

As described above, much of the routine preventive maintenance and repair work in the treatment systems can be accomplished without a unit shutdown, because of the installed spare equipment and bypass piping and valving. There are some planned maintenance activities that will result in treatment system outages. Current plans include an annual one-to-two-week shut down of the AWWT facilities to accommodate thorough tank inspections, cleanouts, and repairs. Those maintenance shutdowns will be scheduled (as much as can be made practical) during periods of expected low rainfall, and low SWRB and BSL storage levels. That strategy will minimize the possibility that storm or remediation wastewaters could be discharged untreated. The Operable Unit 5 ROD provides for relief allowances from the effluent discharge limit of a monthly average of 20 ppb uranium concentration during periods of treatment plant scheduled maintenance. Decisions regarding well operations during treatment plant scheduled maintenance will be made on a case-by-case basis. For planned maintenance shutdowns, advance EPA approval will be obtained for relief allowances that may be requested.

Some breakdowns will lead to system shutdowns. Loss of utilities or a failure in the AWWT DCS would result in a system shutdown. All treatment systems will fail safely on loss of a utility or a major component and are not very complicated to restart. Spare parts inventories follow the original equipment manufacturer's recommendations and a corps of experienced, skilled craftsmen are available for emergency repairs in the treatment systems. A review of previous FEMP wastewater treatment system

outages due to equipment breakdown and a discussion of potential failures in those systems was held among the project's technical staff. No expected breakdown that should lead to a loss of treatment capability for longer than a few days was identified.

7.0 ORGANIZATIONAL ROLES, RESPONSIBILITIES, AND COMMUNICATIONS

This section presents the organizational roles and responsibilities with respect to implementation of this OMMP. Also presented are information needs and communications protocol for coordination with other FEMP project organizations outside the ARWWP and interaction with the EPA and OEPA.

7.1 ORGANIZATION ROLES AND RESPONSIBILITIES

7.1.1 DOE FEMP

The DOE Operable Unit 5 Team Leader is responsible for providing direction and oversight of all activities within the ARWWP.

7.1.2 Operating Contractor

Fluor Daniel Fernald (FDF), previously called Fernald Environmental Restoration Management Corporation (FERMCO), is the operating contractor for the FEMP. The ARWWP is one of several within the Soil & Water Projects Division which includes all projects covering the Operable Unit 1, 2, and 5 scopes of work. Hence, overall management authority and responsibility resides with the Soil & Water Projects Division Vice President, who reports directly to the Office of the President.

The ARWWP Manager, who reports directly to the SWP Vice President, has oversight authority and responsibility for the ARWWP. The following functional groups report directly to the ARWWP Manager:

- Engineering/Construction
- Operations
- Safety and Health
- Controls and Administration
- Hydrogeology.

The ARWWP Engineering/Construction Team is responsible for all engineering design and construction activities within the project which includes:

- Engineering functional requirements, design basis and detailed design drawings and documents
- Title III engineering support during construction

- Start-up Plans, System Operability Test procedures and supervise tests
- Standard Start-up Review Plans and coordinate resolution of issues
- Technical support to Operations
- Coordination of project-specific activities associated with procurement and management of construction contractors.

The ARWWP Operations Team is responsible for all operations and maintenance activities within the project which includes:

- Operations of groundwater extraction and injection well systems
- Operation of all site wastewater treatment systems and their ancillary facilities
- Estimate, plan, and execute corrective and preventative maintenance
- Training and qualification of operators and supervisors
- Develop, review and revise Standard Operating Procedures
- Sampling and analysis of process streams for compliance with operational parameters and established regulatory limits.

The ARWWP Safety and Health Team is responsible for all Safety and Health activities within the project which includes:

- Development and revision of Safety and Health Project matrixes for operations and construction
- Radiological monitoring of activities
- Industrial health monitoring of activities
- Oversight of construction and operations safety programs
- Safety design reviews and technical input.

The ARWWP Controls and Administration Team is responsible for:

- Project cost and schedule baseline development and maintenance
- Monthly performance and variance reporting to DOE
- Estimate at completion funding analysis and reporting
- Change proposal and cost savings coordination
- Project Quality Assurance oversight.

The ARWWP Hydrogeology Team is responsible for all aquifer restoration planning and environmental monitoring/reporting activities within the project which includes:

- Developing and maintaining the aquifer restoration strategy
- Developing and implementing remedy performance groundwater monitoring, data evaluation, and reporting
- Technical input to management on recovery well operation and maintenance
- Fulfilling site NPDES reporting requirements
- Technical input to design and construction of site groundwater extraction/injection systems
- Analysis of state and federal regulations to identify project-specific regulatory requirements
- Preparation of required CERCLA documentation (e.g., RA Work Plan, Start-up Monitoring PSPs, IEMP groundwater section, and various other required reports).

7.2 INTEGRATION WITH OTHER PROJECT ORGANIZATIONS

To better serve the needs of the various remediation projects over the span of the remediation effort, a Wastewater Integration Committee (WWIC) was formed in Fall 1996. The committee consists of ARWWP personnel and representatives from each of the individual remediation projects. Specific objectives, responsibilities, activities, and composition of the committee are defined in the WWIC Charter. The committee has an overall objective of implementing a consistent and integrated project approach for identifying and prioritizing issues related to treating project wastewater and recommending appropriate and timely resolutions. Wastewater Acceptance Guidelines have been developed to assist the FEMP remediation projects in identifying wastewater issues and concerns. Primary responsibilities and activities of the WWIC include: 1) working with the projects to obtain best estimates of water quality and quantity data, 2) applying the guidelines to these estimates to identify areas of concern, and 3) interfacing with the projects to develop an awareness of the functions and capabilities of existing and planned site-wide water treatment facilities and handling operations.

Inter-Project Communication Protocol

Inter-Project wastewater integration issues are identified through discussions of the WWIC. Each of the identified issues are written up and condensed into a descriptive paragraph as shown in Figure 7-1.

The issue is then classified as either a validated concern or a potential concern requiring additional investigation to determine whether it is a valid concern. A resolution to each validated concern is developed. After the resolution is determined, a summary sheet is developed by the WWIC as shown on Figure 7-1. This sheet is then sent to the appropriate Project Liaison for concurrence. This process to date has proved to be very effective and will continue to be used as the inter-project communications/documentation tool.

7.3 REGULATORY AGENCY INTERACTION

Interaction with EPA and Ohio EPA regarding this OMMP occurs initially, during the review and comment resolution process. Future versions of the OMMP will also be submitted for review and will go through a review and comment resolution process similar to this initial submittal. As noted in Sections 1.0 and 3.0, the IEMP (DOE 1997b) provides for the collection and reporting of groundwater remedy performance (IEMP Section 3.0) and treated effluent (IEMP Section 4.0) information that will support operational decisions regarding groundwater restoration and water treatment. The current plan is that wellfield and treatment operational summaries would be included as part of the IEMP quarterly and annual reports. These summaries will allow for agency input as aquifer restoration and water treatment progress. In addition the NPDES and Federal Facilities Compliance Agreement reporting will continue as outlined in Section 4 of the IEMP. The Operable Unit 5 ROD required notifications of storm water bypasses of the SWRB to continue at the stipulated times.

FIGURE 7-1
WASTEWATER INTEGRATION ISSUE IDENTIFICATION/RESOLUTION SHEET - SAMPLE

A.2 Chloride Concentrations in Wastewater Generated From the Remediation of the Waste Pits

Classification: Issue - 1

Description:
Chloride concentrations in WPRAP's combined wastewater from the Clearwell (Stream 13) is expected to average 4018 ppm, and would pose a corrosion problem for the steel components of AWWT piping and conveyance systems. The source of chloride in Stream #13 is Pit Excavation Water (Stream #108) that could be as high as 23,000 ppm during the remediation of Pit 3. Combined process wastewater (Stream #16) that will be discharged from the Collection Tank to the Surge Lagoon for treatment in AWWT Phase II is projected by WPRAP to average 529 ppm Cl. But, the concentration could be as high as 23,000 ppm Cl from Pit Drainage Water (Stream #201) during Pit 3 remediation. Consolidating both Streams #13 and #16 in the Surge Lagoon would result in an average concentration of 2,495 ppm Cl @ 150 gpm, assuming good blending, that would exceed by five time the Waste Acceptance Guideline (WAG) established by the Wastewater Integration Committee (WWIC). Further, the Surge Lagoon is not a blending basin and intermittent concentration surges should be expected from the short-circuiting of flows in and out of the basin. Chloride concentrations exceeding the WAG-based threshold of 500 ppm, chloride slowly attacks welds, valves, pump impellers, and other stress points that can lead to eventual failure of system components even at ordinary temperatures.

Resolution:
The WPRAP commits to isolating wastewater source streams having higher concentrations for pretreatment or sidestream blending to 500 ppm Cl by the ARASA subcontractor prior to discharge to the Surge Lagoon.

Project Concurrence: _____ Date: _____
WPRAP Representative

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APPENDIX A

SOUTH PLUME PERFORMANCE MONITORING AND MAINTENANCE PLAN

SOUTH PLUME PERFORMANCE MONITORING AND MAINTENANCE PLAN FOR OPERABLE UNIT 5

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

JUNE 1997

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

53300-PL-0001
REV. A
DRAFT

SOUTH PLUME PERFORMANCE MONITORING AND MAINTENANCE PLAN FOR OPERABLE UNIT 5

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

JUNE 1997

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

DRAFT

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FIGURES

Figure 1	South Plume Recovery Well, Typical Installation Details

1.0 INTRODUCTION

The objective of this Performance Monitoring and Maintenance Plan (PMMP) for the South Plume Recovery Wellfield system is to document planned maintenance and monitoring requirements to support successful long-term operation of the system. The activities described within this document will become the basis for providing routine maintenance of the recovery well system and for monitoring system performance to determine if more extensive maintenance activities are required. Regularly scheduled maintenance of components of the recovery well system is required so that the difficulties associated with continuous operation will be minimized and thus manageable with the resulting system's online time maximized. Continuous operation of this recovery well system, within practical limitations, is required to maintain desired capture of the South Plume.

2.0 RECOVERY WELL SYSTEM DESCRIPTION

The South Plume Recovery Wellfield system consists of five groundwater extraction wells connected in parallel to a common discharge header. At this time, four of the five recovery wells are in service. These include Recovery Wells 1, 2, 3, and 4. Recovery Well 5 was taken out of service in 1995 because it was not required to maintain capture of the contamination plume. All five of the recovery wells were installed to a bottom elevation of approximately 475 feet above mean sea level. Recovery Wells 1, 2, 3 and 4 are screened in the bottom 40 feet. Recovery Well 5 is screened in the bottom 35 feet. Each recovery well is of different depth, depending upon the surface elevation at the specific location.

All of the recovery wells in service have submersible pump/motor assemblies. Each includes a pitless adapter that transitions the vertical drop pipe to the underground pipe that leads to underground valve pits. The design of each well's instrumentation and controls are identical; flow is controlled by a flow control loop consisting of a flow element (meter), flow totalizer, flow controller, and a flow-control valve. The flow meter and flow-control valve are located underground in valve pits located near each wellhead, while the totalizer and controller are located in a central control building. The valve pits also contain isolation valves, check valves, air releases, and instrumentation. The desired flow set point for each recovery well is entered into an individual controller in the control building. This value is compared continuously to the actual flow measured by the flow meter. When required, the controller adjusts the control valve to maintain the desired flow. The flow totalizer simply integrates the instantaneous flows over time to keep track of the cumulative number of gallons pumped from each well. Pump "start" and "stop" is controlled at a panel located at the well head; it is not remotely monitored or controlled.

In addition, each recovery well has been equipped with an installed pressure transducer that allows the water level within the recovery well to be monitored. This pressure transducer terminates at the wellhead and can be connected by cable to a Hermit data logger. (See Section 5.3.1 for additional details regarding pressure transducer data collection and review).

Well-specific information is presented in the following sections. Typical installation details are shown in Figure 1.

2.1 RECOVERY WELL 1 (Well Number 3924)

Recovery Well 1 was installed in July 1993 with a total depth of 55 feet. The lower 40 feet of this well is screened with stainless steel, wire wrapped, .075-inch slot size screen, set between the 15 and 55 foot depth. Original casing and screen size for this recovery well is 12 inches (pipe size).

In the summer 1995, a failure of the original screen was detected that allowed filter pack and formation materials to enter the recovery well. This problem was corrected by telescoping 40 feet of new 10-inch (pipe size) diameter well screen inside of the existing screen after the well was purged of filter pack and formation materials.

The pump/motor assembly currently installed in Recovery Well 1 is a National M8HC-7 stage bowl assembly with a Pleuger 30 horsepower (HP) motor. This pump is rated at 300 gallons per minute (gpm) at 260 feet of total dynamic head. The manufacturer has stated that this pump/motor assembly can be operated safely within a range of 250 to 500 gpm without damage to the assembly. This pump/motor assembly is currently installed with a shroud to aid in motor cooling. Removal of the shroud and raising the pump/motor assembly to maximize flow past the motor is being scheduled.

2.2 RECOVERY WELL 2 (Well Number 3925)

Recovery Well 2 was installed in July 1993 with a total depth of 65 feet. The lower 40 feet of this well is screened with stainless steel, wire wrapped, .075-inch slot size screen, set between the 25 and 65-foot depth. Casing and screen size for this recovery well is 12 inches (pipe size).

In February 1997, a failure of the original screen was detected during well maintenance activities. This hole allowed filter pack and formation materials to enter the recovery well. This problem was corrected by telescoping 40 feet of new 12-inch (telescope size) well screen inside of the existing screen after well maintenance activities were completed.

The pump/motor assembly currently installed in Recovery Well 2 is a Byron Jackson MQH-8 stage bowl assembly with a 30 HP motor. This pump is rated 300 gpm at 260 feet of total dynamic head. No shroud or other flow-enhancing devices are currently installed or required as this pump/motor assembly is self cooling and does not require flow past the motor to ensure cooling.

2.3 RECOVERY WELL 3 (Well Number 3926)

Recovery Well 3 was installed in July 1993 at a total depth of 109 feet. The lower 40 feet of this recovery well is screened with stainless-steel, wire-wrapped, .075-inch slot size screen set between the 69 and 109 foot depth.

In the summer 1995, a failure of the original screen was detected that allowed filter pack and formation materials to enter the recovery well. This problem was corrected by telescoping 40 feet of new 10-inch (pipe size) diameter well screen inside of the existing screen after the well was purged of filter pack and formation materials.

The pump/motor assembly currently installed in Recovery Well 3 is a National M8HC-7 stage bowl assembly with a Pleuger 30 HP motor. This pump is rated 300 gpm at 260 feet of total dynamic head. The manufacturer has stated that this pump/motor assembly can be operated safely within a range of 250 to 500 gpm without damage to the assembly. No shroud or other flow-enhancing devices are currently installed to aid in motor cooling. However, the pump suction/intake has been raised as high within the screen as practical to maximize flow past the motor and optimize cooling.

2.4 RECOVERY WELL 4 (Well Number 3927)

Recovery Well 4 was installed in April 1993 with a total depth of 114 feet. The lower 40 feet of this well is screened with stainless-steel, wire-wrapped, .050-inch slot size screen, set between the 74 and 114-foot depth. Casing and screen size for this recovery well is 16 inches (pipe size); however, the pitless adaptor at the top of the recovery well is 12 inches. This is significant in that the inside diameter of the pitless adaptor limits the size of tools and equipment that can be used in this well.

The pump/motor assembly currently installed in recovery Well 4 is a Gould's 10IHC-5 stage bowl assembly with a Hitachi 40 HP motor. This pump is rated 300 gpm at 260 feet of total dynamic head. The manufacturer has stated that this pump/motor assembly can be operated safely within a range of 125 to 500 gpm without damage to the assembly. No shroud or other flow-enhancing devices are currently installed to aid in motor cooling. After rehabilitation of all recovery wells is completed, the pump suction/intake will be raised as high within the screen as practical.

2.5 RECOVERY WELL 5 (Well Number 3928)

Recovery Well 5 is not in service currently. It has been determined to be unnecessary for plume capture.

Recovery Well 5 was installed in August 1993 at a total depth of 113 feet. The lower 35 feet of this recovery well is screened with stainless-steel, wire-wrapped, .075-inch slot size screen set between the 78 and 113 foot depth.

In the summer 1994, a failure of the original screen was detected that allowed filter pack and formation materials to enter the recovery well. This failure remains and the recovery well is not in service at this time.

No pump/motor assembly is currently installed in Recovery Well 5.

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3.0 FACTORS AFFECTING SYSTEM OPERATION

The South Plume Recovery Well System began pumping operations in August 1993, as part of the implementation of Operable Unit 5 Removal Action No. 3, South Plume Removal Action. In the intervening time period, Fluor Daniel Fernald (FDF) has obtained valuable operational experience and knowledge that is being used to optimize long-term operation of the system. This experience base has resulted in identification of factors affecting operation life and efficiency, some of which were unknown at the start of pumping operations. These factors have either already been addressed or are incorporated into this plan.

In order to understand better the factors affecting large-scale groundwater pumping operations, FEMP consulted with Moody's of Dayton, a water well maintenance and installation contractor. Moody's has served the water well industry throughout the Great Miami Aquifer for more than 30 years and has extensive experience maintaining large-capacity wells for a number of major water supply systems. Frequencies for routine maintenance and monitoring activities were selected using input received from their evaluation of the South Plume Recovery Well system and based on their experience working with systems of similar magnitude in the regional aquifer.

Several factors affect the performance of the recovery wells. In addition, a number of other specific requirements of this particular system complicate these factors. All of these factors and requirements were considered in developing this maintenance and monitoring plan. First, the South Plume Recovery Wellfield system is placed in and is extracting water from the upper most portions of the Great Miami Aquifer. This fact complicates both pump/motor cooling and iron fouling of the recovery well screen. Normal water well practice would place the screened section of the well deeply in the aquifer and the pump/motor assembly would be placed above the screen in a submerged section of blank casing. Since the South Plume wells were intended to intercept a plume of contamination located near the top of the aquifer, the screened sections begin at, or slightly above, the normal water level. In order to provide the required submergence of the pump/motor assembly, this assembly must be placed within the screened section. The high flow rates required for plume capture combined with the "surgical" removal of the contamination plume has led to difficulties in ensuring that the flow of water passing the motor is adequate for cooling.

Placement of the pump/motor assembly within a screen that is located on the surface of the aquifer also complicates the impacts of iron-fouling. Moody's has confirmed that iron fouling is problematic throughout the regional aquifer and that the details of the FEMP installation further enhance the problem. Combined with the fact that this region of the Great Miami Aquifer contains some of the highest concentrations of iron and iron-fouling bacteria, fouling of the well screens and other downstream equipment has been experienced. (See Section 4.0 for additional information.)

Continuous operation of the well recovery wells also exacerbates the factors noted above. Normal water well industry practice does not require pumping wells to operate continuously. Typical water supply well systems pump between 6 and 10 hours per day and have spare wells that can be rotated in and out as demand requires (especially when maintenance is required). The South Plume Recovery Wellfield system, on the other hand, runs continuously and has no spare wells to compensate for wells taken out of service for maintenance. In fact, when a well goes down for maintenance, the remaining wells must increase their flow to continue the scheduled capture of the plume.

4.0 OPERATIONAL PROBLEMS ENCOUNTERED AND CORRECTIVE ACTIONS

Throughout the operational life of the South Plume Recovery Wellfield, three recurrent factors have caused system outages. These outages have demonstrated the need to maintain an adequate spare parts inventory so that system downtime is minimized. Many corrections have been implemented and the impact of others will be minimized by the implementation of this maintenance and monitoring program. The following sections provide details of the major causes of past outages and those actions that have been taken or will be taken to minimize their impact on system performance.

4.1 IRON FOULING

Fouling of system components, including well screen, control valves, flow meters and check valves, is exacerbated by the FEMP's specific installation design details and pumping objectives, as detailed in Section 2.0.

Iron-fouling bacteria has been identified as responsible for the encrustation of recovery well screens to the degree that extensive rehabilitation efforts were required. (See Appendix A.) It is anticipated that this degree of rehabilitation can be avoided through the routine superchlorination maintenance detailed in Section 5.1.

Iron fouling also has caused operational problems associated with the flow control of the recovery well system. Both flow meters and flow control valves have been affected. Flow meters have been fouled repeatedly by bacterial growth on the flow-sensing elements. The routine cleaning and calibration of flow meters specified in Section 5.2 of this plan are intended to minimize outages caused by fouled flow meters. These meters are also planned to be replaced with magnetic-type flow meters that do not require a flow-sensing element to protrude into the flow stream. This upgrade will be made as part of the South Plume Optimization Project.

Similar fouling has occurred with the flow control valves. The existing control valves rely upon water pressure in the line to position the valve body. This line pressure is transmitted to a diaphragm via a small-diameter tubing that is prone to plugging. Again, the routine maintenance specified in Section 5.2 of this plan is intended to minimize outages. Also, these flow control valves will be replaced with motor-actuated valves as part of the South Plume Optimization Project.

Check valves have been similarly fouled by iron bacteria, and in one specific instance, failed to operate when a well was turned off. The routine inspection and cleaning of the check valves as specified in Section 5.2 is intended to prevent this in the future.

4.2 MOTOR COOLING

The existing pump/motor assemblies installed in Recovery Wells 1, 3, and 4 require flow past the motor to ensure cooling of the motors. The pump/motor assembly installed in Recovery Well 2 has been replaced with a self cooling assembly. Since the screened portions of the well are set immediately below the water table, this requires the pump/motor assembly to be set within the screened section. In the original installation, pump/motor assemblies were set at the bottom of the recovery wells, thus providing little, if any, flow past the motor for cooling. This lack of flow past the motor caused several motor failures and led to subsequent motor manufacturers requiring that flow inducers (shrouds) or cooling lines (recirculation tubes) be installed on pump/motor assemblies to ensure adequate flow past the motor. However, the shrouds and cooling lines caused additional complications. The shrouds increased the overall diameter of the assembly and, because of the tight fit within the screen, restricted the extraction of groundwater from sections of screen that were below the shroud. The cooling lines in several cases failed and fell off of the pump/motor assembly and in one case was directly traced to a hole in the screen.

The FEMP evaluated the relative benefits of adding the cooling modifications against the relative risks to the system, concluding that the external cooling modifications should be abandoned. In order to maximize the ability of the pump/motor assembly to cool itself, it was decided to raise the pump intake setting as high as possible, while maintaining adequate submergence allowing for seasonal water level fluctuations and limited drawdown within the well. The pump intake settings currently are being raised to the levels shown in Figure 1. This setting was determined by considering the lowest seasonal groundwater elevation, adding the required submergence for the pumps (2 feet), and adding an additional 10 feet for pumping drawdown within the well due to screen fouling. Raising the pump/motor assembly as high as possible ensures that the maximum amount of water will flow past the motor to provide cooling.

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The routine monitoring of water levels within the well, along with the quarterly performance testing that evaluates pumping drawdown, will be used to ensure that adequate submergence is maintained. Details of this monitoring are presented in Section 5.3.

The use of motors that do not require an external flow of water across the motor jacket to provide cooling is being evaluated also. A self-cooling pump/motor assembly has been procured and installed in Recovery Well 2. Based on its performance, similar assemblies may be procured for the other recovery wells.

4.3 ELECTRICAL SURGES

Numerous outages of the recovery well system have been attributed to damaged electrical components due to electrical surges that occur during lightning storms. It is important to note that electrical interference can result without a direct lightning strike to the impacted equipment. Surge suppressors have been installed on all recovery well flow-control loops and the associated power supply circuit to prevent damage from surges. Additionally, the suppressors will be tested routinely as specified in Section 5.3 to ensure that the suppressors are in working order.

The reasons for major system outages experienced to date and the resulting problems are summarized in Table 4-1. This table also summarizes the corrective actions for these problems that have been or will be taken to minimize downtimes caused by these problems as detailed in Section 5.0. Tables 4-2, 4-3, 4-4, 4-5, and 4-6 identify historical down-times (of 24 hours or more duration) of each well since start-up.

TABLE 4-1

CAUSES OF RECOVERY WELL OUTAGES AND CORRECTIVE/PREVENTATIVE ACTIONS

Reason for Outage	Result	Action(s)	
Iron Fouling	Well Screen Clogging	1.	Initial rehabilitation of well - See Appendix A.
		2.	Routine superchlorination maintenance - quarterly. See Section 5.1
		3.	Performance testing - quarterly. See Section 5.3.2
	Flow Meter Fouling	1.	Preventative maint. - clean and calibrate - every 6 mo. See Section 5.2
		2.	Operational checks - quarterly. See Section 5.2
		3.	Replace w/ magnetic flow meter as part of South Plume Optimization project.
	Flow-Control Valve Clogging	1.	Preventative maint. - clean tubing every 2 mo. and rebuild every 6 mo. See Section 5.2
		2.	Replace w/ motor controlled valve as part of South Plume Optimization project.
	Check Valve Sticking	1.	Previously added a redundant check valve to system.
		2.	Preventative maintenance - clean and inspect every 6 mo. See Section 5.2
Motor Cooling Requirements	Shrouds restrict flow into recovery well to a limited screen section; cooling/recirculation line failures have damaged well screens.	1.	Ancillary motor cooling devices are being removed.
		2.	Pump suction/intake elevation is being raised as high as possible to promote flow past motor.
		3.	The use of motors that do not require an external flow of water across motor jacket is being evaluated and tested.
Electrical Surges	Electrical components have been damaged repeated due to electrical surges during lightning storms in the area.	1.	Surge suppressors/lightning arrestors added to control circuits and power supplies.
		2.	Surge suppressors/lighting arrestors will be tested monthly. See Section 5.2

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TABLE 4-2
SUMMARY OF OPERATIONAL HISTORY FOR RECOVERY WELL 1 (3924)

Total Days from Aug. 27, 1993 to Dec. 31, 1996 = 1586
Total Days Operational = 1284
Total Days Well Not Operational = 302

Date of Interruption	Date Restored	Duration (Days)
7/27/94	1/13/95	170
1/1/95	1/13/95	13
2/23/95	3/5/95	11
3/23/95	3/24/95	2
9/9/95	9/18/95	10
10/11/95	10/17/95	7
10/22/95	10/24/95	3
1/27/96	2/4/96	9
4/19/96	4/23/96	5
5/24/96	5/28/96	5
5/31/96	6/5/96	6
6/23/96	7/1/96	9
7/7/96	7/11/96	5
7/19/96	7/23/96	5
8/9/96	8/9/96	1
8/16/96	8/28/96	13
9/2/96	9/6/96	5
11/13/96	11/20/96	8
12/7/96	12/9/96	3
1/10/97	1/13/97	4
2/7/97	2/10/97	4
2/17/97	2/17/97	1
4/29/97	4/30/97	2
5/29/97	5/29/97	1

TABLE 4-3
SUMMARY OF OPERATIONAL HISTORY FOR RECOVERY WELL 2 (3925)

Total Days from Aug. 27, 1993 to Dec. 31, 1996 = 1586
Total Days Operational = 1413
Total Days Well Not Operational = 173

Date of Interruption	Date Restored	Duration (Days)
2/4/94	2/6/94	3
1/1/95	1/7/95	7
1/13/95	1/21/95	9
1/13/95	1/24/95	11
9/9/95	9/18/95	10
10/11/95	10/17/95	7
10/18/95	10/22/95	5
2/1/96	2/4/96	4
5/24/96	5/28/96	5
6/23/96	6/28/96	6
7/19/96	7/23/96	5
8/9/96	8/13/96	5
8/16/96	8/28/96	13
9/2/96	9/6/96	5
1/20/97	4/12/97	50
5/1/97	5/27/97	28

TABLE 4-4
SUMMARY OF OPERATIONAL HISTORY FOR RECOVERY WELL 3 (3926)

Total Days from Aug. 27, 1993 to Dec. 31, 1996 = 1586
Total Days Operational = 1332
Total Days Well Not Operational = 254

Date of Interruption	Restored	Duration (Days)
12/30/94	1/17/95	19
1/1/95	1/19/95	19
5/17/95	5/17/95	1
9/9/95	9/25/95	17
10/19/95	10/25/95	7
5/1/96	11/17/96	151
1/10/97	1/13/97	4
4/11/97	4/23/97	13
5/6/97	5/28/97	23

TABLE 4-5
SUMMARY OF OPERATIONAL HISTORY FOR RECOVERY WELL 4 (3927)

Total Days from Aug. 27, 1993 to Dec. 31, 1996 = 1586
Total Days Operational = 1226
Total Days Well Not Operational = 360

Date of Interruption	Date Restored	Duration (Days)
6/4/94	1/5/95	213
1/1/95	1/7/95	7
2/13/95	2/22/95	10
4/5/95	4/11/95	7
8/2/95	8/3/95	2
9/9/95	9/18/95	10
10/22/95	10/25/95	4
4/4/96	4/8/96	5
4/25/96	4/30/96	6
6/4/96	6/6/96	3
6/23/96	6/28/96	6
7/19/96	7/22/96	4
8/9/96	8/9/96	1
9/2/96	9/6/96	5
11/21/96	1/18/97	60
1/1/97	1/8/97	8
1/10/97	1/13/97	4
1/21/97	1/21/97	1
2/5/97	2/6/97	2
2/16/97	2/17/97	2

TABLE 4-6
SUMMARY OF OPERATIONAL HISTORY FOR RECOVERY WELL 5 (3928)

Total Days from Aug. 27, 1993 to Dec. 31, 1996 = 1586
Total Days Operational = N/A
Total Days Well Not Operational = N/A

Date of Interruption	Date Restored	Duration (Days)
1/23/94	1/28/94	6
6/6/94	6/12/94	7
9/11/94	-	-

5.0 MAINTENANCE AND OPERATIONAL MONITORING

Several routine activities are performed to optimize system performance of the South Plume Recovery Wellfield. The following maintenance and operational monitoring activities are described in this section:

- Routine well/screen maintenance, which includes quarterly (at a minimum) superchlorination of the recovery well
- Routine system maintenance, which includes maintenance actions related to valves, instrumentation, and controls associated with each recovery well; this maintenance is performed by FDF Maintenance and Operations personnel
- Operational monitoring, which includes quarterly monitoring of recovery well capacity and pump/motor assembly performance.

5.1 MAINTENANCE OF THE WELL AND SCREEN

Well and screen maintenance is required to maximize system on-stream factors, and to minimize recovery well drawdown and major rehabilitation such as that described in Appendix A. The recovery well will be superchlorinated by the addition of sodium hypochlorite (12-1/2 percent chlorine). Moody's of Dayton recommended the following steps for superchlorination of the FEMP South Plume Recovery Wellfield. These steps will be performed on each well every three months, or more frequently if routine water-level monitoring indicates excessive drawdown. (See Section 5.3) This maintenance action is anticipated to require an outage of 48 hours per recovery well. It is acknowledged in this plan that periodic, major rehabilitation efforts (Appendix A describes rehabilitation scope and durations) may be required every few years or when the drawdown within the well remains consistently excessive, even after superchlorination maintenance. These rehabilitation efforts are not considered to be routine maintenance within the context of this plan.

The routine maintenance of the recovery well and screen involves superchlorination of the well without removal of the pump/motor. This will serve to deter iron-bacteria growth and buildup on the screen and in the local formation and will serve to enhance long-term well production. The basic steps are detailed below:

Step 1:

Shutdown the recovery well pump and allow the static water level to stabilize. Remove the pitless adaptor cover and connect the sodium hypochlorite delivery pump to the tubing installed through the pitless adaptor.

Step 2:

Inject sodium hypochlorite to obtain a 2,000 to 3,000 milligrams per liter (mg/L) concentration of chlorine. This will be determined for each well individually, based on the volume of water in the column pipe. The volume in each well is a function of the depth of water in each well and the diameter of the screen/casing.

Step 3:

Back surge the chlorinated water into the gravel pack and aquifer by starting the installed recovery well submersible pump and pumping until the water reaches the pitless adapter. Shut down the pump and open the sampling port at the well head to allow the water to backflow through the 6-inch drop pipe, pump, screen, and to dissipate into the gravel pack. Repeat this procedure for two hours with approximately five minutes between surges. Allow chlorine to remain in well for 36 hours.

Step 4:

Discharge water by pumping into force main. (Note: The FEMP facility owner and Environmental Compliance must be notified prior to discharge of these waters.) This water will be sampled and analyzed to document its turbidity, chlorine content, and pH. This sampling and analysis must be completed prior to discharging the bulk of the water within the well and will require that the main discharge valve be closed, the pump started, and samples taken from the sampling port at the well head.

5.2 MAINTENANCE OF PUMPS, PIPING, AND CONTROLS

These maintenance activities are directed primarily at the valves, instrumentation, and controls associated with each recovery well. These actions will be incorporated into the FDF Computerized Maintenance Management System (CMMS). This system provides automatic generation of preventative maintenance work orders to ensure that routine maintenance is performed when required. In addition to formal preventative maintenance activities, several routine system checks will be

performed by operations personnel, between scheduled preventative maintenance activities, to ensure that equipment is functioning properly.

The following is a list of preventative maintenance and operational checks that will be routinely performed:

Flow Totalizer: Annual Calibration

The annual calibration of the flow totalizer is anticipated to require an outage of four hours per recovery well.

Flow Controllers: Annual Calibration

The annual calibration of the flow controller is anticipated to require an outage of four hours per recovery well.

Flow Meters: Clean and Calibrate every six months

Cleaning and calibration of the flow meter is anticipated to require an outage of four hours per recovery well.

In addition to the cleaning and calibration of the flow meters, this critical system element is to be flow checked quarterly by operations personnel. This is anticipated to require an outage of two additional hours for each recovery well. The flow check of the flow meters installed at the discharge of each recovery well is performed by isolating flow from each individual well, routing this flow through an independent flow meter, and comparing the quantities to ensure that they are consistent. Additionally, the flow from each well is to be checked in a "no-flow" condition.

As these flow meters have historically been the source of numerous flow control problems, they are planned to be upgraded and replaced as part of the South Plume Optimization Project. The existing Vortex type flow meter will be replaced with a magnetic flow meter. The advantage is that the flow sensing element, which currently extends into the flow stream and quickly becomes encrusted with iron bacterial growth, will be eliminated and the replacement meter will not protrude into the flow stream.

Check Valves: Inspect and Clean Seat every six months

Inspection and cleaning of the check valve is anticipated to require an outage of four hours per recovery well.

The current piping configuration for each of the recovery wells includes two check valves. The second check valve was added to each subsystem as a redundant valve to ensure against possible failure of the original valve. Failure of the check valves could allow combined system effluent to be injected into a well if the well is shut down and not manually valved off. The original check valve cannot be inspected or maintained without removal from the piping system and, because of its location at the extreme end of the piping run in the valve pit, requires that the entire recovery well system be shut down and drained. Therefore, the redundant check valve that was added, was installed between isolation valves and is a "swing-check" valve that is equipped with a removable inspection plate. Inspection and cleaning requires only that the individual recovery well be shut down for approximately four hours.

Control Valves: Clean out/Blowout Tubing every two Months. Complete Rebuild every Six Months. Cleaning/blowout and rebuilding of the control valves are each anticipated to require an outage of four hours per recovery well.

Historically, the Cla-Val® control valves installed on the recovery wells have required frequent corrective maintenance because of flow control problems. In order to minimize or prevent an unacceptable flow and subsequent corrective maintenance, these valves will be placed on a frequent preventative maintenance schedule.

These valves utilize line-water pressure and direct it to a diaphragm that positions the valve. The line pressure is conducted to this diaphragm via small-diameter tubing that routinely becomes clogged with iron bacterial growth. These valves are planned to be replaced with a motor-driven control valve in the South Plume Optimization Project. This will eliminate the problematic pilot tubing that is prone to clogging.

Pressure Indicators: Annual Calibration

Each recovery well has pressure gauges that are utilized in performance testing to determine the pump's discharge head (pressure). Accurate pressure sensing in the full range of pumping pressures is

required for accurate testing. Several of the existing gauges need to be replaced as they do not span the entire pressure range of the pump discharge. No outage is anticipated for pressure-gauge calibration or change out.

Air Release/Vacuum Breakers: Annual Inspection

The air release portion of these devices allow air in the pump discharge piping to be released from the piping within the valve pits upon pump start-up. This prevents the buildup of pockets of trapped air in piping which can cause flow restrictions known as air binding. The vacuum breaker portions of these devices previously allowed the pump-discharge piping to drain when the pump was shut down. However, the addition of a second (redundant) check valve in 1995 prevents the pipe from back flowing. No outage is anticipated for inspection of the air release/vacuum breaker.

Lightning Arrestors: Monthly Test

Lightning arrestors (surge suppressors) were added after repeated damage to flow control circuits was experienced. The damage to the circuits was linked to electric storms in the vicinity of the recovery wells. Routine testing of these devices is required to ensure that they are in working order. No outage of the recovery well is anticipated for this maintenance activity.

5.3 OPERATIONAL MONITORING

The main system performance indicators for the South Plume Recovery Wellfield system will be gathered and summarized in performance tests conducted quarterly. These tests will monitor the specific capacity of each recovery well and the pump/motor assembly performance. Several of the parameters measured may be monitored more frequently to develop additional system data for trending purposes. (See Table 5-1 for a summary of the key parameters to be monitored, monitoring frequency, and recovery well outages anticipated for each.)

5.3.1 Parameters to Be Monitored

System operating parameters that are required to be routinely monitored include the following:

- Water level - static and pumping
- Flow
- Discharge pressure
- Motor amperage draw.

Water Level Monitoring:

Water level, both static and pumping, is perhaps the most critical parameter to be measured and needs to be measured with the most frequency. The drawdown from static water level to the pumping water level is used to calculate a specific capacity for the well and is a direct indication of the degree of fouling of the well screen. The installation depth of the recovery well pump/motor assemblies has been established, based upon an anticipated worst-case drawdown of 10 feet below the seasonal low-static water levels. Historical data was reviewed to determine seasonal lows. While each setting has some added submergence to be conservative, pumping levels will be monitored routinely to ensure that adequate pump/motor submergence is maintained. Each recovery well has an installed pressure transducer that can be linked to an automated data logger. These pressure transducers are located approximately one foot above the pump bowl assembly, which is well above the required minimum submergence for the pump intake. Therefore, as long as a pumping water level is maintained above the transducer, adequate pump intake submergence is ensured.

Data loggers will be installed at each recovery well and will record pumping water levels daily. These daily readings will be checked periodically, downloaded, reviewed, and summarized monthly; and incorporated into an ongoing water-level summary to ensure that adequate submergence is maintained. If water level above the pressure transducer approaches zero head (i.e., one foot above the bowl assembly), superchlorination maintenance, prior to the quarterly superchlorination, will be performed. If, after superchlorination, transducer submergence remains minimal, more extensive rehabilitation efforts may be necessary. (See Appendix A for a description of well rehabilitation.)

Flow Monitoring:

The ability of a recovery well pump/motor to sustain the desired flow is a key indicator of the health of the well and the pump/motor assembly. Specific testing to determine the ability of a pump/motor assembly to perform as expected will be completed quarterly. This testing is detailed in the performance testing description in Section 5.3.2.

Additionally, individual recovery well flow is monitored continuously by the flow controller for each well. The actual flow verses the controller setpoint is checked by operations personnel once per shift on first and second shift each day. If the flow deviates by more than 30 gpm above or below the

setpoint and repeated attempts to stabilize the flow are unsuccessful, the well is shut down temporarily for diagnosis and maintenance.

Discharge Pressure Monitoring.

Pump discharge pressure, coupled with flow, will be monitored quarterly to assess the pump/motor assemblies performance against the manufacturers published performance curves and is detailed in the performance testing description in Section 5.3.

Amperage:

As with flow and pressure, amperage is a good indicator of how the pump/motor assembly is performing. During performance testing, motor amperage draw will be measured on each of the three phases of the electrical supply. Amperage draw is compared to the motor manufacturer' published specifications. Amperage should be below the manufacturer's full-load amperage and should be approximately equal across the phases of the motor. An imbalance of greater than 20 percent across the phases indicates a motor or electrical supply situation that triggers more extensive diagnosis. Additional diagnostics and repairs are not within the scope of this plan.

5.3.2 Performance Testing

Performance testing of the recovery wells will be conducted quarterly to assess their condition; this testing will require an outage of approximately eight hours per well. Performance testing is currently performed by Moody's of Dayton and is summarized in written reports. Static water-level measurements will be made prior to each performance test. This measurement will serve as the basis for computing drawdown within the recovery well. System flow, discharge pressure, pumping level, and motor amperage per phase will be measured at each of at least five different flows for the recovery well. These five flows shall include maximum flow (discharge valve fully open) and zero flow conditions (discharge valve closed).

The results of these measurements will be summarized in two ways. First, the flow and discharge head will be plotted and compared to recovery well pump manufacturer and previously developed head/flow curves. Second, the static water level and pumping levels will be used to calculate drawdown and specific capacity within the recovery well at various flows. As plugging of the well screen due to iron fouling and encrustation progresses, it is expected that drawdown within the well will increase for a

given flow rate. Superchlorination maintenance as described in Section 5.1 will be completed to determine its effect on drawdown levels. If, after superchlorination, the drawdown remains excessive, more extensive rehabilitation efforts will likely be required. (See Appendix A for a description of well rehabilitation.)

Additionally, the amperage draw of the well at various flows will be compared to previous readings and pump/motor manufacturers published information.

TABLE 5-1

PLANNED OUTAGES OF THE SOUTH PLUME RECOVERY WELLFIELD SYSTEM

Item	Description	SPPMMP Reference	Frequency	Duration per Event
1	Performance Testing	§ 5.3.2	Quarterly	≈ 8 hours/well
2	Maint. of the well and screen [b]	§ 5.1	Quarterly [a]	≈ 48 hours/well
3	Flow Controller Calibration	§ 5.3	Annually	≈ 4 hours/well
4	Flow Totalizer Calibration	§ 5.3	Annually	≈ 4 hours/well
5	Flow Meter Clean and Calibrate	§ 5.3	Semi-Annually	≈ 4 hours/well
6	Flow Check by Operations	§ 5.3	Quarterly	≈ 2 hours/well
7	Check Valve Inspect/Clean	§ 5.3	Semi-Annually	≈ 4 hours/well
8	Flow Control Valve Cleaning	§ 5.3	Every 2 months	≈ 4 hours/well
9	Flow Control Valve Rebuild	§ 5.3	Every 6 months	≈ 4 hours/well
10	Rehabilitation	App. A	Variable[b]	≈ 3 weeks

[a]May be required more frequently if excessive drawdown is detected.

[b]Frequency is dependent upon individual well performance. The need for this maintenance activity will be based upon the monitoring of the parameters defined within this plan. Note: Major rehabilitation of the South Plume Recovery Wells is not expected between June 1, 1997, and September 30, 1997.

6.0 REGULATORY ISSUES

The current recovery well rehabilitation efforts and the proposed routine well/screen maintenance require the addition of chemicals to the well. The only proposed chemicals to be added are sodium hypochlorite and hydrochloric acid. The sodium hypochlorite is used for routine well screen maintenance to disinfect the well and inhibit the growth of iron-fouling bacteria. Non-routine, major well rehabilitation efforts require the use of both sodium hypochlorite and hydrochloric acid. The hydrochloric acid is used to break down flow-limiting encrustations on the well screen. The well is purged of these chemicals by pumping to the common force main and combining with other recovery well discharges. The combined flow is directed to discharge and/or treatment, and ultimately discharges to the Great Miami River via the Parshall Flume.

The use of these chemicals in well rehabilitation efforts to date has been monitored closely by FDF Environmental Compliance. Ohio EPA has been notified and has approved of the intended chemical additions and subsequent discharges. The water pumped initially from the recovery well will be turbid, contain iron residual, dissolved scale, and will have a low pH. The discharges of this water will be documented through the procedures for discharge of miscellaneous wastewater sources to treatment systems. This procedure requires advance review by FEMP Environmental Compliance and the treatment system facility owner. Adequate dilution of this stream by other water sources is anticipated so that chlorine, turbidity, and low pH will not affect National Pollutant Discharge Elimination System (NPDES) outfall limits. The chlorine residual is expected to fall to acceptable limits prior to pumping.

In order to discharge chlorinated water, the amount of chlorine residual and rate of discharge must not produce a detectable level of residual chlorine at the Parshall Flume (NPDES Outfall 4001). This requirement is tightly controlled through FEMP Environmental Compliance review using procedure EP-0005, Controlling Aqueous Wastewater Discharges into Wastewater Treatment System.

7.0 ORGANIZATIONAL ROLES AND RESPONSIBILITIES

This section defines the organizational roles and responsibilities associated with the completion of the work defined in this plan. Descriptions of some of the key technical responsibilities of project organizations are provided below.

The DOE Operable Unit 5 Team Leader is responsible for:

- Providing direction and oversight to the completion of the activities defined in this plan
- Acting as the point of contact within DOE and for the regulators and stakeholders for all communications concerning work carried out under this plan.

The FDF Aquifer Restoration / Wastewater Project Director is responsible for:

- Providing overall project management and technical guidance to the Fluor Daniel Fernald team
- Ensuring the necessary resources are allocated to the project for the efficient and safe completion of plan activities
- Overseeing and auditing plan activities to ensure that the work is being performed efficiently and in accordance with all regulatory requirements and commitments, DOE Orders, site policies and procedures, and safe working practices.

The FDF Aquifer Restoration / Wastewater Project Technical Manager is responsible for:

- The safe and prompt completion of work outlined in the plan
- Oversight and programmatic direction of activities
- Providing a technical lead for the collection and interpretation of data
- Reporting to the DOE Operable Unit 5 Team Leader and Fluor Daniel Fernald Aquifer Restoration Project Director on the status of plan activities and on the identification of any problems encountered in the accomplishment of this plan.

The Fluor Daniel Fernald Technical Lead is responsible for:

- Reporting to the Fluor Daniel Fernald Project Manager on the progress of plan activities
- Establishing and maintaining recovery well status files.

- Interpreting and reporting data collected
- Coordinating required maintenance activities with external service contractors.

The Groundwater Monitoring Team will be responsible for

- Collection of water level data
- Compilation of water level data and reporting of data to FDF Technical Lead.

The Wastewater Treatment Operations Team will be responsible for:

- Operation of the recovery well system
- Conducting preventive maintenance
- Training and qualification of operations personnel.

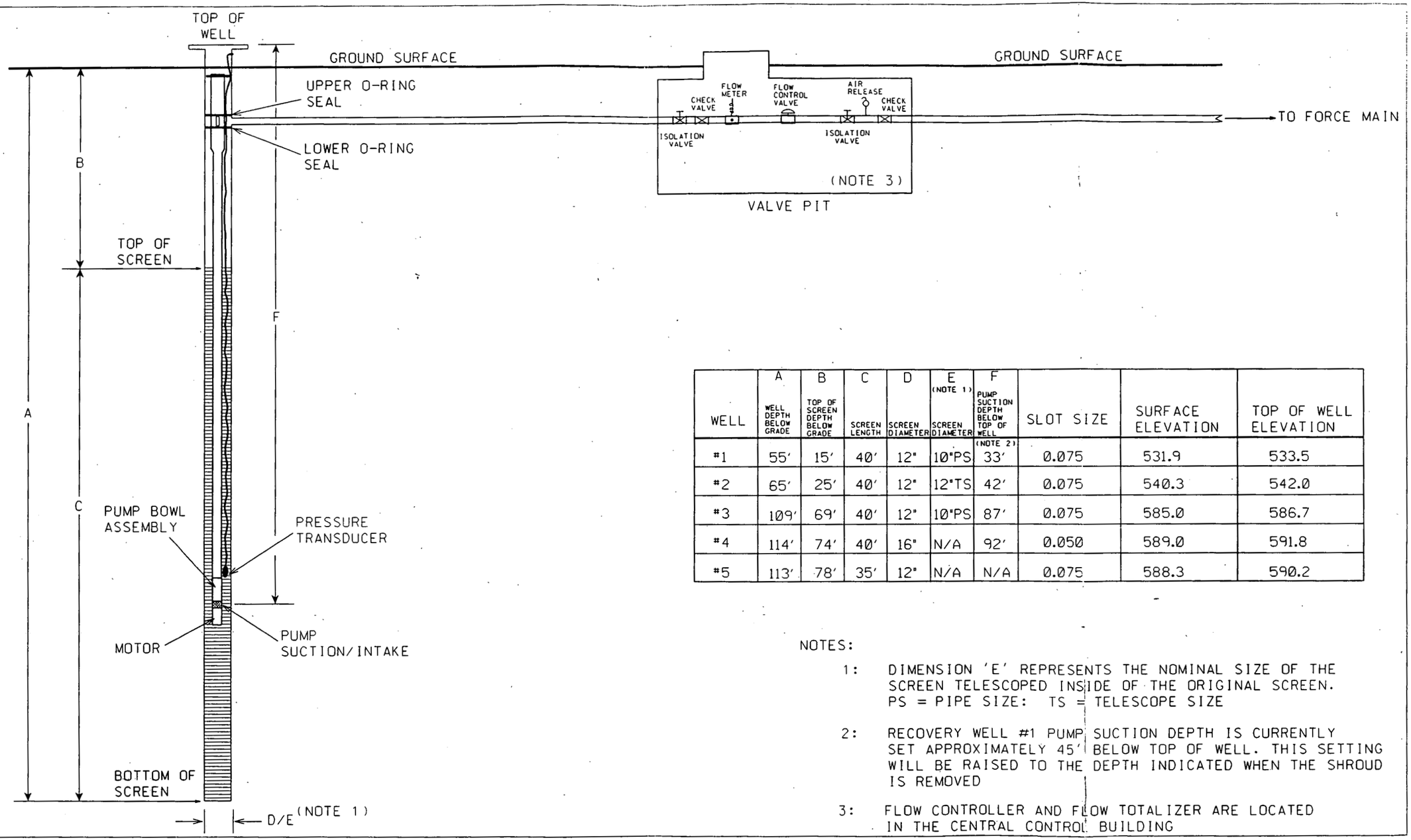
8.0 PATH FORWARD

This plan contains monitoring and maintenance activities, and frequencies based on initial projections. The need for and frequency of these activities may change based on future experience gained through the operation, maintenance, and monitoring of the South Plume Recovery Well system. Parameter monitoring frequency may change, as well.

Data gathered from quarterly performance testing will be summarized in written reports submitted by the sub-contractor upon completion of each test. Each quarterly report will be added to existing reports on file in the South Plume files and compared to past performance. Additionally, daily water level readings and feedback from maintenance personnel regarding the condition of system components will be evaluated to determine if modifications to the frequencies of preventive maintenance activities should be adjusted. The data gathered over the next several months will be logged and trended to establish a sound plan for ensuring that the system operates at an optimum on-stream factor.

Maintenance feedback and component manufacturer suggestions have been used to develop a spare parts list and stock inventories of the most frequently used parts. The availability of spare parts will minimize downtimes associated with all maintenance activities.

This plan will serve as a model for development of monitoring and maintenance activities for future groundwater recovery and injection well systems. Similar plans will be developed for each new injection or recovery well system as part of the specific project documentation required for system startup and operation. Their development will correlate to the individual project schedule.



WELL	A WELL DEPTH BELOW GRADE	B TOP OF SCREEN DEPTH BELOW GRADE	C SCREEN LENGTH	D SCREEN DIAMETER	E (NOTE 1) SCREEN DIAMETER	F PUMP SUCTION DEPTH BELOW TOP OF WELL (NOTE 2)	SLOT SIZE	SURFACE ELEVATION	TOP OF WELL ELEVATION
#1	55′	15′	40′	12"	10"PS	33′	0.075	531.9	533.5
#2	65′	25′	40′	12"	12"TS	42′	0.075	540.3	542.0
#3	109′	69′	40′	12"	10"PS	87′	0.075	585.0	586.7
#4	114′	74′	40′	16"	N/A	92′	0.050	589.0	591.8
#5	113′	78′	35′	12"	N/A	N/A	0.075	588.3	590.2

NOTES:

1: DIMENSION 'E' REPRESENTS THE NOMINAL SIZE OF THE SCREEN TELESCOPED INSIDE OF THE ORIGINAL SCREEN. PS = PIPE SIZE: TS = TELESCOPE SIZE

2: RECOVERY WELL #1 PUMP SUCTION DEPTH IS CURRENTLY SET APPROXIMATELY 45′ BELOW TOP OF WELL. THIS SETTING WILL BE RAISED TO THE DEPTH INDICATED WHEN THE SHROUD IS REMOVED

3: FLOW CONTROLLER AND FLOW TOTALIZER ARE LOCATED IN THE CENTRAL CONTROL BUILDING

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DRAFT
FINAL

NOT TO SCALE

v:\5crw2\dgn\map\hor\dpth\sppm001.dgn 18-SEP-1997

FIGURE 1. SOUTH PLUME RECOVERY WELL TYPICAL INSTALLATION DETAIL

APPENDIX A

SUMMARY OF SOUTH PLUME RECOVERY WELL REHABILITATION EFFORTS THROUGH JUNE 25, 1997

APPENDIX A

FDF is currently performing a systematic rehabilitation of each of the four operating South Plume recovery wells. This effort is required to establish a program of regular recovery well maintenance in order to minimize system downtime. The failure of the pump/motor assembly in Recovery Well 3 in May 1996, as well as subsequent inspections of the recovery well, revealed extensive screen and pump fouling. Industry experts, to include technical representatives of Moody's of Dayton, Byron Jackson, and National Pumps, were consulted to determine an appropriate rehabilitation program and to recommend a routine maintenance program that would address the specific operational inefficiencies identified in the South Plume Recovery Wellfield system.

Additionally, in late May of 1996, each of the four recovery well valve pit components were dissassembled and thoroughly cleaned. Significant acculations of iron encrustations were removed from the internal surfaces of the piping and flow control components within the valve pits. Flow and pumping water levels in each well were checked by FDF engineering staff after each recovery well's valve pit components were cleaned and the pump returned to service.

The following is a summary of rehabilitation efforts through June 25, 1997, listed in chronological order. In addition to the actions detailed below, each recovery well is being equipped with flexible poly tubing to be used for delivery of sodium hypochlorite in the routine well-maintenance activities described in Section 5.0.

A.1 RECOVERY WELL 3

On June 25, 1996, the pump/motor assembly from Recovery Well 3 was pulled from service to determine the cause of pumping failure that had occurred in May 1996. The pump, motor, and shroud were encrusted with iron deposits. These deposits covered the entire pump, motor, and shroud to a thickness of approximately 1/4 to 3/8 inch. Additionally, the intake screen of the pump assembly was approximately 75 percent clogged with iron encrustation. The pump and motor assembly was subsequently returned to the maintenance shop for testing to determine the exact nature of the failure. Preliminary inspection revealed that the motor could be turned by hand while the pump bowl assembly was tightly bound and could not be turned by hand. It should be noted that the pump/motor assembly was reported to be drawing "locked rotor" amperage prior to being pulled. Based on this inspection,

the preliminary conclusion regarding the pump/motor assembly was that the impellers were tightly bound due to iron encrustation and possible damage from pump cavitation caused by the restricted pump inlet screen.

On June 26, 1996, a video inspection of Recovery Well 3 revealed the presence of significant iron encrustation on the top 20 feet of recovery well screen, with significantly less accumulation in the lower 20 feet of screen. In July, the decision was made to rehabilitate the well. In July 1996, a requisition was written to provide wlel rehabilitation services to return Recovery Well 3 to optimal pumping condition.

Between July and early November, required documentation including Davis Bacon determinations and project-specific health and safety plans were completed, a contract was placed with Moody's of Dayton, personnel were trained, and the contractor was mobilized.

Actual rehabilitation efforts began on November 6, 1996, and included the cleaning of the recovery well utilizing dual swab and airlift pumping methods to remove debris. After cleaning, the recovery well was acid treated to break down iron encrustation on the recovery well screen and within the local formation, followed by chlorination to inhibit future iron-fouling bacterial growth. These processes were repeated several times to ensure that the well was rehabilitated to its optimal condition. As an additional protective measure to prevent further corrosion of the six inch discharge piping, the carbon steel pipe was sand blasted and epoxy coated, inside and out.

On November 27, 1996, Recovery Well 3 was returned to service utilizing a new pump/motor assembly taken from the spares inventory. After rehabilitation was complete, performance testing was performed and the specific capacity of this well was determined to average 298 gmp per foot of drawdown. This correlated to a pumping drawdown within the well of only 1.17 feet at 365 gpm. This drawdown at flows approaching the normal operating set point of 400 gpm was considered to be excellent.

In early May of 1997, the performance of Recovery Well 3 became erratic. Closer inspection revealed that the amperage draw of the well was excessive and it was subsequently shut down so that the pump and motor assembly could be pulled and inspected. After removal of the pump/motor assembly and

shroud, a clogged pump intake screen was observed. Moody's of Dayton was consulted to evaluate possible permanent damage to this pump/motor assembly. They recommended that the intake screen be removed and the pump/motor be reinstalled and tested for satisfactory flow, pressure, and amperage draw. The pump/motor was reinstalled and tested on May 29, 1997. The pump/motor assembly performed satisfactorally, however, the discharge pressure was slightly lower than expected.

A.2 RECOVERY WELL 4

During the rehabilitation of Recovery Well 3, the performance of Recovery Well 4 declined to the point where the pump could sustain a minimal flow of approximately 175 gpm. (Normal operating flow for this recovery well is 400 gpm.) At a flow of 175 gpm, the drawdown within the screen was over 17 feet. This amount of drawdown indicated that the well screen was obstructed. Therefore, this well was targeted for rehabilitation immediately following the completion of Recovery Well 3 rehabilitation. Prior to commencing rehabilitation, performance testing of Recovery Well 4 was completed to establish the operational status of the recovery well.

In early December 1996, the pump/motor assembly was removed from Recovery Well 4 by FDF maintenance personnel. Inspection of the assembly indicated iron encrustation and fouling of the pump-intake screen, similar to Recovery Well 3. A subsequent video inspection of the well screen also showed that the screen was fouled with iron build-up from top to bottom.

Subsequent rehabilitation efforts on Recovery Well 4 included the cleaning of the recovery well utilizing dual swab-and-airlift pumping methods to remove debris. After cleaning, the recovery well was acid treated to break down iron encrustation on the recovery well screen and within the local formation followed by chlorination to inhibit future growth of iron fouling bacterial. These processes were repeated several times to ensure that the well was rehabilitated to its optimal condition. As an additional protective measure to prevent further corrosion of the 6 inch discharge piping, the carbon steel pipe was sand blasted and epoxy coated, inside and out.

After rehabilitation was complete, a new pump/motor assembly was taken from spares inventory and installed. This recovery well was returned to service on January 10, 1997. A post-rehabilitation performance test of this well was performed on January 21, 1998, to assess the effectiveness of the screen cleaning and pump replacement. The results of this test indicated an increase in the well

specific capacity. The pump was able to perform as indicated by the manufacturer's head/flow performance curve, producing up to 680 gpm when the discharge valve was fully open. Under this full-flow condition of 680 gpm, the drawdown within the well was only 5.4 feet, compared to the pre-rehabilitation draw down of greater than 17 feet at 175 gpm. Drawdown within the well at 485 gpm (slightly higher than the normal duty point of 400 gpm) was only 3.7 feet.

A.3 RECOVERY WELL 2

Prior to completion of rehabilitation of Recovery Well 4, the performance of Recovery Well 2 had become erratic. While still able to maintain the desired flow of 300 gpm, flow fluctuations became more frequent. Pre-rehabilitation performance testing of Recovery Well 2 was completed on December 31, 1996. This testing confirmed that the recovery well pump/motor assembly was not performing as predicted by the manufacturers head flow performance curve; it could only achieve a peak flow of 320 gpm with the discharge valve fully open.

On January 20, 1997, Recovery Well 2 was taken out of service and the pump/motor assembly was removed from the well by FDF maintenance personnel. Upon inspection, the pump/motor showed evidence of having been embedded in sand-and-filter-pack material. The pump inlet screen was observed to be severely deformed and had an excessive amount of gravel plugging the openings (possibly indicating damage to the well screen). The pump/motor assembly also was found to be missing most of the 3/4-inch recirculation/cooling line that was tapped into the check valve above the pump discharge.

A subsequent video inspection of the recovery well indicated that the screen was fouled from the middle to the bottom of the screen. Also, this video inspection could only be completed to a depth of 60 feet. Since the depth of the well is 65 feet, this indicated that approximately five feet of fill were in the well. This video inspection also revealed the presence of the missing recirculating cooling line in the bottom of the well.

Rehabilitation activities began on February 4, 1997, and included the cleaning of the recovery well utilizing dual swab-and-airlift pumping methods to remove debris. After cleaning, the recovery well was acid treated to break down iron encrustation on the recovery well screen and within the local formation, followed by chlorination to inhibit future growth of iron-fouling bacterial. These processes

were repeated several times to ensure that the well was rehabilitated to its optimal condition. As an additional protective measure to prevent further corrosion of the 6-inch discharge piping, the carbon steel pipe was sand blasted and epoxy coated, inside and out. During the dual swabbing-and-air lifting processes, approximately 17 feet of additional gravel and sand pack material were removed from this recovery well indicating possible damage to the screen.

Following rehabilitation, a video inspection of the well on February 10, 1997, confirmed the presence of a 1 to 1½-inch hole in the screen. A more detailed video inspection on February 14, 1997, utilizing a side-view camera, clearly showed a hole in the well screen. The cause of this hole is believed to be the result of wear induced by a jet of water emanating from the tap hole in the discharge pipe where the recirculation/cooling line was installed.

Several options for repair of this hole were considered. After evaluating the alternatives, it was determined that a new 12-inch telescoping screen (TS) would be telescoped inside of the existing screen and that blank casing would be installed to a depth just below the pitless adaptor. This was completed on March 10, 1997.

On April 10, 1997, a new pump/motor assembly was installed in Recovery Well 2; it was returned to service on April 11, 1997. A post-rehabilitation performance test was performed on April 16, 1997, to assess the condition of the well and to check the pump/motor performance against the manufacturer's head/flow performance curve. Operations personnel identified that the recovery well pump/motor assembly did not seem to be performing as expected. The performance testing of this system confirmed that the pump was not delivering the flow and pressure predicted by the manufacturer, although it was able to maintain the 300 gpm flow required.

This pump/motor assembly was removed from service in early May of 1997 and returned to the original supplier (Moody's of Dayton) for evaluation. This pump and motor were dissassembled and determined to meet original specifications for this assembly. A subsequent flow check of the Recovery Well 2 system revealed that the flow meter was not functioning properly. Therefore, all of the piping and flow control components within the valve pit were removed and cleaned thoroughly to remove all iron encrustations.

A new, self-cooling pump/motor assembly manufactured by Byron Jackson was installed in Recovery Well 2 and it's performance was compared against a certified pump curve. Also, a flow check was performed to ensure that the flow meter was functioning properly. The results of these tests indicated that both the new pump and the flow meter were functioning properly.

A.4 RECOVERY WELL 1

As of June 27, 1997, rehabilitation efforts had not been completed for Recovery Well 1. However, a performance test had been completed to assess the condition of the screen and pump/motor assembly. The results of this pre-rehabilitation performance testing indicated that this recovery well did not experience extensive screen fouling. Minimal drawdown was observed at normal flows and at maximum flows. In order to bring all recovery wells in the South Plume Groundwater Recovery system to a common maintenance status, rehabilitation of this recovery well will be scheduled in FY98.

APPENDIX B

CALCULATION OF PROJECTED ANNUAL AVERAGE STORM WATER FLOWS

APPENDIX B

DOE This appendix was prepared to develop the projected annual average discharge from the SWRB during remediation. Information used to prepare this appendix was obtained from:

- The PTI for the SWRB; Appendix H (Attachment B-1)
- Actual Storm Flow Timeline 1990-1992 (Attachment B-2)
- Figure of "Sitewide Remediation Areas" (Section 4.0)
- Figure of "SWRB Controlled Area Surface Water Runoff" (Section 4.0).

CALCULATION OF STORMWATER PROFILE

Background

Flow to the SWRB comes from runoff during storm events and perched water infiltration which occurs on a daily basis.

For the first few years of SWRB operation, a Storm Sewer Lift Station (SSLS) was operated on the influent sewer to the SWRB. The SSLS intercepted the dry weather flow and pumped it directly to the GMR. Attachment B-2 is flow data for the years 1990-1992, when the SSLS was in operation.

Assumptions

1) Past monitored flow data can be used to predict the average yearly runoff for future flows anticipated from the SWRB as remediation progresses.

2) Each of the former production sub-areas (Areas 3, 4, and 5) has similar runoff coefficients, or C values.

3) Each area has dry weather infiltration flow proportional to surface area.

4) Calculation of Runoff Volume can be made using a formula similar to the SWRB PTI Appendix H (Attachment B-2):

$$V = CRA$$

where: V = volume
R = rainfall
C = runoff coefficient
A = area

or when: V = mgy = mg/yr, R = inches/yr, and A = acres

$$V\ \frac{(mg)}{(yr)} = C \times R\ \frac{(inches)}{(yr)} \times A\ (acres) \times K$$

where $K = \frac{43{,}560\ ft^2}{acre} \times \frac{7.48\ gal}{ft^3} \times \frac{ft}{12\ inches} \times \frac{mg}{10^6\ gal} = 2.715 \times 10^{-2}$

$\therefore V = 2{,}715 \times 10^{-2}\ CRA$ (formula 1)

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5) Calculation of Average Yearly Runoff Flow in gal/min. can be made by:

$$Q = \frac{(gal)}{(min)} = V \frac{(mg)}{(yr)} \times J$$

where $J = \frac{yr}{365\ days} \times \frac{day}{1440\ min} \times \frac{10^6\ gal}{mg} = 1.903$

$\therefore Q = 1.903\ V$ (Formula 2)

or $Q = 1.903\ (2.715 \times 10^{-2}\ CRA)$

$\therefore Q = 5.166 \times 10^{-2}\ CRA$ (Formula 3)

6) C value for:

a) all areas = 0.56 (Reference SWRB PTI)
b) paved = 0.95
c) grassed = 0.3

7) Drainage Areas:

a) Original SWRB drainage area (includes construction of 2nd chamber) = 146 acres
b) Removal Action 16 drainage area (completed 1993) = 19 acres
c) Diverted Parking Lot drainage area = 11.5 acres
d) A1PI Soil Stockpile drainage area = 12 acres

8) Average Yearly Rainfall for site = 40.4 inches

(Ref: 1975 Local Climatological Data in Cincinnati, Ohio)

Calculations

1) Calculation of Anticipated Yearly Runoff Volume prior to Removal Action 16 (1993):

$V = 2.715 \times 10^{-2}\ CRA$ (formula 1)

$= 2.715 \times 10^{-2} \times 0.56 \times 40.4$ in. $\times$ 146 acres

$= 89.679$ mgy

2) Calculation of Anticipated Average Yearly Runoff prior to Removal Action 16 (1993):

$Q = 1.903V$ (formula 2)

$= 1.903\ (89.679)$

$= 170.66$ gpm

3) Check calculated Vs anticipated vs. actuals using the information in Attachment B-2:

$V = 2.715 \times 10^{-2}$ CRA (formula 1)

$= 2.715 \times 10^{-2} \times 0.56 \times R \times 146$ acres

$= 2.22R$

Year	R	V Ant	V Actual	Δ V %
1990	53.49	118.74	122.57	+ 3.2%
1991	34.12	75.74	79.372	+ 4.8%
1992	30.71	68.17	65.556	- 3.8%

Since V Ant within ± 5% of V Actual, calculation logic seems valid.

4) Calculate V & Q removed with the parking lot stormwater diversion project:

V calc $= 2.715 \times 10^{-2}$ CRA (formula 1)

$= 2.715 \times 10^{-2} \times 0.95 \times 40.4$ inches/yr $\times$ 11.5 acres

= 11.983 mgy.

Q calc = 1903 V (from formula 2)

= 1903 (11.983)

= 22.80 gpm

Assume: Q Parking Lot = 20 gpm

5) Calculate V & Q added by stockpiles of soil in A1PI remediation which is outside original area collected by SWRB:

$V = 2.715 \times 10^{-2}$ CIA (formula 1)

$= 2.715 \times 10^{-2} \times 0.3 \times 40.4 \times 12$

= 3.95 mgy.

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Q = 1.903 V (formula 2)

= 1.903 (3.95)

= 7.515

Assume: A1PI Soil Stockpiles = 10 gpm

6) Calculation of Anticipated V & Q for Areas 3, 4, and 5:

Area = original SWRB + R.A. #16 - Parking Lot

= 146 acres + 19 acres - 11.5 acres

= 153.5 acres

V = 2.715×10^{-2} CRA (formula 1)

= $2.715 \times 10^{-2} \times 0.56 \times 40.4$ in/yr x 153.5 acres

= 94.29 mgy

Q = 1.903V

= 1.903 (94.29)

= 179.43 gpm

Assume: Q Areas 3, 4, and 5 = 180 gpm

7) Calculated Q for each of 3 remediated areas (3, 4, and 5) which make up the SWRB drainage area:

Area	%	Q
3	40	72
4	25	45
5	35	63
Total	100%	180 gpm

8) Calculate the average normal infiltration (gal/in rainfall) dry weather flow from the SSLS assuming flow is proportional to rainfall:

- Use Attachment B-2 data

YEAR	V INF	R	V/R
1990	33.003	53.49	0.617
1991	35.718	34.12	1.047
1992	40.474	30.71	1.318

Since V/R does not seem to be consistent, assume dry weather flow is an average:

$$V\ avg = \frac{33.003 + 35.718 + 40.474}{3}$$
$$= 109.195/3$$
$$= 36.40\ mgy$$

$$Q = 1.903V$$
$$= 1.903\ (36.40)$$
$$= 69.26\ gpm$$

Assume: Q infiltration = 70 gpm

9) Calculate the dry weather Q for each subarea assuming it is proportional to the area:

Area	%	Q
3	40	28
4	25	17.5
5	35	24.5
Total	100%	70 gpm

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10) Summarize Total Q (Runoff + Dry Weather) for each subarea:

Area	Q (SWRB) (gpm)	Q (SSLS) (gpm)	Q TOTAL (gpm)	SAY (gpm)
3	72	28	100	100
4	45	17.5	62.5	60
5	63	24.5	87.5	90
Total	180	70	250	250

2 11) Summary of Storm water flows using above calculations and date from Section 4.0 including a) Southern Waste Unit remediation flow = 15 gpm, b) Lime Sludge Pond remediation flow = 5 gpm, and c) Solid WasteLandfill remediation flow = 5 gpm, and shown graphically on Attachment B-3:

Jan 2006 - Dec 2006	47 mgy	(90 gpm)
Jan 2005 - Dec 2005	79 mgy	(150 gpm)
Jan 2004 - Dec 2004	79 mgy	(150 gpm)
Jan 2003 - Dec 2003	81 mgy	(155 gpm)
Jan 2002 - Dec 2002	134 mgy	(255 gpm)
Jan 2001 - Dec 2001	134 mgy	(255 gpm)
Jan 2000 - Dec 2000	134 mgy	(255 gpm)
Oct 1999 - Dec 1999	134 mgy	(255 gpm)
Jan 1999 - Sept 1999	139 mgy	(265 gpm)
July 1998 - Dec 1998	139 mgy	(265 gpm)
Jan 1998 - June 1998	137 mgy	(260 gpm)
July 1997 - Dec 1997	137 mgy	(260 gpm)
Jan 1997 - June 1997	147 mgy	(280 gpm)

ATTACHMENT B-1

ATTACHMENT B-1

THE ACCUMULATED 10-YEAR FREQUENCY RUNOFF VOLUME WAS CALCULATED USING THE RAINFALL-INTENSITY-DURATION CURVE FOR CINCINNATI, OHIO, PREPARED BY THE U.S. WEATHER BUREAU AND SHOWN ON THE PREVIOUS PAGE. THE INDIVIDUAL POINTS WERE CALCULATED IN THE FOLLOWING MANNER:

1. The rainfall intensity in inches per hour was read from the curve for the corresponding storm duration using a return period of 10 years.

2. The value read is multiplied by the corresponding duration to give the total inches of rainfall which has occurred since the beginning of the storm (assumes worst case of storm peak occurs at the beginning of the storm).

3. Inches of rainfall is multiplied by:
   a. Area of drainage basin (163 acres)
   b. Drainage basin composite runoff factor (0.56)
   c. Proper conversion factors to give answer in million gallons.

EXAMPLE:

Duration = 1 hour
From chart - intensity is 1.8 inches per hour

Volume of Runoff =
1.8 in/hr. x 1 hr. x ft./12 in x 163 acres x 43560 ft./acre x 0.56 x 7.48 gal/cu.ft. =

4.46 Million gallons

ATTACHMENT B-2

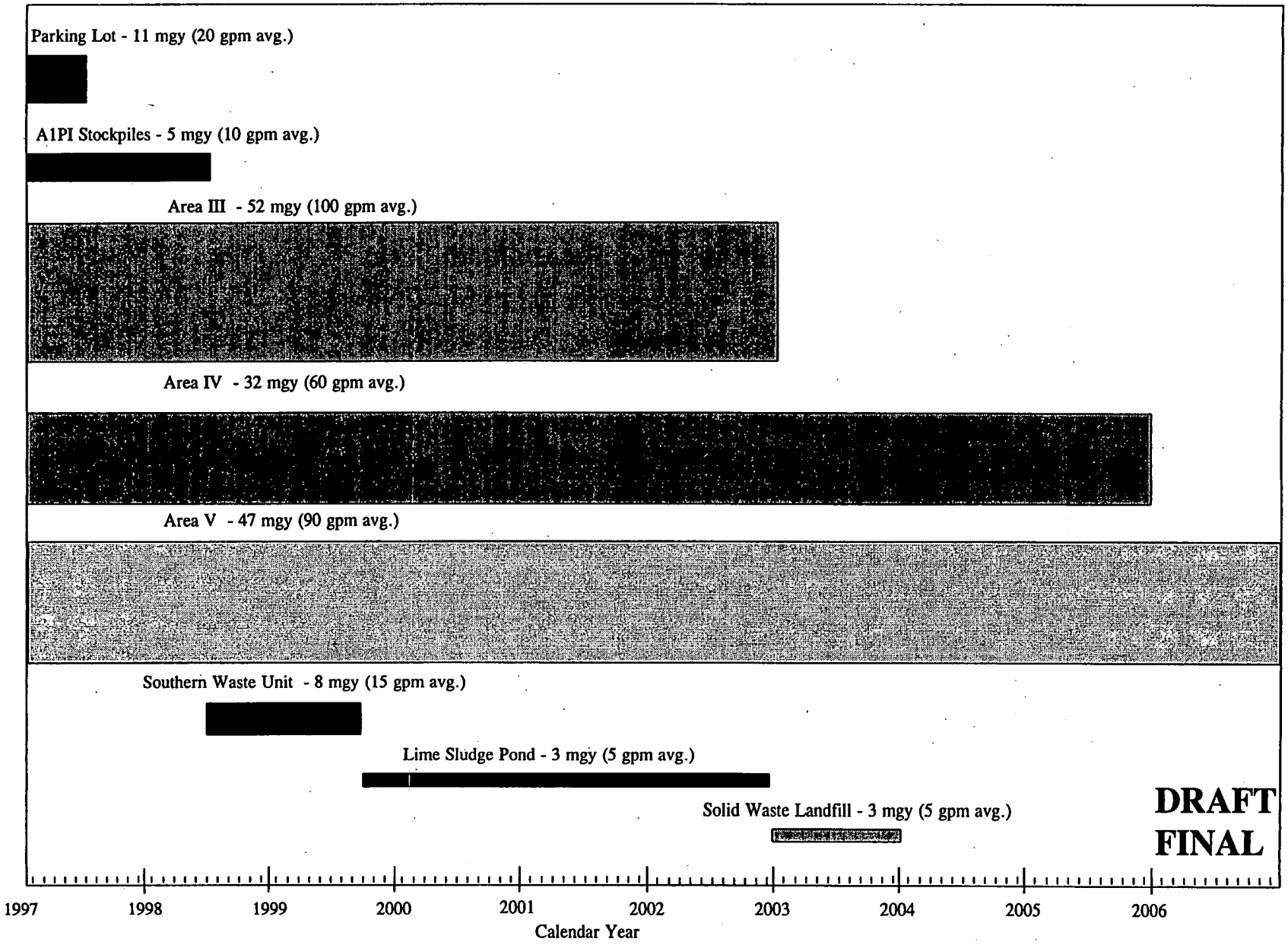
ATTACHMENT B-2

ACTUAL STORM FLOW TIMELINE 1990-1992

	1990			1991			1992		
MONTH	SSLS (M.G.)	RAIN (INCH)	SWRB (M.G.)	SSLS (M.G.)	RAIN (INCH)	SWRB (M.G.)	SSLS (M.G.)	RAIN (INCH)	SWRB (M.G.)
JAN	4.409	3.27	3.794	4.503	2.37	12.488	4.433	3.87	5.870
FEB	4.832	4.80	9.824	2.700	3.44	9.923	2.795	0.69	1.880
MAR	2.409	2.44	6.964	3.322	4.34	13.171	5.602	1.88	3.498
APR	2.404	3.12	5.877	3.859	4.45	10.784	2.976	1.51	4.392
MAY	3.396	9.81	15.530	2.888	2.61	3.087	2.948	2.48	5.234
JUN	0.595	3.92	12.674	2.354	1.67	0.959	2.854	2.83	2.071
JUL	1.070	3.65	14.339	3.050	2.58	6.486	4.232	7.27	11.251
AUG	0.824	3.40	4.560	2.817	4.73	7.331	2.765	1.43	6.744
SEP	2.451	3.30	10.670	2.488	2.08	3.341	2.722	2.05	5.148
OCT	3.125	6.74	16.203	2.249	1.14	1.839	2.656	2.22	4.073
NOV	2.947	2.03	6.965	1.347	1.50	0.679	3.973	3.77	10.962
DEC	4.541	7.01	15.167	4.141	3.21	9.284	2.518	0.71	3.433
TOTAL	33.003	53.49	122.57	35.718	34.12	79.372	40.474	30.71	65.556

ATTACHMENT B-3

Attachment B-3
Storm Water Flow Timeline



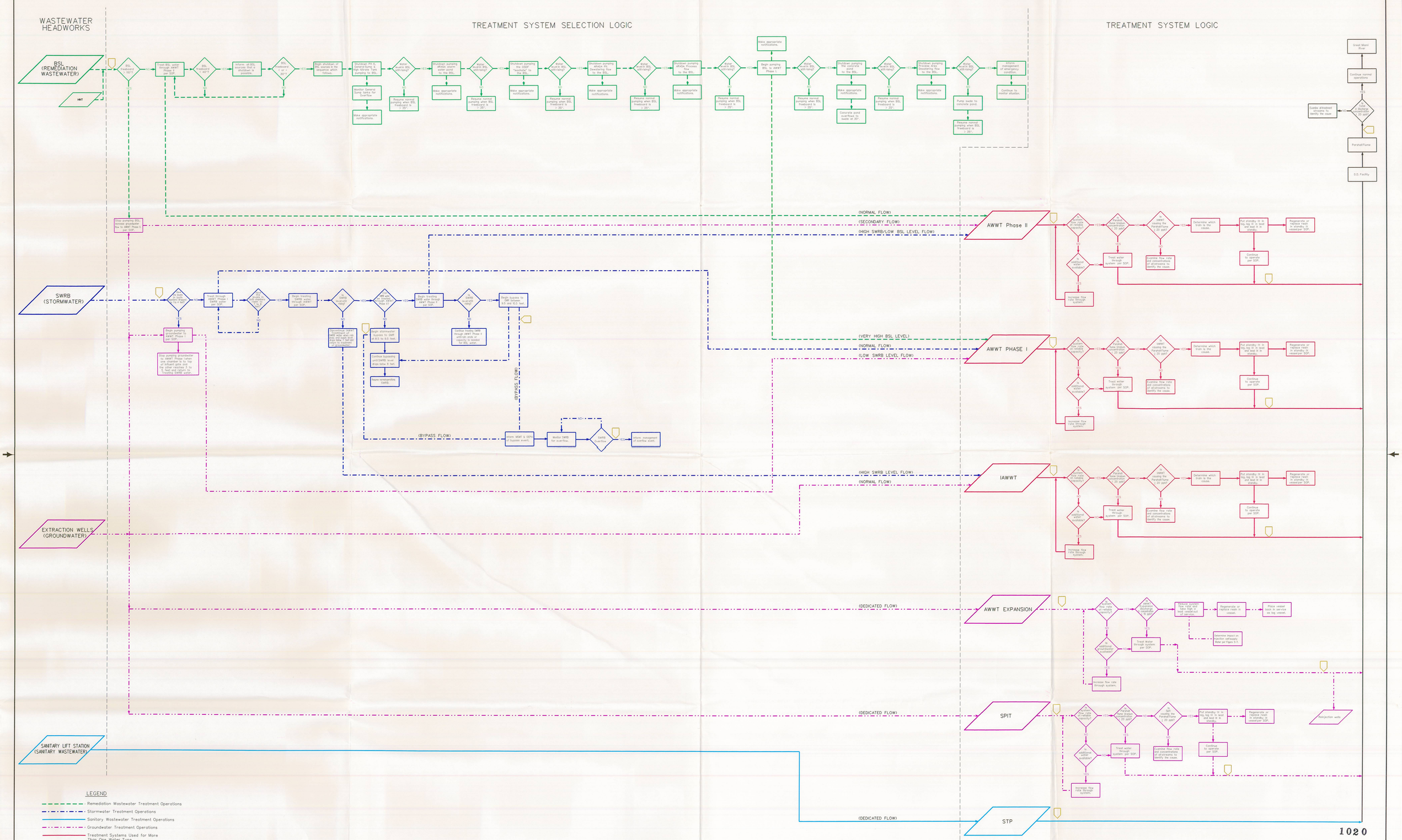
APPENDIX C

ARWWP STANDARD OPERATING PROCEDURES

PROCEDURE NO.	TITLE
08-C-200	PLANT 8 PERCHED GROUNDWATER VOLATILE ORGANIC COMPOUND (VOC) TREATMENT SYSTEM
08-C-216	PLANT 8 PORTABLE DUST COLLECTOR/HEPA UNIT
20-C-510	REMOVAL, TRANSPORT, AND STORAGE OF DECANT SUMP LIQUID FROM K-65 SILOS 1 AND 2
43-C-100	CLEANING GLASS AND PLASTIC LABORATORY WARE
43-C-101	STORING AND HANDLING CHEMICALS
43-C-102	SAMPLE PRESERVATION BY ACID ADDITION
43-C-104	HORIBA WATER QUALITY METER CALIBRATION, OPERATION, AND MAINTENANCE
43-C-105	ION EXCHANGE RESIN SLUICING AND ADDITION - SOUTH PLUME INTERIM TREATMENT (SPIT) SYSTEM
43-C-305	WATER PLANT LABORATORY PROCEDURES
43-C-306	STORM SEWER LIFT STATION
43-C-308	RESPONDING TO INDICATIONS OF OUT-OF-SPECIFICATION EXCURSIONS OF STORM SEWER WATER QUALITY
43-C-310	SAMPLING DRINKING WATER FOR TOTAL COLIFORM DETERMINATION
43-C-313	STORMWATER RETENTION BASIN SLUDGE REMOVAL
43-C-318	SURGE LAGOON UNDERDRAIN SYSTEM
43-C-319	SURGE LAGOON INSPECTION
43-C-324	SAMPLING AND ANALYZING FEMP WATER SUPPLIES
43-C-325	BIODENITRIFICATION HIGH NITRATE TANK
43-C-326	STORMWATER RETENTION BASIN CONTROL SYSTEM OPERATION
43-C-329	BIODENITRIFICATION FACILITY AND EFFLUENT TREATMENT EMERGENCIES
43-C-332	OPERATION OF THE HACH DR/3000 SPECTROPHOTOMETER
43-C-333	SAMPLING DRINKING WATER CONTAINING TOTAL OR FECAL COLIFORM
43-C-334	OPERATION OF THE HACH DR/2000 SPECTROPHOTOMETER
43-C-335	IAWWT (STORMWATER RETENTION BASIN) SYSTEM OPERATION
43-C-337	WASTE PIT AREA STORMWATER RUNOFF CONTROL SYSTEM OPERATION
43-C-339	OFF-NORMAL OPERATION (LOW TRAILER EFFLUENT PH) OF THE IAWWT (STORMWATER RENTION BASIN) FACILITY
43-C-340	AWWT PHASE I AND II OPERATIONS
43-C-341	ADVANCED WASTE WATER TREATMENT BASELINE VALVE LINE-UP
43-C-342	ADVANCED WASTEWATER TREATMENT (AWWT) CONTROL ROOM OPERTIONS
43-C-343	ADVANCED WASTE WATER TREATMENT (AWWT) BULK CHEMICAL SYSTEMS
43-C-344	AWWT SUMPS OPERATIONS AND RESPONSE TO CHEMICAL SPILLS
43-C-345	REGENERATION, SLUICE IN & OUT OF ION EXCHANGE RESIN FOR AWWT PHASES I & II
43-C-347	AWWT EMERGENCY SHOWER SYSTEM OPERATION
43-C-348	AWWT HEATING, VENTILATION AND AIR CONDITIONING SYSTEM OPERATION
43-C-349	AWWT PROCESS AREA MAKE-UP AIR SYSTEM OPERATION
43-C-350	AWWT STEAM AND CONDENSATE SYSTEM OPERATIONS
43-C-353	AWWT TREATED WATER SYSTEM OPERATION
43-C-354	AWWT CHILLED WATER SYSTEM OPERATION
43-C-356	RECEIVING SLURRIES AND CHEMICALS AT THE AWWT SLURRY DEWATERING FACILITY
43-C-357	PRETREATMENT OF MISCELLANEOUS SLURRIES AT THE AWWT SLURRY DEWATERING FACILITY
43-C-358	THICKENING, FILTRATION, AND DISCHARGE AT THE AWWT SLURRY DEWATERING FACILITY
43-C-359	PRETREATMENT OF AWWT SLURRY AT THE AWWT SLURRY DEWATERING FACILITY
43-C-360	BASELINE VALVE LINE-UP FOR THE AWWT SLURRY DEWATERING FACILITY
43-C-361	BUILDING UTILITIES AT THE AWWT SLURRY DEWATERING FACILITY
43-C-362	CLEANING SAMPLE TUBES AT THE AWWT
43-C-412	MANAGEMENT OF THE WATER COVER FOR WASTE PIT 6
43-C-413	HANDLING WASTE MATERIALS WITH THE INDUSTRIAL VACUUM LOADER TRUCK (SUPERSUCKER)
43-C-414	INDUSTRIAL VACUUM LOADER TRUCK (SUPERSUCKER) OPERATION
43-C-415	COAL PILE RUNOFF CONTROL FACILITY OPERATION
43-C-421	ION EXCHANGE RESIN SLUICING AND ADDITION FOR THE IAWWT (STORMWATER RETENTION BASIN) SYSTEM
43-C-501	SANITARY SEWAGE TREATMENT PLANT OPERATION
43-C-502	INDUSTRIAL VACUUM LOADER TRUCK (GUZZLER) OPERATION
43-C-505	ENVIRONMENTAL SAMPLING AT THE SEWAGE TREATMENT PLANT AND THE PARSHALL FLUME
43-C-601	INSPECTION/OPERATION OF SURFACE IMPOUNDMENTS
43-C-701	GENERAL SUMP OPERATION
43-C-903	SOUTH PLUME INTERIM TREATMENT (SPIT) SYSTEM OPERATION
43-C-904	RECOVERY WELL FIELD
43-M-1001	DISSOLVED OXYGEN (DO) AZIDE MODIFICATION OF WINKLER METHOD
43-M-1002	DISSOLVED OXYGEN (DO), MEMBRANE ELECTRODE METHOD
43-M-1003	DPD METHOD FOR FREE AND TOTAL CHLORINE TEST
43-M-1004	TOTAL COLIFORM TESTING BY MEMBRANE FILTER METHOD
43-M-1005	FECAL COLIFORM TESTING OF WATER BY MEMBRANE FILTER METHOD
43-M-1006	BRPADAP TEST FOR SOLUBLE URANIUM BY SPECTROPHOTOMETER
43-M-1007	ALKALINITY (TOTAL AND PHENOLPHALEIN) TESTING OF WATER
43-M-1008	TOTAL HARDNESS TESTING OF WATER BY EDTA TITRIMETRIC METHOD
43-M-1009	TOTAL PHOSPHORUS TESTING OF WATER BY ASCORBIC ACID METHOD WITH PERSULFATE PREDIGESTION
43-M-1010	STABILITY TEST OF WATER BY SATURATION WITH CALCIUM CARBONATE
43-M-1011	PH (HYDROGEN ION) TESTING OF WATER BY ELECTROMETRIC METHOD
43-M-1012	CONDUCTIVITY/RESISTIVITY TESTING OF WATER BY ELECTROMETERIC METHOD
43-M-1013	SPECTROPHOTOMETRIC TEST FOR NITRATES IN WATER USING MODIFIED CADMIUM REDUCTION METHOD
43-M-1014	TOTAL SUSPENDED (NON-FILTERABLE) SOLIDS IN WATER
43-M-1015	TOTAL DISSOLVED (FILTERABLE) SOLIDS IN WATER
43-M-1016	IGNITION TEST FOR VOLATILE AND FIXED SOLIDS IN WATER
43-M-1017	TOTAL SOLIDS IN WATER
43-M-1018	VOLUMETRIC MEASUREMENT OF SETTLEABLE SOLIDS IN WATER
43-M-1020	CHEMICAL OXYGEN DEMAND OF WATER BY REACTOR DIGESTION METHOD WITH COLORIMETRIC DETERMINATION
43-M-1021	BICINCHONINATE METHOD FOR TESTING COPPER IN WATER BY SPECTROPHOTOMETER

ARWWP STANDARD OPERATING PROCEDURES

43-M-1022	QUALITY TESTING OF REAGENT-GRADE WATER
43-M-1023	BIOCHEMICAL OXYGEN DEMAND (BOD) AND CARBONACEOUS BIOCHEMICAL OXYGEN DEMAND (CBOD)
43-M-1024	DETERMINATION OF URANIUM IN WATER: UA-3 LASER INDUCED PHOSPHORESCENCE
43-M-1025	AMMONIA NITROGEN IN WATER BY THE NESSLER METHOD
43-M-1026	IRON IN WATER BY 1,10 PHENANTHROLINE METHOD
43-M-1027	SULFATE IN WATER BY SULFAVER4 METHOD
43-M-1028	NITRATE ION-SELECTIVE ELECTRODE METHOD
43-M-1029	HEXAVALENT CHROMIUM BY COLORIMETRIC METHOD (DR 3000)
43-M-1030	FLUORIDE BY ION-SELECTIVE ELECTRODE METHOD
43-M-1031	SOLUBLE URANIUM BY KINETIC PHOSPHORESCENCE ANALYZER (KPA)
43-M-1032	PH TESTING OF WATER BY ELECTROMETRIC METHOD WITH THE ORION 920A
43-M-1033	PH (HYDROGEN ION) TESTING OF WATER USING ORION 420A
43-M-1034	DETERMINATION OF SPECIFIC GRAVITY USING AN ANALYTICAL BALANCE
43-M-1035	DETERMINATION OF SPECIFIC GRAVITY - DMA-35 DENSITY METER
43-M-1036	WATER TEMPERATURE OF FEMP WASTEWATER
M-123	STANDING ORDERS FOR ADVANCED WASTEWATER TREATMENT FACILITY (AWWT) OPERATIONS
M-137	WATER TREATMENT PLANT LABORATORY QUALITY ASSURANCE PLAN
PO-S-04-006	AERATION FACILITY



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Fernald Environmental Management Project

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WASTEWATER OPERATIONS DECISION FLOW CHART

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Figure 5-2

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