RECORD OF DECISION
SITE 36 OF THE MISCELLANEOUS AREAS OPERABLE UNIT

Crab Orchard National Wildlife Refuge
NPL Site
Marion, Illinois

U.S. Fish & Wildlife Service
Crab Orchard National Wildlife Refuge
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SITE 36 AND OTHER SITES IN THE MISCELLANEOUS AREAS OPERABLE UNIT

A. SITE NAME AND LOCATION

This National Priority List (NPL) site is known as the Sangamo Electric Dump/Crab Orchard National Wildlife Refuge (USDOI)[1], Carterville, Illinois (Refuge). The subjects of this Record of Decision (ROD) are the following sites from the Miscellaneous Areas Operable Unit (MISCA OU), part of this NPL site: Sites 7, 7A, 8, 9, 10, 11, 11A, 12, 16, 20, 21, 22A, 24, 25, 26, 27, 30, 31, 35, and 36. The United States Environmental Protection Agency (USEPA) Identification Project Number for this NPL site is IL8143609487. There are four other MISCA OU sites that are not included in this ROD: Sites 13, 14, 18, and 34. Site 14 is the subject of a separate Record of Decision. Sites 13 and 18 were incorporated into the Additional and Uncharacterized Sites Operable Unit (AUS OU). Site 34 was formed into the Lake Monitoring Operable Unit.

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for Site 36 of the MISCA OU at the Refuge. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record file for this site. The State of Illinois concurs with the Selected Remedy.

Institutional controls will be implemented at Sites 10 and 16 to appropriately restrict human access. If future risk assessments show that the sites are appropriate for unrestricted use or reduced limitations on human activity, the institutional controls will be removed or modified as appropriate.

This decision document also presents the No Further Action decision for Site 22A and the No Action decision for Sites 7, 7A, 8, 9, 11, 11A, 12, 20, 21, 24, 25, 26, 27, 30, 31, and 35.

C. ASSESSMENT OF SITE 36

The response action for Site 36 selected in this Record of Decision is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, and pollutants or contaminants from this site, which may present an imminent and substantial endangerment to the public health or welfare.

[1] The USDOI in the NPL listing stands for the U.S. Department of Interior.

D. DESCRIPTION OF THE SELECTED REMEDY

Overall Site Cleanup Strategy

The Refuge is currently divided into seven Operable Units (OUs). These OUs are:

- Metals Areas (Metals)
- PCB [polychlorinated biphenyl] Areas (PCB)
- Explosives/Munitions Manufacturing Areas (EMMA)
- Miscellaneous Areas (MISCA)
- Water Tower
- Additional and Uncharacterized Sites (AUS)
- Lake Monitoring

The OUs are in various phases of cleanup: investigation, remediation, and long term monitoring. Separate Records of Decision were signed for the Metals OU, PCB OU, and the EMMA OU on March 30, 1990, August 1, 1990, and February 19, 1997, respectively. Separate Explanations of Significant Differences (ESD) were signed for the EMMA OU and the PCB OU on January 11, 2000 and June 23, 2000, respectively. Separate Action Memoranda for removal actions were signed for the Water Towers OU, MISCA OU (for Site 22A), and EMMA OU.

Long term monitoring is being conducted for the on-site landfill at the Metals OU. A major portion of the PCB OU cleanup activities was completed in 1997. Currently, preliminary design activities to meet the requirements of the ESD for groundwater remediation at the PCB OU are in progress. The remaining five operable units are in various stages of investigation and/or construction completion. Remedial and removal activities at the EMMA OU are nearing completion. The Record of Decision for Site 14 of the MISCA OU became final in October 2001. Site 36 and the other MISCA OU sites are the subjects of this ROD. Removal activities at the Water Towers OU are expected to be completed in 2003. The Draft-Final Preliminary Assessment and Site Inspection for the AUS OU was issued September 2001. The Preliminary Screening Assessment for the Lake Monitoring OU was completed on October 9, 2001.

MISCA OU Remedial Investigation (RI)

The MISCA OU RI was done in two phases between 1993 and 1995, and the report, issued in 1996, is referred to in this document as the 1996 RI[2]. It addressed the following 24 sites: 7, 7A, 8, 9, 10, 11, 11A, 12, 13, 14, 16, 18, 20, 21, 22A, 24, 25, 26, 27, 30, 31, 34, 35, and 36. All of these sites are included in this ROD, except Site 14, which is the subject of a separate ROD; Site 34, which became the Lake Monitoring OU; and Sites 13 and 18, which were incorporated into the AUS OU.

Ten of these sites (13, 18, 21, 24, 25, 26, 27, 30, 31, and 35) were excluded from the MISCA OU RI during the work planning process, and determined to require no further investigation. In October 1997, Sites 13 and 18 were included in the AUS OU for assessment of further

[2] Woodward-Clyde (W-C). 1996. Final Report, Remedial Investigation, Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois (Williamson County).

investigation. Site 34 was not investigated as part of the MISCA OU, but was later investigated as the Lake Monitoring OU.

Of the 13 sites that were investigated, eight were determined not to pose an unacceptable risk to human health and the environment (7, 7A, 8, 9, 11, 11A, 12, and 20). Three sites required further action: 14, 22A, and 36.

Institutional controls will be implemented at Sites 10 and 16 to appropriately restrict human access. If future risk assessments show that the sites are appropriate for unrestricted use or reduced limitations on human activity, the institutional controls will be removed or modified as appropriate.

Site 14 is a former industrial site where soil and groundwater are contaminated primarily with toluene, ethylbenzene, xylenes, and methylene chloride. In addition, soil at Site 14 is also contaminated with chromium, which may pose an unacceptable risk to ecological receptors, and with lead above human health risk based concentration. Site 14 is the subject of a separate ROD.

Site 22A is a potential former post-treating facility with dioxin and pentachlorophenol contaminated soil. In 1996, the Department of the Interior/Fish and Wildlife Service (DOI/FWS) conducted a removal action at Site 22A. No additional action is required for Site 22A.

Soil in the vicinity of Site 36 (a wastewater treatment plant area) is contaminated primarily with cadmium, chromium, and PCBs, which may pose an unacceptable risk to human health and the environment.

The USEPA and the DOI have determined that no remedial action is necessary to protect public health, or welfare, or the environment at Sites 7, 7A, 8, 9, 11, 11A, 12, 20, 21, 24, 25, 26, 27, 30, 31, and 35.

Crab Orchard National Wildlife Refuge was established for wildlife conservation and for agricultural, recreational, and industrial purposes by Public Law 361 on August 5, 1947. While parts of the Refuge have been designated for public use activities such as picnicking and camping, all the Refuge sites included in this ROD (all sites except for 24, 25, and 26) are within the 20,000 acre portion of the Refuge with access restrictions. This restricted access part of the Refuge was previously part of the Illinois Ordnance Plant that produced weapons during World War II. After the war, the former ordnance plant buildings, which are widely spaced throughout the area, were leased to industrial tenants. This limited access part of the Refuge serves as a wildlife sanctuary and is mostly wooded and grass-covered, with some agricultural use, in addition to the industrial use. Access other than by industrial tenants and Refuge employees is limited to specific times and locations such as hunting by permit, supervised environmental education tours, and an auto tour. Access restrictions are implemented by fences, gates, signage, automobile decals, and enforced by patrols and fines.

For all the Refuge sites included in this ROD (all sites except 24, 25, and 26), exposure assumptions used in the human health risk assessments were consistent with the current human uses of the area. Regarding future land use, any change in land use inconsistent with any land

use contained in those specific exposure assumptions in the risk assessments will require an evaluation of whether the anticipated land use change will pose unacceptable risks to human health and the environment. This is enforceable under the National Wildlife Refuge System Administration Act (16USC668dd), Section (d)(3)(A)(i), which requires that the Secretary of the Interior (Secretary)"…shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety." The Secretary's determination must be in writing and is subject to public review and comment. Potential land use changes are currently being evaluated through the Comprehensive Conservation Plan (CCP) process that is required by 16USC668dd.

Addressing Principal Threat at Site 36

The Selected Remedy for Site 36 identified in this ROD addresses the source material that poses the principal threat through excavation and containment in an off-site permitted landfill. The source material identified as the principal threat is soil and sludge contaminated primarily with PCBs, cadmium, and chromium.

Major Components of the Remedy for Site 36

The major components of the Selected Remedy are:

- Demolition of the wastewater treatment plant and disposal of the materials in an off-site permitted landfill.

- On-site treatment of impounded water to meet State of Illinois General Use Surface Water Quality Standards, and discharge to a nearby stream.

- Excavation and off-site disposal of contaminated material (soil and sludge from the East Pond, Primary and Secondary Lagoons, soil in the Upper Dove Creek, and soil throughout the wastewater treatment plant area) in permitted landfills. Soil and sludge with PCB concentrations in excess of 50 milligrams per kilogram (mg/kg) will be disposed of in a landfill permitted under the Toxic Substances Control Act (TSCA). Soil and sludge with PCB concentrations less than 50 mg/kg and all other contaminated materials will be disposed of in a landfill permitted under Subtitle D of the Resource Conservation and Recovery Act (RCRA).

- Testing of the material by the Toxicity Characteristic Leaching Procedure (TCLP) to determine if any waste is RCRA hazardous by characteristic and therefore requiring treatment prior to disposal.

- Pre-design sampling to fill data gaps identified in the Feasibility Study Report, including site-specific determination of leaching potential from soil to groundwater (i.e., pH) and biological terrestrial and semi-aquatic tissue sampling.

- Site restoration including backfilling with clean soils, re-grading, and re-establishment of vegetation.

- Groundwater monitoring until groundwater at Site 36 is restored to federal maximum contaminant levels (MCLs) for drinking water (as specified in the Safe Drinking Water Act) and State of Illinois Class I groundwater standards for all contaminants of concern.

- Institutional controls to prohibit installation of potable water wells until the groundwater is restored to MCLs/State of Illinois Class I groundwater standards for all contaminants of concern.

E. STATUTORY DETERMINATION

Statutory Requirement

The Selected Remedy for Site 36 is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The Selected Remedy attains the mandates of CERCLA §121, and, to the extent practicable, the NCP.

Institutional controls will be implemented at Sites 10 and 16 to appropriately restrict human access. If future risk assessments show that the sites are appropriate for unrestricted use or reduced limitations on human activity, the institutional controls will be removed or modified as appropriate. No remedial action is necessary at Sites 7, 7A, 8, 9, 11, 11A, 12, 20, 21, 24, 25, 26, 27, 30, 31, and 35. No further action is required for Site 22A.

Statutory Preference for Treatment

The Selected Remedy in this OU for Site 36 does not satisfy the statutory preference for treatment as a principal element of the remedy for the following reason: The selected alternative is the most reliable (implementability criterion), achieves soil remediation objectives in the shortest period of time, and the cost is reasonable compared to other alternatives. The remedies selected in the previous RODs for the Refuge, including the MAOU, the PCB OU, and the EMMA OU, however, satisfied the statutory preference for treatment as a principal element of the remedy (i.e., reduced the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Five-Year Review

Because the remedy for Site 36 will result in hazardous substances, pollutants or contaminants (groundwater contamination) remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

F. DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary Section of this Record of Decision. Additional information can be found in the Administrative Record file for this site.

- Chemicals of concern and their respective concentrations. (Section E).
- Baseline risk represented by the chemicals of concern. (Section G).
- Cleanup levels established for chemicals of concern and the basis for these levels. (Section L).
- How source materials constituting principal threats will be addressed. (Section K).
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD. (Section F).
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy. (Section L).
- Estimated capital, annual operation and maintenance (O&M), total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected. (Section I).
- Key factors that led to selecting the remedy. (Section L).

G. AUTHORIZING SIGNATURES

Assistant Secretary for Policy, Management and Budget
Department of the Interior

Date 8/8/02

Super-fund Division @rector
United States Environmental Protection Agency
Region 5

Date 9/12/02

DECISION SUMMARY
SANGAMO ELECTRIC DUMP/CRAB ORCHARD NATIONAL WILDLIFE REFUGE (USDOI)
CARTERVILLE, ILLINOIS
SITE 36 AND OTHER SITES IN THE MISCELLANEOUS AREAS OPERABLE UNIT

SECTION A. SITE NAME, LOCATION, AND DESCRIPTION

Name and Location

This National Priority List (NPL) site is known as the Sangamo Electric Dump/Crab Orchard National Wildlife Refuge (USDOI)[3], Carterville, Illinois (Refuge). The subjects of this Record of Decision (ROD) are Sites 7, 7A, 8, 9, 10, 11, 11A, 12, 16, 20, 21, 22A, 24, 25, 26, 27, 30, 31, 35, and 36 of the Miscellaneous Areas Operable Unit (MISCA OU), part of this NPL site. There are four other MISCA OU sites that are not included in this ROD: Sites 13, 14, 18, and 34. Site 14 is the subject of a separate Record of Decision. Sites 13 and 18 were incorporated into the Additional and Uncharacterized Sites Operable Unit (AUS OU). Site 34 was formed into the Lake Monitoring Operable Unit.

CERCLIS ID Number

The United States Environmental Protection Agency (USEPA) Identification Project (CERCLIS) Number for this NPL site is IL8143609487.

Lead and Support Agencies

The Department of the Interior (DOI) is the lead agency and the USEPA, Region 5 and the Illinois Environmental Protection Agency (IEPA) are the support agencies for this project.

Site Type

All sites except 24, 25, and 26 are located on the Crab Orchard National Wildlife Refuge.

Sites 7, 8, 9, 10, 11, and 20 are segments of drainageways in or near an industrial area.

Site 7A is a possible chemical spill area on a lawn in an industrial area.

Sites 11A and 16 are areas surrounding industrial buildings.

Site 12 is a former impoundment for a former above ground storage tank near an industrial area.

Site 21 is a possible former dumping area.

Site 22A is a possible former post treatment facility in the maintenance yard in an industrial area.

[3] The USDOI in the NPL listing stands for the U.S. Department of Interior.

Site 24 is a drainageway adjacent to a soft drink bottling plant, located off-Refuge.

Site 25 is a segment of Crab Orchard Creek, near the former municipal landfill for the City of Marion, Illinois, located off-Refuge.

Site 26 is a segment of Crab Orchard Creek, downstream of a sewage treatment plant in the town of Marion, Illinois, located off-Refuge.

Site 27 is a segment of Crab Orchard Creek.

Sites 30 and 31 are control sites (background sites).

Site 35 is depression lacking vegetation in an agricultural field east of Area 9.

Site 36 is an existing wastewater treatment plant facility.

Site Description

The Refuge, which was established in 1947, consists of 43,500 acres located primarily in Williamson County in southern Illinois (Figure A-1). It features a large lake, Crab Orchard Lake, which was formed by damming Crab Orchard Creek. Figure A-2 shows the locations of the MISCA OU Sites addressed in this ROD and summarized below.

Site 7, the D Area Southeast Drainage Channel, is in industrial area referred to as the D Area. The channel discharges into Crab Orchard Lake. This site is shown on Figure A-3.

Site 7A, the D Area North Lawn, is in the same industrial area as Site 7. Barrels of chemicals were reportedly dumped at this site, shown on Figure A-3.

Site 8, the D Area Southwest Drainage Channel, is a segment of a perennial stream in the same industrial area as Sites 7 and 7A. This site is shown on Figure A-3.

Site 9, the P Area Northwest Drainage, is a segment of a perennial stream channel near an industrial area referred to as the P Area. This site is shown on Figure A-4.

Site 10, the Waterworks North Drainage, is in the same stream as Site 9, only further downstream. It is upstream of the former Refuge Waterworks. This site is shown on Figure A-4.

Site 11, the P Area Southeast Drainage, is a segment of a perennial stream channel near an industrial area. This site is shown on Figure A-4.

Site 11A, P Area North, is within the industrial area known as the P Area. This site is near an abandoned L-shaped covered walkway, a loading dock, and a steamhouse with a concrete pit. This site is shown on Figure A-5.

Site 12, the Area 8 Impoundment, is located within a dry, circular impoundment, in a former industrial area referred to as Area 8. This site is shown on Figure A-6.

Site 16, the Area 7 Industrial Park, includes portions of a building complex designated on the Refuge as Area 7 and portions of the drainageway that flows northward through the center of Area 7. This site is shown on Figure A-7.

Site 20, the D Area South Drainage Channel, is a segment of a drainageway in an industrial area referred to as the D Area. This site is shown on Figure A-8.

Site 21, the Southeast Corner Field, was identified as a possible former dumping area. The site, shown on Figure A-9, is located within a fenced area near the southeast corner of the Refuge.

Site 22A, the Former Post Treating Facility, was part of the maintenance yard in Area 4 and may have been a former wood-treating facility. This site is shown on Figure A-10.

Site 24, the Pepsi Plant West Drainage Ditch, is located near a Pepsi-Cola Bottling Company building. This site is not located on the Refuge and is shown on Figure A-11.

Site 25, Crab Orchard Creek at the Marion Landfill, is located near the former Marion municipal landfill. This site is not located on the Refuge and is shown on Figure A-12.

Site 26, Crab Orchard Creek below the Marion Sewage Treatment Plant, is downstream of Site 25. The Marion Sewage Treatment Plant discharges to Crab Orchard Creek. This site is not located on the Refuge and is shown on Figure A-12.

Site 27, the Crab Orchard Creek Dredge Area, is a segment of Crab Orchard Creek, in an area dredged a number of years ago. It is also located downstream of the Marion Sewage Treatment Plant. This site is shown on Figure A-12.

Site 30, the Munitions Control Site, is in a low-lying area surrounding bunkers that have been used for munitions storage. This site was used as a control (background) site for the 1988 Refuge-wide RI,[4] referred to in this document as the 1988 RI. This site is shown on Figure A-13.

Site 31, the Refuge Control Site, is on the north side of the Refuge, near the current Refuge Maintenance Shop. This site was also used as a control (background) site for the 1988 RI. This site is shown on Figure A-14.

Site 35, the Area 9 Waterway, is located in a depression in an agricultural field east of Area 9. The lack of vegetation in the depression, observed during the 1988 RI, suggested possible contamination. This site is shown on Figure A-15.

Site 36, the Refuge Wastewater Treatment Plant, is located north of Crab Orchard Lake and west of Route 148, as shown on Figure A-16. The site covers about 47 acres; the facility, which is currently in operation, occupies about one-third of the site. Site 36 includes the wastewater treatment structures, the former sludge drying beds, two unused ponds, two sewage lagoons that

[4] O'Brien and Gere Engineers, Inc. 1988/1989. Remedial Investigation Report/Feasibility Study Report, Crab Orchard National Wildlife Refuge. Completed for U.S. Fish and Wildlife Service, Marion, Illinois, and Sangamo Weston, Inc., Atlanta, Georgia.

are in use, the surrounding grounds, and ditches leading away from the site. The site is primarily grass-covered with some wooded areas (Figure A-17).

SECTION B. SITE HISTORY

History of Site Industrial Activities

During World War II, a portion of what is now the Refuge was the site of the Illinois Ordnance Plant (IOP), a bomb and munitions manufacturing facility operated by Sherwin Williams Defense Corporation for the War Department. When the war ended in 1945, the site was transferred to the War Assets Administration, and many former IOP buildings were leased to industrial tenants. The Refuge was created in 1947, with a multiple mission, including wildlife management, recreational and agricultural use, and industrial operations. Over the years, some 200 tenants have operated manufacturing and/or storage facilities under lease to the Department of the Interior/Fish and Wildlife Service (DOI/FWS) at the Refuge. Many of these have been small businesses or short-term tenants. Larger and/or longer term tenants have included manufacturers of ordnance and explosives, electrical components, inks and printing materials, machined and plated metal parts, various painted products, and boats.

History of Investigations

The NPL Site has been divided into several OUs, based on geography, contaminant sources, and contaminant types. The development of these OUs is discussed below.

A Refuge-wide Remedial Investigation (1988) and a Feasibility Study (1989) (O'Brien & Gere) (RI/FS)[5] were completed shortly after the NPL listing. The RI/FS identified seven sites that posed unacceptable risks to human health and the environment, and proposed remediation for these sites. Four of these were contaminated primarily with PCBs [polychlorinated biphenyls] and were formed into the PCB OU. Three were contaminated primarily with heavy metals and comprised the Metals OU. The RODs for the PCB and Metals OUs were signed in 1990. Remediation at both OUs is complete, except for the trichloroethylene (TCE) contamination at Sites 32/33 of the PCB OU.

In addition to the sites requiring remediation, the 1988 RI identified twenty-two sites as requiring no further work or needing further investigation, monitoring, or maintenance. DOI, the Department of the Army, the USEPA, and the IEPA entered into a Federal Facilities Agreement (FFA) in 1991,[6] which defined roles and responsibilities for the CERCLA investigations and remediation.

[5] O'Brien and Gere Engineers, Inc. 1988/1989. Remedial Investigation Report/Feasibility Study Report, Crab Orchard National Wildlife Refuge. Completed for U.S. Fish and Wildlife Service, Marion, Illinois, and Sangamo Weston, Inc., Atlanta, Georgia.

[6] U.S. Environmental Protection Agency, Region V, and the Illinois Environmental Protection Agency, and the United States Department of the Interior, and the United States Department of the Army, 1991. Federal Facilities Agreement Under CERLCA Section 120, in the Matter of the U.S. Department of the Interior's Crab Orchard National Wildlife Refuge. September 1991.

The FFA for the Refuge designated these twenty-two sites, plus Site 36 as the MISCA OU. The FFA assigns the DOI the role of lead agency for the MISCA OU. The DOI added another site, Site 22A to the MISCA OU. The sites comprising the MISCA OU and the action related to each of these sites are summarized in Table B-1.

DOI completed a Remedial Investigation/Baseline Risk Assessment (RI) of these 24 sites in two phases from 1993 to 1995[7]. This RI investigated thirteen sites (Sites 7, 7A, 8, 9, 10, 11, 11A, 12, 14, 16, 20, 22A and 36). The remaining eleven sites (13, 18, 21, 24, 25, 26, 27, 30, 31, 34, and 35) were excluded from investigation as part of the MISCA OU RI. In October 1997, Sites 13 and 18 were incorporated into the AUS OU. In October 1999, DOI completed a RI Addendum[8] to further delineate the contamination at Sites 14 and 36. In August 2000 and December 2000, DOI completed Feasibility Study Reports for Sites 14[9] and 36[10], respectively. Site 14 is the subject of a separate ROD. Site 34 formed the Lake Monitoring OU.

SECTION C. COMMUNITY PARTICIPATION

Public Participation Requirements of CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)

A Community Relations Plan was developed in 1989 and revised in 1992 to document community concern and to plan public involvement activities. Interviews of the community were conducted in 1994 to re-assess community concerns. A number of public meetings were held to keep the public informed of activities at the site. Public meetings specific to the MISCA OU included those held in April 1994, December 1996, September 2000, and January 2001. DOI has also sent out fact sheets and issued news releases at various times during the RI/FS and removal action process. Fact sheets specific to the MISCA OU were issued in March 1994, May 1996, December 1996, September 2000, and December 2000.

A removal action was conducted at Site 22A in 1996. A fact sheet was sent out in May 1996 and a news release issued on July 8, 1996 announcing a cleanup was being conducted to remove contaminated soils. The notice of availability of the administrative record was published in the Marion Daily Republican, a local newspaper, on June 30, 1996 and July 1, 1996.

The Proposed Plan for Site 36 of the MISCA OU at the Crab Orchard National Wildlife Refuge was made available to the public on December 15, 2000. Copies of the Proposed Plan were sent to people on the Refuge CERCLA mailing list, and copies were placed in the information repositories. The notice of the availability of the Proposed Plan and administrative record, and the notice of the public meeting were published in the Marion Daily Republican and the

[7] Woodward-Clyde (W-C). 1996. Final RI Report, Remedial Investigation Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois (Williamson County).

[8] URS Greiner Woodward-Clyde (URS). 1999. Draft Final RI Addendum Report, Sites 14 and 36 Investigations. Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County).

[9] URS Corporation (URS). 2000. Final Feasibility Study. Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County). Volume I, Site 14.

[10] URS Corporation (URS). 2000. Final Feasibility Study. Miscellaneous Areas Operable Unit. Crab Orchard National Wildlife Refuge Superfund Site. Marion, Illinois (Williamson County). Volume II, Site 36.

Southern Illinoisian, the two local newspapers of widest circulation, on December 14, 2000. A public comment period was held from December 15, 2000 to January 16, 2001. A public meeting was held on January 11, 2001 to present the Proposed Plan to a broader community audience than those that had already been involved at the site. At this meeting, representatives from USEPA, IEPA, and DOI answered questions about problems at the site and the remedial alternatives. A court reporter was present to record comments. No comments were made. No comments were received during the comment period.

The Proposed Plan and other CERCLA-related documents for the MISCA OU and the other Refuge OUs are available for public review at the following repositories:

U.S. Fish and Wildlife Service
Refuge Headquarters
8588 Route 148
Marion, IL 62959
(618) 997-3344, Ext. 361

Morris Library
Southern Illinois University-Carbondale
Carbondale, IL 62901
(618) 453-2818

The Administrative Record file is located at the FWS Refuge Headquarters listed above.

Views on Future Land Use and Future Beneficial Use of Water

DOI solicited public views on land and water use on the Refuge and is in the process of developing a Comprehensive Conservation Plan (CCP) for the Refuge. The CCP is a long-term plan that guides management decisions and identifies Refuge's goals, objectives, and strategies for achieving the Refuge system mission. It provides other Agencies and the public with clear understanding of the desired future conditions of the Refuge and how the FWS will implement management strategies. There will be additional opportunities for public comment.

SECTION D. SCOPE AND ROLE OF OPERABLE UNIT

The scope and role of the operable unit was discussed in Section B, above. The MISCA OU is one of seven OUs on the Refuge.

SECTION E. SUMMARY OF SITE CHARACTERISTICS

E.1 Conceptual Site Models

This section summarizes the baseline ecological (BERA) and human health risk assessments conducted during the MISCA OU RI. Eight of the subject sites were excluded from the RI during the work planning process: Sites 21, 24, 25, 26, 27, 30, 31, and 35. These sites are discussed further below.

The BERA was conducted at twelve of the subject sites (7, 7A, 8, 9, 10, 11, 11A, 12, 16, 20, 22A, and 36). Sampling was conducted at all but three of these sites (7, 7A, and 8), which were judged to represent little likelihood of ecological risk. The purpose of the BERA was to determine the likelihood that adverse ecological effects may occur or are occurring as results of exposure to existing (i.e., baseline) conditions at the MISCA OU sites. The results of this study were used to identify sites where no further action is needed and to rank the remaining sites according to degree of concern.

Human health risk assessments were conducted only at Sites 22A and 36. Detailed discussions of the methods, assumptions and results from the ecological and human health risk assessments are contained in Appendices B and C of the 1996 RI report, respectively. Human health risk assessments were not done for the rest of the subject sites based on the conclusion of the 1996 RI that there was little likelihood of potential human health risks associated with these sites.

The conceptual model, which is qualitative in nature, provides both the basis and guidance in conducting the quantitative, analytical phase of the risk assessment. The conceptual model is derived by tracing the chemicals of concern (COCs) from their source to the receptors. For sites that were included in the BERA and that contained permanent water bodies, receptors of primary concern were aquatic biota and those animals which prey on the aquatic biota: great blue heron and raccoons. At the other sites that were included in the BERA (Sites 11A, 12, 16, 20, and 22A) where terrestrial contamination was the primary concern, deer, quail, mice and robins were selected as receptors of potential concern (plus fox and hawk at Site 22A).

Table E-1 summarizes the conceptual models derived for eight of the sites for which additional analysis was required: 9, 10, 11, 11A, 12, 16, 20 and 22A.

E.1.1 Sites 24, 25, 26, 30 and 31

Sites 24, 25 and 26 are not located within Refuge boundaries. Based on the conclusions of the 1988 RI, the FFA stated that no further work was necessary at Sites 24, 25, and 26. Therefore, these sites were not included in any of the Phase I or Phase II RI activities.

Sites 30 and 31 were control sites (used to determine Refuge background values) therefore no contamination was expected at either of the sites. Sites 30 and 31 were excluded from the MISCA RI during the work planning process, so these sites were not evaluated further during the Phase I or the Phase II RI activities.

E.1.2 Sites 7, 7A, 8, 21, 27, and 35

Human Health Risk

The 1996 RI concluded that there was no evidence of contamination at any of these sites. Therefore, no human health risk assessment was done for Sites 7, 7A, 8, 21, 27, and 35.

Ecological Risk

Sites 7, 7A, 8, 21, 27 and 35 were all evaluated in the Preliminary Ecological Risk Assessment (PERA) (1996 RI). At Sites 7 and 8, the results for all of the constituents detected were below the preliminary levels of concern (PLCs). At Site 7A, manganese was the only constituent detected above PLCs; however, the detection was within the background range for the Refuge.

At Sites 21, 27, and 35, the 1988 RI concluded that conditions sites did not represent a significant risk to human or ecological receptors. As a result, no sampling was done at Sites 21, 27 or 35 during either the 1993 Phase I or 1996 Phase II RI, although an ecological field reconnaissance was done at each of these sites (along with Sites 7, 7A and 8). A more in-depth preliminary site assessment was done for Sites 21 and 27 during the MISCA 1993 Phase I RI, and the site histories showed no evidence of possible sources of contamination at these sites. As a result, no further assessment was done for these sites.

E.1.3 Conceptual Site Model for Site 9

Human Health Risk

The 1996 RI reported that there was little likelihood of potential human health risk at this site because of the minimal evidence of contamination. Therefore, a human health risk assessment was not done.

Ecological Risk

The following information is from the 1996 RI Report.

This site is located in a perennial stream situated in a bottomland hardwood community. Aquatic biota both on and off-site, are potentially at risk from exposure to the one constituent of concern, silver, that was detected in the stream sediment sample. The report concluded that the elevated silver at this site is probably reflective of natural variability in this region rather than an indication of anthropogenic activity. Nonetheless, silver was retained in the analysis. Aquatic organisms could be exposed by direct exposure to the sediments and surface water and by consumption of sediment both at the site and downstream, where contaminants could be transported.

Since raccoons and great blue herons are top predators of aquatic prey, they were chosen as the terrestrial receptors for this site. Exposure for raccoons and herons would occur primarily via ingestion of drinking water, sediment and food (i.e., aquatic prey).

E.1.4 Conceptual Site Model for Site 10

Human Health Risk

The 1996 RI reported that the Refuge restricts human use of Site 10, and anticipates future restrictions on human use at the site. The report states “a human health risk assessment was not

conducted at Site 10 since a completed exposure pathway for human risk does not exist at this site."

Ecological Risk

The following information is from the 1996 RI Report.

This site is located in a perennial stream and the upper reaches of a beaver pond. Aquatic organisms both on and off-site (Crab Orchard Lake), are potentially at risk from exposure to the COCs detected in the stream sediment samples. The sources of these chemicals are presumably the cumulative loads associated with the industrial complexes located upstream of the site. Aquatic organisms could be exposed by direct contact to the sediments and surface water and by consumption of sediment and food both at the site and downstream, where these chemicals would be transported.

Since raccoons and great blue herons are top predators, they were chosen as the terrestrial receptors for this site. Raccoons and herons could be exposed through ingestion of drinking water, sediment and food (i.e., aquatic prey that bioconcentrate these compounds).

E.1.5 Conceptual Site Model for Site 11

Human Health Risk

The 1996 RI reported that there was little likelihood of potential human health risk. Therefore, a human health risk assessment was not done.

Ecological Risk

The following information is from the 1996 RI Report.

This site is located in a narrow drainage way that develops eventually into a perennial stream. Aquatic and terrestrial organisms, both on and off-site, are potentially at risk from exposure to silver, which was detected in the stream sediment sample. The report concluded that the elevated silver at this site is probably reflective of natural variability in this region rather than an indication of anthropogenic activity. Nonetheless, silver was retained in this analysis. Aquatic organisms could be exposed by direct exposure to the sediments and surface water and by consumption of sediment and food both at the site and downstream, where silver could be transported.

Since raccoons and great blue herons are top predators of aquatic prey, they were chosen as the terrestrial receptors for this site. Exposure for raccoons and herons could occur primarily via ingestion of drinking water, sediment and food (i.e., aquatic prey).

E.1.6 Conceptual Site Model for Site 11A

Human Health Risk

The 1996 RI reported that there was little likelihood of potential human health risk at this site. Therefore, a human health risk assessment was not done.

Ecological Risk

The following information is from the 1996 RI Report.

The habitat at the site is essentially a lawn area. As such, terrestrial organisms are the primary receptors at risk from exposure to the volatile organics and metals identified at this site. The source of these contaminants is presumably associated with industrial facilities, as the site is a series of drainage ways that carry runoff from the industrial facility (Figure A-5). Deer, quail, mice and robins were chosen as the most appropriate terrestrial receptors. These animals could be exposed through ingestion of soil and food.

Exposure of aquatic organisms to these COCs might occur during and following heavy rains when water and soils may run off the site into the permanent stream flowing through Sites 9 and 10 or if groundwater transports chemicals from the site to nearby surface waters. However, exposures associated with either of these possibilities would be infrequent and short in duration and exceedingly low in magnitude, given dilution with surface runoff and stream flow. In any case, potential risks associated with this off-site transport are indirectly evaluated as part of the assessments of Sites 9 and 10.

E.1.7 Conceptual Site Model for Site 12

Human Health Risk

The 1996 RI reported that there was little likelihood of potential human health risk. Therefore, a human health risk assessment was not done.

Ecological Risk

The following information is from the 1996 RI Report.

The habitat at the site is primarily terrestrial. Therefore, deer, quail, mice and robins were chosen as the most appropriate terrestrial receptors. These animals are potentially at risk from exposure to two volatile organics, acetone and methyl ethyl ketone (MEK); two polynuclear aromatic hydrocarbons (PAHs), phenanthrene and pyrene; and silver detected in soil samples from this site. The source of the elevated soil concentrations is likely related to historical and/or existing industrial use of the site. Deer, quail, mice and robins could be exposed through ingestion of soil and food, plus inhalation of acetone and MEK in air vapors.

Exposure of aquatic organisms to these COCs will be chiefly restricted either to: (1) periods during and following heavy rains when water and soils may run off the site into permanent

streams; or, (2) sites where groundwater might carry these chemicals from the site into nearby surface waters. However, exposures associated with either of these possibilities would be infrequent and short in duration and exceedingly low in magnitude, given dilution with surface runoff and stream flow. Hence, risks to aquatic biota associated with off-site migration of chemicals from this site were not quantified.

E.1.8 Conceptual Site Model for Site 16

Human Health Risk

The 1996 RI reported that the Refuge restricts human use of Site 16, and anticipates future restrictions on human use at the site. The report states "a human health risk assessment was not conducted at Site 16 since a completed exposure pathway for human risk does not exist at this site."

Ecological Risk

The following information is from the 1996 RI Report.

The habitat at this site is primarily terrestrial with a drainage way consisting of an intermittent stream. Terrestrial organisms are potentially at risk from the volatile organics, Aroclors and metals identified at this site. The source of these chemicals is related to historical and/or present use of the industrial park. Deer, quail, mice and robins were chosen as the most appropriate terrestrial receptors, given the nature of the site. These animals could be exposed through ingestion of soil and food, and inhalation of vapors potentially contaminated by volatile organics. Risks to aquatic organisms would be largely restricted to periods following heavy rainfalls when these constituents might be carried off site to an intermittent stream that eventually discharges into Crab Orchard Lake. However, these exposures would be infrequent and short in duration and exceedingly low in magnitude, given dilution with surface runoff and stream flow. Hence, risks to aquatic biota associated with off-site migration of chemicals from this site were not quantified.

E.1.9 Conceptual Site Model for Site 20

Human Health Risk

The 1996 RI reported that there was little likelihood of potential human health risk. Therefore, a human health risk assessment was not done.

Ecological Risk

The following information is from the 1996 RI Report.

The habitat at this site is primarily terrestrial with a drainage way that receives runoff from the vicinity. Thus, terrestrial organisms (i.e., deer, quail, robin and mouse) are potentially at risk from silver and lead detected in soils at this site. The source of these metals might be related to

historical industrial use at the site, but may also reflect natural variability in the region, particularly for silver. Receptors could be exposed through ingestion of soil and food.

Risks to aquatic organisms would be largely restricted to periods following heavy rainfalls when the metals might be carried off-site to a stream that discharges into Crab Orchard Lake. However, these exposures would be infrequent and short in duration and exceedingly low in magnitude, given dilution with surface runoff and stream flow. Hence, risks to aquatic biota associated with off-site migration of chemicals from this site were not quantified.

E.1.10 Conceptual Site Model for Site 22A

Human Health Risk

The following information is from the 1996 RI Report.

The conceptual site model (CSM) is a schematic representation of the contaminant source areas, chemical release mechanisms, environmental transport media, potential human intake routes, and potential human receptors. A CSM should identify complete exposure pathways that result in significant human exposure and indicated the data needed to evaluate those pathways.

The potential receptors evaluated at this site were site workers, hypothetical construction workers, and hypothetical recreational receptors/trespassers considering current and reasonably anticipated future land use scenarios for Site 22A.

Site 22A is located adjacent to the former Refuge shop and maintenance yard in Area 4 West. Site 22A consists of an area where posts were treated with wood preservatives during the 1950s and early 1960s. It is believed that the posts were dipped into a tank of wood preservative then placed in the open to dry. The tank is believed to have formerly been located in a small building/shed. The posts were set out to dry in a gravel area, which extended from the building to the west. The area of concern at Site 22A is the area surrounding the location of the former small building/shed and gravel pad.

A potential source of chemical releases at this site may be wood preservatives released to the soil. The mixing with soil is the primary potential chemical release mechanism. Once released to the soil, the chemicals may then be released to groundwater by infiltration/percolation, to the atmosphere by volatilization or wind erosion, or they could be transported by storm water. Direct contact with the contaminated soil could also occur.

Direct contact with surface soil by site workers and recreational receptors and surface and subsurface soil by hypothetical construction workers represented potentially complete ingestion and dermal contact pathways. Inhalation of volatile emissions and particulate matter from soil represented a potentially complete pathway for site workers, recreational receptors/trespassers, and hypothetical construction workers.

Storm water runoff from the gravel pad and surrounding area could carry contaminants to sediment in the drainage way north of the site. Potential exposures to the sediments within the drainage way by site workers, recreational receptors/trespassers, and hypothetical construction

workers represented potentially complete ingestion and dermal contact pathways. Air, contaminated either by volatilization of contaminants from sediments or airborne particulate matter, represented a potentially complete inhalation pathway to site workers, recreational receptors, and hypothetical construction workers at the site.

Contaminants could potentially be carried downgradient to Pigeon Creek or Crab Orchard Lake. However, exposure to surface water and sediments was considered an insignificant pathway because sediments are covered by lake water, and only boat fishing is allowed in the area of the lake downgradient from Site 22A. The primary exposure to the recreational receptors/trespassers is through uptake and ingestion of caught fish. However, to be conservative, surface water and sediment concentrations in the creek and lake were evaluated based on contaminant concentrations at the site. In addition, potential recreational receptors/trespassers exposures to these downgradient concentrations were evaluated using fish concentrations modeled with sediment and groundwater concentrations at the site (whichever provides the highest fish concentrations). This is a conservative approach because contaminants are not likely to be transported approximately 1,000 feet to Pigeon Creek. Additionally, if a contaminant were transported to Pigeon Creek or Crab Orchard Lake, the volume of non-site related water would significantly dilute its concentration. Recreational receptors/trespassers may also be exposed to site contaminants via ingestion of deer meat from hunted deer, which may graze on the site.

In the baseline risk assessment, groundwater was judged to be an incomplete exposure pathway for receptors at Site 22A because there is currently no public or domestic use of groundwater on the Refuge. However, groundwater may migrate from this site and discharge downgradient to streams or Crab Orchard Lake. Potential surface water concentrations were evaluated based on groundwater concentrations at the site. This pathway was also indirectly evaluated based on the ingestion of caught fish from these water bodies.

In summary, potentially complete human exposure pathways evaluated in the risk assessment are:

Site Workers

- Ingestion of and dermal contact with surface soils and sediments along drainage ways
- Inhalation of volatile emissions or airborne particulate matter from surface soils and drainage way sediments

Hypothetical Construction Workers

- Ingestion of and dermal contact with soils (surface and subsurface) and sediments along the drainage ways
- Inhalation of volatile emissions or airborne particulate matter from soils and drainage way sediments

Recreational Receptor/Hypothetical Trespasser

- Ingestion of and dermal contact with surface soils and sediments along the drainage way

- Inhalation of volatile emissions and airborne particulate matter from surface soil, including drainage way sediments

Ecological Risk

The following information is from the 1996 RI Report.

The habitat at this site is primarily terrestrial with an intermittent stream channel providing drainage. Terrestrial organisms are the primary receptors at risk from exposure to the volatile organics, PAHs, pentachlorophenol, pesticides, dioxins/furans and metals detected at this site. The potential source of these contaminants is related to the historical use of this site for treating poles. Deer, quail, mice, robins, hawks and fox could be exposed through ingestion of soil and food, and inhalation of air vapors.

Exposure of aquatic organisms to these COCs will be chiefly restricted either to: (1) periods during and following heavy rains when potentially contaminated water and soils may run off the site into intermittent or permanent streams; or, (2) sites where potentially contaminated groundwater discharges into surface water. However, these exposures would be infrequent and short in duration and exceedingly low in magnitude, given dilution with surface runoff and stream flow. The lack of significant off-site migration is also supported by the results of chemical and toxicological analysis of sediments from the stream adjacent to this site. Hence, risks to aquatic biota associated with off-site migration of chemicals from this site were not quantified.

E.1.11 Conceptual Site Model for Site 36

Human Health Risk

The routes by which a person could be exposed to contamination were identified. Each route of exposure was evaluated for the potential receptors. This information is discussed in the baseline human health risk assessment (1996 RI) which assessed potential health risks associated with exposure of three receptor groups: site workers, hypothetical construction workers, and hypothetical recreational receptors.

Potentially complete exposure pathways for site workers include ingestion, dermal contact, and inhalation of contaminants in surface soil and sludge. Potentially complete exposure pathways for construction workers include ingestion, dermal contact, and inhalation of contaminants in surface and subsurface soil, sediment, sludge, and surface water. Potentially complete exposure pathways for recreational receptors include ingestion, dermal contact, and inhalation of surface soil, sediment, and surface water and ingestion of fish and deer. The risk assessment considered analytical data collected from sampling of lagoon and pond sludge; surface soil; sediment along ditches and creeks; and surface water in the lagoons, East Pond, and creeks.

Ecological Risk

The overall study area for Site 36 is about 47 acres, approximately one-third of which is presently occupied by the wastewater treatment facility (Figure A-17). Following removal of the wastewater treatment plant and associated ponds and lagoons, Site 36 will become an upland terrestrial habitat. Upper Dove Creek, the wastewater treatment plant outfall channel, will be removed and filled. The entire site will become a functional component of the overall ecosystem within the Refuge. Ecological communities, including microbes, invertebrates, plants, reptiles, amphibians, birds and mammals were considered relevant to the evaluation. In consideration of the anticipated future ecological structure within Site 36, both in the short term and long term, nine assessment endpoints were developed, as follows:

Site 36 Soil

- Impaired survival and/or growth of microbes, vascular plants, invertebrate detritivores, and fossorial or ground foraging vertebrates exposed to MEK, acetone, and methylene chloride in soil.

- Impaired survival and/or growth of soil invertebrates and fossorial or ground gleaning or probing vertebrates exposed to PAHs in soil.

- Impaired reproduction of ground gleaning or probing secondary consumers exposed to PAHs by extensively feeding on soil invertebrates that have limited capacity to metabolize PAHs accumulated from soil.

- Impaired survival, growth, reproduction and/or development of soil microbes, vascular plants, soil invertebrates, and fossorial, ground probing or gleaning vertebrate consumers exposed to 3-nitroanaline and n-nitrosodiphenylamine in soil and accumulated into dietary forage from soil.

- Impaired survival and/or reproduction of soil invertebrates exposed to PCBs, aldrin, chlordane, DDE, DDT, endrin, and 2,3,7,8-Tetrachlorodibenzo-p-dioxin toxicity equivalent (TCDD TEQ) in soil.

- Impaired reproduction of vertebrate consumers exposed to PCBs, aldrin, chlordane, DDE, DDT, endrin, and TCDD TEQ in soil and accumulated into dietary forage.

- Impaired survival, growth, reproduction and/or development of vascular plants, soil microbes, invertebrates and fossorial or ground gleaning primary and secondary consumers exposed to antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, and/or zinc in soil and accumulated into dietary forage.

Site 36 – Dove Creek

- Impaired survival and/or reproduction of benthic invertebrate detritivores exposed to PCBs, aldrin, chlordane, DDE, DDT, endrin, and heptachlor in sediment.

- Impaired reproduction of vertebrate consumers, specifically those that fed extensively on benthic detritivores, exposed to PCBs, aldrin, chlordane, DDE, DDT, endrin, and heptachlor in sediment and accumulated into benthic macroinvertebrates.

Conceptual exposure models were also developed for Site 36 based on the anticipated ecological community structure, employing the concept of ecological guilds. An ecological guild is a grouping of species by ecologically relevant functional groups (e.g., decomposers[11], primary producers[12], herbivores[13], omnivores[14], insectivores[15], etc.) and by feeding behaviors (ground-gleaning, aerial hawking, etc.). Through this categorization, those guilds with the greatest potential for exposure to contaminants of potential ecological concern (COPECs) were identified from which specific species were selected to represent the ecological guild (i.e., used as the receptors of concern). Certain animals were considered to be essentially resident within the site (e.g., soil invertebrates, small rodents, shrews, etc.) while for others, the site represents only a portion of their home range (e.g., the bobcat, fox, hawk, etc.). For a given level of contamination within relevant media, the potential adverse effect to various species within the ecosystem at risk was found to be highly variable due to differences in area use.

E.2 Site Overview

This section contains the following information for each subject site of this ROD:

- history of the site
- size of the site
- geographical and topographical features
- surface and subsurface features
- areas of archaeological or historical importance
- sampling strategy
- suspected sources of contamination
- types of contamination and the affected media

Additional contaminant information for Site 36 is presented in Section E.3.

The sites comprising the MISCA OU and the action related to each of these sites are summarized in Table B-1. The MISCA OU sites investigated are presented in Figure A-2 and described below.

E.2.1 Site 7, D Area Southeast Drainage Channel

The D Area was the former IOP Detonator Loading Line. Since the 1950s, this area has been leased by industrial tenants for explosives and munitions manufacturing.

[11] Organisms that break down organic material, such as bacteria and fungi.

[12] Plants.

[13] Organisms that eat plants.

[14] Organisms that eat both plants and animals.

[15] Organisms that eat insects.

Site 7 is located in an intermittent stream located to the southeast of the D Area. The site includes only those sample locations shown on Figures A-3 and E-1 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-3 shows the features of Site 7. The stream flows south and southwest and it discharges into Crab Orchard Lake. Other than the intermittent stream as discussed above, there are no other distinguishing surface or subsurface features associated with this site.

No areas of known archaeological or historical importance are located at Site 7.

The suspected source of contamination at this site is industrial discharges into streams and drainage ditches from industrial activities in Area 2.

The previous investigations at Site 7 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The results from the 1993 RI and the 1996 RI are both reported in the 1996 RI Report. The limits of Site 7 are defined by the sample locations and the sample depths described below.

1988 RI

One composite surface water sample and one composite sediment sample (0 to 1 foot deep) were collected from this site during the 1988 RI. The 1988 RI sample locations for Site 7 are shown on Figure E-1.

1993 Phase I RI

One composite soil sample (1.7 to 1.8 feet deep) and one discreet soil sample (1.9 feet deep) were collected from this site during the Phase I RI. Samples collected during the 1996 RI were analyzed for explosives and for the CERCLA target analyte list (TAL) of inorganic constituents and the target compound list (TCL) of organic constituents. The TCL list includes volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and PCBs. The TAL list includes inorganic compounds such as metals and cyanide. The 1993 Phase I RI sample locations for Site 7 are shown on Figure A-3 of this report.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

Mercury was detected during the 1988 RI in a composite sediment sample and its duplicate (0.040 milligrams per kilogram (mg/kg) and 0.3 mg/kg, respectively).

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.2 Site 7A, D Area North Lawn

This site is also in the D Area. Site 7A is located in a 3-acre lawn to the northwest of the D Area building complex. This site includes only those sample locations shown on Figures A-3, E-2 and E-3 of this report. These sample locations were collected from a three-acre lawn area; however, the entire lawn area was not included in this site – only the former sample locations are a part of this site. These sample locations were not surveyed, but they can be approximated from the figure.

Figures A-3 and E-2 show the features of Site 7A. Runoff from this site drains to an un-named drainage way that flows approximately 2500 feet and discharges into Crab Orchard Lake. It was reported at this site that barrels of chemicals were dumped on a knoll in this lawn area; however, there was no evidence of a knoll on site. There were a few depressions in the lawn area. There were no other surface or subsurface features observed in this area.

No areas of known archaeological or historical importance are located at Site 7A. Barrels of chemicals were reportedly dumped at this site.

The previous investigations at Site 7A included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 7A are defined by the sample locations and the sample depths described below.

1988 RI

Composite soil samples were collected at three transect locations and at the location of a low spot at this site, during the 1988 RI. Samples were collected from depth intervals of 0-6 inches, 6-12 inches, 1-2 feet and 2-3 feet at each sample location. The 1988 RI sample locations can be located using Figures E-2 and E-3 of this report.

1993 Phase I RI

Four composite soil samples (ranging from 1.4 to 1.7 feet deep) and four discreet soil samples (ranging from 1.8 to 1.9 feet deep) were collected from this site during the Phase I RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1993 Phase I RI sample locations for Site 7A are shown on Figure A-3 of this report.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

Magnetometer and electromagnetic surveys done during the 1988 RI did not detect anomalies suggestive of buried metallic objects; however, mercury was detected in six composite soil samples at concentrations ranging from 0.022 mg/kg to 0.029 mg/kg.

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.3 Site 8, D Area Southwest Drainage Channel

Site 8 is located in a perennial stream to the south of the D Area that receives surface runoff from the active industrial facility in the D Area. This site includes only those sample locations shown on Figures A-3 and E-1 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-3 shows the features of Site 8. The stream flows to the southwest for approximately 4,000 feet and it discharges into Crab Orchard Lake. There are no other distinguishing surface or subsurface features associated with this site.

No areas of known archaeological or historical importance are located at Site 8.

The suspected source of contamination at this site is industrial discharges into streams and drainage ditches from industrial activities in Area 2.

The previous investigations at Site 8 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 8 are defined by the sample locations and the sample depths described below.

1988 RI

One composite surface water and one composite sediment sample (0 to 1 foot deep) were collected from this site during the 1988 RI. The 1988 RI sample locations for Site 8 are shown on Figure E-1.

1993 Phase I RI

Two composite soil samples (ranging from 1.6 to 1.7 feet deep) and two discreet soil samples (ranging from 1.6 to 1.7 feet deep) were collected from this site during the Phase I RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1993 Phase I RI sample locations for Site 8 are shown on Figure A-3.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

The only reported organic constituent from the 1988 RI was 4,4-DDT at concentration of 22 micrograms per kilogram (ug/kg) (wet weight basis). No SVOC results were reported. Based on the 1988 RI criteria, this detection was not considered to be of concern. No metals were detected above levels of concern.

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.4 Site 9, P Area Northwest Drainage

Site 9 is located in a perennial stream to the northwest of the P Area. The P Area was the former IOP Primer Loading Line, and was later used by industrial tenants for explosive and munitions manufacturing. This site includes only those sample locations shown on Figures A-4 and E-1 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-4 shows the features of Site 9. This stream segment receives runoff from munitions manufacturing facilities in the D and P Areas. The stream flows to the southwest and discharges into Crab Orchard Lake. There are no other distinguishing surface or subsurface features associated with this site.

No areas of known archaeological or historical importance are located at Site 9.

The suspected source of contamination at this site is industrial discharges into streams and drainage ditches from industrial activities in Area 2.

The previous investigations at Site 9 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 9 are defined by the sample locations and the sample depths described below.

1988 RI

One composite surface water and one composite sediment sample (0 to 1 foot deep) were collected from this site during the 1988 RI. The 1988 RI sample locations for Site 9 are shown on Figure E-1.

1993 Phase I RI

Two composite soil samples (ranging from 2.0 to 2.1 feet deep) and one discreet soil sample (from 1.8 feet deep) were collected from this site during the Phase I and were analyzed for explosives, CERCLA TAL inorganics, and TCL organics. The 1993 Phase I RI sample locations are shown on Figure A-4.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

Low levels of PCBs and mercury were detected during the 1988 RI.

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.5 Site 10, Waterworks North Drainage

Site 10 is partially located in the southwest-flowing perennial stream to the northwest of the P Area (downstream from Site 9) and is partially located in a southeast-flowing drainage way that is located just west of the Sites 9/10 perennial stream. This site includes only those sample locations shown on Figures A-4, E-1 and E-4 of this report. This site has samples located in a perennial stream and in a drainage way. These sample locations were not surveyed, but they can be approximated from the figure.

Figures A-4 and E-4 show the features of Site 10. As discussed above, the site is located in perennial stream and partially in a drainage way. The second (southeast-flowing) drainage way discharges into the (southwest flowing) stream which discharges into Crab Orchard Lake. There are no other distinguishing surface or subsurface features associated with this site.
No areas of known archaeological or historical importance are located at Site 10.

The suspected source of contamination at this site is industrial discharges into streams and drainage ditches from industrial activities in Area 2.

The previous investigations at Site 10 included the 1988 RI, the 1993 Phase I RI, and the 1996 Phase II RI. The limits of Site 10 are defined by the sample locations and the sample depths described below.

1988 RI

Two composite surface water samples, one composite sediment sample (0 to 1 foot deep), and five grab sediment samples (0 to 1 foot deep) were collected from this site during the 1988 RI. The 1988 RI sample locations for Site 10 are shown on Figure E-1.

1993 Phase I RI

Two composite soil samples (ranging from 1.5 to 2.3 feet deep) and two discreet soil samples (ranging from 1.6 to 1.7 feet deep) were collected from this site during the Phase I RI. These samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1993 Phase I RI sample locations are shown on Figure A-4.

1996 Phase II RI

Two discreet soil samples (from 0.2 to 1.0 feet deep), seven discreet sediment samples (ranging from 1.0 to 3.0 feet deep), three composite sediment samples (ranging from 0.0 to1.0 feet deep), and two surface water samples were collected during the 1996 Phase II RI. Samples collected during the Phase II RI were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1996 Phase II RI sample locations are shown in Figure E-4.

Results

During the 1988 RI, two SVOCs, bis(2-ethylhexyl)phthalate and n-nitrosodimethylamine, were detected at the estimated concentrations of 540 ug/kg and 270 ug/kg, (wet weight basis)

respectively, in a composite sediment sample taken at the stream discharge area in Crab Orchard Lake. Based on the 1988 RI criteria, none of these detections were considered to be of concern. No inorganics were detected above levels of concern.

In the 1996 Phase II RI, trichloroethene and 1,2 dichloroethene were detected at Site 10, but the concentrations were well below their PLCs, and were not evaluated further. Benzo(a)anthracene and benzo(b)fluoranthene were detected above their PLCs.

E.2.6 Site 11, P Area Southeast Drainage

Site 11 is located in a narrow drainage way southeast of the P Area. This stream segment receives runoff from parts of the active industrial facility at the P Area. This site includes only those sample locations shown on Figures A-4 and E-1 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-4 shows the features of Site 11. The drainage way flows to the southeast, then to the south and then to the southwest (approximately 3,000 feet) and it discharges into Crab Orchard Lake.
This site is located in a narrow drainage way as discussed above. There are no other distinguishing surface or subsurface features associated with this site.

No areas of known archaeological or historical importance are located at Site 11.

The suspected source of contamination at this site is industrial discharges into streams and drainage ditches from industrial activities in Area 2.

The previous investigations at Site 11 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 11 are defined by the sample locations and the sample depths described below.

1988 RI

One composite surface water and one composite sediment sample (0 to 1 foot deep) were collected from this site during the 1988 RI. 1988 RI sample locations for Site 11 are shown on Figure E-1.

1993 Phase I RI

One composite soil sample (from 1.7 to 1.9 feet deep) and one discreet soil sample (from 1.3 feet deep) were collected from this site during the Phase I RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1993 Phase I RI sample locations are shown on Figure A-4.

1996 Phase II RI

No additional sampling was done at this site during the Phase II RI.

Results

During the 1988 RI, the following VOCs were reported at the noted estimated concentrations in the sediment samples (wet weight basis): 1,1-dichloroethene at 14 ug/kg, carbon disulfide at 3 ug/kg, chlorobenzene at 2 ug/kg, chloroform at 6 ug/kg, toluene at 2 ug/kg. The following SVOCs were reported at the noted concentrations in the sediment samples (wet weight basis): methylnaphthalene at 4 ug/kg, benzyl alcohol at 8 ug/kg, and n-nitrosodimethylamine at 63 ug/kg (estimated). Based on the 1988 RI criteria, none of these detections were considered to be of concern. No inorganics were detected above levels of concern.

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.7 Site 11A, P Area North

Site 11A is located in the northern portion of the P Area, near several existing buildings that were reportedly used for storage of materials for explosives production. This site includes only those sample locations shown on Figures A-5 and E-5 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figures A-5 and E-5 show the Site 11A features. Runoff from the area of the site flows to drainage ditches that carry the water to the northwest of the P Area, into a southwest-flowing drainage way discharging into Crab Orchard Lake. There were drainage ditches, two buildings and an L-shaped walkway located in the area of Site 11A. Samples were collected from the drainage ditches.

No areas of known archaeological or historical importance are located at Site 11A. Chemicals were reportedly dumped onto the ground at this site.

The previous investigations at Site 11A included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 11A are defined by the sample locations and the sample depths described below.

1988 RI

Four soil composite samples (0 to 1 foot deep) and four sediment composite samples (0 to 1 foot deep) were collected from this site during the 1988 RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1988 RI sample locations are shown on Figure E-5.

1993 Phase I RI

Four composite soil samples (ranging from 1.5 to 1.9 feet deep) and four discreet soil samples (ranging from 1.7 to 1.8 feet deep) were collected from this site during the Phase I RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1993 Phase I RI sample locations are shown on Figure A-5.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

During the 1988 RI, the following VOCs were reported at the noted maximum concentrations in the sediment samples (based on wet weight): 1,1,2-trichloroethane at 19 ug/kg, acetone at 430 ug/kg, bromoform at 7 ug/kg (estimated), chloroform at 4 ug/kg (estimated) and methylene chloride at 27 ug/kg. The following SVOCs were reported at the noted concentrations in the sediment samples (based on wet weight): 2-methylnaphthalene at 3 ug/kg, 2-methylphenol at 4 ug/kg, bis (2-ethylhexyl) phthalate at 49 ug/kg (estimated), chrysene at 24 ug/kg, di-n-butyl phthalate at 1,106 ug/kg, n-nitrosodimethylamine at 262 ug/kg (estimated), and phenol at 28 ug/kg. Based on the 1988 RI criteria, none of these detections were considered to be of concern. No inorganics were detected above levels of concern.

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.8 Site 12, Area 8 Impoundment

Site 12 is located to the east of former Building III-1-24, in Area 8 in the area of a circular impoundment approximately 100 feet in diameter. In the past, there was an aboveground storage tank located within the circular berm. The tank was reportedly used to store fuel oil for the IOP boiler house previously located nearby, and was reportedly removed during the early 1960s.

This site includes only those sample locations shown on Figures A-6 and E-6 of this report. Most of the sample locations at this site are located within an abandoned impoundment (circular bermed area). These sample locations were not surveyed, but they can be approximated from the figure.

Figures A-6 and E-6 show Site 12 features. The wall of the bermed area are 6 feet high and the wall was previously breached. Several black oily pools in and around the impoundment, and bare patches of black sediment and tars located in the impoundment were reportedly visible in the mid-1980s. By 1992 these features were not visible. The area is now overgrown with trees and vegetation.

No areas of known archaeological or historical importance are located at Site 12.

The suspected source of contamination at this site is the former fuel oil tank that was located in this impoundment. Black oily pools in and around the impoundment, and bare patches of black sediment and tars located in the impoundment were observed at this site during previous investigations.

The previous investigations at Site 12 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 12 are defined by the sample locations and the sample depths described below.

1988 RI

One composite soil sample (0 to 1 foot deep) and one composite sediment sample (0 to 1 foot deep) were collected from this site during the 1988 RI. The 1988 RI sample locations are shown on Figure A-6.

1993 Phase I RI

Two composite soil samples (ranging from 1.8 to 2.2 feet deep) and two discreet soil samples (ranging from 1.7 to 1.8 feet deep) were collected from this site during the Phase I RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. The 1993 Phase I RI sample locations are shown on Figure E-6.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

During the 1988 RI, the following SVOCs were reported at the noted estimated concentrations in the sediment samples (based on wet weight): acenaphthene at 35 ug/kg (estimated), anthracene at 104 ug/kg (estimated), fluoranthene at 35 ug/kg (estimated), fluorene at 108 ug/kg (estimated), n-nitrosodimethylamine at 2,174 ug/kg, phenanthrene at 655 ug/kg, and pyrene at 301 ug/kg (estimated). Based on the 1988 RI criteria, none of these detections were considered to be of concern. No inorganics were detected above levels of concern.

No PLCs were exceeded for any constituents in the 1996 RI.

E.2.9 Site 16, Area 7 Industrial Park

This site is located within the boundaries of Area 7, the former IOP Inert Storage Area. The buildings in the area have been leased to a variety of industrial tenants since the end of World War II. The 1988 RI reported that, in the mid-1980s, black residues were reported near five of the large buildings in this area. This site includes only those sample locations shown on Figures A-7, E-7, E-8 and E-9 of this report. Samples were located in the stream and around Buildings IN-3-4, IN-3-5, IN-4-4, IN-5-2, IN-5-3 and IN-6-1. Three of these buildings were reportedly used to recover and recycle waste oil, and one was reportedly used to refurbish mining equipment (1988 RI). These sample locations were not surveyed, but they can be approximated

from the figure. The sample locations, sample depths, and sample analyses discussed below in this report define the limits of the site.

Figures A-7 and E-8 show Site 16 features. There are several warehouse-type buildings remaining in Area 7. There is an intermittent stream that runs from south to north through the center of this site, which coincides, with the center of Area 7. This stream transports all drainage from Area 7 northward and discharges to Crab Orchard Lake. There were some oil-stained soils noted during RI activities, next to some of the buildings mentioned above. This oil-stained soil is no longer evident on site.

No areas of known archaeological or historical importance are located at Site 16.

The suspected sources of contamination at this site were a waste oil recovery and recycling facility, and a facility that refurbished mining equipment.

The previous investigations at Site 16 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The sample locations, the sample depths and the sample analyses described below define the limits of Site 16.

1988 RI

Three composite surface water samples, four composite sediment samples (0 to 1 foot deep) and nine composite soil samples (0 to 1 foot deep) were collected from this site during the 1988 RI. The 1988 RI sample locations are shown on Figures A-7 and E-7 of this document.

Site 16 Sample Depths and Analyses for 1988 RI Sampling[1]

Sample No.	Sample Matrix	Sample Depth	Sample Analyses
16-1	Water	Surface	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-2	Sediment	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-3	Water	Surface	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-4	Sediment	0-1 ft	VOCs, SVOCs, Pesticides/PCBs, Metals, CN, Explosives, Indicator Parameters
16-5	Water	Surface	No sample results in report.
16-6	Sediment	0-1 ft	No sample results in report.
16-7	Water	Surface	No sample results in report.
16-8	Sediment	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-9	Soil	Surface	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-10	Soil	0-1 ft	VOCs, SVOCs, Pesticides/PCBs, Metals, CN, Explosives, Indicator Parameters
16-11	Soil	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters

Site 16 Sample Depths and Analyses for 1988 RI Sampling[1]

Sample No.	Sample Matrix	Sample Depth	Sample Analyses
16-12	Soil	Surface	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-13	Soil	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-14	Soil	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-15	Soil	Surface	VOCs, SVOCs, Pesticides/PCBs, Metals, CN, Explosives, Indicator Parameters
16-16	Soil	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-17	Soil	0-1 ft	VOCs, Pesticides, Metals, CN, Explosives, Indicator Parameters
16-18	Water	Surface	VOCs, BNAs, Pest/PCBs, Metals, pH
16-19	Sediment	0-1 ft	VOCs, BNAs, Pest/PCBs, Metals, pH

[1] Note that Sample Analysis information was obtained from Appendix I of the 1988 O'Brien and Gere RI report.

1993 Phase I RI

Two composite soil samples (ranging from 0.5 to 0.8 feet deep) and two discreet soil samples (ranging from 1.8 to 1.9 feet deep) were collected from this site during the Phase I RI. The 1993 Phase I RI sample locations are shown on Figure E-8.

Site 16 Sample Depths and Analyses for 1993 Phase I RI Sampling

Sample No.	Sample Matrix	Sample Depth	Sample Analyses
COSO1601	Soil	0.5-0.6 ft	SVOCs, Pesticides/PCBs, Explosives, Metals, Cyanide
COSO1602	Soil	1.9 ft	VOCs
COSO1603	Soil	0.7-0.8 ft	SVOCs, Pesticides/PCBs, Explosives, Metals, Cyanide
COSO1604	Soil	1.8 ft	VOCs

1996 Phase II RI

Three discreet sediment samples (ranging from 0.5 to 2.0 feet deep) were collected from this site during the 1996 Phase II RI. The 1996 Phase II RI sample locations are shown on Figure E-9.

Site 16 Sample Depths and Analyses for 1996 Phase II RI Sampling

Sample No.	Sample Matrix	Sample Depth	Sample Analyses
COSE21601	Sediment	1.0-1.7 ft	VOCs, SVOCs, Pest/PCBs, Metals
COSE21602	Sediment	1.0-2.0 ft	VOCs, SVOCs, Pest/PCBs, Metals
COSE21603	Sediment	0.5-2.0 ft	VOCs, SVOCs, Pest/PCBs, Metals

Results

The 1988 RI detected SVOCs, primarily phthalates and PAHs, and PCBs in the soils and sediments near these buildings. Three composite sediment samples and nine composite soil samples were collected in the area of the five buildings, and analyzed for a variety of compounds (O'Brien and Gere, 1988). SVOCs were detected in two samples: a composite soil sample collected on the south side of Buildings IN-5-2 and IN-5-3 and a composite sediment sample from the north-south flowing drainage ditch. The detected SVOCs and their respective concentrations were bis(2-ethylhexyl)phthalate (44 ug/kg and undetected); anthracene (256 ug/kg and undetected), chrysene (253 ug/kg and estimated at 41 ug/kg); dibenzofuran (estimated at 6 and 50 ug/kg); di-n-butylphthalate (7 and 41 ug/kg); fluoranthene (389 ug/kg and undetected); naphthalene (undetected and estimated at 51 ug/kg); n-nitrosodimethylamine (estimated at 115 ug/kg and undetected); phenanthrene (estimated at 19 and 107 ug/kg); and pyrene (356 ug/kg and estimated at 34 ug/kg). The PCB compound Aroclor 1254 was detected in samples collected north of former Building IN-3-5 and south of former Buildings IN-5-2 and IN-5-3; the concentrations were 2,552 ug/kg and 280 ug/kg, respectively.

By the time of the 1996 Phase II RI, four of the five buildings had been removed, and there was no black residue observed in the area.

Detections of PCBs and some metals during the 1996 Phase II RI exceeded PLCs.

E.2.10 Site 20, D Area South Drainage Channel

Site 20 is located in a drainage ditch to the east of Building F-2-2, in the F Area. This drainageway segment receives runoff from a nearby abandoned industrial building and chemicals were reportedly formerly dumped in this area (1988 RI). The F Area was the former IOP Fuse Loading Line, and has been used by industrial tenants primarily for munitions manufacturing, since the 1950s. This site includes only those sample locations shown on Figures A-8, E-1, and E-10 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figures A-8 and E-10 show site features at Site 20. The drainage ditch where the Site 20 samples were collected is located to the east of existing Building F-2-2. The drainage ditch flows to the northeast and it discharges into an un-named stream that flows to the southwest and discharges into Crab Orchard Lake. There was a sheen on the water in this drainage ditch, during RI sampling activities.

No areas of known archaeological or historical importance are located at Site 20.

Chemicals were reportedly dumped at this site.

The previous investigations at Site 20 included the 1988 RI, the 1993 Phase I RI and the 1996 Phase II RI. The limits of Site 20 are defined by the sample locations and the sample depths described below.

1988 RI

One composite sediment sample (0 to 1 foot deep) was collected from this site during the 1988 RI. The 1988 RI sample location is shown on Figures A-8 and E-1.

1993 Phase I RI

One composite soil sample (from 1.0 to 2.0 feet deep) and one discreet soil sample (from 1.5 feet deep) were collected from this site during the Phase I RI. Samples were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics.

The 1993 Phase I RI sample locations are shown on Figure E-10.

1996 Phase II RI

No additional sampling was done at this site during the 1996 Phase II RI.

Results

A composite sediment sample collected from the drainage way during the 1988 RI detected two SVOCs: bis(2-ethylhexyl)phthalate at an estimated concentration of 2,320 ug/kg and n-nitrosodimethylamine at an estimated concentration of 336 ug/kg. These compounds were not detected in samples taken during the 1996 Phase II RI.

In the 1996 RI, no PLCs were exceeded for any constituents.

E.2.11 Site 21, Southeast Corner Field

The site is located south east of Area 7 in a pasture. A pile of concrete debris was observed at this site. It was later determined that the rubble was probably part of a church that pre-dated the IOP (1996 RI). This site includes only those sample locations shown on Figure A-9 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-9 shows the site features for Site 21. Site 21 is a fenced area that gradually slopes to the southeast towards a swampy ditch. There are many large trees in the area. The site is a fenced area that was believed to have been a possible dumping area, due to the presence of some concrete rubble near one end of the site. There was no evidence of dumping at this site, other than the concrete rubble.

No areas of known archaeological or historical importance are located at Site 21.

1988 RI

During the 1988 RI, several samples were analyzed and magnetometer and electromagnetic surveys were conducted. Four composite soil samples (0 to 1 foot depth) were collected along north-south transects at this site during the 1988 RI. The 1988 RI sample locations are shown on Figure A-9. These sample locations and sample depths define the limits of Site 21. This site was not included in the MISCA OU RI.

Results

The 1988 RI reported that no metallic objects were buried at the site. Constituents that were detected in the soil samples and their estimated concentrations are as follows: 2-methylnaphthalene at 51 ug/kg; dibenzofuran at 18 ug/kg; n-nitrosodimethylamine at 11 ug/kg; phenanthrene at 105 ug/kg; Aroclor 1254 at 133 ug/kg; and mercury at 0.037 and 0.041 mg/kg. No detected contaminants exceeded any levels of concern.

Historic and aerial photo review done as part of the 1996 Phase II RI indicated that the debris might have been from demolition of a church. No evidence of industrial usage was found and no sampling was done at this site as part of the 1996 RI.

E.2.12 Site 22A, Former Post Treating Facility

Site 22A is a part of the former IOP shop and maintenance yard in Area 4. This site is located behind the Old Refuge Shop and it is shown on Figures A-10 and E-11 of this report. Site 22A is approximately 2 acres and included a gravel area and concrete slabs. This site has been remediated as part of a removal action in 1996. Approximately 6,412 cubic yards of contaminated soils were removed and placed in an on-site landfill of another operable unit.

Figures A-10 and E-11 show the features of the site. Runoff from Site 22A drains to the northwest into a natural drainage channel running west to Pigeon Creek. The gravel area and concrete slab were removed.

The site has been remediated and regraded and was sloped to drain north into the north-west trending natural drainageway. Gravel was placed over the backfilled soils. It is suspected that posts were historically treated (dipped in a tank of wood preservative) and laid out to dry in this area. There is no evidence of the former treatment facility.

No areas of known archaeological or historical importance are located at Site 22A.

This primary source of contamination at this site is possibly a wood post treatment facility.

Site 22A is suspected as the area used during the 1960s for treating wood posts with pentachlorophenol (1996 RI).

This site was not investigated as part of the 1988 RI as it had not been identified. The previous investigation at Site 22A included the 1993 Phase I RI and the 1996 Phase II RI, and pre-excavation confirmation sampling done in 1996.[16]

1993 Phase I RI

Eight composite soil samples (ranging from 0.6 to 2.7 feet deep) and four discreet soil samples (ranging from 2.0 to 2.5 feet deep) were collected from this site during the Phase I. The 1993 Phase I RI sample locations are shown on Figure A-10. Samples were analyzed for dioxins/furans, explosives and for the CERCLA TAL inorganics and TCL organics.

1996 Phase II RI

Forty-nine discreet soil samples (ranging in depth from 0.1 to 16.5 feet) and six groundwater samples (from newly installed monitoring wells) were collected from this site during the 1996 Phase II RI. The 1996 Phase II RI sample locations are shown on Figure E-11. During Phase II, additional samples were taken to delineate the vertical and horizontal extent of the dioxins/furans and SVOCs in soil. Groundwater monitoring wells were installed and the groundwater was analyzed for dioxins/furans, explosives and for the CERCLA TAL inorganics and TCL organics. Also in Phase II samples were obtained for biological testing.

1996 Pre-Excavation Confirmation Sampling

Prior to the removal action at Site 22A, 20 pre-excavation confirmation soil samples were collected to verify the areal extent and depth of contaminated soil to be removed. Twelve soil samples were collected from 0 to 0.5 feet below ground surface (bgs) along the perimeter and 50 feet from the perimeter of the proposed excavation area. Eight subsurface soil samples were collected from 2.5 to 3.0 feet bgs within the proposed excavation area. Subsurface soil samples were selected randomly in an attempt to confirm the proposed excavation limits. The samples were analyzed for dioxins, furans and pentachlorophenol[17].

Two additional subsurface soil samples were collected in a hotspot. One composite sample was taken from 20 random locations in a 10-foot by 10-foot plan area with depths ranging up to 3.5 feet bgs. A discrete soil sample was taken at a depth of 3.5 feet to 4.5 feet bgs. The composite sample was analyzed for pentachlorophenol. The discrete sample was analyzed for total pentachlorophenol, pentachlorophenol by the toxicity characteristic leaching procedure (TCLP), total organic carbon (TOC), and pH.

[16] Woodward-Clyde, 1997, Draft Feasibility for the Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, Appendix A.

[17] This information was included in Appendix A of the Draft Feasibility Study for the Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, Woodward-Clyde, 1997.

Results

The significant contaminants detected in soils at this site during the 1996 RI were pentachlorophenol, dioxins and other contaminants including 4,4-DDT, 4,4-DDE, 4,4-DDD, selenium, mercury, and zinc.

The Phase I RI sample results indicated the Site 22A soil had been impacted by four SVOCs. In addition, several dioxin/furan compounds were present above the PLC values at depths ranging up to 3 feet bgs, and spanning an area that extended a distance of approximately 320 feet.

The Phase II sample results indicated surface samples contained pentachlorphenol, Aroclor 1254, and dioxins/furans. Analytical results for the subsurface soil samples indicated the presence of dioxins/furans and some SVOCs. Both dioxins/furans and pentachlorophenol were identified in the deep samples, indicating that a downward transport may have occurred to depths of at least 10 feet bgs.

E.2.13 Site 24, Pepsi Plant West Drainage Ditch

Site 24 is located in a drainage ditch north and west of the Pepsi-Cola Bottling Company, adjacent to a roadway. Site 24 is located outside of the Refuge property boundary. This site includes only those sample locations shown on Figure A-11 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-11 shows the site features of Site 24. The ditch receives drainage from the site and it discharges into Crab Orchard Lake. There are no other notable site features.

It was suspected that hazardous materials were being discharged into the drainage ditch at this site.

The previous investigation at Site 24 included the 1988 RI.

1988 RI

One grab surface water sample and one grab sediment sample (0 to 1 foot deep) were collected from the drainage ditch at this site during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample locations are shown on Figure A-11 of this report. These sample locations and depths define the limits of Site 24. Site 24 was not included in the MISCA OU RI.

Results

Although slightly elevated levels of mercury were detected in ditch sediments at this site in the 1988 RI, it was concluded that Site 24 was not a potential source of contamination and did not contribute mercury to Crab Orchard Lake. The FFA states that no further work is required for Site 24. This site was not investigated as part of the MISCA OU.

E.2.14 Site 25, Crab Orchard Creek at the Marion Landfill

This site is located in Crab Orchard Creek, both upstream and downstream of the old Marion Municipal Landfill and an adjacent pond. Crab Orchard Creek was dammed during the 1930s to form Crab Orchard Lake, the major lake on the Refuge. Site 25 is located outside the Refuge boundaries. This site includes only those sample locations shown on Figure A-12 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-12 shows the site location. The site is also located within a ¾ acre pond that is located next to the old Marion Municipal Landfill. Crab Orchard Creek discharges into Crab Orchard Lake. These are the only notable features at this site.

It was suspected that contamination from the former municipal landfill was entering Crab Orchard Creek at this site.

The previous investigation at Site 25 included the 1988 RI.

1988 RI

Three composite surface water samples and three composite sediment samples (0 to 1 foot deep) were collected from this site during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample locations are shown on Figure A-12 of this report. The sample locations and depths shown on the figure define the limits of Site 25.

Results

Cyanide was detected in two of several sediment samples obtained during the 1988 RI, at concentrations of 10.7 and 90 mg/kg. The 1988 RI concluded that the site was not contributing cyanide to Crab Orchard Lake, and that Site 25 did not pose an unacceptable exposure risk to human health or the environment. The FFA states that no further work is required for Site 25, which is not on the Refuge. This site was not investigated as part of the MISCA OU.

E.2.15 Site 26, Crab Orchard Creek below the Marion Sewage Treatment Plant

The site is located in Crab Orchard Creek, downstream of the Marion Sewage Treatment Plant. Site 26 is located outside the Refuge boundaries. This site includes only those sample locations shown on Figure A-12 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-12 shows the location of Site 26 in Crab Orchard Creek. Crab Orchard Creek discharges into Crab Orchard Lake. There are no other distinguishing surface or subsurface features associated with this site.

It was suspected that contaminants from the Marion Sewage Treatment Plant were being discharged into Crab Orchard Creek.

The previous investigation at Site 26 included the 1988 RI.

1988 RI

Two composite surface water samples and two composite sediment samples (0 to 1 foot deep) were collected from this site during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample locations are shown on Figure A-12 of this report. The sample locations and depths shown on the figure define the limits of Site 26.

Results

Based on the results of several sediment samples, the 1988 RI concluded that Site 26 does not pose unacceptable risk to human health or the environment. The 1988 RI included the collection and analysis of two composite soil samples in which no VOCs or metals were detected (no SVOC analysis was done). The FFA states that no further work is required at this site. This site was not investigated as part of the MISCA OU.

E.2.16 Site 27, Crab Orchard Creek Dredge Area

The site is located in a former dredge area of Crab Orchard Creek. This site was investigated in the 1988 RI to evaluate whether discharges from the Marion sewage treatment plant may be impacting Crab Orchard Lake. Site 27 is downstream of the sewage treatment plant and upstream of Crab Orchard Lake.

This site includes only those sample locations shown on Figure A-12 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figures A-12 shows the location of Site 27. The site is a former dredged area as discussed above. There are no other distinguishing surface or subsurface features associated with this site.

No areas of known archaeological or historical importance are located at Site 27.

Discharges from the Marion Sewage Treatment Plant were suspected to have impacted this site. The previous investigation at Site 27 included the 1988 RI.

1988 RI

O'Brien and Gere (1988) investigated the site to evaluate whether discharges from the Marion sewage treatment plant may be impacting Crab Orchard Lake. One composite surface water sample and one composite sediment sample (0 to 1 foot deep) were collected from this site during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample locations are shown on Figure A-12 of this report. The sample locations and depth shown in the figure define the limits of Site 27.

Results

Cyanide was detected in a sediment sample from the creek bed upstream of the site (at Site 26) at levels high enough that the 1988 RI recommended monitoring of the stream. Field observations

and review of historic aerial photos done as part of the 1996 RI did not show any evidence of industrial activity in this area. The Preliminary Ecological Risk Assessment determined that there is little likelihood of potential ecological risk at this site. The 1996 RI did not include investigation of this site.

E.2.17 Site 30, Munitions Control Site

Site 30 was selected to represent an uncontaminated control (background) site for the 1988 RI. The site is located in a low-lying area, north of Igloo FAI-1-12. This site (Site 30) includes only those sample locations shown on Figure A-13 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-13 shows the physical features of the site. There were no known surface or subsurface features at this site, other than the nearby explosives storage igloos (FAI-1-11 and FAI-1-12).

No areas of known archaeological or historical importance are located at Site 30.

There were no suspected sources of contamination at this site. This site was used as control (background) sites.

The previous investigation at Site 30 included the 1988 RI.

1988 RI

There were two surface soil samples and one groundwater sample (from a monitoring well that was installed) collected during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample locations are shown on Figure A-13 of this report. The sample depths and locations shown in the figure define the limits of Site 30.

Results

Since this site was a control site and the samples collected did not indicate contamination, the 1996 RI did not include further investigation.

E.2.18 Site 31, Refuge Control Site

Like Site 30, Site 31 was a control (background) site used for the 1988 RI. The site is located just north of the current FWS Maintenance Shop located north and east of the current FWS Headquarters Building. This site includes only those sample locations shown on Figure A-14 of this report. These sample locations were not surveyed, but they can be approximated from the figure.

Figure A-14 shows the physical features of the site. There were no known surface or subsurface features at this site, other than the nearby FWS Maintenance Shop.

No areas of known archaeological or historical importance are located at Site 31.

There were no suspected sources of contamination at this site. This site was used as control (background) sites.

The previous investigation at Site 31 included the 1988 RI.

1988 RI

Two surface soil samples and one groundwater sample (from a monitoring well that was installed) were collected during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample locations are shown on Figure A-14 of this report. The sample locations and depths shown in the figure define the limits of Site 31.

Results

Since this site was a control site and the samples collected did not indicate contamination, the 1996 RI did not include further investigation.

E.2.19 Site 35, Area 9 Waterway

Site 35 is an un-vegetated, low-lying spot in an agricultural field to the east of Area 9. This site does not have a known history of industrial use. This site includes only the sample location shown on Figure A-15 of this report. The location of this sample was not surveyed, but it can be approximated from the figure.

Figure A-15 shows the location of Site 35. This site is located in low-lying spot where vegetation does not grow as discussed above. There are no other distinguishing surface or subsurface features associated with this site.

No areas of known archaeological or historical importance are located at Site 35.

There was no suspected source of contamination identified at this site. Contamination was suspected at this site due to the lack of vegetation at the site.

The previous investigation at Site 35 included the 1988 RI.

1988 RI

One composite soil sample was collected from this site during the 1988 RI (O'Brien and Gere, 1988). The 1988 RI sample location is shown on Figure A-15 of this report. The sample depth and location shown in that figure define the limits of Site 35.

Results

A trace of PCBs (0.016 mg/kg of Aroclor 1254) and an unusually high specific conductance (11,650 uMohs/cm[18]) were reported in the 1988 RI. The risk assessment done as part of the

[18] micromhos per centimeter

1988 RI concluded that the site posed no risk to human or wildlife receptors. Refuge records show that the field that contains Site 35 has been leased as agricultural land since at least 1962. The Preliminary Ecological Risk Assessment determined that there is little likelihood of potential ecological risk at this site. No further investigation was conducted as part of the 1996 RI.

E.2.20 Site 36, Refuge Wastewater Treatment Plant

Site 36 covers approximately 47 acres and consists of the existing wastewater treatment plant facility, formerly used wastewater treatment features, and surrounding grounds and ditches. Figure A-16 shows the location of Site 36.

The wastewater treatment plant, which is currently in use, was constructed in 1942 and/or 1943 as part of the IOP and was reportedly designed to treat up to 0.5 million gallons of sewage per day. The plant used an activated sludge treatment with mechanical aeration, chlorination facilities, heated sludge digestion, and sludge drying beds. Not all of these processes are still in use. Sludge is currently disposed of off-site. The treatment plant outfall discharges to a drainage channel excavated during original construction to carry treatment plant effluent to Dove Creek, which eventually flows into Pigeon Creek further downstream (Figure A-17). This constructed ditch is called "Upper Dove Creek."

Two small ponds, West Pond (about 0.05 acres) and East Pond (about 0.3 acres), were constructed east of the sand beds in the late 1950s (Figure A-17). Neither the West Pond nor the East Pond is currently in use. During use, the West Pond reportedly received sludge directly from the anaerobic digester, and the East Pond received overflow from the West Pond. During the time these ponds were used, sludge was excavated out of the West Pond and piled to the north and east of the sand beds and West Pond. The approximate location of the former sludge pile is shown in Figure A-17. In 1989, FWS removed this sludge and disposed of it off site.

Two larger lagoons, the Primary Lagoon and the Secondary Lagoon (Figure A-17), which are about 2 acres each, were constructed south of the treatment plant in the early 1970s. They serve as a backup to the treatment plant, receiving wastewater that exceeds treatment plant capacity. This typically occurs during periods of heavy rainfall due to infiltration of rainwater into the system. Before the lagoons were installed, excess raw wastewater was diverted directly to the plant outfall.

The plant has treated wastewater from the IOP and subsequent industrial tenants at the Refuge. Industrial activities at the Refuge have included plating, machining, painting, ink stenciling, storage and handling of pesticides, and the manufacturing of capacitors, munitions, pyrotechnics and explosive devices, inks, and fiberglass boats, among others.

Figures A-16 and A-17 show the physical features of the site. Natural relief is about 20 feet at the site. The site is on a relatively elevated area that slopes gently toward Pigeon Creek, the drainage located to the east of the site. Pigeon Creek flows into Crab Orchard Lake about a half-mile south of the site.

The area north of the plant along Dove Creek and around the East Pond is wooded. Most of the rest of the site, except for the lagoons, is grass-covered.

No proposed remedial action will occur in designated wetlands or 100-year floodplains.

The major structures at the site are the treatment plant, which is in use, and the anaerobic sludge digester located south of the plant, which is currently not in use. The anaerobic sludge digester is mostly earth-covered. It appears as a grass-covered mound with a structure at the top.

Other former wastewater features include the sand beds, West Pond (about 0.05 acres), and the East Pond (about 0.3 acres), all located east of the treatment plant (Figure A-17).

The treatment plant outfall discharges to a drainage channel excavated during original construction to carry treatment plant effluent to Dove Creek. This approximately 600-foot long constructed ditch is called "Upper Dove Creek." Dove Creek eventually flows into Pigeon Creek further downstream (Figure A-17). Quail Creek is also a constructed ditch (east of the lagoons).

The Primary Lagoon and the Secondary Lagoon (Figure A-17), which are about 2 acres each, are currently in use as part of the treatment facility.

No areas of known archaeological or historical importance are located at Site 36.

The previous investigations at Site 36 included the 1993 Phase I RI, the 1996 Phase II RI and the 1998-1999 RI Addendum.

1993 Phase I RI

Two composite soil samples (ranging from 0.0 to 1.0 feet deep) and six discreet soil samples (ranging from 0.0 to 1.0 feet deep) were collected from this site during the Phase I RI (Golder Associates, 1993). The 1993 Phase I RI sample locations are shown on Figure E-12 of this report.

1996 Phase II RI

The 1996 Phase II RI involved sampling site features associated with waste treatment, discharge, and disposal at the wastewater treatment plant. The 1996 Phase II RI sample locations are shown on Figures E-13 and E-14 of this report. No sampling was done inside the wastewater treatment plant itself, which was still in operation. Samples were taken of the sludge and soil in the East Pond, the West Pond, the former sludge drying beds, the primary and secondary lagoons, and the discharge points of these areas. Four groundwater monitoring wells were installed and sampled, at the locations shown in Figure A-17. Surface water samples were taken in the impoundments and ditches.

Samples were analyzed for the CERCLA TCL of organic constituents, dioxins/furans, and the CERCLA TAL of inorganic constituents. Some samples were also analyzed for explosives. Some samples with high contaminant concentrations were analyzed by the TCLP test to evaluate the potential for the presence of Resource Conservation and Recovery Act (RCRA) hazardous materials.

Solid phase toxicity tests were conducted to evaluate effects of sediments from Upper Dove Creek on *Hyallela* and fathead minnow. The results indicated that the sediments were acutely lethal to both species.

A human health baseline risk assessment and ecological risk assessment were done. The risk assessments identified PCBs, aldrin, 4,4'-DDE, cadmium, and TCDD TEQ (dioxins/furans) as contaminants of concern. There were detections of some metals above federal maximum contaminant levels (MCLs) and State of Illinois Class I groundwater standards.

1998-1999 RI Addendum

The 1998-1999 RI Addendum had two basic purposes: 1) to further delineate the extent of contamination at the site, and, 2) to re-evaluate ecological risk. DOI elected to do a prospective ecological risk assessment using current USEPA guidance that was not available at the time the 1996 RI baseline ecological risk assessment was done. In addition, some contaminant concentrations found during the 1998-1999 investigation exceeded those found in the 1996 RI.

The 1998-1999 investigation focused on the contaminants of concern identified during the 1996 RI. Based on the 1996 RI results, concentrations of concern of aldrin, 4,4'-DDE, and TCDD TEQ were confined to the sludge in the East Pond. PCBs and cadmium were judged to be controlling contaminants, and the investigation focused on defining the extent of those contaminants in the soil. Sludge samples from the Primary and Secondary Lagoons were sampled and tested primarily to evaluate whether any of the sludge was RCRA hazardous by characteristic or would require special treatment for elevated PCB levels.

Site Summary

The primary contaminants are PCBs, cadmium, chromium, aldrin and dioxins/furans[19], although a number of other contaminants are present. These contaminants pose unacceptable risk to ecological receptors at the site. PCBs and aldrin pose unacceptable risks to humans. Ingestion of water extracted from this aquifer poses a potential risk to human health because concentrations of thallium and antimony are greater than MCLs for drinking water (as specified in the Safe Drinking Water Act) and State of Illinois Class I groundwater standards.

A Proposed Plan to address the contamination at this site was made available to the public for comments on December 15, 2000. The public comment period ended on January 16, 2001. This ROD addresses cleanup action to be taken at Site 36.

The contamination at this site appears to be a result of past industrial discharges to the wastewater treatment plant.

[19] Dioxins/furans are a group of similar organic chemicals with variable chlorination. The toxicity of the different chemicals varies, depending on the structure and the degree of chlorination. Rather than list concentrations of all the related chemicals (congeners), concentration is usually expressed in terms of toxic equivalents (TEQ) of the most toxic congener of the group, 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (TCDD). Herein after in this document, dioxins/furans will be referred to as TCDD TEQs.

E.3 Site 36 - Additional Contaminant Characterization

Types and Characteristics of COCs

As a result of the 1998-1999 RI Addendum, a number of additional potential COCs were identified. PCBs, aldrin, DDE, cadmium and TCDD TEQ remained the primary contaminants. These, along with chromium, which was found at significant levels, are discussed below. Most of the health effects information in this section was obtained from the Centers for Disease Control.

PCBs

PCBs are a group of manufactured organic chemicals that contain 209 individual chlorinated chemicals (known as congeners). PCBs are either oily liquids or solids and are colorless to light yellow in color. They have no known smell or taste. There are no known natural sources of PCBs. Some commercial PCB mixtures are known in the United States by their industrial trade name, Aroclor.

PCBs don't burn easily and are good insulating material. They have been used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in 1977 because of evidence that they build up in the environment and cause harmful effects. Products containing PCBs are old fluorescent lighting fixtures, electrical appliances containing PCB capacitors, old microscope oil, and hydraulic fluids.

PCBs are very stable in the environment. They are relatively insoluble in water, but soluble in nonpolar organic solvents and biological lipids (fats). They are generally regarded as highly bioaccumulative. They tend to accumulate in the fatty tissue of organisms.

Health effects of PCBs:

- Exposure generally occurs through ingestion.
- PCBs can affect the skin and liver.
- PCBs have been shown to be carcinogenic in animal studies. The U.S. Department of Health and Human Services has determined that PCBs may reasonably be anticipated to be carcinogens.

Aldrin

Aldrin is a pesticide that was in popular use from 1950 to 1970 for crops such as corn and cotton. Because of concerns about damage to the environment and the potential harm to human health, EPA banned all uses of aldrin and dieldrin in 1974 except to control termites. In 1987, EPA banned all uses.

Aldrin evaporates rapidly from aquatic environments and also probably from soil. Adsorption to organic materials, biotransformation by aquatic organisms, and biodegradation are important fate processes. Volatilization half-lives of less than a few days are likely in aquatic systems when

sorption process and biotransformation do not occur rapidly. The primary product of aldrin degradation is dieldrin. Biotransformation and biodegradation occur slowly but may be the final fate processes in sediments.

Health effects of aldrin:

- Exposure generally occurs through inhalation.
- Aldrin can cause liver damage and digestive problems.

DDE

DDE is a degradation product of DDT. Because of damage to wildlife and the potential harm to human health, the use of DDT was banned in the U.S., except for public health emergencies. The major fate processes for DDE in aquatic environments are bioaccumulation and sorption to sediments and biota.

Health effects of DDE:

- Exposure through inhalation or ingestion of contaminated soil particles.
- Effects the nervous system.
- Considered a probable human carcinogen by USEPA.

Cadmium

Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). Cadmium does not corrode easily and has many uses. In industry and consumer products, it is used for batteries, pigments, metal coatings, and plastics.

The most important valence state of cadmium in soils is +2. The solubility of cadmium appears to be highly dependent on soil pH along with the surfaces that it might adhere to, and the presence of organics. Residual fractions of organically bound cadmium appear to be relatively stable and immobile in most soils.

Health effects of cadmium:

- Exposure generally occurs through inhalation and ingestion.
- Cadmium damages the lungs, can cause kidney disease, and may irritate the digestive tract.
- Cadmium can adversely affect development, reproduction, and neurological processes in animals.
- The U.S. Department of Health and Human Services has determined that cadmium and cadmium compounds may reasonably be anticipated to be carcinogens.

Chromium

Chromium (Cr) is a naturally occurring element found in rocks, soil, plants, animals, and in volcanic dust and gases. The majority of chromium in soil is typically in Cr^{+3} form, but it may

be present in oxidation states ranging from Cr^{+2} to Cr^{+6}. Cr^{+3} is an essential nutrient in our diet, but we need only a very small amount. Other forms of chromium are not needed by our bodies. Chromium compounds have no taste or odor. Chromium is used for making steel and other alloys, bricks in furnaces, dyes and pigments, chrome plating, leather tanning, and wood preserving.

Chromium will adsorb to clay particles, but this is pH dependent. Values reported in the literature for the distribution coefficient, K_d, which is a measure of a chemical's tendency to adsorb to soil, range widely (e.g., by three orders of magnitude) for chromium, which may reflect measurement of mixed Cr^{+6}/Cr^{+3} systems. Cr^{+3} has a higher affinity for soil adsorption than does Cr^{+6}. Volatilization of chromium does not occur at typical atmospheric temperatures. Chromium is inorganic and therefore does not biodegrade.

Health effects of chromium:

- Exposure can occur through inhalation or ingestion.
- Certain types of chromium can affect the kidneys, liver, respiratory tissue, and the gastrointestinal tract.
- The Department of Health and Human Services has determined that certain Cr^{+6} compounds are known carcinogens.

Dioxins (CDDs)

Dioxins, or chlorinated di-benzo-p-dioxins (CDDs) are a family of 75 chemically related compounds (congeners) commonly known as chlorinated dioxins. One of these compounds, 2,3,7,8-TCDD, is one of the most toxic of the CDDs and is the one most studied. In the pure form, CDDs are crystals or colorless solids. CDDs enter the environment as mixtures containing a number of individual components. CDDs are not intentionally manufactured by industry except for research purposes. They (mainly 2,3,7,8-TCDD) may be formed during the chlorine bleaching process at pulp and paper mills. CDDs are also formed during chlorination by waste and drinking water treatment plants. They can occur as contaminants in the manufacture of certain organic chemicals. CDDs are released into the air in emissions from municipal solid waste and industrial incinerators. CDD concentrations are generally expressed in terms of toxic equivalents of 2,3,7,8-TCDD, referred to as TCDD TEQs.

When released into the air, some CDDs may be transported long distances, even around the globe. When released in wastewater, some CDDs are broken down by sunlight, some evaporate to air, but most attach to soil and settle to the bottom sediment in water. CDD concentrations may build up in the food chain, resulting in measurable levels in animals.

Health effects of dioxins/furans:

- Exposure generally occurs through ingestion, inhalation, and skin contact.
- Dioxins/furans can cause skin disease and changes in metabolism.

Quantity/Volume of Waste

There is an estimated 17,000 cubic yards of contaminated soil and sludge.

The estimated quantity of contaminated soil is 12,000 cubic yards.

There is approximately 5,000 cubic yards of contaminated sludge. Of this amount of sludge, approximately 1,000 cubic yards has PCB concentrations over 50 mg/kg and must be handled separately, in accordance with the Toxic Substance Control Act (TSCA).

An estimated 500,000 gallons of surface water in contact with contaminated sludge will require treatment.

There will also be debris from the wastewater treatment plant.

Concentrations of COCs in each media

Soil and sludge

The maximum concentrations of the primary COCs detected in soil and sludge are summarized in the table below.

Summary of Detected Constituents in Soil and Sludge at Site 36

Contaminant	Maximum Concentration (mg/kg)	Location of Maximum Concentration
PCBs	844 J	Upper Dove Creek soil
Aldrin	5.8	East Pond sludge
DDE	0.85	East Pond sludge
Cadmium	584	Primary lagoon sludge
Chromium	259	Primary lagoon sludge
TCDD TEQ	1×10^{-4}	East Pond sludge

Groundwater

Thallium was detected above the MCL/State of Illinois Class I groundwater standard of 0.002 milligrams per Liter (mg/L) at Monitoring Wells COMW236-3 and COMW236-4, at concentrations of 0.0225 mg/L and 0.0058 mg/L, respectively. Antimony was detected above the MCL/State of Illinois Class I groundwater standard of 0.006 mg/L at Well COMW236-3, at a concentration of 0.040 mg/L. Thallium and antimony were also detected in the East Pond sludge. The thallium detection in the sludge was greater than both the federal and State of Illinois screening values used for potential groundwater impacts. The antimony detection in the sludge exceeded the State of Illinois screening value for groundwater impacts.[20] The sludge is suspected as the source of the elevated groundwater concentrations.

Surface Water

The table below summarizes exceedances of Illinois General Use Water Quality Standards that were established for Site 36.[21] All the exceedances noted are from impounded water in the East Pond.

Summary of Detected Constituents in East Pond Surface Water at Site 36

Constituent	Maximum Concentration Detected ug/L (total)	Illinois Site-Specific Water Quality Standard Exceeded	Maximum Acceptable Criteria Concentration, ug/L
Aroclor-1248	0.31 J	Human health	5.6×10^{-5} for PCBs
4,4'-DDE	0.034 J	Human health	0.00019
Cadmium	14.4	AATC, CATC	9.7, 1.1
Iron	6,070	AATC	1,000

AATC = Acute Aquatic Toxicity Criteria
CATC = Chronic Aquatic Toxicity Criteria
ug/L = micrograms per Liter

RCRA Hazardous Wastes and Affected Media

None of the contaminants on-site are considered to be listed RCRA hazardous wastes because the specific industrial source has not been identified.

[20] The federal screening value used for antimony is the USEPA Region 9 preliminary remediation goal (PRG) for migration to groundwater, with a dilution/attenuation factor of 1. There is no Region 9 screening value for thallium. The State of Illinois screening values used for thallium and antimony were the "TACO" Tier 1 migration to groundwater values for Class I groundwater, listed at Title 35 of the Illinois Administrative Code, Section 742, Appendix B, Table C. TACO is Illinois' voluntary program, Tiered Approach to Cleanup Objectives.

[21] These standards were established in accordance with Title 35 of the Illinois Administrative Code (35 IAC), Parts 302.208 and 302.210.

A number of sludge samples with relatively high concentrations of cadmium and chromium were tested by TCLP and none were shown to be RCRA hazardous by characteristic. The maximum TCLP results for cadmium and chromium were 0.78 mg/L (compared to the limit of 5 mg/L) and 0.098 mg/L (compared to the limit of 1 mg/L), respectively. This indicates there is a low potential for leaching.

Soil and sludge will be tested to determine if it is considered a RCRA characteristic hazardous waste at the time of remediation, prior to disposal. If any is found to be a RCRA hazardous waste by characteristic, it will be treated and disposed in accordance with RCRA requirements.

E.4 Site 36 - Location of Contamination and Potential Routes of Migration and Volume of Affected Media

Lateral and Vertical Extent of Contamination

Figure E-15 shows the lateral extent of contamination at Site 36. The figure shows four separate areas of contamination, from north to south:

Upper Dove Creek. This is the ditch at the northern part of the site that receives the discharge from the plant. Contamination here ranges in depth from one to 2.5 feet.

Treatment Area. This is the area east of the plant that includes the East Pond, the West Pond, the sludge drying beds, and the area of the former sludge piles. Contamination in this area ranges in depth from about 6 inches to 3 feet, except at the former sludge drying beds, where it extends to the full four-foot depth of the sand beds.

Primary and secondary lagoons. There is an estimated one foot of contamination in the lagoons, about 6 inches of sludge, and 6 inches of soil.

Current and Potential Future Surface and Subsurface Routes of Human or Environmental Exposure

Humans could be exposed to contaminated soil, sludge and surface water through ingestion, inhalation and/or dermal contact. Ecological receptors could be exposed through direct ingestion of soil, sludge or surface water and/or through ingestion of contaminated organisms.

There are no current users of groundwater at this site. The primary potential future exposure route for human health is through drinking contaminated groundwater. Ingestion of water extracted from this aquifer poses a potential risk to human health because USEPA's acceptable risk range is exceeded and concentrations of contaminant are greater than MCLs for drinking water (as specified in the Safe Drinking Water Act) and the State of Illinois Class I groundwater standards. Migration of contaminated groundwater to Crab Orchard Lake is a potential exposure pathway.

Likelihood for Migration of COCs

If the contamination in sludge and soil is not remediated, it will continue to migrate, by transport in surface water runoff and overflow of the existing impoundments. Contaminants in the groundwater may migrate to Crab Orchard Lake, but because of the low concentrations and effects of attenuation, the effect is likely to be minimal.

Human and Ecological Populations That Could Be Affected

Potential future construction workers and recreational users could be affected. Small terrestrial herbivores and omnivores and insectivorous birds are the ecological receptors most at risk.

E.5 Site 36 - Groundwater Contamination

Description of Affected Aquifer

Based on the site investigation conducted at the Refuge, the groundwater at Site 36 is a Potable Resource Groundwater (State of Illinois Class I groundwater standards) in accordance with Title 35 of the Illinois Administrative Code, Section 620 as determined by the State of Illinois.

The affected aquifer consists of sandy layers in the silty clay glacial till that underlies the site. It is unconfined. Groundwater depths in the four wells at the site ranged from about 0.5 to 14 feet below the ground surface. Bedrock was encountered in three of the four borings drilled for the wells, but the borings were terminated at the bedrock surface. Sandstone was encountered in two of the borings and shale in the other.

Hydraulic conductivity values, based on slug tests performed in the four monitoring wells, ranged from 2×10^{-5} centimeters per second (cm/s) to 7×10^{-4} cm/s, with an average of 2.6×10^{-4} cm/s.

Groundwater Flow Directions and Discharge Locations

Groundwater elevations in the four wells indicate that the flow is east-southeast, toward Pigeon Creek. The groundwater may discharge into Pigeon Creek, or into Crab Orchard Lake to the south.

Interconnection between Surface Contamination and Groundwater Contamination

Elevated levels of antimony and thallium in the monitoring well downgradient of the East Pond, where the sludge has elevated levels of antimony and thallium suggest that the contaminants have migrated from the sludge into the groundwater.

SECTION F. CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

F.1 Land Uses

This section summarizes current and future land use.

Crab Orchard National Wildlife Refuge was established for wildlife conservation and for agricultural, recreational, and industrial purposes by Public Law 361 on August 5, 1947. While parts of the Refuge have been designated for public use activities such as picnicking and camping, all the Refuge sites included in this ROD (all sites except for 24, 25, and 26) are within the 20,000 acre portion of the Refuge with access restrictions. This restricted access part of the Refuge was previously part of the Illinois Ordnance Plant that produced weapons during World War II. After the war, the former ordnance plant buildings, which are widely spaced throughout the area, were leased to industrial tenants. This limited access part of the Refuge serves as a wildlife sanctuary and is mostly wooded and grass-covered, with some agricultural use, in addition to the industrial use. Access other than by industrial tenants and Refuge employees is limited to specific times and locations such as hunting by permit, supervised environmental education tours, and an auto tour. Access restrictions are implemented by fences, gates, signage, automobile decals, and enforced by patrols and fines.

For all the Refuge sites included in this ROD (all sites except 24, 25, and 26), exposure assumptions used in the human health risk assessments were consistent with the current human uses of the area. Regarding future land use, any change in land use inconsistent with any land use contained in those specific exposure assumptions in the risk assessments will require an evaluation of whether the anticipated land use change will pose unacceptable risks to human health and the environment. This is enforceable under the National Wildlife Refuge Administration Act (16USC668dd), Section (d)(3)(A)(I), which requires that the Secretary of the Interior (Secretary)"…shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety." The Secretary's determination must be in writing and is subject to public review and comment. Potential land use changes are currently being evaluated through the CCP process that is required by 16USC668dd.

F.1.1 Sites 7, 7A, and 8 Land Use

- Current Land Use. Sites 7, 7A, and 8 are located in the D Area, an active ordnance manufacturing facility.

- Current Adjacent Land Use. The D Area is located within the Refuge boundaries, and is at the northern part of Industrial Area 2, which contains the industrial subareas B, D, F, and P. The Industrial Area 2 is surrounded by land that is used as part of the Refuge's agricultural crop program, and by other wooded Refuge lands. The closest urban area, Carterville, Illinois, is approximately 1 miles west of the D Area; the nearest residential property is about three quarters of a mile north of the D Area, just beyond the Refuge property boundary. Crab Orchard Lake is a little less than a mile west of the site.

- Anticipated Future Use. In the short term, these sites are planned to remain part of an industrial facility. Long-term use alternatives are being developed in the CCP, which is a long-term plan that guides management decisions and identifies Refuge's goals, objectives, and strategies for achieving the Refuge system mission. It provides other Agencies and the public with clear understanding of the desired future conditions of the Refuge and how the FWS will implement management strategies. Long-term alternatives under consideration in

the CCP include continued industrial use, and gradual restoration to wildlife habitat through attrition.

F.1.2 Sites 9 and 10 Land Use

- Current Land Use. Sites 9 and 10 are located in the part of the Refuge designated as Area 2 (between the B Area and the P Area), which is part of an active ordnance manufacturing facility.

- Current Adjacent Land Use. The Industrial Area 2 is surrounded by land that is used as part of the Refuge's agricultural crop program, and by other wooded Refuge lands. The closest urban area, Carterville, Illinois, is approximately one mile west of the sites with the nearest residential property being approximately a mile north of the site, just beyond the Refuge property boundary. Crab Orchard Lake is approximately 1,000 to 2,000 feet to the southwest of the site.

- Anticipated Future Use. In the short term, these sites are planned to remain part of an industrial facility. Long-term use alternatives are being developed in the CCP. Long-term alternatives under consideration in the CCP include continued industrial use, and gradual restoration to wildlife habitat through attrition.

F.1.3 Sites 11 and 11A Land Use

- Current Land Use. Sites 11 and 11A are located in the P Area, an active ordnance manufacturing facility.

- Current Adjacent Land Use. The P Area is located within the Refuge boundaries, and is at the southern part of Industrial Area 2, which contains the industrial subareas B, D, F, and P. The Industrial Area 2 is surrounded by land that is used as part of the Refuge's agricultural crop program, and by other wooded Refuge lands. The closest urban area, Carterville, Illinois, is approximately one mile west of the site; the nearest residential property is approximately 1 mile northeast of Area 2P, just beyond the Refuge property boundary. Crab Orchard Lake is about 1000 feet south of the P Area.

- Anticipated Future Use. In the short term, these sites are planned to remain part of an industrial facility. Long-term use alternatives are being developed in the CCP. Long-term alternatives under consideration in the CCP include continued industrial use, and gradual restoration to wildlife habitat through attrition.

F.1.4 Site 12 Land Use

- Current Land Use. Site 12 is in Area 8, a former large industrial area, a portion of which still retains some industrial activity. Site 12 is in a part of the former facility that is no longer used and is being allowed to return to a natural state.

- Current Adjacent Land Use. Area 8 is part of the Refuge and is primarily woods and grassland, with an industrial facility at the south end. The closest urban area, Marion,

Illinois, is approximately 4.5 miles northeast of Area 8; the nearest residential property is approximately 1.5 miles south of Area 8, just beyond the Refuge property boundary. Crab Orchard Lake is approximately 1.5 miles north of Area 8.

- Anticipated Future Use. The site is in an area that is planned to become a functional piece of the overall ecosystem within the Refuge.

F.1.5 Site 16 Land Use

- Current Land Use. Site 16 is located in the center of Area 7, which is an active warehousing area within the Crab Orchard National Wildlife Refuge.

- Current Adjacent Land Use. Area 7 is on the Refuge is surrounded by woods, grassland, and cropland. The closest urban area, Marion, Illinois, is slightly less than 3.5 miles northeast of the site; the nearest residential property is about 1.5 miles to the east of the site, just beyond the Refuge property boundary. Crab Orchard Lake is about 2,000 feet to the north.

- Anticipated Future Use. In the short term, this site is planned to remain part of a warehousing area. Long-term use alternatives are being developed in the CCP. Long-term alternatives under consideration in the CCP include continued industrial use, and gradual restoration to wildlife habitat through attrition.

F.1.6 Site 20 Land Use

- Current Land Use. Site 20 is located in the F Area, an active explosives manufacturing facility.

- Current Adjacent Land Use. The F Area is located within the Refuge boundaries, and is at the eastern part of Industrial Area 2, which contains the industrial subareas B, D, F, and P. The Industrial Area 2 is surrounded by land that is used as part of the Refuge's agricultural crop program, and by other wooded Refuge lands. The closest urban area, Carterville, Illinois, is approximately one mile west of the site; the nearest residential property is approximately one mile to the north of the site, just beyond the Refuge property boundary. Crab Orchard Lake is approximately 0.6 miles south of the site.

- Anticipated Future Use. In the short term, this site is planned to remain part of an active industrial facility. Long-term use alternatives are being developed in the CCP. Long-term alternatives under consideration in the CCP include continued industrial use, and gradual restoration to wildlife habitat through attrition.

F.1.7 Site 21 Land Use

- Current Land Use. Site 21 is located in pastureland.

- Current Adjacent Land Use. Site 21 is surrounded by pasture, cropland and woods. The closest urban area, Marion, Illinois, is a little over 3.5 miles northeast of the site; the nearest

residential property is approximately 1.5 miles northeast of the site, just beyond the Refuge property boundary. Crab Orchard Lake is about 4,500 feet to the north of the site.

- Anticipated Future Use. The site is planned to become a functional piece of the overall ecosystem within the Refuge.

F.1.8 Site 22A Land Use

- Current Land Use. Site 22A is located just west of Area 4 an active industrial area. It has been converted into a gravel parking lot.

- Current Adjacent Land Use. Site 22A is surrounded mainly by woods and grassland, with some industrial facilities to the east. The closest urban area, Marion, Illinois, is approximately 4 miles east of the site; the nearest residential property is approximately 2,000 feet north of the site, just beyond the Refuge property boundary. Crab Orchard Lake is approximately 3,000 feet southwest of the site.

- Anticipated Future Use. In the short term, this site is planned to be maintained as a parking lot. Long term alternatives are being developed in the CCP.

F.1.9 Site 24 Land Use

- Current Land Use. Site 24 is an active soft drink bottling plant and it is not located within Refuge boundaries.
- Current Adjacent Land Use. Site 24 is located approximately one-half mile west of the northeastern most corner of the Refuge, south of Old Route 13. The closest urban area, Marion, Illinois, is approximately two-thirds miles east of the site; the nearest residential property is about 200 feet north of the site. Crab Orchard Lake is a little more than two and a half miles to the southwest.

- Anticipated Future Use. The anticipated future use of this site is not known.

F.1.10 Site 25 Land Use

- Current Land Use. Site 25 is located next to a former municipal landfill and it is not located within the Refuge boundaries.

- Current Adjacent Land Use. Site 25 is located approximately 3.5 miles east of the eastern border of the Refuge. The closest urban area, Marion, Illinois, is approximately 0.8 miles northwest of the site; the nearest residential property is about 1,000 feet southeast of the site. Crab Orchard Lake is almost five miles to the southwest.

- Anticipated Future Use. The anticipated future use of this site is not known.

F.1.11 Site 26 Land Use

- Current Land Use. Site 26 is located next to an active sewage treatment facility and it is not located within the Refuge boundaries.

- Current Adjacent Land Use. Site 26 is located a little over two miles east of the eastern border of the Refuge. The closest urban area, Marion, Illinois, is approximately 700 feet north of the site; the nearest residential property is about 400 feet north of the site. Crab Orchard Lake is almost four miles to the southwest.

- Anticipated Future Use. The anticipated future use of this site is not known.

F.1.12 Site 27 Land Use

- Current Land Use. Site 27 is located within a floodplain area, next to Crab Orchard Creek and the site is within the Crab Orchard National Wildlife Refuge.

- Current Adjacent Land Use. Site 27 is located approximately one-half mile south of Area 6, which is an active explosive storage area. The closest urban area, Marion, Illinois, is approximately 2.5 miles northeast of the site; the nearest residential property is approximately 1.5 miles east of the site, just beyond the Refuge property boundary. Crab Orchard Lake is about 1,000 feet to the southwest of the site.

- Anticipated Future Use. The site is planned to become a functional piece of the overall ecosystem within the Refuge.

F.1.13 Site 30 Land Use

- Current Land Use. Site 30 is located in Area 13, which is an active explosives storage facility within the Crab Orchard National Wildlife Refuge.

- Current Adjacent Land Use. Area 13 consists of widely spaced former explosive storage bunkers, and is primarily covered with woods and grass. The closest urban area, Carterville, Illinois, is approximately 5 miles north of the site; the nearest residential property is approximately 1.2 miles south of the site, just beyond the Refuge property boundary. Crab Orchard Lake is approximately 1.6 miles northeast of the site.

- Anticipated Future Use. In the short term, this site is planned to remain part of an active industrial facility. Long-term use alternatives are being developed in the CCP. Long-term alternatives under consideration in the CCP include continued industrial use, and gradual restoration to wildlife habitat through attrition.

F.1.14 Site 31 Land Use

- Current Land Use. Site 31 is located in a wooded area to the northwest of the current FWS Maintenance Shop.

- Current Adjacent Land Use. The site is surrounded by woods. The closest urban area, Carterville, Illinois, is approximately 3 miles northwest of the site; and the nearest residential property is a little over one mile north of the site, just beyond the Refuge property boundary. Crab Orchard Lake is approximately 500 feet south of the site.

- Anticipated Future Use. The site is planned to become a functional piece of the overall ecosystem within the Refuge.

F.1.15 Site 35 Land Use

- Current Land Use. Site 35 is located near Area 9 on land that is currently used for agricultural purposes.

- Current Adjacent Land Use. The site is in a Refuge area used for crops and pasture. The closest urban area, Marion, Illinois, is approximately 3.8 miles northeast of the site; the nearest residential property is approximately 3.6 miles south of the site, just beyond the Refuge property boundary. Crab Orchard Lake is about 2,000 feet north of the site.

- Anticipated Future Use. The site is planned to become a functional piece of the overall ecosystem within the Refuge.

F.1.16 Site 36 Land Use

- Current Land Use. Site 36 is currently a wastewater treatment facility.

- Current Adjacent Land Use. The nearest active industrial area to Site 36 is Area 2, located about a quarter of a mile west of the site. The surrounding Refuge area consists primarily of cropland, woods, and grassland. The closest urban area, Marion, Illinois, is approximately 4.5 miles east of the site, the nearest residential property is about a half-mile to the northeast, just beyond the Refuge property boundary. Crab Orchard Lake is about a half-mile to the southeast.

- Anticipated Future Use. After this site is remediated, it is planned to become a functional piece of the overall ecosystem within the Refuge. Any change in land use inconsistent with any land use contained in those specific exposure assumptions in the human health or ecological risk assessments will require an evaluation of whether the anticipated land use change will pose unacceptable risks to human health and the environment or negatively impact the effectiveness of the selected remedy.

F.2 Groundwater and Surface Water Uses

F.2.1 Current Groundwater and Surface Water Use

Groundwater and surface water on the Refuge are not currently being used for drinking water. Groundwater on the Refuge is not currently used for any purpose. Crab Orchard Lake was previously used as the Refuge drinking water source, but its use was discontinued several years

ago. All surface water on the Refuge is used by the wildlife for which the Refuge was established. Crab Orchard Lake is also used for recreational boating, fishing, and swimming.

F.2.2 Potential Beneficial Future Use of Groundwater

Groundwater at all of the subject sites located within Refuge boundaries (all sites except Sites 24, 25, and 26), is not currently being used as a drinking water source although it overlies a bedrock aquifer, which is a regional drinking water source.

Based on the site investigations at Site 36, the groundwater at this site is a Potable Resource Groundwater (State of Illinois Class I groundwater standards) in accordance with Title 35 of the Illinois Administrative Code, Section 620 as determined by the State of Illinois.

At Site 22A, three monitoring wells were installed; however, groundwater at this site was not classified using the State of Illinois Class I groundwater standards in accordance with Title 35 of the Illinois Administrative Code, Section 620 as determined by the State of Illinois.

The groundwater at Sites 7, 7A, 8, 9, 10, 11, 11A, 12, 16, 20, 21, 27, 30, 31 and 35 was not investigated and therefore not classified in accordance with Title 35 of the Illinois Administrative Code, Section 620.

The potential beneficial use of groundwater at Sites 24, 25 and 26 is not known since these sites are not located within the Refuge boundaries.

F.2.3 Potential Beneficial Future Use of Surface Water

While there are no permanent streams on any of the sites addressed in this document, except for Sites 8, 9, 10, and 36, runoff from all of the sites (except Sites 21 and 35) contributes to permanent water bodies on the Refuge, which are used by wildlife. Runoff from the sites eventually flows to Crab Orchard Lake. Crab Orchard Lake will continue to be used for recreational activities.

F.2.4 Beneficial Use Timeframe

There is currently no planned future use of the groundwater at any of the sites located within the Refuge boundaries (all sites except for Sites 24, 25 and 26). The planned future use of groundwater at Sites 24, 25 and 26 is not known.

F.2.5 Location of Anticipated Use

As discussed in the potential beneficial use above, there are currently no known plans for the use of the groundwater at any of the subject sites, including the contaminated aquifer at Site 36. However, without remediation at Site 36, contamination from this aquifer may migrate into the bedrock aquifer that is used as a drinking water source off-Refuge.

SECTION G. SUMMARY OF SITE RISKS

The information in this section was obtained from the 1996 RI, the 1997 Pre-Draft Report Feasibility Study for the MISCA OU (WCC, 1997)[22], and Final Feasibility Study for the MISCA OU (URS, 2000)[23].

G.1 Human Health Risk Summary

As discussed in Section E, all the sites except Sites 22A and 36 were judged to represent an acceptably low human health risk, based on site use and analytical results. Baseline human health risk assessments were done only for Sites 22A and 36.

G.1.1 Site 22A Human Health Risk Summary

For site workers, the highest calculated noncarcinogenic hazard index was 0.009. This index does not exceed 1.0; therefore, no unacceptable adverse health effects are expected.

The highest excess lifetime cancer risk calculated for site workers was 3×10^{-5}. This is within the EPA's target range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1991d; DPA 1990a). The primary contributor to the risk was dermal contact with dioxin and dioxin-like compounds in surface soil. This risk was calculated using conservative assumptions which likely significantly over-estimate actual exposures at the site. For example, exposure was assumed to occur for several hours a day, several days a week throughout the year, for 25 years when in reality, exposure only occurs during occasional mowing. Therefore, the risk estimate is probably significantly over-estimated.

For construction workers, the highest calculated noncarcinogenic hazard index was 0.006. This index is below 1.0; therefore, no unacceptable adverse health effects are expected.

The highest excess lifetime cancer risk calculated for construction workers was 1×10^{-6}. This is within the EPA's target range of 1×10^{-6} to 1×10^{-4}. The primary contributors to the risk were ingestion and dermal contact with dioxin and dioxin-like compounds in soil. As stated previously, the risk assessment used conservative estimates of dermal permeability and exposure rates; therefore, the risk estimates are probably significantly over-estimated.

The highest calculated noncarcinogenic hazard index for recreational receptors/trespassers was 0.001. This is below 1.0; therefore, no unacceptable adverse health effects are expected.

The highest excess lifetime cancer risk calculated for recreational receptors/trespassers was 1×10^{-5}. This is within the EPA's target range of 1×10^{-6} to 1×10^{-4}. The primary contributors to the risk were ingestion and dermal contact with dioxin and dioxin-like compounds. The risk is

[22] Woodward Clyde, March, 1997. Pre-Draft Report, Feasibility Study, Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.

[23] URS Greiner Woodward Clyde, September 2000. Site 36 Feasibility Study, Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.

probably over-estimated because Site 22A is approximately 2 acres in size while the average deer grazing range is approximately 240 acres. Therefore, it is unlikely that a deer would obtain 10 percent of its diet from Site 22A as was assumed in the risk assessment.

Using the same methodology and assumptions applied in the risk assessment, baseline human health potential remediation goals (BHRGs) for dioxins/furans (expressed as 2,3,7,8-TCDD TEQ concentrations) were derived for each receptor, equal to the $1x10^{-6}$ risk level. These BHRGs are 60 nanograms per kilogram (ng/kg) for site worker and 1,000 ng/kg for recreational receptors. All soil remaining on the site, as represented by analytical results for soil samples not removed by the removal action, have met the BHRG of 60 ng/kg. The highest remaining soil TEQ concentration is 39 ng/kg, located at a depth of 4 to 6 feet below the ground surface.

Contaminant levels were also compared with USEPA Region 9 preliminary remediation goals (PRGs) for residential soil. Maximum detected concentrations of COCs are summarized in the table below.

Summary of Maximum Detections of Contaminants of Concern in Soil at Site 22A

Contaminant	Maximum Original Concentration, mg/kg	Maximum Concentration after Removal Action, mg/kg	USEPA Region 9 PRG for Residential Soil, mg/kg
Pentachlorophenol	26	4.6 (8.5 to 9.5 ft depth)	3.0
Dioxins and furans (TCDD TEQs)	3,800E-6	81E-6	3.9E-6
DDT	0.038	0.023	1.7
DDE	0.042	0.027	1.7
DDD	0.012	0.004	2.4
PCBs	0.140	0.140	0.22
Mercury	0.26	<0.12	23
Selenium	2.3	<2	390
Zinc	119	81	23,000

Only TCDD TEQs and one pentachlorophenol detection exceeded the Region 9 residential PRGs. However, the maximum TCDD TEQ was below USEPA's current cleanup goal for TCDD TEQ of one part per billion. For pentachlorophenol, the reasonable maximum exposure (RME) for this site is below the Region 9 PRG. Of 29 samples originally analyzed for pentachlorophenol at Site 22A, 18 represent soil that was excavated and disposed as part of the removal action. Of the 11 samples from soil that was outside the excavated area, 9 were non-detect for pentachlorophenol, one had a detection of 0.054 mg/kg, and one had a detection of 4.6 mg/kg, from the depth interval 8.5 to 9.5 feet below the ground surface. This area was backfilled with clean soil to the ground surface.

Based on the human health risk assessment, comparison to Region 9 Residential PRGs, and the current USEPA cleanup goals for dioxin, Site 22A was determined to require no further action for protection of human health.

G.1.2 Site 36 Human Health Risk Summary

Chemicals of Concern

Chemicals of concern identified in the baseline human health risk assessment are PCBs and aldrin. Maximum concentrations of PCBs (130 mg/kg) and aldrin (5.8 mg/kg) were both found in the East Pond sludge.

Exposure Assessment

Potential human receptors identified in the risk assessment for Site 36 as part of the 1996 MISCA OU RI include site workers, hypothetical construction workers, and hypothetical recreational receptors/trespassers. Potentially complete exposure pathways for these receptors include ingestion and dermal contact with surface and/or subsurface soils, ingestion and dermal contact with surface water, and inhalation of volatile emissions and particulate matter from surface and/or subsurface soils. For recreational receptors, a potentially complete pathway is ingestion of deer that were exposed to contaminants from foraging at the site.

Toxicity Assessment

Total noncarcinogenic (non-cancer health effects) hazard indexes (HIs) and cancer risks were calculated for site workers, hypothetical construction workers, and hypothetical recreational receptors. The non-carcinogenic HIs are indicators of the health hazards to humans, and are based on hazard quotients (HQs). An HQ is the ratio of a single substance exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period[24]. An HQ of less than one for a single substance and a given exposure pathway, for example, dermal contact with aldrin, indicates an acceptable risk level for that substance/exposure pathway. An HI reflects the estimated combined effect of multiple contaminants and exposure pathways, and is calculated as the sum of the HQs for multiple substances and/or multiple exposure pathways.

Summary of Risk Characterization

The baseline human health risk assessment assessed potential health risks associated with exposure of three receptor groups: site workers, construction workers, and recreational receptors. Potential types of exposure for these receptors include ingestion (incidental swallowing of some contaminated water and/or ingestion of fish or deer from the Refuge), skin contact, and inhalation of contaminated soil particles. The risk assessment considered data collected from sampling of lagoon and pond sludges, surface soil, soil deposits along ditches, and surface water in the lagoons, East Pond, and ditches.

Of the metals detected in groundwater, only antimony and thallium exceeded background levels. Antimony was detected in one well at 40 ug/L, which is above the USEPA Region III Risk

[24] USEPA, 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual*, EPA/540/1-89/002.

Based Concentration (RBC) for tap water of 15 ug/L[25]. Detections of antimony and thallium exceeded MCLs and State of Illinois Class I groundwater standard in two wells. The 1996 baseline risk assessment concluded that since there is no current domestic use of groundwater on the Refuge, the groundwater ingestion pathway was incomplete. Future use scenarios were not addressed in the baseline risk assessment.

The 1996 baseline human health risk assessment considered Site 36 as one exposure area, meaning that the site was not broken up into the different areas of concern. Total noncarcinogenic (non-cancer health effects) HIs and cancer risks were calculated for site workers, hypothetical construction workers, and hypothetical recreational receptors by summing risks calculated for each receptor for each of the potentially complete exposure pathways. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposure within a single media or across media. Any HI value greater than 1.0 suggest that a non-carcinogen potentially presents unacceptable health risk. Using each pathway evaluated, carcinogenic and non-carcinogenic health risks were characterized for the reasonable maximum exposure scenario (RME).

Using RME concentrations of COCs, noncarcinogenic HIs were acceptable for site workers and recreational receptors, but exceeded the comparison value of 1 for construction workers (HI=2.4). Table G-1 summarizes the results from the baseline human health risk assessment.

Cancer risks are characterized in terms of the excess probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Excess probability means the increased probability over and above the normal probability of getting cancer (i.e., background risk), which in the United States is 1 in 3[26]. For each chemical and exposure pathway, excess lifetime cancer risk is calculated by multiplying the average daily chemical intake by the slope factor, which is a risk-per-unit chemical intake. Slope factors are based primarily on the results of animal studies. The USEPA assumes that humans are as sensitive to all animal carcinogens as the most sensitive animal species. For each receptor category, cancer risks are calculated separately for each carcinogen and each exposure pathway, and the resulting risks are summed to yield a total upper bound estimate of cancer risk due to multiple exposures. Cancer risks for the RME were contained within the acceptable risk range established by the USEPA. Cancer risks are probabilities for expressing estimated excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. A cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under specific exposure conditions at a site. The USEPA generally attempts to reduce the cancer risk posed by a Superfund Site to a range of 1×10^{-4} to 1×10^{-6}. Table G-1 provides a summary of cancer risks for all exposure routes. Based on risks to the construction worker and recreational receptor, potential clean up goals were established for PCBs (5 mg/kg), and aldrin (0.8 mg/kg).

[25] No Region III tap water RBC was available for thallium at the time of the risk assessment. In addition, there was no State of Illinois Class I standard for thallium at the time of the risk assessment.

[26] This summary is from the 1996 Phase II RI. References are included in the RI report.

G.2 Ecological Risk Summary

G.2.1 Site 7 Ecological Risk Summary

At Site 7, the results for all of the constituents detected were all below the PLCs. Based on site inspections and preliminary screening, the PERA concluded that there is little likelihood of potential ecological risk at Site 7 and recommended no further assessment for the site (Golder and Associates, 1993). As a result, the site was not sampled during the 1996 Phase II RI and the site was not evaluated further in the BERA.

G.2.2 Site 7A Ecological Risk Summary

At Site 7A, manganese was detected above PLCs, however it was within the background range for the Refuge and therefore no further evaluation of manganese was necessary at this site. Based on site inspections and preliminary screening, the PERA concluded that there is little likelihood of potential ecological risk at Site 7A and recommended no further assessment for the site (Golder and Associates, 1993). As a result, the site was not sampled during the 1996 Phase II RI and the site was not evaluated further in the BERA.

G.2.3 Site 8 Ecological Risk Summary

Ecological Risk Indexes (ERIs) were calculated in the PERA for terrestrial and aquatic organisms. At Site 8, MEK was detected above PLCs in one sample, however the ERIs calculated for the target organisms at this site were below 1.0, which suggests that there is little likelihood of ecological risks to either aquatic biota or terrestrial wildlife from exposure to MEK at this site. Based on site inspections and preliminary screening, the PERA concluded that there is little likelihood of potential ecological risk at Site 8 and recommended no further assessment for the site (Golder and Associates, 1993). As a result, the site was not sampled during the 1996 Phase II RI and it was not evaluated further in the BERA.

G.2.4 Site 9 Ecological Risk Summary

Site 9 was included in both the PERA and the BERA. No contaminants of concern were identified in surface water at Site 9 (Woodward Clyde, 1996). Based on PLC and background concentration screening, silver was retained for deterministic analysis in the BERA. The HQs calculated in the BERA for exposure of terrestrial receptors to silver in sediment are all less than 1.0 using the likely maximum exposure (LME) scenario. Based on sediment toxicity tests conducted on samples collected from Site 10, silver poses not hazard to aquatic biota at Site 9 (Woodward Clyde, 1996). The BERA concluded that Site 9 poses little potential risk to environmental receptors and recommended no further action for the site (Woodward Clyde, 1996).

G.2.5 Site 10 Ecological Risk Summary

Site 10 was included in both the PERA and the BERA. HQs calculated in the BERA for exposure of the chosen terrestrial receptors to detected chemicals in soils, sediment and surface waters did not exceed 1.0 using the LME scenario. No toxicity benchmarks for avian receptors

were found for fluoranthene at Site 10. Therefore, fluoranthene remained a constituent of potential concern for the site. This adds uncertainty to the risk assessment; however, based on the risks calculated for mammalian species, there is no evidence that this contaminant is present at levels of concern (Woodward Clyde, 1996). Concerning aquatic biota, the results of the sediment toxicity tests indicate no lethal or sublethal effect from acute exposure to bottom sediments from Site 10 (Woodward Clyde, 1996).

The BERA concluded that Site 10 poses little potential risk to environmental receptors and recommended no further action (Woodward Clyde, 1996).

G.2.6 Site 11 Ecological Risk Summary

Site 11 was included in both the PERA and the BERA. Based on PLC and background concentration screening, silver was retained for deterministic analysis in the BERA. HQs calculated in the BERA for exposure of the chosen terrestrial receptors to silver detected in sediment did not exceed 1.0 using the LME scenario. Based on sediment toxicity tests conducted on samples from Site 10, silver poses no hazard to aquatic biota at Site 11.

The BERA concluded that Site 11 poses little potential risk to environmental receptors and recommended no further action for the site (Woodward Clyde, 1996).

G.2.7 Site 11A Ecological Risk Summary

Site 11A was included in both the PERA and the BERA. HQs calculated in the BERA for exposure of terrestrial receptors to these chemicals did not exceed 1.0 using the LME scenario; however, the potential toxicity of 2,4,6-TNT to robins or quail was not evaluated due to the lack of available toxicity benchmarks for avian receptors (Woodward Clyde, 1996). Therefore, this chemical remained a constituent of potential concern at this site. This adds uncertainty to the risk assessment; however, based on the risks calculated for mammalian species, there is no evidence that this contaminant is present at levels of concern (Woodward Clyde, 1996). With respect to aquatic biota, no contaminant of potential concern was identified for Site 11A (Woodward Clyde, 1996).

The BERA concluded that Site 11A poses little potential risk to environmental receptors and recommended no further action for the site (Woodward Clyde, 1996).

G.2.8 Site 12 Ecological Risk Summary

Site 12 was included in both the PERA and the BERA. HQs calculated in the BERA for exposure of terrestrial receptors to chemicals of concern are all less than 1.0 using the LME scenario (Woodward Clyde, 1996). With respect to aquatic biota, no contaminant of potential concern was identified for Site 12 (Woodward Clyde, 1996).

The BERA concluded that Site 12 poses little potential risk to environmental receptors and recommended no further action for the site (Woodward Clyde, 1996).

G.2.9 Site 16 Ecological Risk Summary

Site 16 was identified in the RI as posing potential ecological and/or human health risks. This site was evaluated in both the PERA and the BERA. The BERA for Site 16, identified cadmium as a contaminant of concern (HQ≥1) for mice, robins and quail; Aroclors as contaminants of concern for mice and robins; and lead as a contaminant of concern for robins based on the LME scenario. Risks to higher-level predators were negligible. Cadmium and lead for the robin, and cadmium for the mouse, appear to be contaminants of concern in the central tendency exposure (CTE) exposure scenario. The BERA did not include an assessment for xylenes, MEK or ethylbenzene for quail or robins because of the lack of suitable toxicity data. The findings of the BERA indicated that PCBs, cadmium and lead detected in soil/sediment at Site 16, may pose a risk to mice, robins and/or quail.

Based on the findings of the BERA, a further risk-based evaluation was done for this site in the Feasibility Study by calculating risk-based potential remediation goals and comparing these values to detected site concentrations of PCBs, cadmium and lead. These calculations and comparisons concluded that remediation of Site 16 to address human health and/or ecological concerns, was not necessary. As a result, it was not necessary to evaluate remedial alternatives for Site 16 during the Feasibility Study.

G.2.10 Site 20 Ecological Risk Summary

Site 20 was included in both the PERA and the BERA. Based on PLC and background concentration screening, silver and lead were retained for deterministic analysis in the BERA. HQs calculated in the BERA for exposure of terrestrial receptors to lead and silver do not exceed 1.0 using the LME scenario (Woodward Clyde, 1996). With respect to aquatic biota, no contaminant of potential concern was identified for Site 20 (Woodward Clyde, 1996).

The BERA concluded that Site 20 poses little potential risk to environmental receptors and recommended no further action for the site (Woodward Clyde, 1996).

G.2.11 Site 21 Ecological Risk Summary

Based on a qualitative assessment which did not identify a complete exposure scenario (there was no established waste source on site), the 1988 RI concluded that Site 21 did not represent a risk of chemical exposure to potential wildlife receptors (O'Brien and Gere, 1988). The 1988 RI recommended no further evaluation of this site.

A more in-depth preliminary site assessment was done for Site 21 during the 1993 Phase I RI and the site history showed no evidence of a possible source of contamination at this site. Site 21 was also included in the PERA completed for the 1993 Phase I RI. Based on site inspections and preliminary screening, the PERA concluded that there is little likelihood of potential ecological risk at Site 21 and recommended no further assessment for the site (Golder and Associates, 1993). Since there was no evidence of contamination, the site was not sampled during the MISCA OU RI (during either Phase I or Phase II) and the site was not evaluated further in the BERA (Woodward Clyde, 1996).

G.2.12 Site 22A Ecological Risk Summary

Site 22A was identified in the RI as posing potential ecological and/or human health risks. This site was evaluated in both the PERA and the BERA. The BERA for Site 22A shows that the presence of dioxins in soils and sediments at this site could pose a risk, based on a toxicity equivalent basis, to most of the environmental receptors (mouse, robin, quail, fox, and hawk) evaluated in this study. Based on the LME scenario, the other contaminants of concern at this site included total Aroclors, 4,4-DDT, 4,4-DDE, 4,4-DDD, pentachlorophenol, mercury, selenium, and zinc for the robin; and pentachlorophenol, mercury, selenium, and zinc for the mouse. For the CTE exposure scenario, the contaminants of interest are reduced to dioxins, mercury, and selenium for the mouse, and dioxins for the robin.

The potential risk from mercury and selenium may be over-estimated because the toxicity to these contaminants was based on their organic forms, which tend to be the most toxic forms. No evidence exists to suggest the form of mercury or selenium present at the site.

There is no toxicity benchmarks for 2-methylnapthalene for avian receptors. Consequently, it remains a chemical of potential concern.

Because of the above-mentioned risks, the FWS initiated a time-critical removal action (TCRA) at Site 22A, which was completed from July through September of 1996. The TCRA removed near surface soils from depths ranging up to seven feet to remove contaminants of concern. Both pre-excavation and post-excavation confirmation sampling was also done. After the TCRA was completed, a further risk-based evaluation was done for this site in the Feasibility Study[27] to re-evaluate the potential ecological and human health risks at the site, using both RI and confirmation sampling data. This risk-based evaluation included calculating risk-based potential remediation goals and comparing these values to detected site concentrations. These calculations and comparisons concluded that the remediation done at Site 22A adequately addressed the soil contamination at this site. Furthermore, soils remaining at the site, overall, do not pose unacceptable health threats to either humans or ecological receptors. As a result, it was not necessary to evaluate remedial alternatives for Site 22A during the Feasibility Study.

G.2.13 Site 24 Ecological Risk Summary

Site 24 was excluded from the scope of the MISCA OU RI, because it is not part of the Refuge and the FFA specifies no further action for the site. As a result, no ecological risk assessment was done for this site.

G.2.14 Site 25 Ecological Risk Summary

Site 25 was excluded from the scope of the MISCA OU RI, because it is not part of the Refuge and the FFA specifies no further action for the site. As a result, no ecological risk assessment was done for this site.

[27] Woodward-Clyde, March 1997, Pre-Draft Report, Feasibility Study for the Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.

G.2.15 Site 26 Ecological Risk Summary

Site 26 was excluded from the scope of the MISCA OU RI, because it is not part of the Refuge and the FFA specifies no further action for the site. As a result, no ecological risk assessment was done for this site.

G.2.16 Site 27 Ecological Risk Summary

The 1988 RI concluded that there was insufficient data to determine risks to fish, wildlife and humans at Site 27 (O'Brien and Gere, 1988). Therefore, a quantitative receptor analysis and risk assessment was not performed. Follow-up monitoring of surface water and sediments was recommended (O'Brien and Gere, 1988).

A more in-depth preliminary site assessment was done for Site 27 during the 1993 Phase I RI and the site history showed no evidence of a possible source of contamination at this site. Site 27 was also included in the PERA completed for the 1993 Phase I RI. Based on site inspections and preliminary screening, the PERA concluded that there is little likelihood of potential ecological risk at Site 27 and recommended no further assessment for the site (Golder and Associates, 1993). Since there was no evidence of contamination, the site was not sampled during the MISCA OU RI (during either Phase I or Phase II) and the site was not evaluated further in the BERA (Woodward Clyde, 1996).

G.2.17 Sites 30 and 31 Ecological Risk Summary

Since Sites 30 and 31 were used as background sites, they were excluded from the scope of the MISCA OU RI and no ecological risk assessments were done for these sites.

G.2.18 Site 35 Ecological Risk Summary

Based on a qualitative assessment which did not identify a complete exposure scenario (there was no established waste source on site), the 1988 RI concluded that Site 35 did not represent a risk of chemical exposure to potential wildlife receptors (O'Brien and Gere, 1988). The 1988 RI recommended no further evaluation of this site.

A more in-depth preliminary site assessment was done for Site 35 during the 1993 Phase I RI and the site history showed no evidence of a possible source of contamination at this site. Site 35 was also included in the PERA completed for the 1993 Phase I RI. Based on site inspections and preliminary screening, the PERA concluded that there is little likelihood of potential ecological risk at Site 35 and recommended no further assessment for the site (Golder and Associates, 1993). Since there was no evidence of contamination, the site was not sampled during the MISCA OU RI (during either Phase I or Phase II) and the site was not evaluated further in the BERA (Woodward Clyde, 1996).

G.2.19 Site 36 Ecological Risk Summary

A BERA was conducted as part of the 1996 Phase II RI. The purpose of the BERA was to determine the potential for adverse ecological effects to occur as a result of exposure to existing

conditions at the MISCA OU sites. For Site 36, the assessment concluded that Dove Creek and the West Pond on Site 36 posed little or no risk to ecological receptors. Risks were also judged to be negligible at the Primary Lagoon and East Pond. To incorporate updated methodologies for ecological risk assessment, and provide for additional consideration of resource management goals at the Refuge, the DOI decided to re-evaluate the ecological risk assessment for Site 36 to support the FS.

The FS ecological risk evaluation consists of three components that, in combination, comprise USEPA's general approach as outlined in Guidelines for Ecological Risk Assessment[28]. These are (1) Problem Formulation; (2) Risk Analysis; and (3) Risk Characterization. Problem Formulation is the process of establishing the goals, breadth and focus of the ecological risk assessment. Problem formulation begins by evaluating available information to identify and characterize: (1) the contaminants known or suspected to be present; (2) the ecosystem(s) potentially at risk; and (3) the anticipated ecological effects. This leads to the identification of ecologically relevant endpoints that are the actual values to be protected (assessment endpoints). A conceptual model identifies and describes complete exposure pathways, providing a basis for selection of measures of exposure and measures of effect that are linked to the assessment endpoints. For higher trophic level organisms, receptors were selected that are representative of each the assessment endpoints. These are referred to as Receptors of Concern (ROCs).

Following removal of the wastewater treatment plant and associated ponds and lagoons, Site 36 will become an upland terrestrial habitat. A stream on the site, Dove Creek, will become an ephemeral stream with flows associated only with precipitation. Only the lower portion of Dove Creek was evaluated as an aquatic ecosystem[29]. ROCs evaluated in conjunction with the terrestrial and aquatic portions of Site 36 are summarized below.

ROCs FOR SITE 36 (Terrestrial Receptors)

Herbivores	Invertebrate Consumers	Omnivores	Carnivores
White-tailed deer	Little Brown Bat	White-footed Mouse	Red Fox
Prairie Vole	Carolina Wren	Marsh rice rat	Gray fox
Fox Squirrel	Blue Gray Gnatcatcher	Short-tailed shrew	Coyote
Golden mouse	American Woodcock	Cotton mouse	Bobcat
Eastern Cottontail	American Robin	Wild Turkey	Red-tailed hawk
Mourning Dove		Gray Catbird	Red-shouldered hawk
Cedar Waxwing		Carolina Chickadee	Barred owl
Brownheaded Cowbird		Bobwhite Quail	American kestrel
American Goldfinch			

[28] USEPA. 1998. *Guidelines for Ecological Risk Assessment*. United States Environmental Protection Agency, Risk Assessment Forum. Washington, D.C. EPA/630/R-95/002F (see also 63FR93:26845-26924).

[29] As discussed elsewhere, "Upper Dove Creek" is a constructed channel.

ROCs FOR SITE 36 (Semiaquatic Receptors)

Herbivores	Invertebrate Consumers	Omnivores	Carnivores
Muskrat	Brown bat	Wood duck	Great blue heron
Canada goose	Marsh wren	Snipe	Mink
	Tree swallow	Raccoon	

In the ecological risk analysis conducted for the Site 36 feasibility study, conservative assumptions were applied in a mathematical approach using literature-based information to evaluate potential impacts. With the exception of sediment toxicity tests previously collected in Dove and Pigeon Creeks, biological field data were not collected to directly evaluate effects to ecological receptors associated with site-related chemicals.

The golden mouse, representing small terrestrial herbivores, was identified as the most sensitive ecological receptor for PCBs at Site 36. This means that organisms such as the golden mouse can potentially be adversely affected by lower levels of PCBs than other species at Site 36. The evaluation suggested that adverse ecological effects could potentially occur at concentrations greater than about 0.85 mg/kg. The majority of locations where PCB concentrations exceeded this RBC were associated with the Upper Dove Creek area.

The marsh rice rat was identified as the most sensitive receptor to cadmium. The RBC for the marsh rice rat, along with several other receptors, is below the measured background value for the Refuge (1.4 mg/kg). Therefore, cadmium concentrations exceed the RBC level in all areas of concern at Site 36.

The blue-gray gnatcatcher was identified as the most sensitive receptor to chromium. Again, the resultant RBC is below the measured background value for the Refuge (35.1 mg/kg). Thus, chromium concentrations exceed this level in all areas of concern at Site 36.

The short-tailed shrew was identified as the most sensitive receptor to TCDD TEQ. The evaluation suggested that adverse ecological effects could potentially occur at concentrations greater than about 0.000045 mg/kg (45 parts per trillion). The majority of locations where TCDD TEQ concentrations exceeded this RBC were associated with the East Pond area.

Other COPECs evaluated also posed potential risk to ecological receptors. However, based on available data, PCBs, cadmium, and chromium pose the greatest potential risks and have the greatest extent. This will be verified during pre-design sampling.

The risk based concentrations presented above represent levels where these contaminants would, in theory, not adversely affect wildlife at Site 36. For cadmium however, it is infeasible to reduce concentrations to below background levels. An evaluation was conducted to determine how cleaning up the site to different levels of cadmium would affect the cadmium exposures to wildlife at Site 36. An iterative process was examined to compare remedial targets with predicted exposure concentrations following remediation. By iteratively reducing the target cadmium concentrations (for example, removing soil above 20 mg/kg, 10 mg/kg, and 4 mg/kg

cadmium) it was found that a target removal concentration of 4 mg/kg reduced the overall average cadmium exposure concentration to 1.4 mg/kg (site background)[30].

Such simulations allowed for a more realistic and appropriate response to the potential ecological risks calculated within Site 36. Based on results of the risk-reduction scenario analysis, remediation to 4 mg/kg cadmium was considered to be sufficiently protective of ecological resources within Site 36 and further reduction in cadmium would not result in substantial additional risk reduction.

Examination of this cadmium remediation level indicated that three small areas still contained PCB concentrations greater than target levels of 0.85 mg/kg. When remediation of the site was based on cadmium levels of 4 mg/kg, and PCB levels of 0.85, the exposure concentrations to chromium were below background levels, and to all other chemicals were estimated to be below levels of concern.

Conclusion

The response action selected for Site 36 in this ROD is necessary to protect human health or welfare or the environment from actual or threatened release of hazardous substances, pollutants or contaminants from this site, which may present an imminent and substantial endangerment to public health or welfare.

SECTION H. REMEDIAL ACTION OBJECTIVES

H.1 Sites 10 and 16

Appropriately limit human activity at Sites 10 and 16.

H.2 Site 36

Remedial action objectives (RAOs) for Site 36, based on existing knowledge of the site and potential risks, are:

- Reduce the probability and degree of ecological exposure associated with soil containing PCBs, cadmium, chromium, TCDD TEQ and other contaminants to acceptable risk levels.

- Reduce the probability and degree of exposure of construction workers and recreational receptors associated with soil or sludge containing PCBs, aldrin, and all other contaminants of concern to acceptable risk levels.

- Protect groundwater at Site 36 by reducing the concentrations of COCs within a reasonable amount of time to levels below that which could further degrade groundwater.

[30] Background levels shown in the table are the currently accepted background values for the refuge, and are interim values. USFWS is integrating recently obtained background data from the AUS OU with the existing background data to produce a more representative and robust background dataset. During the pre-design phase for Site 36 and upon approval of the FFA partners, the combined background dataset will replace the 1996 background dataset at Site 36.

- Ensure that potable water supplies wells are not installed at this site in the region of exceedances of MCLs/State of Illinois Class I groundwater standards until the groundwater is restored to MCLs/State of Illinois Class I groundwater standards for all contaminants of concern.

Remediation of the media of concern at Site 36 to the designated remediation goals, which represent the acceptable levels for both human and ecological receptors, is proposed to achieve these RAOs.

SECTION I. DESCRIPTION OF ALTERNATIVES

Three alternatives were developed and evaluated, including the No-Action Alternative.

The costs presented for each alternative include capital costs (such as equipment, labor and other construction expenses to put the remedy in place) and operation and maintenance (O&M) costs (such as monitoring the groundwater or maintaining the cap).

A list of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) which apply to the site are listed and described in the Statutory Determinations Section of this ROD.

I.1 Alternative 1 – No Action

Alternative 1 assumes that no remedial action would be implemented. This alternative is required by the National Contingency Plan, and it serves as a baseline against which other alternatives are compared.

I.2 Alternative 2 – Excavation/Off-site Disposal/Groundwater Monitoring

Pre-design Testing

Pre-design sampling will be done to fill data gaps identified in the Feasibility Study Report. Examples of the types of sampling to be done are installation of additional monitoring wells, site-specific determination of leaching potential from soil to groundwater (i.e., pH) and biological terrestrial and semi-aquatic tissue sampling.

Demolition of Wastewater Treatment Plant

The wastewater treatment plant facilities would be demolished and the materials disposed in an off-site permitted landfill.

Treatment Components

Approximately 500,000 gallons of impounded water at the East Pond would be removed and passed through an on-site treatment train (e.g., oil/water separator, alum, filter, and granular activated carbon). Water resulting from dewatering of sludge would be treated the same way.

The treated water would be discharged to surface water after meeting the State of Illinois General Use Water Quality Standards.

There are no treatment components for soil, sludge and groundwater.

Containment (or Storage) Components

- Excavation, dewatering (as needed), and disposal of an estimated 1,000 cubic yards of PCB-contaminated soil/sludge (PCB concentrations greater than 50 mg/kg) from the East Pond and Upper Dove Creek in an off-site TSCA-permitted landfill.

- Excavation and disposal of an estimated 12,000 cubic yards of soil contaminated with PCBs (concentrations less than 50 mg/kg), cadmium, chromium, and other COCs. This soil is from the Treatment Area and Upper Dove Creek, and will be disposed of in an off-site RCRA Subtitle D landfill.

- Excavation, dewatering, and disposal of an estimated 4,200 cubic yards of soil/sludge from the Primary and Secondary Lagoons in an off-site RCRA Subtitle D landfill.

No on-site containment components are included.

Site Restoration

Site restoration would include backfilling with clean soils and re-grading areas and re-establishment of vegetation.

Institutional Control Components

- Institutional controls to prohibit installation of potable water wells until the groundwater is restored to MCLs/State of Illinois Class I groundwater standards for all contaminants of concern.

- Groundwater monitoring until groundwater at Site 36 is restored to MCLs/State of Illinois Class I groundwater standards for all contaminants of concern.

I.3 Alternative 3 – Institutional Action/ Soil Cover/ Excavation/ Off-site Disposal/Groundwater Monitoring

Alternative 3 would be completed as described in Alternative 2, except the contamination in the Primary and Secondary Lagoons would be left in place and a soil cover would be constructed over the contaminated material.

Pre-design Testing

Pre-design sampling will be done to fill data gaps identified in the Feasibility Study Report. Examples of the types of sampling to be done are installation of additional monitoring wells,

site-specific determination of leaching potential from soil to groundwater (i.e., pH) and biological terrestrial and semi-aquatic tissue sampling.

Treatment Components

Approximately 500,000 gallons of impounded water at the East Pond would be removed and passed through an on-site treatment train (e.g., oil/water separator, alum, filter, and granular activated carbon). Water resulting from dewatering of sludge would be treated the same way. The treated water would be discharged to surface water after meeting the State of Illinois General Use Water Quality Standards.

There are no treatment components for soil, sludge and groundwater.

Containment (or Storage) Components

- Excavation, dewatering (as needed), and disposal of an estimated 1,000 cubic yards of PCB-contaminated soil/sludge (PCB concentrations greater than 50 mg/kg) from the East Pond and Upper Dove Creek in an off-site TSCA-permitted landfill.

- Excavation and disposal of an estimated 12,000 cubic yards of soil contaminated with PCBs (concentrations less than 50 mg/kg), cadmium, chromium, and other COCs. This soil is from the Treatment Area and Upper Dove Creek, and will be disposed of in an off-site RCRA Subtitle D landfill.

- Placement of a soil cover over the Primary and Secondary Lagoons which will consist of at least 6 feet of soil, to protect the sludge left in place from erosion and infiltration of most surface water. This will include a 3-foot protective soil layer and a 3-foot low permeability soil layer to comply with ARARs. Impounded water will be removed and sludge will be stabilized prior to construction of the cover. The sludge will not be stabilized to stop contaminant migration, but to add strength for support of the cover. Approximately 38,000 cubic yards of subgrade fill, low permeability clay, and soil capable of supporting vegetation will be placed in the lagoons. Seeding and mulching will be conducted to establish vegetation, and a fence would be installed around the lagoons. Post-closure care will be required for 30 years and will include inspection, maintenance and repair, and groundwater monitoring. It is assumed that three new monitoring wells would be installed downgradient and two new monitoring wells installed upgradient of the lagoons. Provisions could be made for altering the length or frequency of sampling of groundwater monitoring, based on evaluation of analytical results. For estimating cost, groundwater monitoring is assumed to last for 30 years.

Site Restoration

Site restoration including backfilling with clean soils and re-grading areas and re-establishment of vegetation.

Institutional Control Components

- Institutional controls to prevent any activity that could compromise the integrity of the soil cover at the lagoons.

- Institutional controls to prohibit installation of potable water wells until the groundwater is restored to MCLs/State of Illinois Class I groundwater standards for all contaminants of concern.

- Groundwater monitoring until groundwater at Site 36 is restored to MCLs/State of Illinois Class I groundwater standards for all contaminants of concern.

I.4 Common Elements and Distinguishing Features of Each Alternative

This section addresses the two action alternatives only.

- Key ARARs Associated with Alternatives. For both action alternatives the Toxic Substances Control Act, the Clean Water Act, the Solid Waste Disposal Act, the Illinois Solid Waste Landfill regulations, and the Illinois General Use Water Quality Criteria are key ARARs. Both alternatives include off-site landfilling of contaminated materials, and Alternative 3 would involve compliance with Illinois Solid Waste regulations for on-site disposal. It would also involve a waiver for the liner and leachate collection system requirements of the Illinois solid waste regulation.

- Long-term Reliability of Alternatives. Alternative 2 is more reliable because all contaminated material is disposed of in landfills with leachate collection systems and liners. Alternative 3 involves leaving some sludge on-site with a cover, but no liner or leachate collection system.

- Quantity of Untreated and Treated Residuals to be Disposed Off-site or Managed On-site. For both alternatives, about 12,000 cubic yards of soil and about 1,000 cubic yards of sludge from the East Pond would be disposed off-site. For Alternative 2, approximately 4,200 cubic yards of contaminated sludge and soil from the Primary and Secondary Lagoons would be disposed off-site, and for Alternative 3 this material would be left on-site and covered.

  For both alternatives, some contaminated groundwater would be left, that will require monitoring.

- Time Required for Design and Construction. Both alternatives would require about 2 years for design and construction.

- Time Required to Reach Cleanup Levels. For both alternatives, soil cleanup goals would be achieved with construction completion, except that Alternative 3 would involve some waste being permanently on-site, but protected from exposure to receptors.

- Cost for Each Alternative. The following table presents a summary of the capital cost, annual operation and maintenance, and present worth cost for each of the alternatives.

Present Worth Cost for each of the Alternatives

Cost	Alternative 1	Alternative 2 (thousands $)	Alternative 3 (thousands $)
Capital Cost	$0	$5,086	$5,236
Annual O&M	$0	$14	$23
Present Worth	$0	$5,263	$5,519

The cost estimates used a discount rate of 7% and the duration of O&M was assumed to be 30 years.

- Use of Presumptive Remedies and/or Innovative Technologies. Presumptive remedies are those remedies that are USEPA's preferred technologies for common categories of sites. None of the alternatives evaluated for the site are considered presumptive remedies[31]. Innovative technologies are newly invented processes that have been tested yet lack enough testing to predict the outcome at various sites. Innovative technologies were considered for this site, but were screened out. A difficulty with several technologies that may have been effective with PCBs is that they did not address the metals contamination.

I.5 Expected Outcomes of Each Alternative

- Available Land Uses Upon Achieving Performance Standards. After this site is remediated, it is planned to become a functional piece of the overall ecosystem within the Refuge. For both Alternatives 2 and 3, there will be restrictions on potable water wells until the groundwater is restored. With Alternative 3, there will also be restrictions on digging, and long-term monitoring of the cover will be required.

- Available Groundwater Uses Upon Achieving Performance Standards. For both action alternatives, groundwater use will be restricted until MCLs/State of Illinois Class I groundwater standards are achieved.

SECTION J. COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the alternatives in terms of the nine criteria as required by the NCP (Section 300.430(f)(5)(i)). Each of the nine criteria is first explained. The results are summarized in Table J-1. An alternative providing the "best balance" of tradeoffs with respect to the nine criteria is determined from this evaluation.

[31] USEPA. 1993. Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites With Volatile Organic Compounds in Soils. Office of Solid Waste and Emergency Response, Directive 9355.0-48FS; EPA 540-F-93-048; PB 93-963346.

J.1 Overall Protection of Human Health and the Environment

This criterion addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls. All of the alternatives, except the no-action alternative, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site through treatment of soil contaminants, engineering controls, and/or institutional controls.

Both action alternatives protect both human and ecological receptors by removal and off-site disposal of contaminated materials. This applies to all locations for Alternative 2 and to all locations except the Primary and Secondary Lagoons for Alternative 3. Alternative 3 includes long-term monitoring of the soil cover and the groundwater in the vicinity of the covered material to ensure that potential human and ecological receptors are protected from contaminants left on-site.

Both action alternatives would protect against further degradation of the groundwater through removal of the source of groundwater contamination, the sludge at the East Pond. Both action alternatives provide comparable protection of human health and the environment. Alternative 1, the No Action Alternative, would not provide protection of human health and the environment.

J.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA Section 121(d)(4). ARARs applying to the site are listed and described in the Statutory Determinations Section of this ROD.
Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking waiver.

Alternative 1 does not comply with ARARs. Alternative 2 fully complies with all ARARs. Alternative 3 complies with all ARARs with the exception of requiring a waiver for the liner and leachate collection system requirements of the solid waste landfill regulations (Title 35 of the Illinois Administrative Code [35 IAC], Part 811).

J.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Ecological and human health risks associated with contaminated soil and sludge would remain for Alternative 1 as well as the potential for future releases. Alternative 2 would reduce the human health and ecological risks through excavation and disposal for the entire site. Alternative 3 would reduce the human health and ecological risks through excavation and disposal for the Treatment Area and Upper Dove Creek. The risks posed by contaminated sludge at the Primary and Secondary Lagoons would be reduced through the construction of a soil cover. Long-term management of the soil covers would be needed. Both Alternatives 2 and 3 would protect against further degradation of the groundwater through source removal (East Pond sludge) and groundwater monitoring. Groundwater cleanup is expected to be effective in the long-term because the soils which may be leaching unacceptable levels of contamination would be removed. Residual contaminants accessible to the general public after completion of remedial activities would be minimal and would be below acceptable levels.

J.4 Reduction of Mobility, Toxicity, and Volume Through Treatment

Reduction of mobility, toxicity, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. This criterion evaluates an alternative's use of treatment to reduce the harmful nature of contaminants, their ability to move in the environment and the amount of contamination present.

None of the alternatives would reduce the toxicity, mobility, or volume of contaminated soil and sludge through treatment.

Alternatives 2 and 3 would reduce the toxicity of contaminated surface water by treatment of the impounded surface water at the East Pond.

J.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternative 1 (No-action) does not provide any short-term effectiveness during the remedial action because no action is taken.

Alternatives 2 and 3 would pose little or no risk to the community. Trucks on public roads would be covered to prevent potential exposure. In addition, local officials would be consulted to insure that routes do not travel through residential areas. Excavation of contaminated materials would present some short-term physical and environmental hazards for workers. Air monitoring on-site and at the site boundaries and engineering controls would control the potential for exposure. Workers would be required to wear appropriate levels of protection to avoid exposure during excavation and treatment activities.

J.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Alternative 1 has no action to implement. Alternatives 2 and 3, in general, would be readily implemented. Alternative 2 would require installation of additional monitoring wells. Alternative 3 would require installation of additional monitoring wells and design and construction of a soil cover for the lagoons. Technologies are reliable for Alternatives 2 and 3.

J.7 Cost

Alternative 2 was the least costly, followed by Alternative 3. The estimated present worth cost for Alternative 2 is $5,263,000 and $5,519,000 for Alternative 3. Cost summaries can be found in Table J-1.

J.8 State Acceptance

The State of Illinois has expressed its support for Alternative 2. The State does not believe that Alternative 1 provides adequate protection of human health and the environment.

J.9 Community Acceptance

The public did not have any comment on the Preferred Remedy identified in the Proposed Plan.

SECTION K. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that USEPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Principal threat wastes include source materials such as the contaminated soil and sludge at Site 36, which pose unacceptable risk to human health and the environment.

The action alternatives address the principal threat waste by excavation and off-site disposal for Alternative 2, and by a combination of excavation and off-site/on-site disposal for Alternative 3. Treatment technologies were evaluated, but primarily because of the complex mixture of contaminants, no treatment technologies were considered feasible.

SECTION L. SELECTED REMEDY

L.1 Summary of the Rationale for the Selected Remedy

Alternative 2 was selected because it complies with ARARs without waivers, and the cost is reasonable compared to the other alternative.

Both action alternatives are comparable with respect to the following criteria:

- Overall protection of human health and the environment
- Long-term effectiveness and permanence
- Short-term effectiveness
- Implementability
- Reduction of toxicity, mobility, or volume through treatment
- Community acceptance

The alternatives differ with respect to these criteria:

- Compliance with ARARs
- Cost

The selection was then based upon a comparison of the alternatives to these two criteria. Alternative 2 is about 4.6 percent less expensive than Alternative 3. Alternative 2 fully complies with all ARARs. Alternative 3 complies with all ARARs with the exception of requiring a waiver for the liner and leachate collection system requirements of Illinois State Solid Waste Landfill Regulations (35 IAC 811). Alternative 2 was selected because it fully complies with all ARARs and is slightly less expensive than Alternative 3.

L.2 Detailed Description of Selected Remedy for Sites 10, 16, and 36

The Selected Remedy for Site 36 consists of the excavation and disposal of the sludge in the East Pond and Primary and Secondary Lagoons, the soil in Upper Dove Creek, and the soil throughout the Treatment Area. Clearing and grubbing will be required prior to excavation for areas with vegetation. The Selected Remedy also includes sampling, demolition, and disposal of the wastewater treatment plant.

Impounded water at the East Pond will be removed and passed through an on-site treatment train (e.g., oil/water separator, alum, filter, and granular activated carbon) and discharged to surface water. The treated water will be required to meet State of Illinois General Use Water Quality Standards. The impounded water in the Primary and Secondary Lagoons is part of the existing wastewater treatment plant. Samples collected as part of the RI had exceedances only for iron.

It is assumed that as part of the decommissioning of the plant this impounded water will be drained and treated in the existing facility, if necessary.

The sludge at the East Pond and lagoons, soil at Upper Dove Creek, and soil throughout the Treatment Area will be excavated using standard excavation equipment. Since all soil samples tested at Site 36 passed the TCLP test, it was assumed that soil will be transported in sealed trucks to a local solid waste landfill. Verification sampling for TCLP will be required prior to transport.

Sludge from the East Pond and soil from Upper Dove Creek with PCBs exceeding 50 mg/kg will be dewatered, placed in sealed containers, and hauled to a TSCA-permitted landfill for disposal. The landfill must be in compliance with current laws and have a good compliance record. Dewatered sludge from the lagoons and non-TSCA-regulated soil from Dove Creek will be placed and transported in sealed trucks to a local solid waste landfill (RCRA Subtitle D).

Site restoration will include backfilling Upper Dove Creek (the manmade channel from the wastewater treatment plant), backfilling and re-grading areas of soil removal at the Treatment Area, re-grading lagoons, re-grading at East Pond, and re-establishment of vegetation. The former location of Upper Dove Creek will be graded to match the grade of the surrounding area, with a gentle slope of less than 2% to the natural Dove Creek. The lagoons will be graded to match surrounding grade, with a gentle slope toward Quail Creek. The Treatment Area will be backfilled to the original grade. For cost purposes, vegetation will include planting saplings and clover throughout the entire site at a density of approximately 700 trees per acre. In addition to the saplings, a crop cover (clover) will be planted and the soil will be amended with lime and fertilizer.

Costs presented in Appendix B include demolition, removal, and disposal of the wastewater treatment plant structures. In addition, pre-design sampling will be completed for the sludge in the digesters, around the perimeter of the structures, and under some structures. The sampling at the facility was assumed, for cost purposes, to consist of 10 samples taken around the perimeter of the structures and under the structures for contaminants of concern. The sludge in the digesters was assumed to be non-hazardous based on results from TCLP samples taken in the East Pond and the Primary and Secondary Lagoons. The treatment plant sampling will be detailed in the pre-design sampling plan.

Additional areas have been identified to require pre-design samples. Specific locations are presented in the FS report.

Pre-design sampling would also include collection of data to allow for a site-specific determination of leaching potential from soil to groundwater (i.e., pH). In addition, biological terrestrial and semi-aquatic tissue samples will be analyzed for selenium, thallium, and silver at a minimum, and possibly for the full TAL. Biological terrestrial tissue samples will also be analyzed for cadmium and PCBs at a minimum and possibly for the full TAL. For cost purposes, it was assumed that 5 samples would be taken for terrestrial and semi-aquatic tissue each, and each of the samples would be analyzed for TAL inorganics and PCBs. Details of the sampling will be presented in the pre-design work plan.

The confirmation sampling[32] will include both vertical and lateral sampling to ensure that the remediation goals are met. For cost purposes it was assumed that twenty samples would be taken in each of the three areas of concern (Treatment Area, Dove Creek, and the Primary and Secondary Lagoons) and analyzed for COCs. Details of confirmation sampling will be presented in the remedial design work plan.

Protection of groundwater, to prevent further degradation, will be accomplished through the removal of the source material for the groundwater contamination, and groundwater monitoring. The full extent of groundwater contamination above ARARs will be determined during the pre-design phase for Site 36. Pre-design activities will include an evaluation of the actual or potential impact contaminated overburden groundwater at Site 36 has had on the underlying bedrock aquifer. Additional monitoring wells will be installed. For cost purposes, four additional wells located near the East Pond and two wells upgradient of COMW236-4 (but downgradient of the wells near the East Pond) are assumed. Groundwater in and around the region of exceedances of MCLs/State of Illinois Class I groundwater standards will be monitored until the groundwater is restored for COCs. The groundwater monitoring will verify the extent of the region of exceedances, and confirm that contaminant concentrations are declining as a result of the remediation. The first four quarterly sampling events will include sampling the available functional wells at Site 36 for all the site COCs except dioxins/furans. Dioxins/furans will be analyzed for in samples collected from the well immediately downgradient of the East Pond, where the highest dioxin/furan detections were found in the sludge, for the first two quarterly sampling events. If at the 5-year review these standards have not been met, the groundwater monitoring will be re-evaluated according to the triggers discussion below.

Institutional controls will be implemented at Site 36 to ensure that potable water supply wells are not installed at the site in the region of exceedances of MCLs/State of Illinois Class I groundwater standards until groundwater is restored for contaminants of concern. Institutional controls will also be implemented at Sites 10 and 16 to appropriately restrict human access. If future risk assessments show that the sites are appropriate for unrestricted use or reduced limitations on human activity, the institutional controls will be removed or modified as appropriate. These institutional controls will be implemented, maintained, and enforced by DOI/FWS. An Institutional Control Implementation Plan (ICIP) will be prepared as part of the Remedial Design Document. The following items will be included in the ICIP:

- Identification of specific land use restrictions applicable to sites 10, 16 and 36, the specific geographic extent of the restrictions, and the basis for the restrictions.

- Implementation of enforcement procedures, including control methods, use of existing GIS contaminant database for the site, and visual inspection frequency and methodology.

- Procedure for routine inspection reports.

[32] Confirmation samples will be designed based upon Methods for Evaluating the Attainment of Cleanup Standards, EPA 230/02-89-042; and Statistical Methods for Evaluating the Attainment of Cleanup Standards, Volume 3, Reference-Based Standards for Soils and Solid Media, EPA/230/R-94/004.

The exposure assumptions used in the human health risk assessments were consistent with the current human uses of the site. Regarding future land use, any change in land use inconsistent with any land use contained in those specific exposure assumptions in the risk assessments will require an evaluation of whether the anticipated land use change will pose unacceptable risks to human health and the environment or negatively impact the effectiveness of the selected Site remedy. This is enforceable under the National Wildlife Refuge Administration Act (16USC668dd), Section (d)(3)(A)(I), which requires that the Secretary of the Interior (Secretary)"…shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety." The Secretary's determination must be in writing and is subject to public review and comment. Potential land use changes are currently being evaluated through the CCP process that is required by 16USC668dd.

Triggers During Groundwater Monitoring Period

After the active remediation is complete and during the time that groundwater is being monitored, monitoring wells will be sampled on a quarterly basis, at least initially. If any of the following occurs, all parties of the FFA will be notified, and they will determine what, if any action needs to be taken:

- Contaminant concentrations in groundwater exhibit an increasing trend,
- Near-source wells exhibit large increases in concentrations,
- Contaminants are identified in monitoring wells outside the original plume,
- Contaminant concentrations are not decreasing at a sufficiently rapid rate to meet the remedial objectives.

Specifics on time for restoration will not be included in the ROD. These issues will be addressed in the development of the Operation and Maintenance Plan for the site.

L.3 Summary of the Estimated Remedy Cost

The information in the cost estimate, presented in Appendix B, is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Difference (ESD), or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to –30 percent of the actual project cost.

The detailed cost estimate for the Selected Remedy is presented in Appendix B of this ROD. The total capital cost for the preferred remedy is estimated at $5,086,000, the total operation and maintenance cost is estimated at $14,000, and the total present worth cost is estimated at $5,263,000.

L.4 Expected Outcomes of the Selected Remedy

The expected land use, groundwater use, anticipated socio-economic and community impacts, and anticipated environmental and ecological benefits of the Selected Remedy are as follows:

Land Use. After this site is remediated, it is planned to become a functional piece of the overall ecosystem within the Refuge.

Groundwater Use. Institutional controls will be implemented at Site 36 to ensure that potable water supply wells are not installed at the site until groundwater is restored. Groundwater is expected to reach MCLs/State of Illinois Class I groundwater standards for COCs, as a result of the removal of the contaminant source. There is no present use of this groundwater.

Anticipated Community Impacts and Environmental and Ecological Benefit. This site will go from an industrial site to becoming a functional piece of the overall Refuge ecosystem.

L.5 Cleanup Levels for Selected Remedy

Cleanup levels for Site 36 are summarized in the table below. Sources of the cleanup levels are as follows:

- Human health risk-based cleanup levels for PCBs and aldrin are the preliminary remediation goals from the MISCA OU 1996 Phase II RI baseline human health risk assessment.

- The human health risk-based cleanup level for TCDD TEQ has been revised consistent with current USEPA policy, presented in OSWER[33] Directive 9200.4-26, dated 13 April 1998. The directive states that until USEPA develops guidance based on a comprehensive on-going study of dioxins/furans, USEPA will generally use 1 part per billion (ppb) (0.001 mg/kg) for residential soil cleanup levels. This value, 1 ppb TCDD TEQ, equates to an estimated cancer risk of 2.5E-4 to residential users. In accordance with USEPA policy, 1 ppb will be used for protection of human health. Use of a residential value for this site, which is not a residential site, is a conservative interpretation of the guidance. Using this value, all detected concentrations at the site are below the cleanup level.

- Soil Ecological Risk LOAEL RBCs are the lowest observed adverse effect level (LOAEL) RBCs for each receptor group (considered interim cleanup levels; see discussion below).

- USEPA Region 9 Soil PRGs/State of Illinois Tiered Approach to Corrective Action Objectives (TACO) Tier 1 values. The first number (USEPA Region 9) is the lower of the following:

  - United States Environmental Protection Agency (USEPA) Region 9 Soil PRGs for industrial soil,

  - USEPA Region 9 soil screening levels for migration to groundwater.

[33] Office of Solid Waste and Emergency Response

The second number (TACO) is the lower of the following:

- TACO Tier 1 soil remediation objectives for commercial/industrial properties (lowest exposure route specific value for soils) (35 IAC, Section 742, Appendix B), and

- State of Illinois TACO Tier 1 soil remediation objectives for the soil component of the groundwater ingestion exposure route value for Class I groundwater (35 IAC, Section 742, Appendix B).

The first three columns of cleanup levels shown in the table apply to soil. The lowest value, shown shaded in the table is the controlling cleanup level. As shown in the footnote in the following table, some of the cleanup levels are considered to be interim. These interim values are discussed below.

Contaminant	**Human Health Risk-Based Cleanup Level** (mg/kg)	**Soil Ecological Risk LOAEL RBC** (mg/kg)[1]	**USEPA Region 9 Soil PRGs/TACO Tier 1 Values** (mg/kg)[2]	**MCLs/State of Illinois Class I Groundwater Standards** (ug/L)
PCBs	5	0.85	NA—see Human Health Risk-Based Cleanup Level	0.5
Aldrin	0.8	0.22	NA—see Human Health Risk-Based Cleanup Level	NA
Chlordane	Concentrations within acceptable risk levels	1.58	10 / 1.6	2
4-4' DDE	Concentrations within acceptable risk levels	0.225	12 / 17	NA
4-4' DDT	Concentrations within acceptable risk levels	0.227	12 / 17	NA
Endrin	Concentrations within acceptable risk levels	0.416	1 / 1	2
Heptachlor	Concentrations within acceptable risk levels	1.21	0.55 / 1	0.4
TCDD TEQ	Concentrations within acceptable risk levels	4.5E-5	Concentrations within acceptable risk levels	0.3E-5
Total High Molecular Weight PAHs	Concentrations within acceptable risk levels	30.1	NA / NA	NA
Benzo(a) anthracene	Concentrations within acceptable risk levels	NA	2 / 2	NA
Benzo(a)pyrene	Concentrations within acceptable risk levels	NA	0.29 / 0.8	0.2
Benzo(b) fluoranthene	Concentrations within acceptable risk levels	NA	2.9 / 5	NA
Benzo(k) fluoranthene	Concentrations within acceptable risk levels	NA	29 / 49	NA
Chrysene	Concentrations within acceptable risk levels	NA	160 / 160	NA
Dibenzo(a,h) anthracene	Concentrations within acceptable risk levels	NA	0.29 / 0.8	NA
Fluoranthene	Concentrations within acceptable risk levels	NA	4,300 / 4,300	NA
Indeno(1,2,3) pyrene	Concentrations within acceptable risk levels	NA	2.9 / 8	NA

Contaminant	Human Health Risk-Based Cleanup Level (mg/kg)	Soil Ecological Risk LOAEL RBC (mg/kg)[1]	USEPA Region 9 Soil PRGs/TACO Tier 1 Values (mg/kg)[2]	MCLs/State of Illinois Class I Groundwater Standards (ug/L)
Pyrene	Concentrations within acceptable risk levels	NA	4,200 / 4,200	NA
Total Low Molecular Weight PAHs	Concentrations within acceptable risk levels	332	NA/NA	NA
Acenapthene	Concentrations within acceptable risk levels	NA	570 / 570	NA
Anthracene	Concentrations within acceptable risk levels	NA	12,000 / 12,000	NA
Fluorene	Concentrations within acceptable risk levels	NA	560 / 560	NA
Naphthalene	Concentrations within acceptable risk levels	NA	84 / 12	NA
Phenanthrene	Concentrations within acceptable risk levels	NA	NA / NA	NA
Acetone	Concentrations within acceptable risk levels	1,267	16 / 16	NA
Methyl-Ethyl Ketone (MEK)	Concentrations within acceptable risk levels	5,393	28,000 / NA	NA
Methylene Chloride	Concentrations within acceptable risk levels	265	0.02 / 0.02	NA
3-Nitroanaline	Concentrations within acceptable risk levels	263	NA / NA	NA
N-Nitroso-diphenyl amine	Concentrations within acceptable risk levels	176	1 / 1	NA
Antimony	Concentrations within acceptable risk levels	2.46	5 / 5	6
Arsenic	Concentrations within acceptable risk levels	13.0 (19.4) [3]	2.7 / 29	50
Cadmium	Concentrations within acceptable risk levels	4.0 [4]	8 / 5.2	5
Chromium	Concentrations within acceptable risk levels	29.4 (35.1) [3]	38 / 420	100
Copper	Concentrations within acceptable risk levels	23.5	76,000 / 59,000	650
Lead	Concentrations within acceptable risk levels	118	750 / 400	7.5
Manganese	Concentrations within acceptable risk levels	212 (5,884) [3]	32,000 / 91,000	150
Mercury	Concentrations within acceptable risk levels	1.1	610 / 0.89	2
Nickel	Concentrations within acceptable risk levels	74.4	130 / 100	100
Selenium	Concentrations within acceptable risk levels	0.553 (0.6) [3]	5 / 6.3	50
Silver	Concentrations within acceptable risk levels	0.395	34 / 4.4	50
Thallium	Concentrations within acceptable risk levels	0.471	130 / 2.6	2
Zinc	Concentrations within acceptable risk levels	41.4 (79.1) [3]	12,000 / 5,100	5,000

NA – Not Applicable

1 Interim cleanup level.

2 Interim cleanup level. For the TACO metal values, the soil pH was conservatively estimated at 6.25; pH will be measured during pre-design sampling. Region 9 migration to groundwater values are based on a dilution-attenuation factor of 20. For cases shown as "NA-see human health risk based Cleanup Level," the migration to groundwater screening value was greater than the site-specific human health risk based cleanup level.

3 The ecological RBC was below metal background values in soil for the Refuge, therefore background values, as noted in parentheses, are used as preliminary remediation goals for these contaminants. Background levels shown in the table are currently accepted background

values for the Refuge, and are interim values. USFWS is integrating recently obtained background data from the AUS OU with the existing background data to produce a more representative and robust background dataset. During the pre-design phase for Site 36 and upon approval of the FFA partners, the combined background dataset will replace the 1996 background dataset at Site 36. In the event background values for cadmium and other inorganic constituents change, cleanup levels based on background will be re-evaluated.

4 Cadmium of 4 mg/kg does not represent the lowest ecological RBC, but is considered adequately protective of ecological receptors. The lowest ecological RBC for cadmium is 0.218 mg/kg, which is below its current background value of 1.4 mg/kg.

Interim Cleanup Levels Based on Ecological Risk

During the pre-design sampling, biological tissue samples will be obtained and analyzed for some constituents. Very conservative assumptions were made in the FS ecological risk model because these field data were not available. If appropriate, the FS ecological risk model will be re-evaluated based on these site-specific data, which could result in adjusted cleanup levels. The sampling design and specific uses of the results will be described in detail in the pre-design work plan.

Biological tissue samples will be taken for PCBs, cadmium, selenium, thallium, and silver during pre-design sampling. Biological tissue sampling may be performed for the other inorganics, if pre-design sediment/soil samples show that it is relevant and necessary. The results of this sampling may change the interim cleanup levels listed in the above table. If the pre-design sampling indicates the presence of unacceptable risk to semi-aquatic receptors, cleanup levels will be determined using the biological sampling results.

Interim Cleanup Levels for Human Health Risk

The USEPA Region 9 PRGs and Illinois TACO Tier 1 soil screening values are also considered interim because they are based on generic values. If soil values during pre-design sampling are found to exceed the Region 9/TACO values, DOI will develop site-specific remediation goals based on EPA's risk assessment guidance. Note that for all constituents except aldrin, heptachlor, PAHs, mercury, acetone and methylene chloride, the remediation to the cleanup levels listed above would be based on FS ecological risk interim cleanup levels (they are the most stringent). However, if biological tissue samples reveal that ecological-based interim cleanup levels may be increased, cleanup levels may be based on any more stringent human health risk assessment. Additional site-specific data that will allow for the potential development of site-specific soil values will be collected during pre-design sampling (for example, pH and hydraulic conductivity).

Changes in Interim Cleanup Levels

Any changes in interim cleanup levels from those presented in this ROD will be documented as required by CERCLA and the NCP.

SECTION M. STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that

employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

M.1 Protection of Human Health and the Environment

The Selected Remedy for Site 36 protects human health and the environment by removing the principal threat wastes. The remedy will reduce potential risks to human health and the environment posed by exposure to site contaminants by excavating soils and sludge above human health-based and ecological based criteria. The risk will be reduced to the acceptable risk range of 1×10^{-4} to 1×10^{-6} for carcinogens, and the hazard indices for non-carcinogens will be less than 1.0.

Removal of soils and sludge will reduce the source of groundwater contamination. The Selected Remedy will implement groundwater monitoring to confirm source removal performance. Institutional controls will be implemented to ensure that no potable wells are installed at the site before the groundwater is restored. Five-year reviews will be required to evaluate performance.

M.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy would meet the ARARs presented in the following sections through removal of principal threat wastes which also as the source for groundwater contamination. The following sections describe chemical-specific, action-specific, and location specific ARARs/TBCs (To Be Considered Criteria) that apply to Site 36.

M.2.1 Chemical-Specific ARARs/TBCs

Chemical-specific ARARs/TBCs for Site 36 are listed in Table M-1, with comments explaining why each was included for consideration as an ARAR or TBC. Sources used to identify these ARARs/TBCs included standards and criteria that are typically considered as ARARs under CERCLA, as well as recently published guidance that should be regarded as TBCs. The following presents more detailed information for some of the ARARs/TBCs listed in Table M-1:

- Clean Water Act. Ambient Water Quality Criteria were established under the Federal Water Pollution Control Act Amendment of 1972, later amended in 1977 (known as the Clean Water Act). The USEPA has established federal guidelines for development of water quality criteria to protect human health and aquatic life from exposure to pollutants. These federal ambient water quality criteria (AWQC) are developed as guidelines from which states determine their water quality standards. While the AWQC themselves have no direct regulatory impact, they are used to derive regulatory requirements which can include water quality-based effluent limitations, water quality standards or toxic pollutants effluent standards. The use of the AWQC is based on the designated or potential use of surface water. These are then translated into enforceable effluent limitations in a point source National Pollutant Discharge Elimination System (NPDES) permit for direct discharge to surface waters. If there is a discharge planned during remediation activities, due to management of pond water for example, the substantive requirements of a NPDES permit will be met. In addition, remediation will comply with storm water requirements.

- Safe Drinking Water Act. MCLs (40 CFR Part 141) are relevant and appropriate for site groundwater. The groundwater at Site 36 is not currently being used as a source of drinking water, but the aquifer at the site could potentially be used as a drinking water source in the future.

- Illinois Surface Water Standards. Surface water standards are applicable if site-related chemicals impact surface water in area creeks or lakes. Illinois surface water quality standards (35 Illinois Administrative Code [IAC] Part 302) are applicable to surface water at Site 36. Effluent standards (35 IAC Part 304) are applicable for discharges to surface water. The State of Illinois has developed site-specific General Use Water Quality Standards for Site 36 under 35 IAC 302.

- Illinois Groundwater Quality Standards. Illinois groundwater quality standards (35 IAC Part 620) identify standards for groundwater classes I (potable resource), II (general resource), III (special resource), and IV (other). The groundwater at Site 36 was determined to be Class I according to 35 IAC 620.210 (a)(4), based on hydraulic conductivity.

- Illinois Environmental Protection Act Title 35, Subtitle F Public Water Supplies. Part 611 Primary Drinking water Standards is included for the same reason as given for the Safe Drinking Water Act.

M.2.2 Action-Specific ARARs/TBCs

Action-specific ARARs/TBCs for Site 36 are listed in Table M-2, with comments explaining why each was included for consideration as an ARAR or TBC (a TBC is a criterion to be considered. It may be based on guidance or a voluntary program but it is not enforceable.) Action-specific ARARs are requirements that establish restrictions or controls on specific remedial activities. These requirements are action-specific because they are directly tied to the remedial alternative and not the specific chemical of concern at the site. The following presents more detailed information for ARARs/TBCs listed in Table M-2:

Resource Conservation and Recovery Act. The Resource Conservation and Recovery Act (RCRA) of 1976, as amended, governs hazardous waste under Subtitle C and solid waste under Subtitle D.

Under Subtitle C, for remedial actions that may involve treatment or disposal of hazardous waste (e.g., excavated soils that fail to meet TCLP requirements), several requirements will be applicable, including identification and listing (40 CFR Part 261), generator standards (40 CFR Part 262), transporter standards (40 CFR Part 263), owner and operator standards for hazardous waste treatment, storage, and disposal facilities (40 CFR Part 264), land disposal restrictions (40 CFR Part 268), and the hazardous waste permit program (40 CFR Part 270).

Under Subtitle D, Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257), and Criteria for Municipal Waste Landfills (40 CFR Part 258) are relevant and appropriate for remedial actions involving containment of contaminated media left in-place, and soils disposed of off-site.

Solid Waste Disposal Act. The Guidelines for Land Disposal of Solid Waste (40 CFR Part 241), are relevant and appropriate for remedial actions involving containment of contaminated media left in-place and soils disposed of off-site.

The Toxic Substances Control Act (TSCA). regulations are applicable for management and disposal of PCBs-containing material if remedial action includes removal and disposal of material containing PCBs contamination greater than 50 mg/kg.

Illinois Hazardous Waste Management Rules are applicable state regulations, if hazardous waste is identified at the site. Applicable rules are 35 IAC Part 702, (RCRA and UIC [Underground Injection Control] Permits), Part 703 (RCRA Permit Program), Part 705 (Procedure for Permit Issuance), Part 720 (Hazardous Waste Management System), Part 721 (Identification and Listing of Hazardous Waste), Part 723 (Standards Applicable to Transporters of Hazardous Waste), and Part 728 (Land Disposal Restrictions).

Illinois Special Waste Rules. If any material is removed and disposed as a special waste, Illinois special waste regulations (35 IAC Parts 808, 809) are applicable.

Clean Water Act and Illinois Surface Water Standards. Remedial actions that may involve discharge to surface water (e.g., ex-situ treatment of impounded water), applicable requirements include the NPDES and Illinois effluent standards (35 IAC Part 304).
Illinois Groundwater Quality Standards. The Illinois groundwater quality standards (35 IAC Part 620) are applicable for remedial actions that involve monitoring of groundwater.

Clean Air Act and Illinois Air Quality Standards. Remedial actions that may involve air emissions, Illinois air quality, particulate emission, and organic emission standards (contained in 35 IAC Parts 243, 212, and 215, respectively) are applicable. Part 215 requirements do not apply to remedial activities that do not result in emission of organic material greater than 8 lb/hr.

Occupational Safety and Health Act (OSHA) regulations are applicable to all on-site remedial activities.

M.2.3 Location-Specific ARARs/TBCs

Location-specific ARARs/TBCs for Site 36 are presented in Table M-3, with comments explaining why each was included as an ARAR or TBC. Location-specific ARARs are those requirements that establish restrictions on remedial activities based on the geographic location of the site and surrounding areas. In general, the locations involved for the proposed remedial actions at Site 36 do not include sensitive or regulated resources. Therefore, the requirements listed in Table M-3 are not expected to be triggered by remedial activities in the areas to be remediated at Site 36. However, remedial actions must be compatible with the established purposes of the Refuge, including wildlife conservation and development of agricultural, recreational, and industrial resources. Potentially applicable requirements presented in Table M-3 include:

National Wildlife Refuge System Administration Act – 16 USC 668, this law is applicable to areas designated as part of the National Wildlife Refuge System. It requires that remedial action that take place at Site 36 be compatible with the established purposes of the Refuge.

Endangered Species Act – 16 USCA Section 1531 to 1544, this law is applicable if endangered species or critical habitat is present at Site 36.

Archaeological and Historic Preservation Act – 16 USCA Sect. 469, this law is applicable if archaeological or historical data is uncovered during remedial action at Site 36.

Native American Graves Protection and Repatriation Act – PL 101-601, is applicable if Native American or cultural items are found during remedial activities.

Land Use in the CERCLA Remedy Selection Process – OSWER Directive No. 9355.7-04, is a TBC for determination of the reasonably anticipated land use for Site 36.

M.3 Cost Effectiveness

In the lead agency's judgement, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP§300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money spent.

The selected alternative was the lowest cost action alternative evaluated.

M.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recover Technologies) to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the nine criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering State and community acceptance.

The Selected Remedy removes the materials constituting principal threats at the site by removing it and disposing of it in off-site permitted landfills. The Selected Remedy includes water treatment by pumping contaminated water from the East Pond, and dewatering sludge, and then treating the water on site. The Selected Remedy does not present short-term risks different from

the other treatment alternatives. There are no special implementability issues that sets the Selected Remedy apart from any of the other alternatives evaluated.

M.5 Preference for Treatment as a Principal Element

The Selected Remedy does not include treatment as a principal element. The Selected Remedy is the most reliable and cost-effective alternative considered. Because of the complex mixture of chemicals at this site, treatment alternatives were not considered feasible.

M.6 Five-year Review Requirements

Because this remedy will result in contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review is, or will be, protective of human health and the environment.

GLOSSARY OF TERMS

Administrative Record *– A file that contains the information used to make a decision on the selection of a response action under CERCLA. The file is established at or near a site and is available for public review.*

Ambient Water Quality Criteria (AWQC) *– USEPA designated limits for toxic chemicals in surface waters. The levels are set to protect plant, fish, and animal habitats in the areas surrounding the surface waters.*

Applicable or relevant and appropriate requirements (ARARs) *– The Federal and State environmental laws and regulations that a Selected Remedy must comply with. These requirements vary among sites and alternatives.*

Aquifer *– Water-filled natural underground zone.*

Baseline Ecological Risk Assessment (BERA) *- The process whereby potential risks to plants and animals due to the presence of constituents of concern are quantitatively evaluated. This information is used to determine whether remedial actions are necessary.*

Background (Levels) Concentrations *– Naturally occurring chemicals present in air, water, or soil in concentrations, which would normally be expected.*

Baseline Ecological Risk Assessment (BERA) *- The analysis that estimates the effects of human action(s) on a natural resource and interprets the significance of those effects, taking into account uncertainties Such analysis includes initial hazard identification, exposure and dose-response assessments, and risk characterization.*

Bioaccumulation *– The buildup of toxic chemicals in living things.*

Carcinogenic *– Term used to describe chemicals or substances that are known or suspected to cause cancer in humans based on observed health effects in humans or existing data from animal laboratory tests.*

Capital Costs – *Capital costs are expenditures required to construct or install the remedial action. Capital costs can also include major predicted expenditures in future years.*

Comprehensive Conservation Plan (CCP) *- The Department of Interior (DOI), is currently preparing a Comprehensive Conservation Plan (CCP) for the Refuge, in accordance with the requirements of Subsection 7(A)(2)(I) of Public Law 105-57, National Wildlife Refuge System Improvement Act of 1997. The CCP will identify necessary actions that may mitigate problems that could adversely effect wildlife and human health.*

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) *– A federal law enacted in 1980 and subsequently modified by the Superfund Amendments and Reauthorization Act of 1986 (SARA). This act resulted in the creation of a trust fund, commonly*

known as "Superfund," which provides money to investigate and clean up abandoned or uncontrolled hazardous waste sites.

***Ex situ Remediation** – The removal of water or soil from its original place to perform the remedial action.*

***Exposure Pathways** – The routes by which chemicals reach receptors. These routes may include (for example) drinking groundwater or inhaling windblown dust.*

***Feasibility Study (FS)** – A study that selects a remedial action at a site through a series of evaluation steps. The FS identifies, develops, and evaluates several alternatives for addressing contamination.*

***Federal Facility Agreement (FFA) –** Binding agreement between the Department of the Interior, U.S. Environmental Protection Agency, Illinois Environmental Protection Agency, and Department of Army which designates roles for these agencies during cleanup and schedules activities.*

***Groundwater** – Water that is present in the open spaces between soil particles (silt, sand, gravel) and/or rock fractures below the ground surface.*

***Heavy Metals** - Metallic elements (e.g., mercury, chromium, cadmium, arsenic, and lead) that can damage living things at low concentrations and tend to accumulate in the food chain.*

***Home Range** – Habitat area frequently used by wildlife.*

***State of Illinois Class I Groundwater Standards –** Maximum allowable concentrations of specific chemical constituents in groundwater which is classified as Class I: Potable Resource Groundwater in accordance with Title 35 of the Illinois Administrative Code, Section 620.210 (35 IAC 620.210). The standards are published in 35 IAC 620.410.*

***In-situ Remediation** – Remedial action performed where the contaminated soil or water is not removed and is treated in place.*

***Miscellaneous Areas Operable Unit (MISCA OU) –** An operable unit is a grouping of a number of sites within a larger Superfund site. The grouping may be based on contaminant types, media, similarity of cleanup actions, or potentially responsible parties. The MISCA OU is made up of those areas that were proposed in the 1988 RI (O'Brien and Gere) to require no further work or that will need further investigation, monitoring, or maintenance. The FFA added another site (36), and another was added later by DOI (22A).*

***Monitoring** - Ongoing collection of information about the environment that helps gauge the effectiveness of a clean-up action.*

***Monitoring** - Ongoing collection of information about the environment that helps gauge the effectiveness of a clean-up action.*

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – *This regulation deals with two primary subjects. The first is the procedure for responding to oil spills that occur in U.S. waters. The second is a program for identifying and cleaning up abandoned hazardous waste sites under the Superfund (CERCLA) program.*

National Priorities List (NPL) - *USEPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund.*

Non-carcinogenic *– The term used to describe chemicals or substances that are not known or suspected to cause cancer in hums. This term generally refers to chemicals that my not cause cancer, but potentially produce other unwanted health effects.*

Operable Unit *– An individual action that is part of the overall remedy for a particular site. This portion of the remedial response manages migration, or eliminates or addresses a release, threat of a release, or an exposure pathway. Operable units may address geographic portions of a site, specific-site problems, or initial phases of an action.*

Operation and Maintenance Costs *– Operation and maintenance costs are those post construction/ installation costs necessary to verify the continued effectiveness of the remedial action. They include labor, equipment and material costs associated with activities such as monitoring.*

Ordnance *– Military weapons and equipment, including artillery and ammunition.*

Organic Constituents *– Chemical compounds composed primarily of carbon, including materials such as solvents, oils, and pesticides.*

Polychlorinated Biphenyls (PCBs) *– A group of organic compounds related by their basic chemical structure. They are highly resistant to degradation, but have a tendency to be retained in body tissue. Due to their efficient electrical conductivity properties, they were widely used in capacitors, transformers, and other products in the U.S. before 1980.*

Potable – *Describes water that is safe for drinking and cooking.*

Preferred Alternative *– The remedial alternative initially proposed for implementation as a result of the screening process conducted during the FS.*

Preliminary Levels of Concern *– The screening levels were used to determine whether a measure concentration of a constituent was potentially harmful to human health or wildlife, thus warranting further investigation.*

Present Worth Cost *– Evaluation method for expenditures that occur over different time periods. By comparing all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. When calculating the present worth cost for Superfund sites, total operations & maintenance costs are to be included.*

Proposed Plan *– This Proposed Plan identifies the Preferred Alternative initially proposed for cleaning up the site as presented in the Feasibility Study.*

Receptor *– Ecological entity (human, animal, or plant) exposed to the hazardous substance.*

Record of Decision (ROD) *– A legal document that describes in detail the remedy selected for an entire NPL site or a particular operable unit. The ROD summarizes the results of the RI/FS and includes a formal response to public comments.*

Reference Dose (RfD) *– The daily acceptable level of constituents of concern intake. This number is used to estimate potential for non-carcinogenic effects.*

Remedial Design *– engineering design of the Selected Remedy.*

Remedial Investigation/Feasibility Study (RI/FS) – *An in-depth study designed to:*

- *gather data needed to determine the nature and extent of contamination at a Superfund site*
- *establish site cleanup criteria*
- *identify alternatives for remedial action*
- *and support technical and cost analyses of alternatives.*

Remediation - *Methods used to remove or contain hazardous wastes at a Superfund site.*

Remediation Goals *– Remedial action objectives and remediation goals are the target cleanup levels for chemicals at a contaminated site.*

Resource Conservation and Recovery Act (RCRA) – *Federal act that established a regulatory system to track hazardous wastes from the time they are generated to their final disposal. RCRA also provides for safe hazardous waste management practices and imposes standards for transporting, treating, storing, and disposing of hazardous waste.*

Responsiveness Summary *- Comments presented during the public meeting and received during the public comment period that are considered and addressed by the lead agency.*

Sludge *– Semi-solid residue from any of a number of air or water treatment processes; can be hazardous.*

Superfund Amendments and Reauthorization Act of 1986 (SARA) *– This act modified specific provision in CERCLA.*

Superfund *- The program operated under the legislative authority of CERCLA and SARA that funds and carries out EPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the National Priorities List, investigating sites for inclusion on the list, determining their priority, conducting and/or supervising cleanup and other remedial actions, and recovering the costs of these actions from primary responsible parties.*

Superfund Amendments and Reauthorization Act of 1986 (SARA) *– This act modified specific provision in CERCLA.*

Surface Water *– Water on the earth's surface such as streams, ponds, and lakes.*

To Be Considered (TBC) Values *– State advisories, guidance, non-binding guidelines, or other standards that are not legally binding that may be considered when fashioning a protective remedy for a site.*

Toxicity Characteristic Leaching Procedure (TCLP) *– USEPA-approved laboratory procedure used to determine if a waste material is characteristically hazardous.*

TABLE B-1
MISCELLANEOUS AREAS OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

SITE NUMBER	LOCATION	SITE NAME	ACTION
7	Area 2 D	Southeast Drainage Channel	No Action
7A	Area 2 D	North Lawn	No Action
8	Area 2 D	Southwest Drainage Channel	No Action
9	Area 2 P (North)	Northwest Drainage Channel	No Action
10	Area 2 P (North)	North Drainage Channel	Institutional Controls
11	Area 2 P	Southeast Drainage Channel	No Action
11A	Area 2 P (North)	Walkway Structures	No Action
12	Area 8	Impoundment	No Action
13	Area 8	Change House	Transferred to AUS OU
14	Area 8	Site 14	Remedial Action Needed—addressed in separate ROD
16	Area 7	Industrial Park	Institutional Controls
18	Area 13	Loading Platform	Transferred to AUS OU
20	Area 2 F	South Drainage Channel	No Action
21	Area 7	Southeast Corner Field	No Action
22A	Area 4	Old Refuge Shop Post Treating Facility	No Further Action
24		Pepsi Plant West Drainage Ditch (Site Located Outside Refuge)	No Action
25		Crab Orchard Creek downgradient of Marion Landfill (Site Located Outside Refuge)	No Action
26		Crab Orchard Creek Marion Sewage Treatment Plant (Site Located Outside Refuge)	No Action
27		Crab Orchard Creek Dredge Area	No Action
30	Area 13	Munitions Control Site (Background)	No Action
31		Established Refuge Control Site (Background)	No Action
34		Crab Orchard Lake	Lake Monitoring OU
35	Area 9	East Waterway	No Action
36	Area 3 North	Wastewater Treatment Plant	Remedial Action Needed

TABLE E-1
CONCEPTUAL EXPOSURE MODEL FOR THE MISCA OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Site / Affected Media	Chemicals of Concern	Primary Release Mechanisms	Primary Transport Media	Primary Exposure Points	Primary Exposure Routes	Receptors
Site 9 Sediment	Silver	Dissolution Resuspension	Water Sediment	At source; Downstream	Dermal Absorption Ingestion (water, sediment, food)	Aquatic life Raccoon Great Blue Heron
Site 10 Sediment and Surface Water	Volatiles	Dissolution	Water Sediment	At source; Crab Orchard Lake	Dermal Absorption Ingestion (water, sediment, food)	Aquatic life Raccoon Great Blue Heron
	Semi-volatiles Metals	Dissolution Resuspension	Water Sediment	At source; Crab Orchard Lake	Dermal Absorption Ingestion (water, sediment, food)	Aquatic life Raccoon Great Blue Heron
Site 11 Sediment	Metals	Dissolution Resuspension	Water Sediment Food	At source; Downstream	Dermal Absorption Ingestion (water, sediment, food)	Aquatic life Raccoon Great Blue Heron
Site 11A Soils	Volatiles	Volatilization Runoff	Water Air	At source	Inhalation Ingestion (soils)	White-tailed deer American robin Bobwhite quail White-footed mice
	2,4,6-TNT Metals	Runoff	Water Soil	At source	Ingestion (soil, food)	White-tailed deer American robin Bobwhite quail White-footed mice

TABLE E-1
CONCEPTUAL EXPOSURE MODEL FOR THE MISCA OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Site / Affected Media	Chemicals of Concern	Primary Release Mechanisms	Primary Transport Media	Primary Exposure Points	Primary Exposure Routes	Receptors
Site 12 Soils	Volatiles	Volatilization Runoff	Water Air	At source	Inhalation Ingestion (soils)	White-tailed deer American robin Bobwhite quail White-footed mice
	PAHs Silver	Runoff	Water Soil	At source	Ingestion (soil, food)	White-tailed deer American robin Bobwhite quail White-footed mice
Site 16 Soils	Volatiles	Volatilization Runoff	Water Air	At source	Inhalation Ingestion (soils)	White-tailed deer American robin Bobwhite quail White-footed mice
	PCBs Metals	Runoff	Water Soil	At source	Ingestion (soil, food)	White-tailed deer American robin Bobwhite quail White-footed mice
Site 20 Soils	Metals	Runoff	Water Soil	At source	Ingestion (soil, food)	White-tailed deer American robin Bobwhite quail White-footed mice
Site 22A Soils and Groundwater	Volatiles	Volatilization Runoff	Water Air	At source	Inhalation Ingestion (soils)	White-tailed deer American robin Bobwhite quail White-footed mice
	Semi-volatiles Pesticides Dioxin PCBs Metals	Runoff	Water Soil	At source	Ingestion (soil, food)	White-tailed deer American robin Bobwhite quail White-footed mice Red fox Red-tailed hawk

Note: The information in this table was obtained from the 1996 Phase II RI report (WCC, 1996).

TABLE G-1
SITE 36
SUMMARY OF HUMAN HEALTH RISKS
FROM BASELINE HUMAN HEALTH RISK ASSESSMENT

RME

Receptor	Scenario	Pathway	Excess Lifetime Cancer Risk	Potential Remediation Goals Developed?	Noncancer Hazard Index	Potential Remediation Goal Developed?
Site worker	Reasonable Maximum Exposure	Soil/sediment ingestion	1E-06		0.004	
		Soil/sediment dermal contact	1E-06		0.003	
		Soil/sediment inhalation	2E-08		0.000004	
		All	**3E-06**	**Yes**	**0.007**	No
Construction Worker	Reasonable Maximum Exposure	Soil/sediment ingestion	3E-06		0.8	
		Soil/sediment dermal contact (1)	9E-06		1.6	
		Soil/sediment inhalation	8E-10		0.00002	
		Surface water dermal contact	8E-09		0.003	
		Surface water ingestion	5E-09		0.00009	
		All	**1E-05**	**Yes**	**2.4**	**Yes**
Recreational receptor	Reasonable Maximum Exposure	Soil/sediment ingestion	1E-06		0.01	
		Soil/sediment dermal contact	4E-06		0.02	
		Soil/sediment inhalation	6E-09		0.0000005	
		Surface water dermal contact	1E-07		0.004	
		Surface water ingestion	5E-09		0.0001	
		Fish ingestion	1E-05		0.1	
		Deer ingestion	4E-06		0.04	
		All	**2E-05**	**Yes**	**0.2**	No

All risk and hazard values obtained from Tables C.11-35 through C.11-41, Summary of Human Health Risks at Site 36, Remedial Investigation of the Miscellaneous Areas Operable Units, Volume IV, Appendix C (July 1995).

(1) An error was identified in the original calculations. Dermal absorption of beryllium was assessed at 100% absorption, rather than 1% absorption. The reported risk level contributed by beryllium was 3.09x10-7, whereas the correct risk level was 3.09x10-9. This reduced the overall risk level for the dermal pathway from 9.36x10-6 to 9.06x10-6.

TABLE J-1

DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE 36

EVALUATION CRITERION	ALTERNATIVE 1 - No Action	ALTERNATIVE 2 - Excavation/Off-Site Disposal/Groundwater Monitoring	ALTERNATIVE 3 - Institutional Actions/Soil Cover/Excavation/Off-Site Disposal/ Groundwater Monitoring
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT			
Human Health Protection	No reduction of risk.	Excavation and off-site disposal would protect construction workers, site workers, and recreational receptors from risks associated with exposure to contaminated soil, sediment, and sludge. Protection of groundwater would be provided through removal of potential source material, groundwater monitoring, and establishing a groundwater management zone for groundwater that exceeds MCLs/Class I standards.	Excavation and off-site disposal and the construction of a soil cover over the lagoons would protect construction workers, site workers, and recreational receptors from risks associated with exposure to contaminated soil, sediment, and sludge. Protection of groundwater would be provided through removal of potential source material, groundwater monitoring, and establishing a groundwater management zone for groundwater that exceeds MCLs/Class I standards.
Environmental Protection	No reduction of risk.	Excavation and off-site disposal would protect ecological receptors at the site from risks associated with exposure to contaminated soil, sediment, and sludge.	Excavation and off-site disposal and the construction of a soil cover over the lagoons would protect ecological receptors at the site from risks associated with exposure to contaminated soil, sediment, and sludge.
COMPLIANCE WITH ARARs			
Compliance with ARARs	Does not meet ARARs.	Meets ARARs through groundwater monitoring.	Meets ARARs.
Appropriateness of Waivers	Not appropriate since equivalent standard of performance would not be attained as defined in 40 CFR 300.430(f)(i)(ii)(c)(4).	None required.	A waiver from 35 IAC Part 811 is required, because this alternative does not include a liner and leachate collection system for disposal of sludge in the lagoons.
LONG-TERM EFFECTIVENESS			
Magnitude of Residual Risk	Potential remains for direct contact with contaminants at levels that pose a potential human health or ecological risk. Potential for future release from sediment, soil and sludge to off-site surface water and groundwater.	Ecological and human health risks associated with exposure to contaminated soil, sediment, and sludge would be removed through excavation and off-site disposal. Eliminates the potential for future releases to surface water and groundwater. Residual risk associated with groundwater exceedances would be monitored.	The soil cover, with proper maintenance, would reduce probability of exposure to contaminated sludge remaining in the lagoons. Institutional controls and fencing would prohibit access to site. Excavation and disposal would remove potential human and health risks associated with contaminated media. Residual risk associated with groundwater exceedances would be monitored.
Adequacy and Reliability of Controls	No protection against present or future risks posed by on-site contaminants.	Technology is reliable.	Soil cover technology is reliable if cover is periodically inspected and monitored. Groundwater monitoring would be needed for contaminants left in place. Institutional controls would be reliable.
Need for 5-year Review	Would be required to show that risk has not increased.	Required as a matter of EPA policy until clean levels are achieved allowing unlimited use and unrestricted exposure.	Required to ensure that adequate protection is maintained.

TABLE J-1

DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE 36

EVALUATION CRITERION	ALTERNATIVE 1 - No Action	ALTERNATIVE 2 - Excavation/Off-Site Disposal/Groundwater Monitoring	ALTERNATIVE 3 - Institutional Actions/Soil Cover/Excavation/Off-Site Disposal/ Groundwater Monitoring
REDUCTION OF TOXICITY, MOBILITY, AND VOLUME			
Treatment Process Used	None.	Contaminated soil, sediment, and sludge is excavated and disposed off-site.	Contaminated soil, sediment, and sludge is excavated and disposed off-site. Construction of soil cover to minimize contaminant leaching and reduce possibility for exposure to sludge in the lagoons.
Reduction of TMV	None.	Mobility of contaminants in soil would be reduced by off-site disposal. No reduction of toxicity or volume.	Cover would reduce mobility of contaminant in sludge in the Primary Lagoon by limiting surface water infiltration. Mobility of contaminants in excavated soil, sediment, and sludge would be reduced by off-site disposal. No reduction of toxicity or volume.
SHORT-TERM EFFECTIVENESS			
Time Required to Achieve Remedial Action Objectives	Objectives would not be achieved.	Excavation and off-site disposal of contaminated soil, sediment, and sludge would meet RAOs as soon as construction activity could be completed.	Excavation and off-site disposal of contaminated soil, sediment, and sludge would meet RAOs as soon as construction activity would be completed. Construction of soil cover would also meet RAOs as soon as construction activity is completed.
Protection of Community During Remedial Action	No action taken.	Little or no risk is posed to the community.	Little or no risk is posed to the community.
Protection of Workers During Remedial Action	No action taken.	Some risk for workers, due to physical hazards of excavation activity and potential for direct exposure to contaminants. Workers would need to be health and safety trained.	Some risk for workers, due to physical hazards of excavation activity and construction of soil cover, and potential for direct exposure to contaminants. Workers would need to be health and safety trained.
IMPLEMENTABILITY			
Ability to Construct and Operate	Not applicable.	Groundwater monitoring (including installation of additional wells), excavation and off-site disposal are readily implemented.	Groundwater monitoring (including installation of additional wells), excavation, off-site disposal, cover construction, and fencing are readily implemented.
Technical Feasibility	Not applicable.	Excavation activity will require appropriate safety precautions.	Excavation and construction activities will require appropriate safety precautions. Soil cover is reliable if properly maintained. Additional monitoring wells are required to adequately monitor site.
COST			
Capital Cost	$0	$5,086,000	$5,236,000
Annual O&M	$0	$14,000	$23,000
Present Worth	$0	$5,263,000	$5,519,000

TABLE M-1

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal			
Safe Drinking Water Act	**42 USC Section 300**		
National Primary Drinking Water Regulations and national Revised Primary Drinking water Regulations	40 CFR Part 141	Establishes maximum contaminant levels (MCLs), health-based standards for specific contaminants. MCLs are applicable for drinking water as supplied to the end users of public water supplies.	Applicable because groundwater could potentially be a drinking water source in the future.
National Primary Drinking Water Implementation Regulations	40 CFR Part 142	Establishes procedures for granting variances from MCL requirements. Specifies best technologies for treatment of various pollutants.	Applicable. See above.
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes secondary MCLs which are guidelines for public drinking water systems to protect the aesthetic quality fo the water. Secondary MCLs are not Federally enforceable.	Since MCLs are applicable, secondary MCLs are TBCs.
Maximum Contaminant Level Goals (MCLGs)	40 CFR Parts 141, 142 Public Law NO. 99-339, 100 Stat. 642 (1986)	Establishes nonenforceable health goals for drinking water quality at a level at which no adverse health effects may arise with an adequate margin of safety.	TBC.
Clean Water Act (Federal Water Pollution Control Act), as amended	**33 USCA Sect. 1251 et seq.**		
National Pollutant Discharge Elimination System (NPDES) Regulations	40 CFR Part 122, 125	Establishes procedures for determination of effluent limitations for point source discharges of chemicals to waters of the United States, protective of beneficial uses.	Applicable for discharge to surface water.

TABLE M-1

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Ambient Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water, 1976, 1980, 1986	Requires states to establish ambient water quality criteria for surface water based on use classifications and the criteria stated under Section 304(a) of the Clean Water Act.	Relevant and appropriate for surface water.
Guidelines Establishing Test Procedures for the Analysis of Pollutants	40 CFR Sect. 136.1-5 and Appendices A-C	Specific analytical procedures for NPDES applications and reports.	Applicable for discharge to surface water.
National Pretreatment Standards	40 CFR 403	Applies to discharges of chemicals to publicly-owned treatment works (POTWs). Requires that such chemicals not interfere with operation of the POTW, or pass through the POTW at concentrations which cause a violation of the POTW's NPDES permit, or contaminate sewage sludge.	Applicable for discharge to a POTW.
Resource Conservation and Recovery Act (RCRA) (Solid Waste Disposal Act) as amended	**42 USC Sect. 6901-6992K**		
Criteria for Classification of Solid Waste Disposal Facilities and Practices (Subtitle D)	40 CFR Part 257	Established criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health and the environment.	Relevant and appropriate for remedial actions involving containment of contaminated media left in-place.
Identification and Listing of Hazardous Waste	40 CFR Part 261.4	Defines characteristics of hazardous wastes and provides lists of hazardous wastes. Identifies solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 124, 262-265, 268, 270, and 271.	Potentially applicable to wastes generated by remedial activities, including investigation-derived wastes, excavated soil, or solid wastes generated by treatment of soil or hazardous wastes.

TABLE M-1

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Releases from Solid Waste Management Units	40 CFR Part 264.94	Subpart F (264.94) gives concentration limits in groundwater for hazardous constituents from a regulated unit.	Relevant and appropriate for remedial actions involving containment of contaminated media left in-place if listed hazardous constituents are found in groundwater.
Soil Screening Guidance	USEPA 1996a	Presents a methodology to calculate risk-based soil screening levels (SSLs) for contaminants in soil that may be used to identify areas requiring further investigation at Superfund Sites. SSLs can be generic SSLs based on conservative default values or site-specific SSLs based on a more detailed analysis.	TBC for detected soil contamination.
USEPA Region III Risk-Based Concentrations	USEPA 1999	Risk-based concentrations (RBCs) are derived for residential or industrial/commercial soil, tap water, ambient air, and fish using conservative exposure scenarios. RBCs are updated semi-annually.	TBC for detected soil contamination. Concentrations based on site-specific risk assessment take precedence over RBCs.
ECO Update	EPA 1996b	Presents ecotox thresholds (ETs), which are media-specific contaminant concentrations above which there is sufficient concern regarding adverse ecological effects. ETs are to be used for screening purposes in the Superfund ecological risk assessment process.	TBC for detected sediment contamination at site. ETs are meant for screening purposes only and are not regulatory criteria, site-specific cleanup standards, or remediation goals.

TABLE M-1

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
USEPA Region 9 Preliminary Remediation Goals	USEPA 1998b	Region 9 preliminary remediation goals (PRGs) are risk-based concentrations that can be used to screen pollutants in environmental media, trigger further investigation, and provide an initial cleanup goal, if applicable.	TBC for detected soil contamination.
Clean Air Act (CAA), as amended	**42 USCA Sect. 7401-7671Q**		
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR Part 50	Establishes ambient air quality standards for certain "criteria pollutants" to protect public health and welfare.	Applicable for remediation that results in release of regulated compounds to air.
National Emission Standards for Hazardous Air Pollutants (NESHAPS)	40 CFR Part 61	Provides standards for emissions of designated hazardous air pollutants, including mercury, beryllium, asbestos, and inorganic arsenic, from certain activities.	Relevant and appropriate if remediation results in releases of regulated compounds to air.
State			
Illinois Environmental Protection Act	**415 Illinois Compiled Statutes (ILCS) 5/1 *et seq.*** Subtitle B: Air Pollution		
Air Quality Standards	35 IAC Part 243: Air Quality Standards 35 IAC 243.120, .122-.126	Establishes ambient air quality standards.	Applicable if remedial activities result in the emission of regulated chemicals to air.
	35 IAC Part 212: Visual and Particulate Matter Emission Standards 35 IAC 212.110, .123, .301.	Establishes particle emission standards for various sources and processes, including fugitive particulate emission standards from storage piles and conveyors.	Applicable if remedial activities result in the emission of particulate matter.
	35 IAC Part 215: Organic Material Emission Standards and Limitations 35 IAC 215.101, .122, .301, .541.	Specified organic chemical emission limits for various sources, including construction activities, storage, and loading operations.	Applicable if remedial activities result in the emission of organic material >8lbs/hr.

TABLE M-1

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
	Subtitle C: Water Pollution		
General Use Water Quality Standards	35 IAC Part 302: Water Quality Standards Subpart B: General Use Water Quality Standards 35 IAC 302.208, .210	Establishes numerical standards for chemical constituents in general use waters of the state, and establishes procedures for deriving criteria for other toxic substances without numerical standards.	Applicable for surface water in area, creeks, or lakes impacted by site-related chemicals.
Standards for Effluent in State Waters	35 IAC Part 304: Effluent Standards 35 IAC 304.101-.106, .120-.126, .141	Establishes requirements regarding effluent discharges, dilution, and maximum allowable concentrations for various chemical and physical parameters.	Applicable for discharges to surface water.
Pretreatment Program	35 IAC Part 310: Pretreatment Program Subpart B: Pretreatment Standards	Established requirements and standards for discharges to a POTW.	Applicable for discharges to a POTW.
	Subtitle F: Public Water Supplies		
Primary Drinking Water Standards	35 IAC Part 611: Primary Drinking Water Standards	Establishes Maximum contaminant levels (MCLs) for public water supply systems.	Applicable for Site 36, for the same reason that federal standards (MCLs and MCLGs) are applicable. Groundwater at Site 36 is a potential future drinking water source.
Ground Water Quality Standards and Use Classification	35 IAC Part 620: Groundwater Quality	Establishes groundwater classification, non-degradation provisions, numerical Objectives for groundwater quality, and procedures and protocols for management and protection of groundwater. Also provides for determination of a health advisory for other chemicals and for mixtures.	Applicable for Site 36. Groundwater is classified as Class I (35 IAC 620.210(a)(4)) at Site 36 based on hydraulic conductivity. Class I standards (620.410) at Site 36 have been exceeded. A groundwater management zone (620.250) is required for any residual contamination above standards.
	Subtitle G: Waste Disposal		

TABLE M-1

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Illinois Hazardous Waste Management Rules	35 IAC Part 702: Resource Conservation and Recovery Act (RCRA) and Underground Injection Control (UIC) Program 35 IAC Part 703: RCRA Permit Program 35 IAC Part 720 Hazardous Waste Management System	Identifies chemicals and wastes classified as hazardous. State of Illinois rules generally parallel federal EPA rules.	Applicable to wastes generated by remedial activities, including investigation-derived wastes and excavated soil/sediment, if found to meet the definition of a hazardous waste.
Risk Based Cleanup Objectives	35 IAC Part 742: Tiered Approach to Corrective Action Objectives	Establishes tiered methodology for deriving soil and groundwater remediation objectives to be used for all Bureau of Land programs (state Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RCRA, Leaking Underground Storage Tank (LUST), Site Remediation Program). Tabulates Tier 1 remediation objectives for a list of chemicals. Less stringent and more site-specific values can be derived under a Tier 2 or 3 assessment.	TBC for cleanup of contaminated soil and groundwater. For Site 36, can be used to derive soil remediation objectives to address contaminants in groundwater above Illinois Class I standards. This can be done using the soil component of the groundwater ingestion route.

TABLE M-2

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal			
Resource Conservation and Recovery Act (RCRA) (Solid Waste Disposal Act (SWDA)), as amended	**42 USCA Sect. 6901-6992K**		
Guidelines for the Land Disposal of Solid Wastes	40 CFR Part 241	Delineates minimum levels of performance required of any solid waste land disposal site operation; provides mandates for federal agencies. Primarily addresses design and operation of solid waste landfills.	Relevant and appropriate for remedial actions involving containment of contaminated media left in-place.
Criteria for Classification of Solid Waste Disposal Facilities and Practices	Subtitle D 40 CFR Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health, and thereby constitute prohibited open dumps.	Relevant and appropriate for remedial actions involving containment of contaminated media left in-place.
Criteria for Municipal Waste Landfills	Subtitle D 40 CFR Part 258	Sets forth minimum criteria for municipal solid waste landfills, including design, operation, monitoring, corrective action, closure, and post-closure care requirements.	Relevant and appropriate for remedial actions involving containment of contaminated media left in-place.
Hazardous Waste Management Systems General	Subtitle C 40 CFR Part 260	Provides definitions, general standards, and information applicable to 40 CFR Parts 260-265, 268.	Applicable for remedial activities involving hazardous waste management.
Identification and Listing of Hazardous Wastes (Subtitle C)	Subtitle C 40 CFR Part 261	Defines those solid wastes which are subject to regulations as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271.	Applicable for remedial activities involving the need to identify hazardous waste.
Standards Applicable to Generators of Hazardous Waste	Subtitle C 40 CFR Part 262	Establishes standards for generators of hazardous waste.	Applicable for remedial activities involving generation of hazardous waste.

TABLE M-2

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Standards Applicable to Transporters of Hazardous Waste	Subtitle C 40 CFR Part 263	Establishes standards which apply to transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Applicable for remedial activities that will involve off-site transportation if material is identified as hazardous waste.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Subtitle C 40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or disposal hazardous waste.	Relevant and appropriate for remedial activities that will involve on-site treatment, storage, or disposal of hazardous waste.
Interim Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities	Subtitle C 40 CFR Part 265	Establishes minimum national standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure or if the facility is subject to post-closure requirements, until post-closure responsibilities are fulfilled.	Applicable for remedial activities that will involve on-site treatment, storage, or disposal of hazardous waste..
Land Disposal	40 CFR Part 268	Identifies hazardous wastes restricted from land disposal and treatment standards for restricted wastes and waste treatment residuals.	May be applicable to disposal of wastes that are specified in this regulation.
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic EPA permitting requirements.	Potentially applicable for waste material that meets definition of hazardous waste.
Clean Water Act (Federal Water Pollution Control Act)	**33 USCA Sect. 1251-1376**		
National Pollutant Discharge Elimination System	40 CFR Parts 122, 125	Requires permits for the discharge of pollutants from any point source into waters of the United States.	Applicable for discharge to surface water.

TABLE M-2

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Stormwater Runoff Requirements	40 CFR Sect. 122.26(b)(14)(x)	Requires that storm water runoff be monitored and controlled on construction sites greater than five acres.	Applicable if the remediation site is greater than five acres; relevant and appropriate for smaller sites.
National Pretreatment Standards	40 CFR Part 403	Sets pretreatment standards to control pollutants which pass through or interfere with treatment processes in publicly owned treatment works (POTW) or which may contaminate sewage sludge.	Applicable for discharge to a POTW.
Toxic Substances Control Act (TSCA)	**15 USCA Sect. 2601-2692**		
	40 CFR Part 761	Establishes storage and disposal requirements for PCBs.	Applicable for disposal of PCB-containing material required to be managed according TSCA.
Clean Air Act (CAA), as amended	**42 USCA Sect. 7401-7671Q**		
New Source Performance Standard - Municipal Solid Waste Landfills (Proposed)	56 FR 104 (proposed Subpart WWW to 40 CFR Part 60)	Proposed rule for control of non-methane organic compounds (NMOCs) from municipal solid waste landfills emitting > 167 TPY NMOCs and with maximum design capacity of ≥ 111,000 T.	TBC for remedial actions involving containment of contaminated media left in-place.
National Emission Standards for Hazardous Air Pollutants (NESHAPS)	40 CFR Part 61	Provides standards for emissions of designated hazardous air pollutants, including mercury, beryllium, asbestos, and inorganic arsenic, from certain activities.	Relevant and appropriate for remedial action includes building demolition that results in releases of regulated compounds.
Hazardous Materials Transportation Act	**40 USCA Sect. 1801-1813**		
Hazardous Materials Transportation Regulations	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Applicable for remedial actions that involve off-site transportation of hazardous materials.

TABLE M-2

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Occupation Safety and Health Act of 1970	**PL 91-596** **29 USCA Sect. 651-678**		
Occupational Safety and Health Standards	29 CFR Part 1910	Establishes safety and health requirements for personnel working with hazardous materials and hazardous waste.	Applicable to on-site remedial activities.
Safety and Health Regulations for Construction	29 CFR Part 1926	Establishes protection standards (e.g., hazard communication, excavation and trenching requirements) for workers involved in hazardous waste operations.	Applicable to on-site remedial activities.

TABLE M-2

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
State			
Commercial and Public Building Asbestos Abatement Act	**225 Illinois Compiled Statutes (ILCS) 207**		
	Chapter I: Department of Public Health		
Asbestos Abatement for Public and Private Schools and commercial and Public Building in Illinois	77 Illinois Administrative Code (IAC) Part 855	Training for asbestos workers in public and commercial buildings.	May be applicable for building demolition.
Illinois Environmental Protection Act	**415 ILCS 5/1 *et seq***		
	Subtitle B: Air Pollution		
Air Quality Standards	35 IAC Part 243: Air Quality Standards 35 IAC 243.10, .122-.126	Establishes ambient air quality standards.	Applicable for remedial activities resulting in emissions to air.
Particulate Emission Standards	35 IAC Part 212: Visual and Particulate Emission Standards 35 IAC 212.110, .301, .304-.307, .316.	Establishes criteria for the emission of particulate matter from different operations, including fugitive particulate emissions from storage piles and conveyors (Subpart ?).	Applicable for remedial activities involving soil/sediment excavation, stockpiling, and hauling, resulting in emissions to air.
Organic Emission Standards	35 IAC Part 215: Organic Material Emission Standards and Limitations.	Establishes emission limits for new incinerators and lists emission report contents.	Applicable for remedial activities resulting in emissions of organic material to air.
	Subtitle C: Water Pollution		

TABLE M-2

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Standards for Effluents in State Waters	35 IAC Part 304: Effluent Standards 35 IAC 304.101-.106, .120-.126, .141.	Establishes requirements regarding effluent discharges, dilution, and maximum allowable chemicals for various chemical and physical parameters.	Applicable for discharge to surface water in area.
National Pollutant Discharge Elimination System (NPDES) Permits	Part X, Subpart A: NPDES Permits 35 IAC 309.101-.119, .141-.152, .154-.156, .181-.185, .191	Establishes permit requirements for treatment, pretreatment, and discharge requiring NPDES permit.	Applicable for discharge to surface water.
	Subtitle F: Public Drinking Water Supply		
Ground Water Quality Standards and Use Classification	35 IAC Part 620: Groundwater Quality	Establishes groundwater classification, non-degradation provisions, numerical Objectives for groundwater quality, and procedures and protocols for management and protection of groundwater.	Applicable for monitoring of groundwater, which is considered to be Class I at Site 36 and for establishing a groundwater management zone.
	Subtitle G: Waste Disposal		
Hazardous Waste Management Rules	35 IAC Part 702: Resource, Conservation, and Recovery Act (RCRA) and Underground Injection Control (UIC) Program, 35 IAC Part 703: RCRA Permit Program, 35 IAC Part 705: Procedure for Permit Issuance, 35 IAC Part 720: Hazardous Waste Management System, 35 IAC Part 721: Identification and Listing of Hazardous Waste, 35 IAC Part 723: Standards Applicable to Transporters of Hazardous Waste, 35 IAC: Part 728: Land Disposal Restrictions	Outlines general management of hazardous waste in relation to RCRA. State of Illinois rules generally parallel federal EPA rules.	Relevant and appropriate for monitoring of groundwater. Part 725 is applicable if hazardous wastes are managed on-site in tanks, containers, or containment buildings for less than 90 days.

TABLE M-2

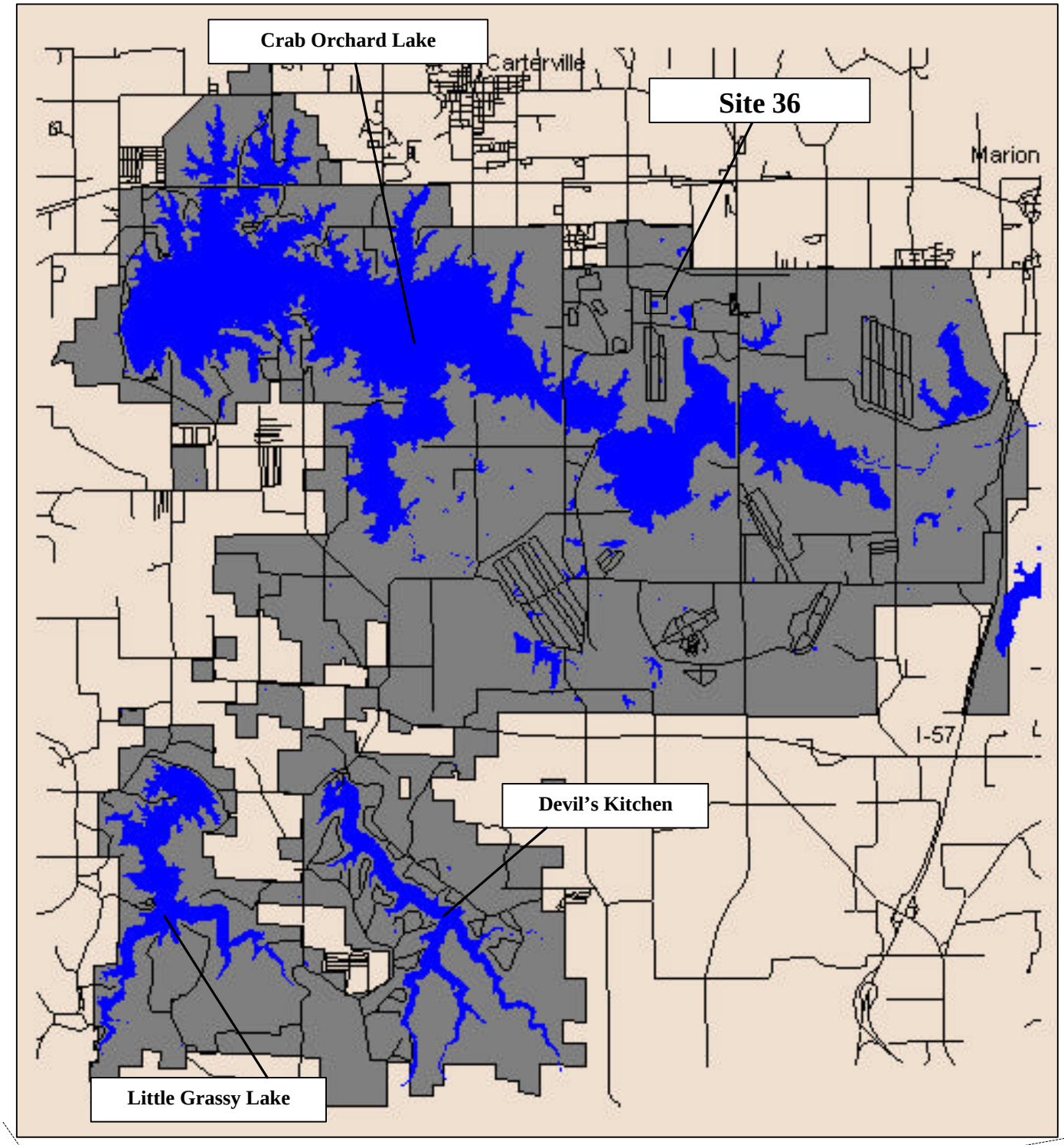
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)/ TO BE CONSIDERED CRITERIA (TBCs) FOR SITE 36

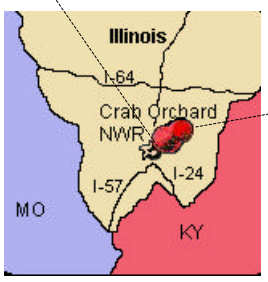
Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Risk Based Cleanup Objectives	35 IAC Part 742: Tiered Approach to Corrective Action Objectives	Establishes tiered methodology for deriving soil and groundwater remediation objectives applicable to all Bureau of Land programs (state Comprehensive, Environmental Response, Compensation, and Liability Act (CERCLA), RCRA, Leaking Underground Storage Tank (LUST), Site Remediation Program). Tabulates Tier 1 remediation objectives for a list of chemicals. Less stringent and more site-specific values can be derived under a Tier 2 or 3 assessment.	TBC for cleanup of contaminated soil or groundwater.
Special Waste Regulations	35 IAC Part 808: Special Waste Hauling Part 809: Special Waste Classification	Defined special (non-RCRA) wastes and outlines requirements for permitting and hauling of special wastes to TSD facilities.	Applicable if sludge and/or sediments are removed and disposed as a special waste in a permitted landfill.
Landfill Disposal	35 IAC Part 811: Standards for New Solid Waste Landfills	Outlines requirements for disposal of inert wastes (Subpart B), putrescible and chemical wastes (Subpart C) and special wastes (Subpart D).	Relevant and appropriate for remedial actions involving containment of contaminated media left in-place. Applicable if remedial actions involve on-site disposal.

TABLE M-3

LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)/ TO BE CONSIDERED (TBCs) FOR SITE 36

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
Federal			
National Wildlife Refuge System Administration Act	**16 USC 668 et seq;**	Limits actions allowed in areas designated as part of National Wildlife Refuge System.	Applicable. Remedial action must be compatible with the established purposes of the Refuge (e.g., wildlife conservation; development of agricultural, recreational, and industrial resources).
Management and General Public Use of the National Wildlife Refuge System	Executive Order 12996		
National Wildlife Refuge System Improvement Act of 1977	PL 105-57, 111 Stat. 1252.		
Endangered Species Act	16 USCA Sect. 1531 to 1544 50 CFR Part 200 50 CFR Part 402	Protects endangered species and the critical habitats upon which endangered species depend.	Applicable if endangered species or critical habitat is present.
Archaeological and Historic Preservation Act of 1974	16 USCA Sect. 469; 36 CFR Part 65 40 CFR 6301(c)	Established procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	Applicable if archaeological or historical data is uncovered during remedial action at Site 36.
Native American Graves Protection and Repatriation Act[1]	PL 101-601	Requires that if Native American remains or cultural items are found on federal lands, the appropriate tribe must be notified, and all activity in the area of discovery must cease for at least 30 days.	Applicable if Native American remains or cultural items are found during remedial activities.
Antiquities Act of 1906[1]	16 USCA 431-433 15 USC 461-467**???** 43 CFR Part 3	Provides for protection of historic and prehistoric ruins and objects on Federal lands.	Applicable if historical ruins or objects are found during remedial activities.
State			
Human Skeletal Remains Protection Act	Illinois Revises Statutes 1989, Ch. 127, pars. 2661 et seq.	Requires action to be taken for the handling of skeletal remains resulting from unexpected discovery during construction activities.	Applicable if human skeletal remains are discovered during remedial activities.

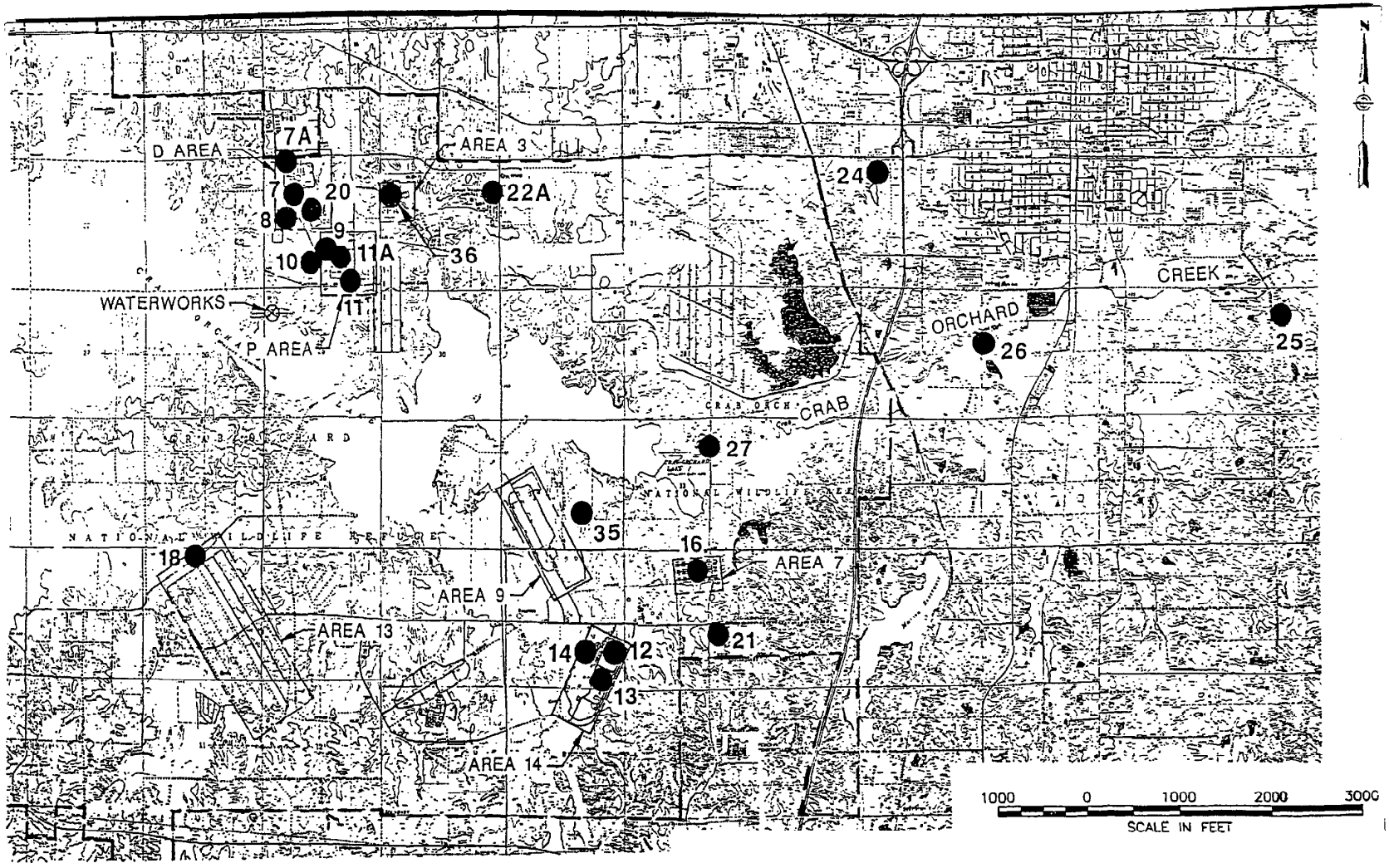




N

Source: U.S. Fish & Wildlife Service Web Site, *Crab Orchard National Wildlife Refuge Area Map*, http://www.fws.gov/r3pao/cr_orch/map.htm

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marian, Illinois	Crab Orchard National Wildlife Refuge	FIG NO. **A-1**

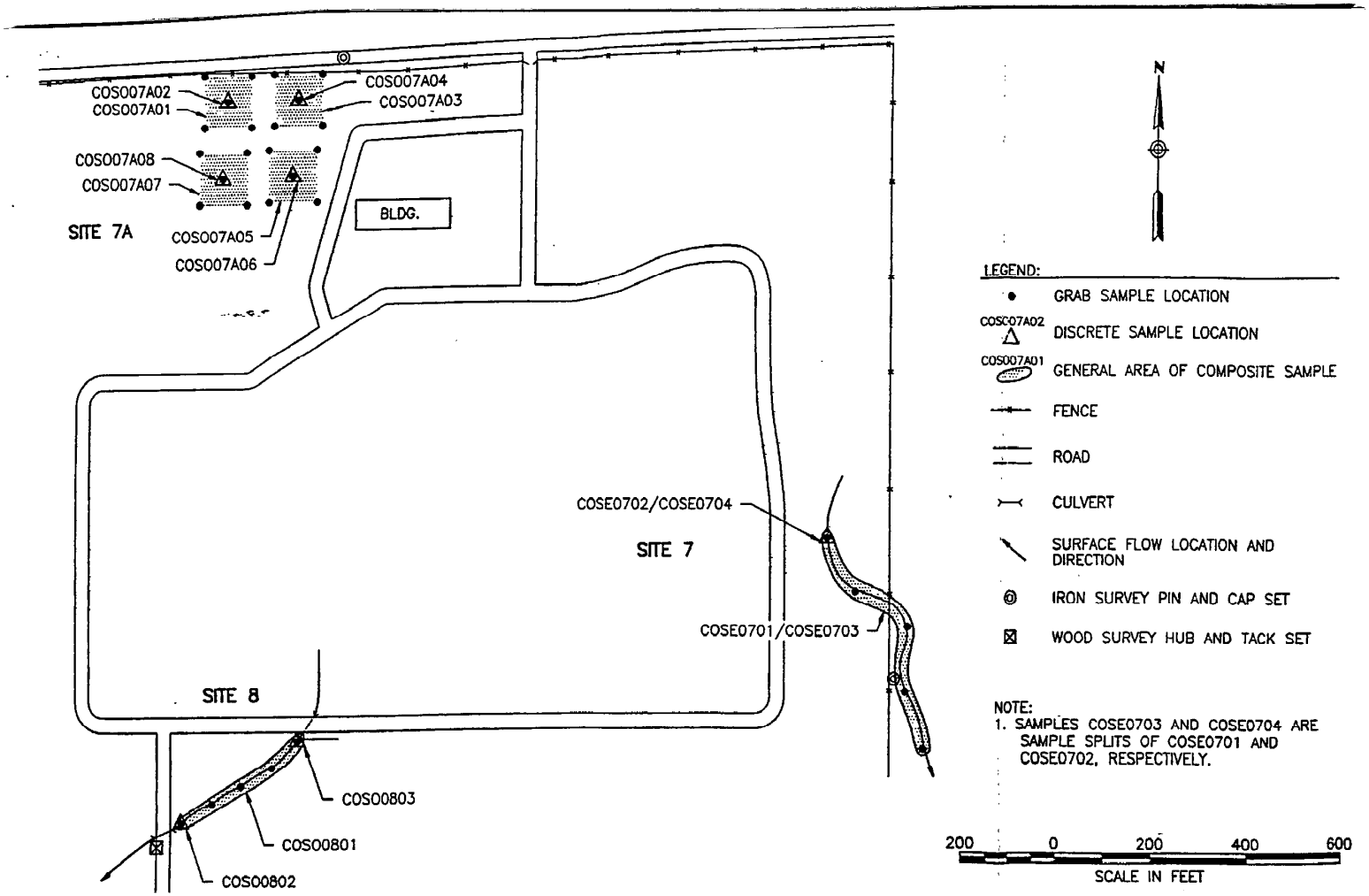


Sites 30 and 31 are control (background) sites and therefore are not shown on this figure.

REFERENCE: FIGURE B2 FROM APPENDIX B OF 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Miscellaneous Areas Operable Unit	FIG. NO. A-2

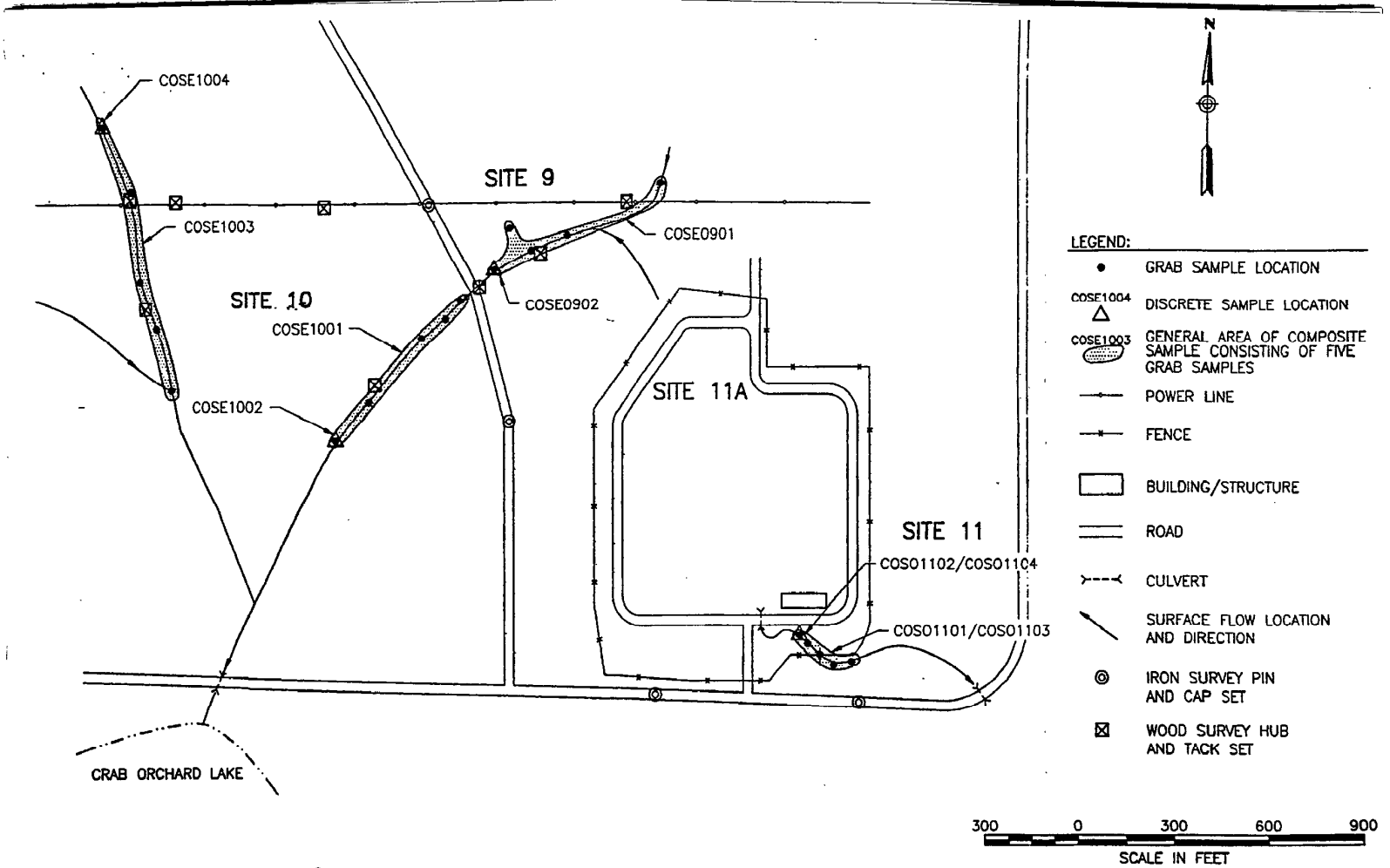
File: E:\232000026.00\PA-SI REPORT-AUS OU\TITLE BLOCKS FOR CUT AND PASTE\JPG A-2.DWG Last edited: SEP. 06, 01 @ 1:56 p.m. URS Corp.



REFERENCE: FIGURE 2-1 FROM
1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Sites 7, 7A and 8 Phase-I Sample Locations	FIG. NO. A-3

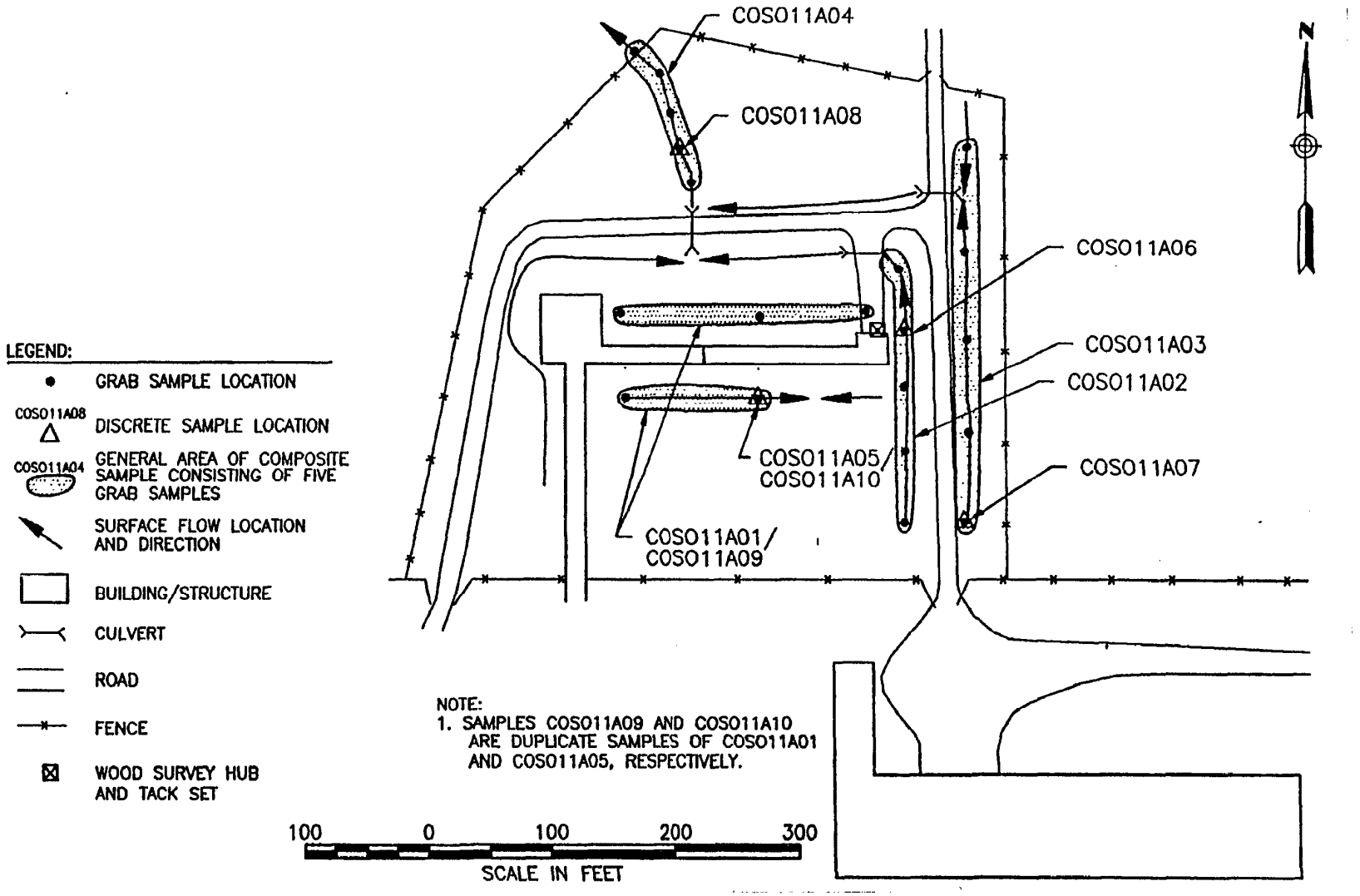
File: E:\232000026.00\PA-SI REPORT-NJS OU\TITLE BLOCKS FOR CUT AND PASTE\PS A-3.DWG Last edited: SEP. 06, 01 @ 3:09 p.m. URS Corp.



NOTE:
1. SAMPLES COSO1103 AND COSO1104 ARE SAMPLE SPLITS OF COSO1101 AND COSO1102, RESPECTIVELY.

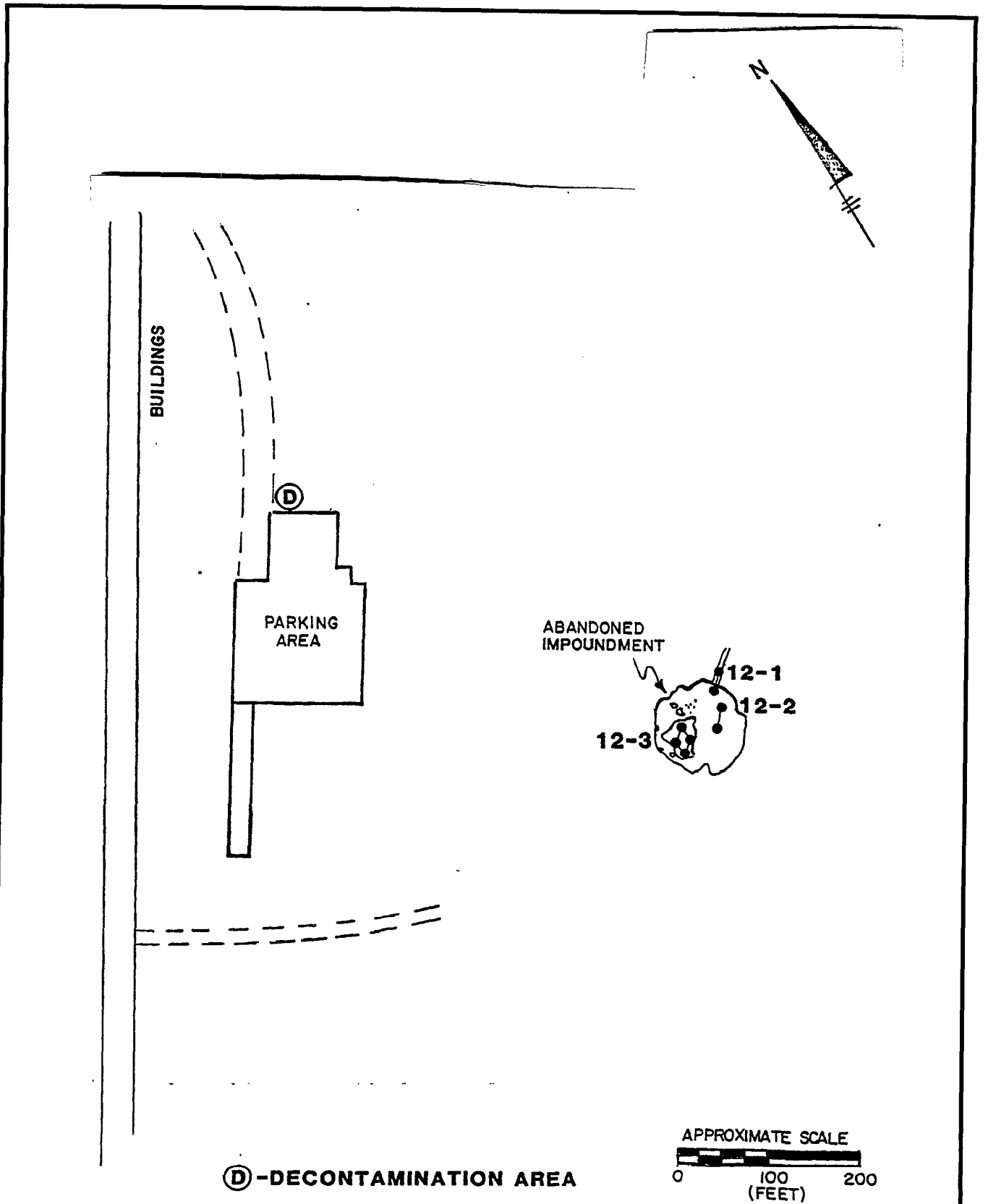
REFERENCE: FIGURE 2-2 FROM 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Sites 9, 10, and 11 Phase-I Sample Locations	FIG. NO. A-4



REFERENCE: FIGURE 2-4 FROM
1996 PHASE II RI (W-C, 1996)

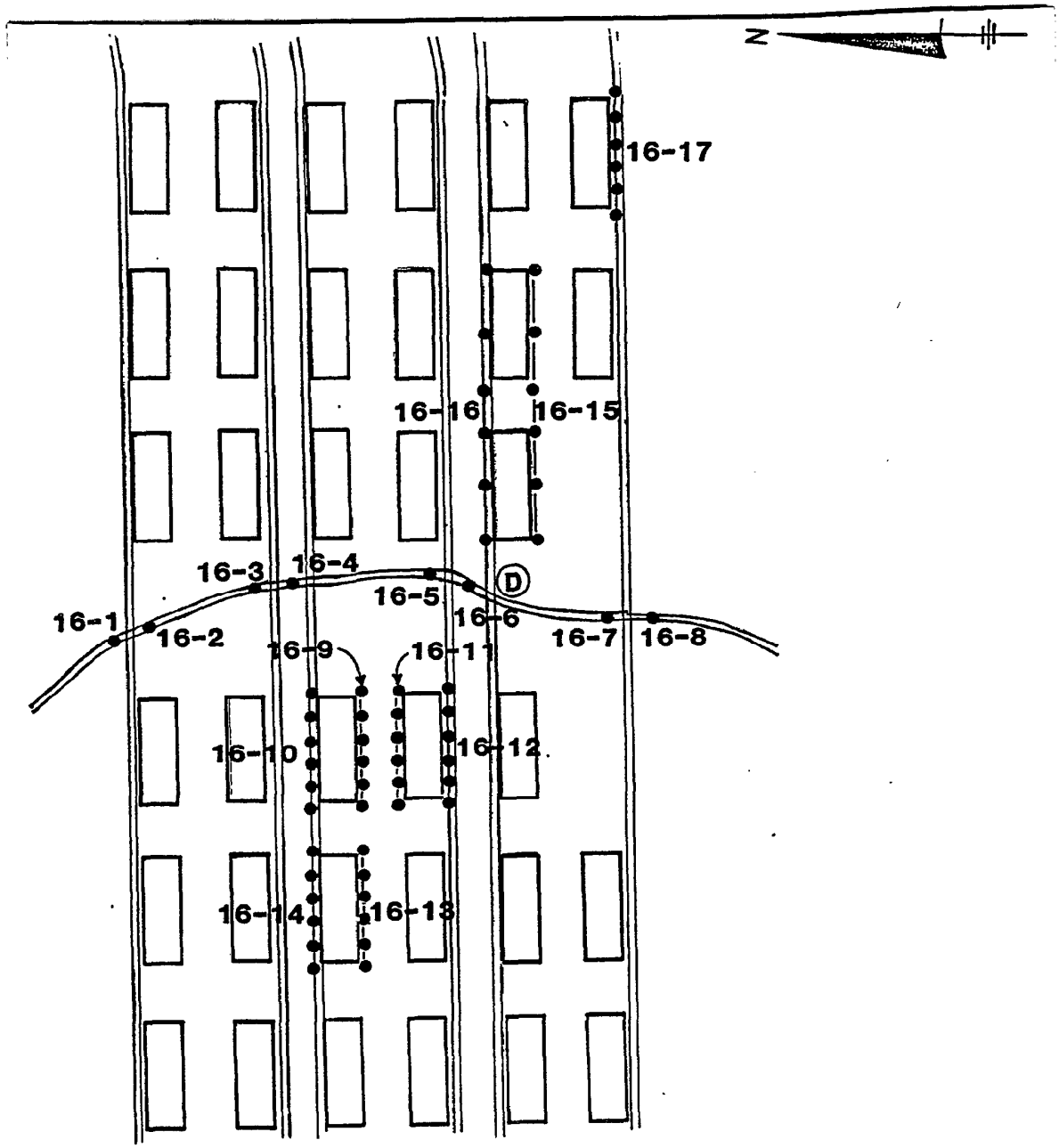
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 11A Phase-I Sample Locations	FIG. NO. A-5



REFERENCE: FIGURE 19-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 12 Area 8 Impoundment Phase I	FIG. NO. A-6

File: E:\232000026.00\PA-SI REPORT-AUS OU\TITLE BLOCKS FOR CUT AND PASTE\Fig A-6.DWG Last edited: SEP. 06, 01 @ 3:08 p.m. URS Corp.



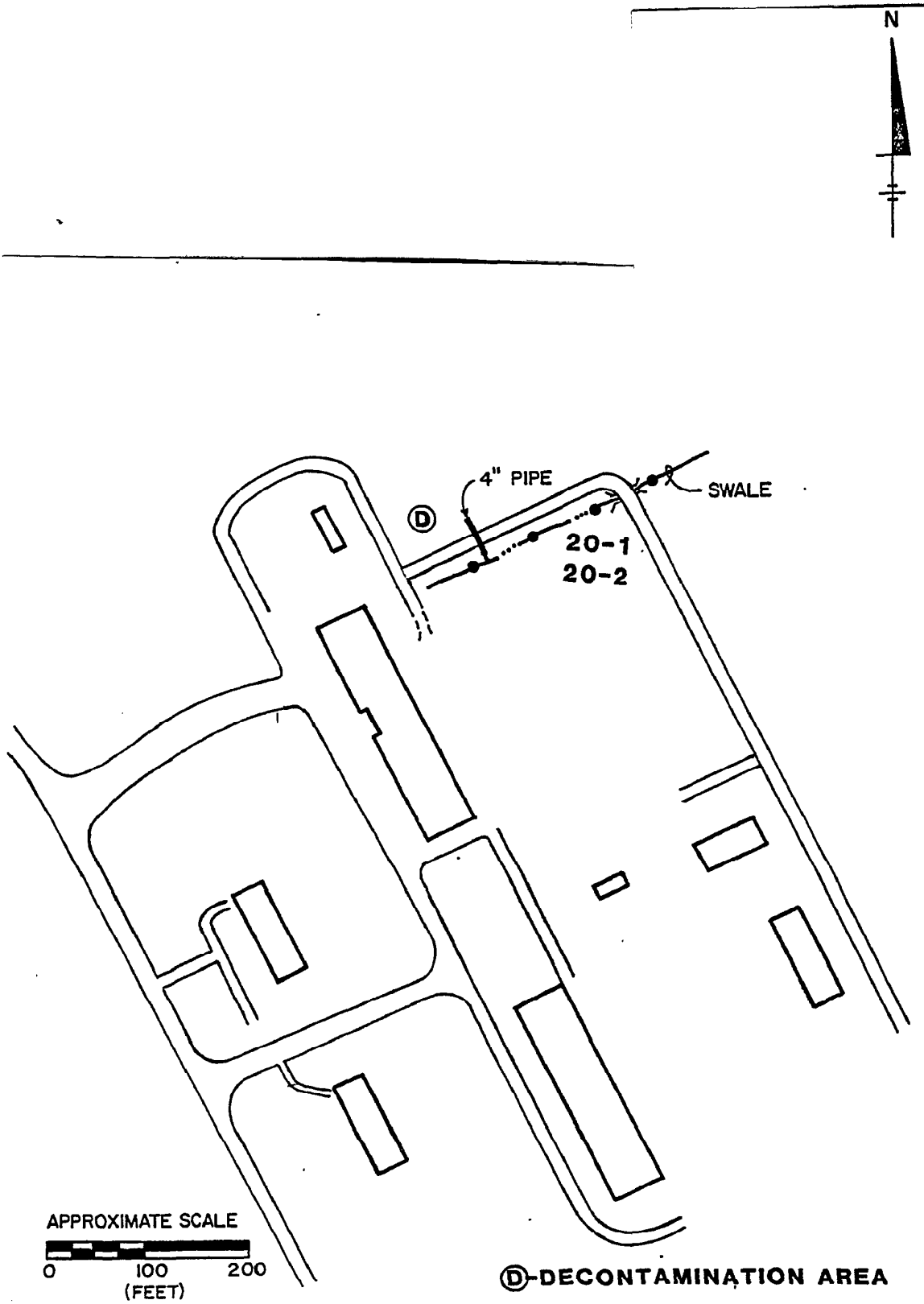
Ⓓ - DECONTAMINATION AREA

APPROXIMATE SCALE

0 100 200
(FEET)

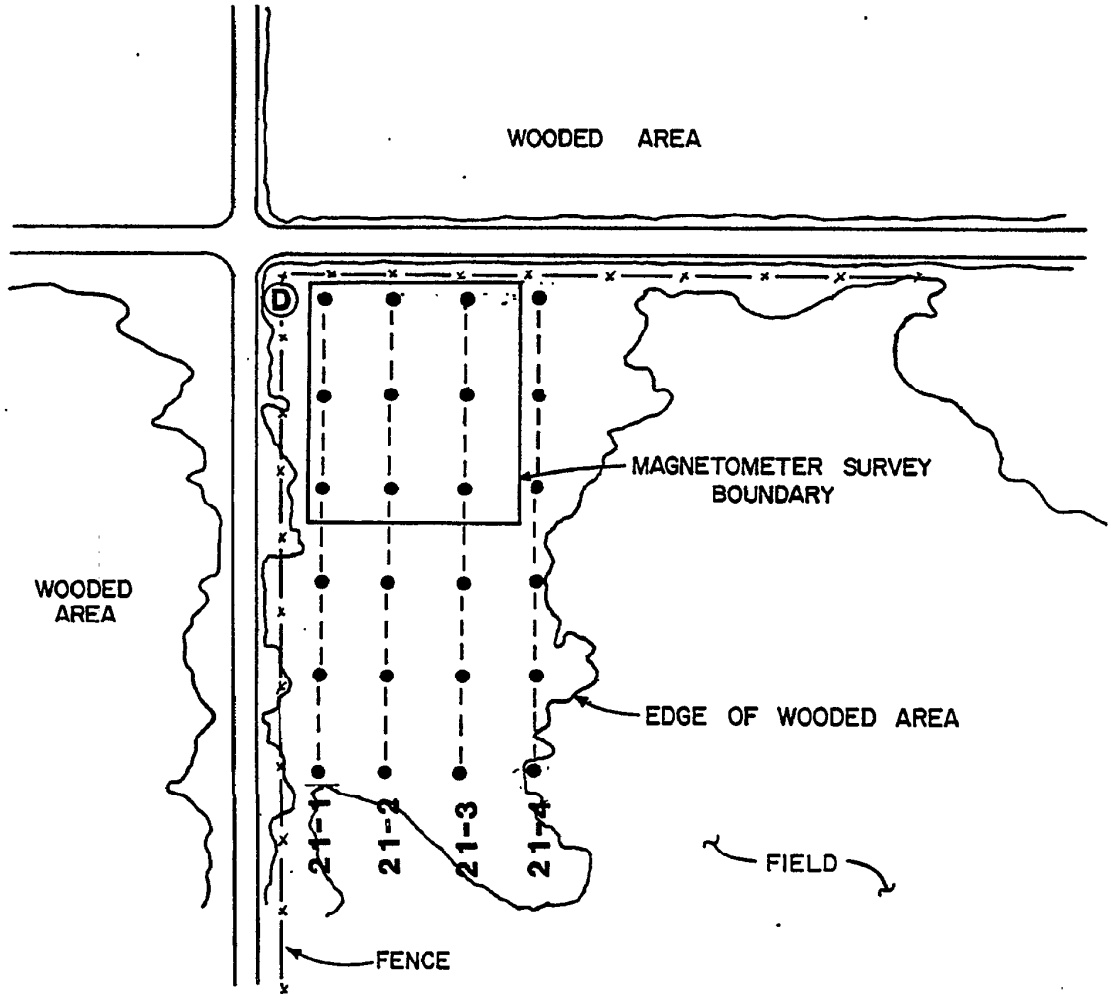
REFERENCE: FIGURE 22-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 16-Area 7 Industrial Park Phase I	FIG. NO. A-7



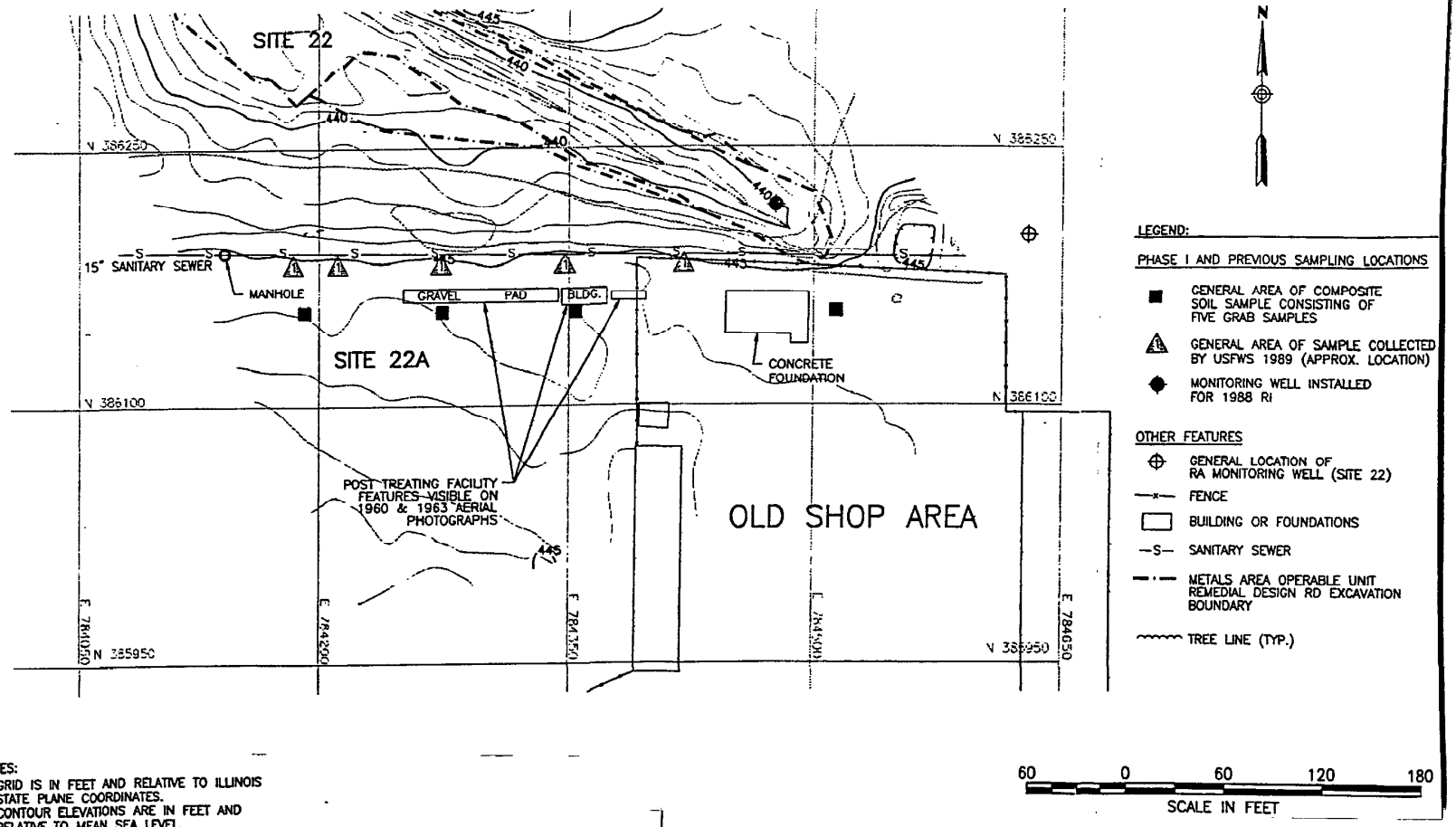
REFERENCE: FIGURE 27-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 20 D Area South Drainage Channel Phase I	FIG. NO. A-8



REFERENCE: FIGURE 28-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

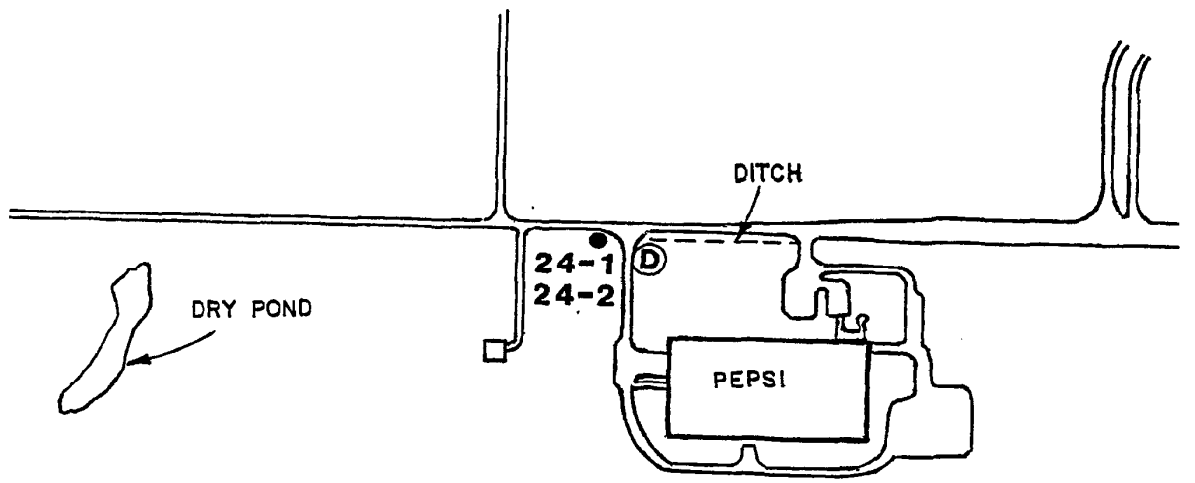
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 21 Southeast Corner Field Phase I	FIG. NO. A-9



NOTES:
1. GRID IS IN FEET AND RELATIVE TO ILLINOIS STATE PLANE COORDINATES.
2. CONTOUR ELEVATIONS ARE IN FEET AND RELATIVE TO MEAN SEA LEVEL.
3. CONTOUR INTERVAL IS ONE FOOT.
4. BASE MAP FROM DRAWING CER 61-400E, SHEET REF. NO. C4, DATED FEB., 1993, BY WOODWARD-CLYDE CONSULTANTS.

REFERENCE: FIGURE 2-11 FROM 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Post Treating Facility (Site 22A) Phase I Sample Locations	FIG. NO. A-10

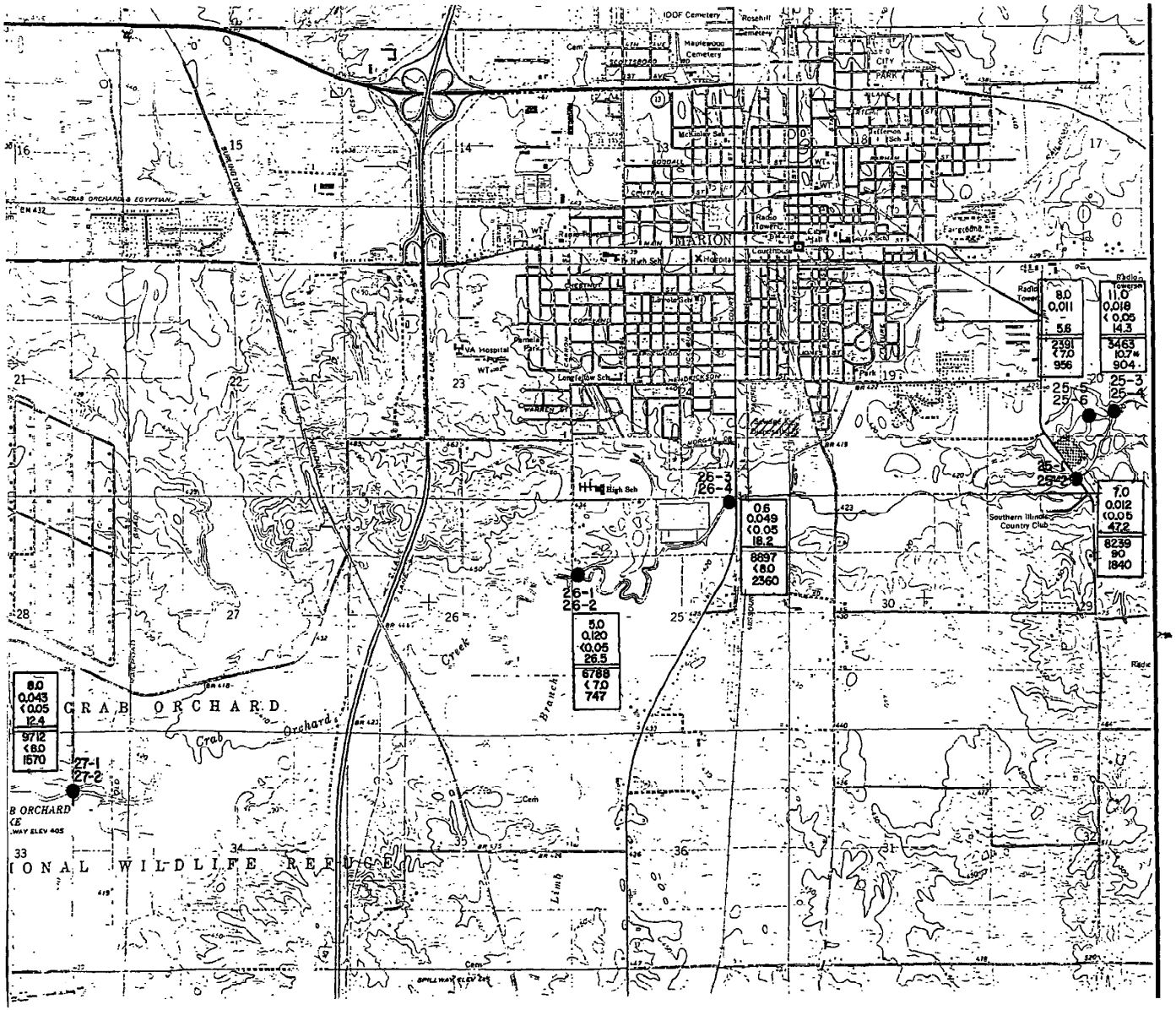


APPROXIMATE SCALE
0 100 200
(FEET)

Ⓓ -DECONTAMINATION AREA

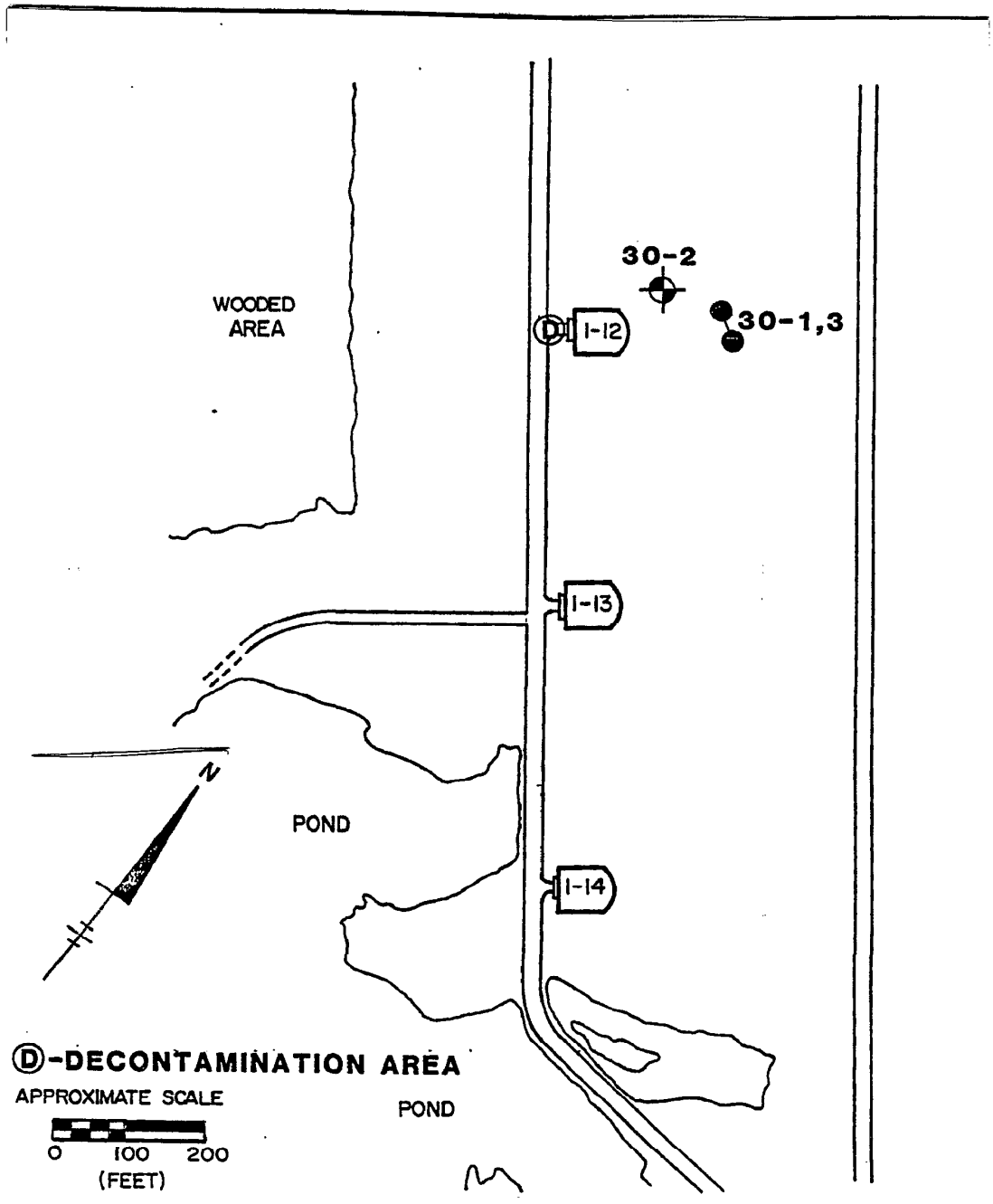
REFERENCE: FIGURE 3Ø-1 FROM
1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 24 Pepsi-West Drainage Phase I	FIG. NO. A-11



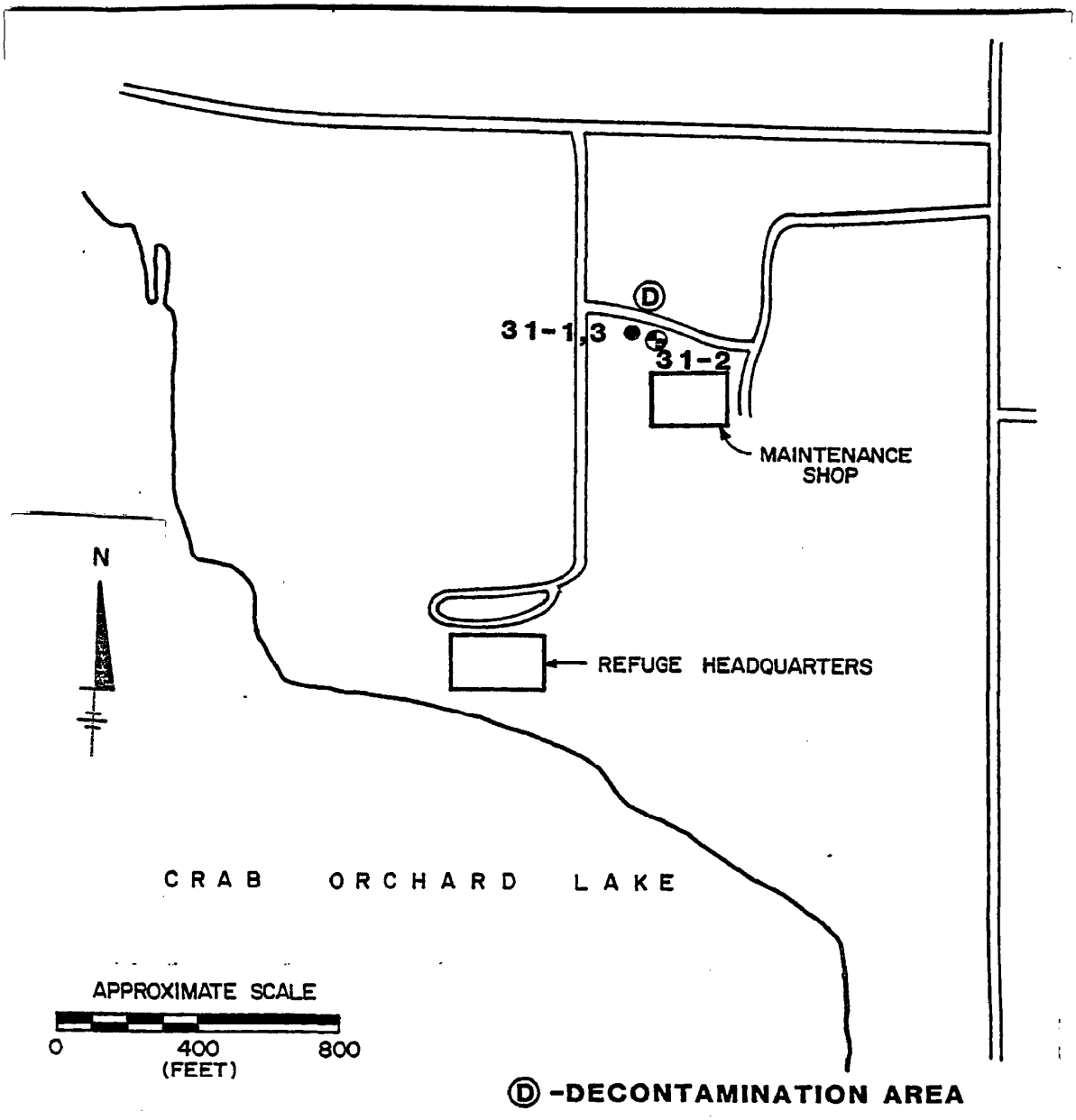
REFERENCE: FIGURE 31-1 FROM
1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Sites 25, 26, and 27 Crab Orchard Creek Phase I	FIG. NO. A-12



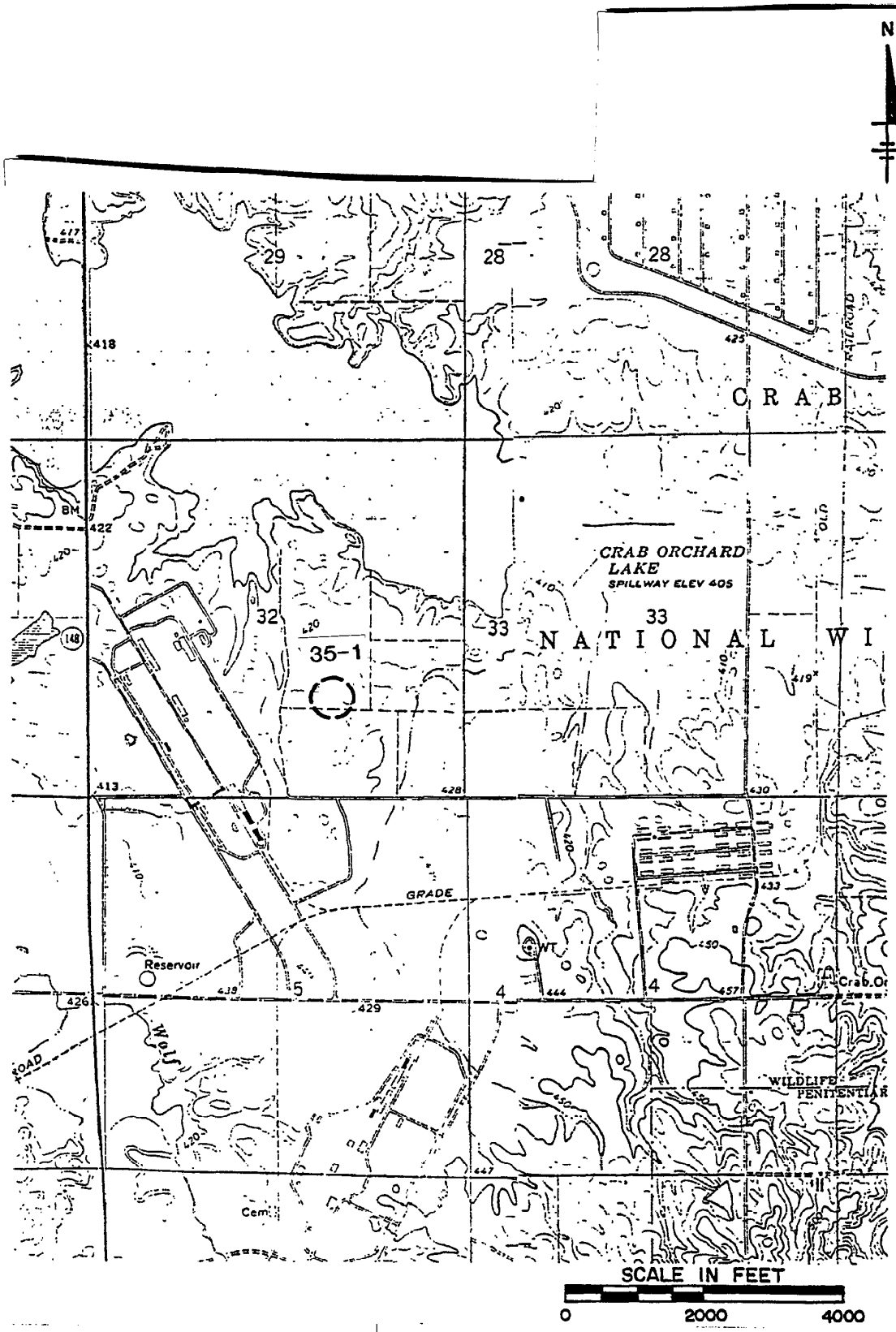
REFERENCE: FIGURE 8-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 30 Munitions Control Site	FIG. NO. A-13



REFERENCE: FIGURE 8-2 FROM 1988 RI (O'BRIEN & GERE, 1988)

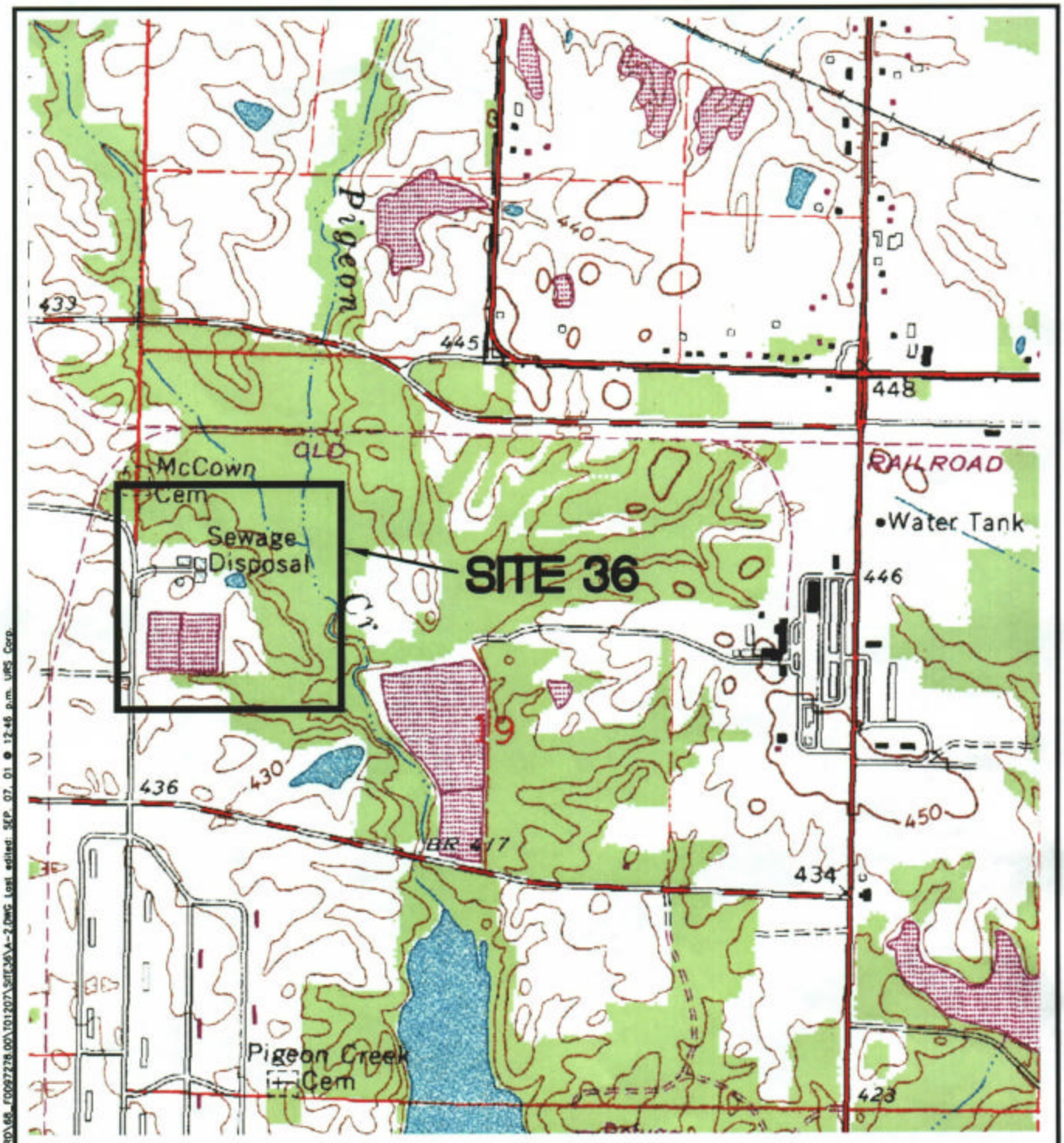
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 31 Refuge Control Site	FIG. NO. A-14



REFERENCE: FIGURE 39-1 FROM
1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 35 Area 9 Waterway Phase I	FIG. NO. A-15

File: E:\232000026.00\PA-SI REPORT-AUS OU\TITLE BLOCKS FOR CUT AND PASTE\FIG A-17.DWG Last edited: SEP. 06, 01 @ 3:11 p.m. URS Corp.



BASE MAP: USGS 1:24,000 DIGITAL RASTER GRAPHIC – CRAB ORCHARD LAKE, HERRIN, JOHNSTON CITY, MARION.

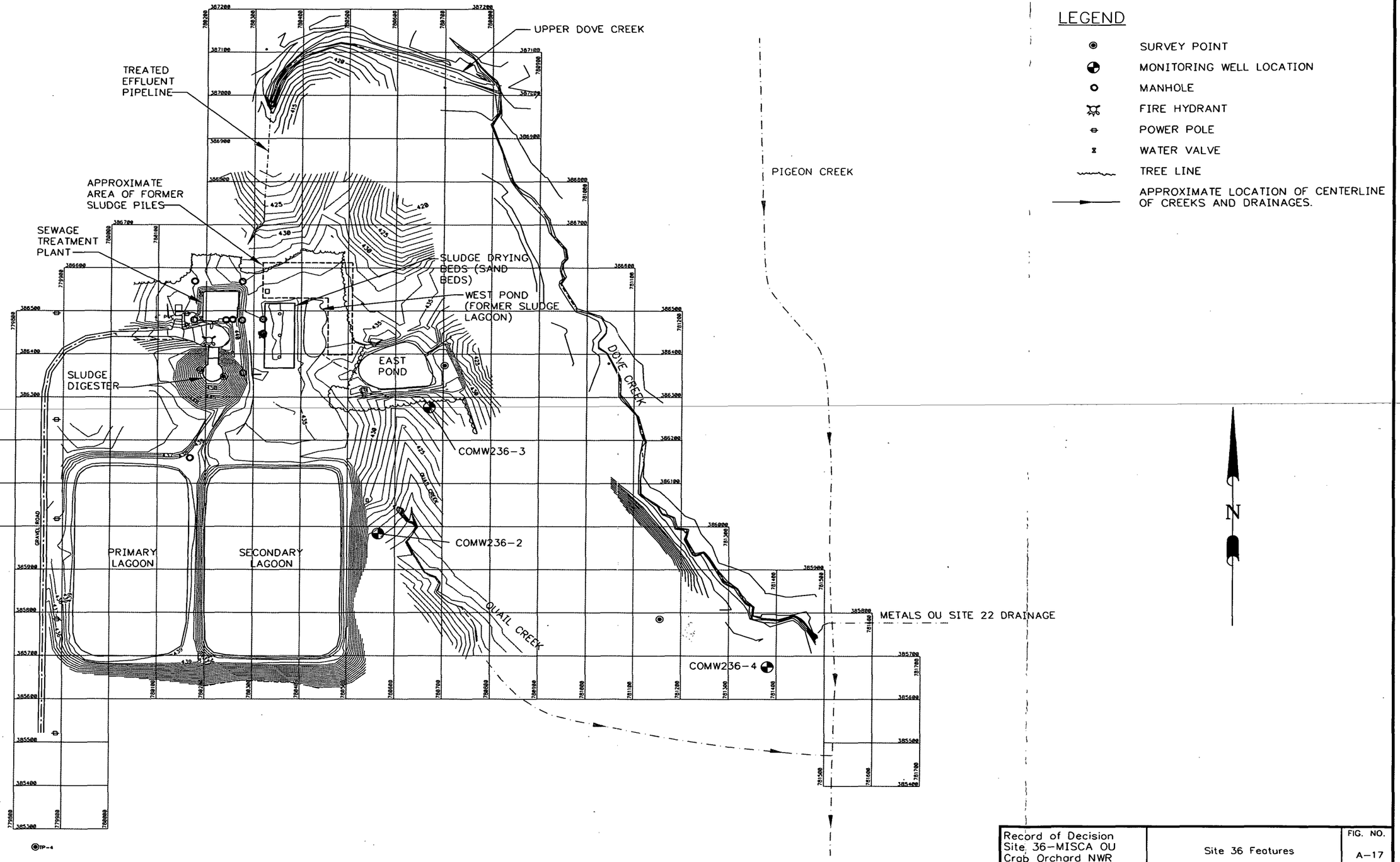
N

1000 500 0 1000

SCALE IN FEET

Record of Decision Site 36–MISCA OU Crab Orchard NWR Marion, Illinois	Site 36 Location	FIG. NO. A-16

File: E:\687009272800\CRAB_ORCHARD\CRAB_ORCHARD\68_70092728.00\101207\SITE36\A-2.DWG Last edited: SEP. 07, 01 @ 12:46 p.m. URS Corp.

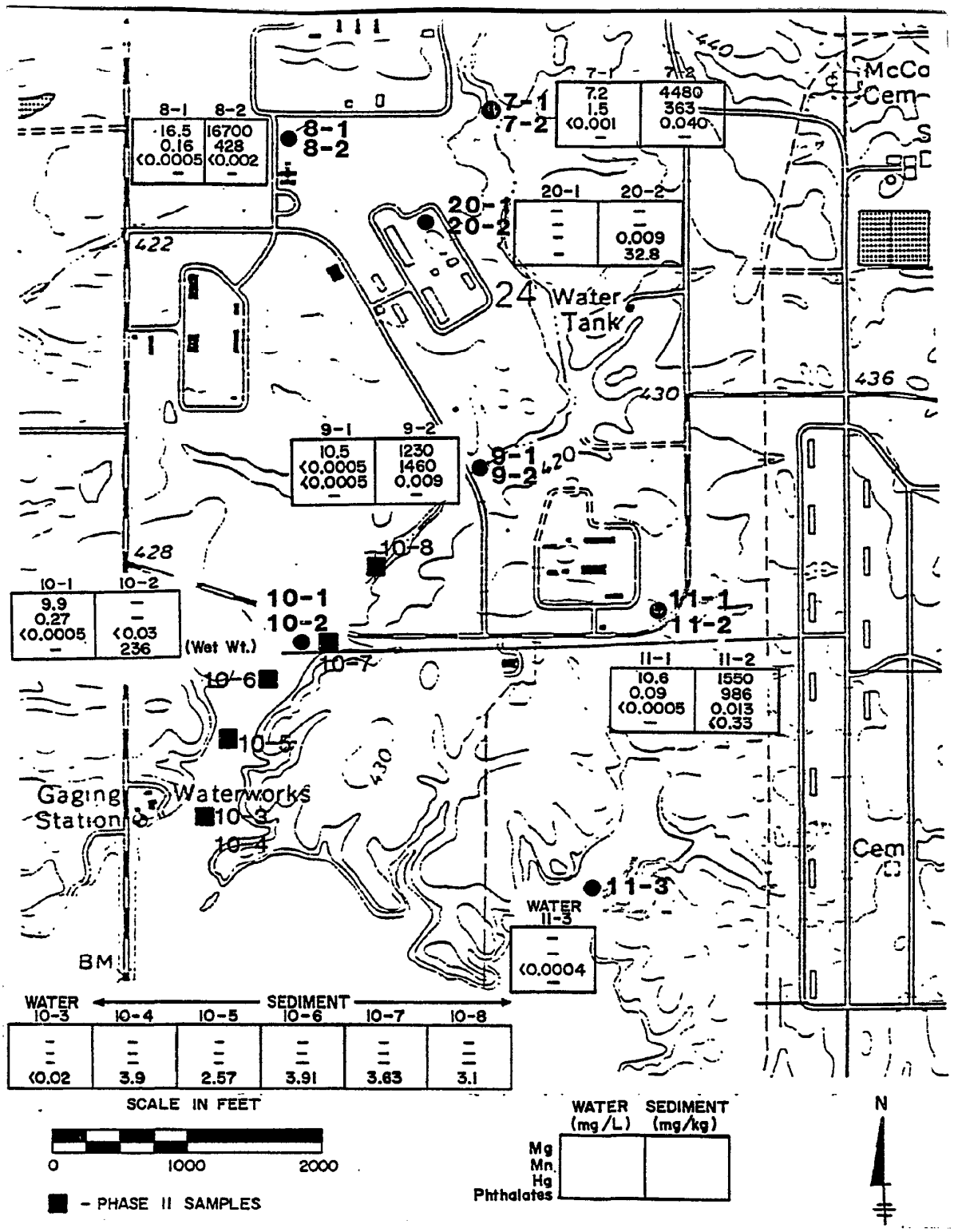


LEGEND

- SURVEY POINT
- MONITORING WELL LOCATION
- MANHOLE
- FIRE HYDRANT
- POWER POLE
- WATER VALVE
- TREE LINE
- APPROXIMATE LOCATION OF CENTERLINE OF CREEKS AND DRAINAGES.

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 36 Features	FIG. NO. A-17

File: E:\68FOD9727800\CRAB_ORCHARD\CRAB_ORCHARD\68_FOD97278.00\T01207\SITE36\F2-2_T01270.DWG Last edited: FEB. 25, 02 @ 12:25 p.m. by: PAFISCHO

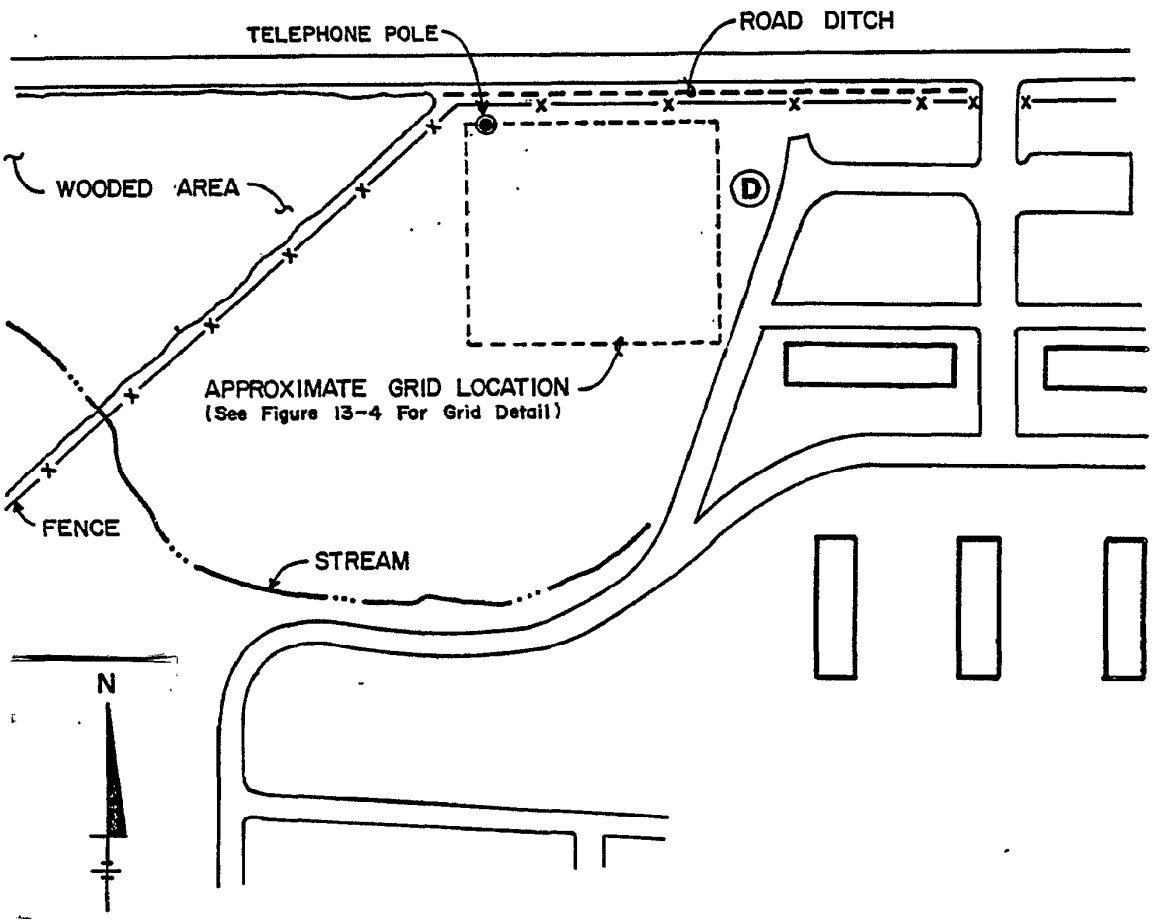


REFERENCE: FIGURE 16-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Waterworks Sampling Locations Phase I & II	FIG. NO. E-1

File: E:\232000026.00\PA-SI_REPORT-AUS_OU\TITLE BLOCKS FOR CUT AND PASTE\FIG E-9.DWG Last edited: SEP. 07, 01 @ 11:31 a.m. URS Corp.

STUDY AREA LOCATION



(D) - DECONTAMINATION AREA

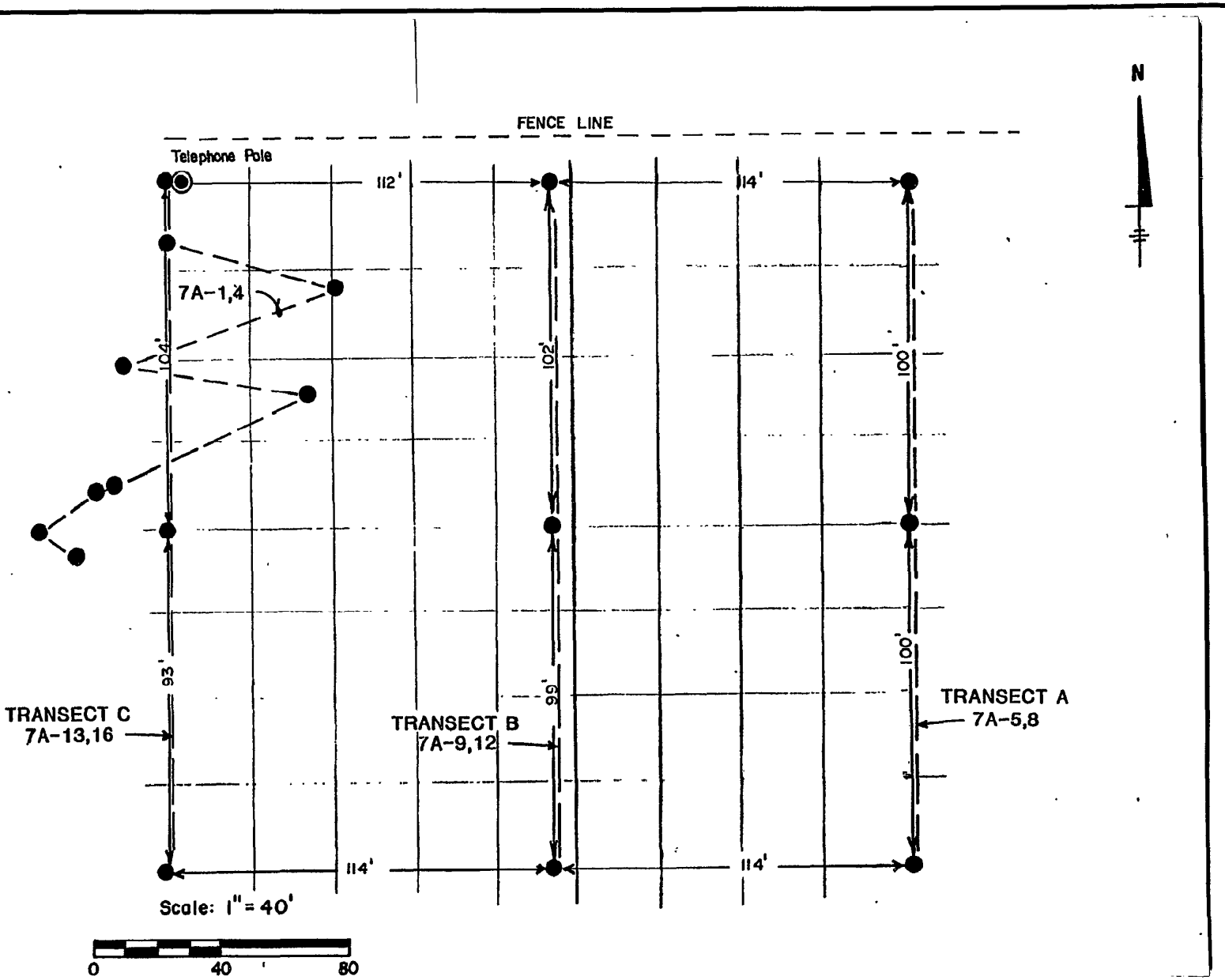
APPROXIMATE SCALE

0 100 200

(FEET)

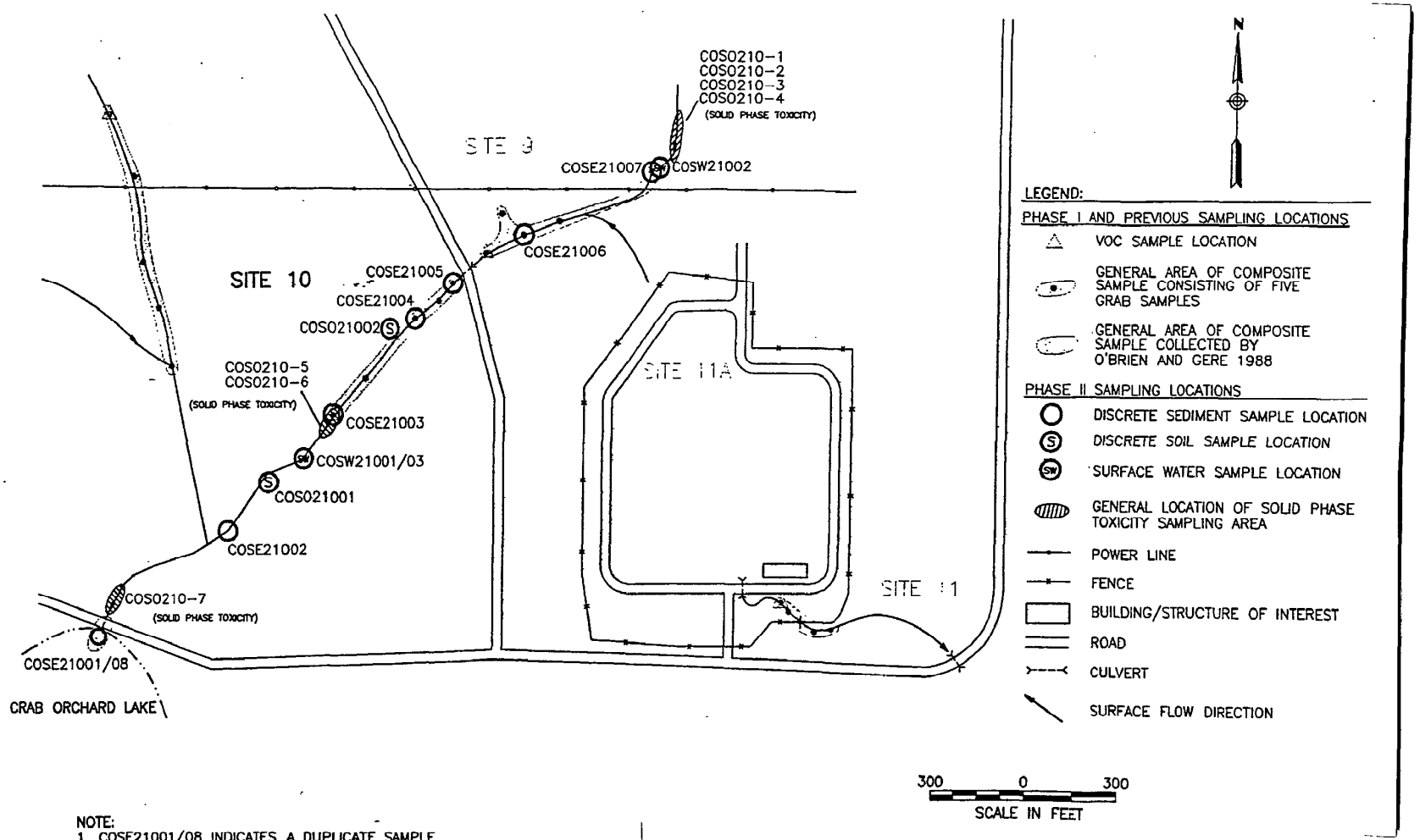
REFERENCE: FIGURE 13-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site No. 7A D Area North Lawn Phase I	FIG. NO. E-2



REFERENCE: FIGURE 13-4 FROM
1988 RI (O'BRIEN & GERE, 1988)

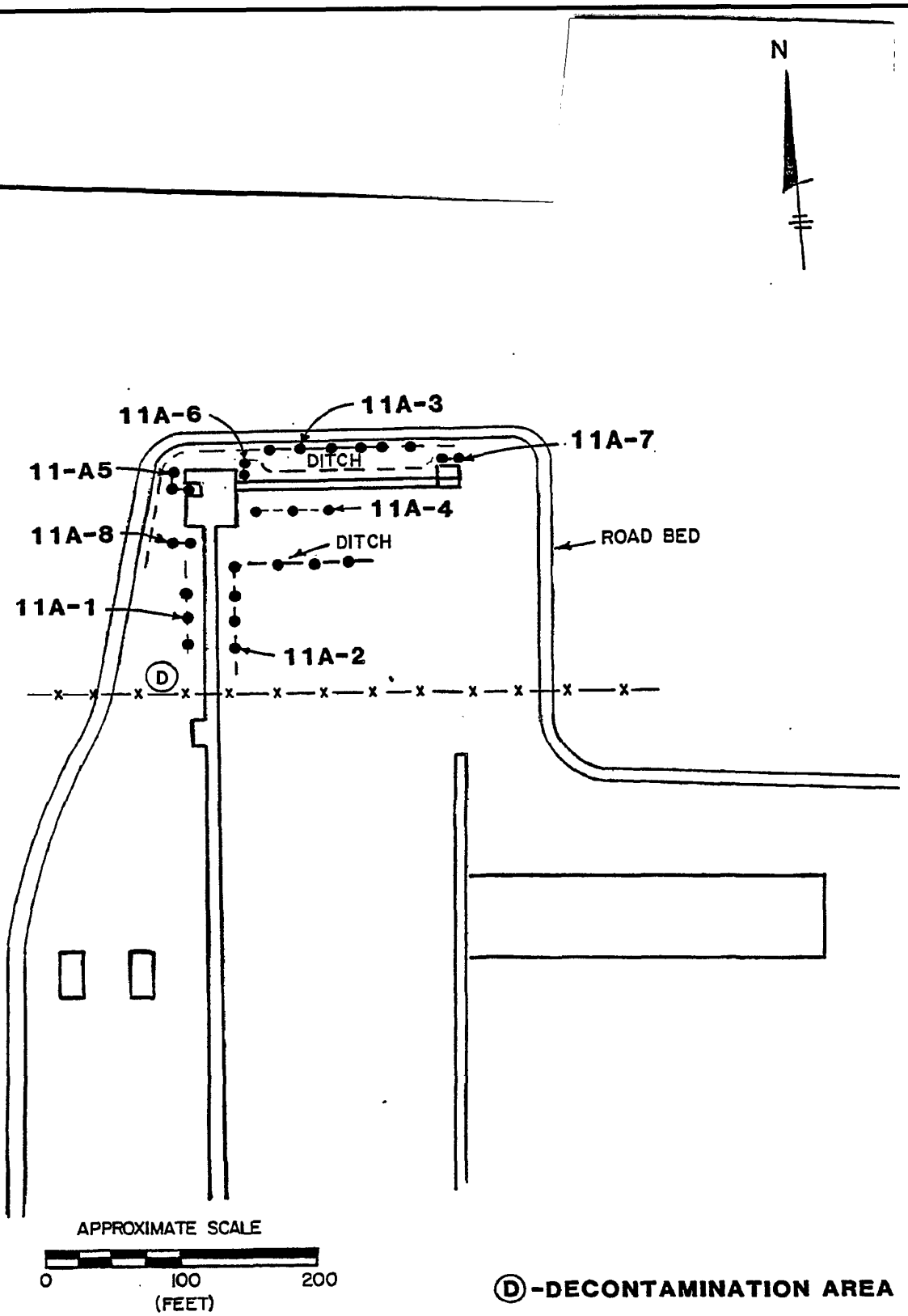
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 7A Sampling Locations Phase I	FIG. NO. E-3



NOTE:
1. COSE21001/08 INDICATES A DUPLICATE SAMPLE (COSE21008) WAS COLLECTED WITH THE INVESTIGATIVE SAMPLE (COSE21001).

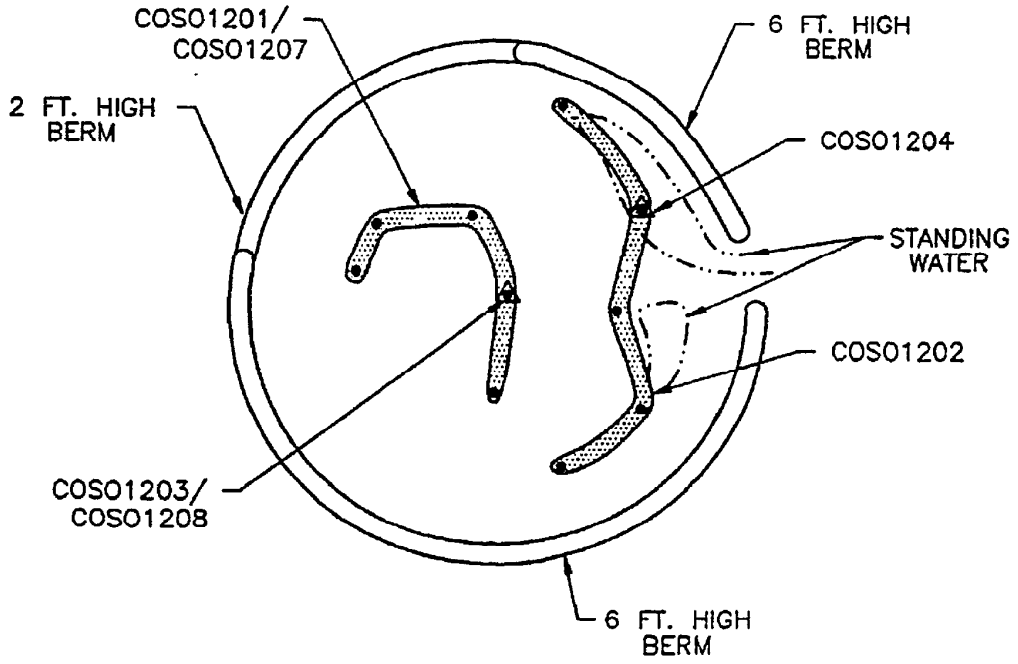
REFERENCE: FIGURE 2-3 FROM
1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 10 Phase II Sampling Locations	FIG. NO. E-4



REFERENCE: FIGURE 18-1 FROM 1988 RI (O'BRIEN & GERE, 1988)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 11A P Area North Phase I	FIG. NO. E-5



NOTE:
1. SAMPLE COSO1208 IS A DUPLICATE OF COSO1203.
2. SAMPLE COSO1207 IS A DUPLICATE OF COSO1201.

LEGEND:

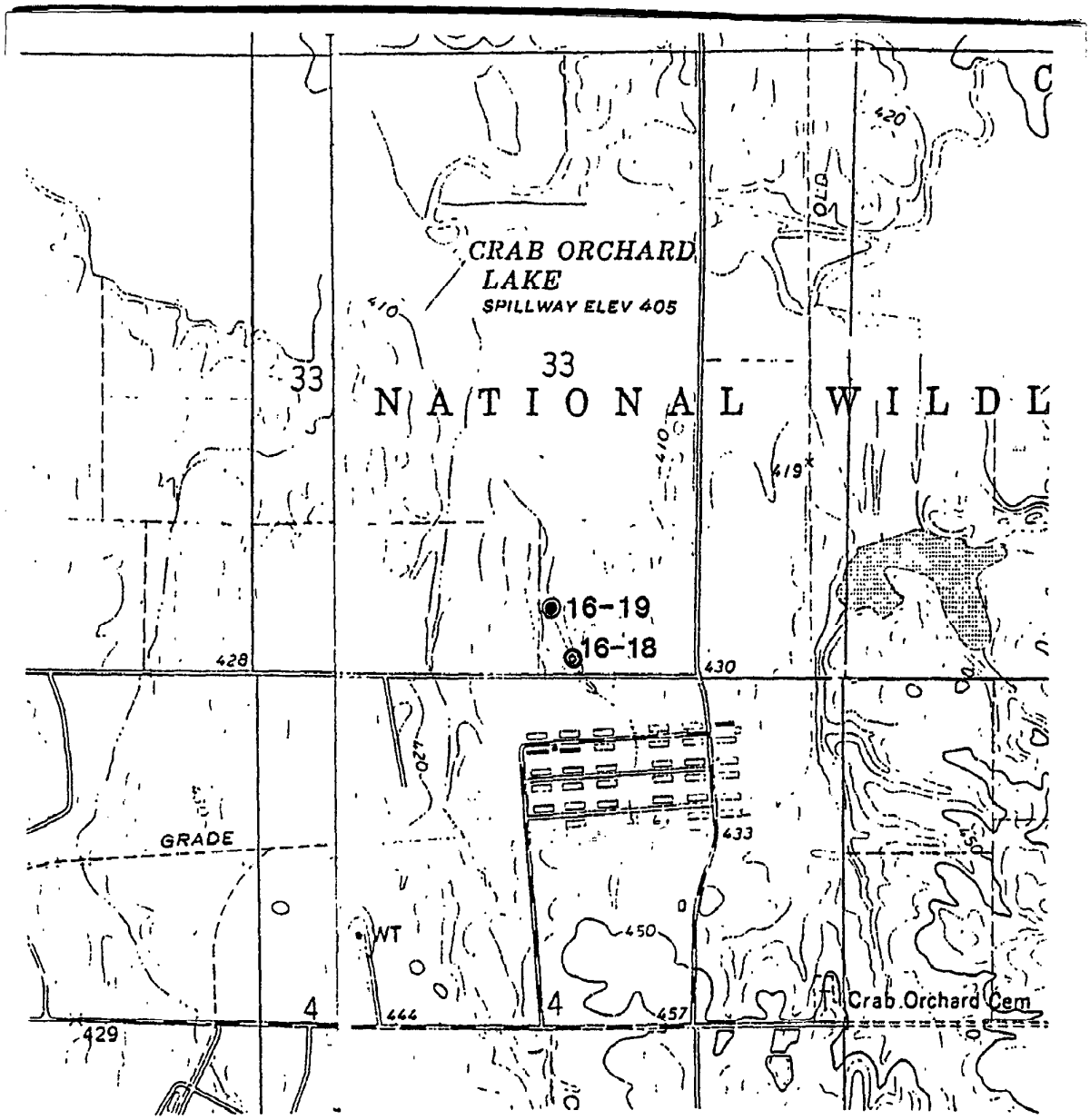
- • GRAB SAMPLE LOCATION
- COSO1203 △ DISCRETE SAMPLE LOCATION
- COSO1201 GENERAL AREA OF COMPOSITE SAMPLE

50 0 50 100 150

SCALE IN FEET

REFERENCE: FIGURE 2-5 FROM 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 12 Phase-I Sample Locations	FIG. NO. E-6



N

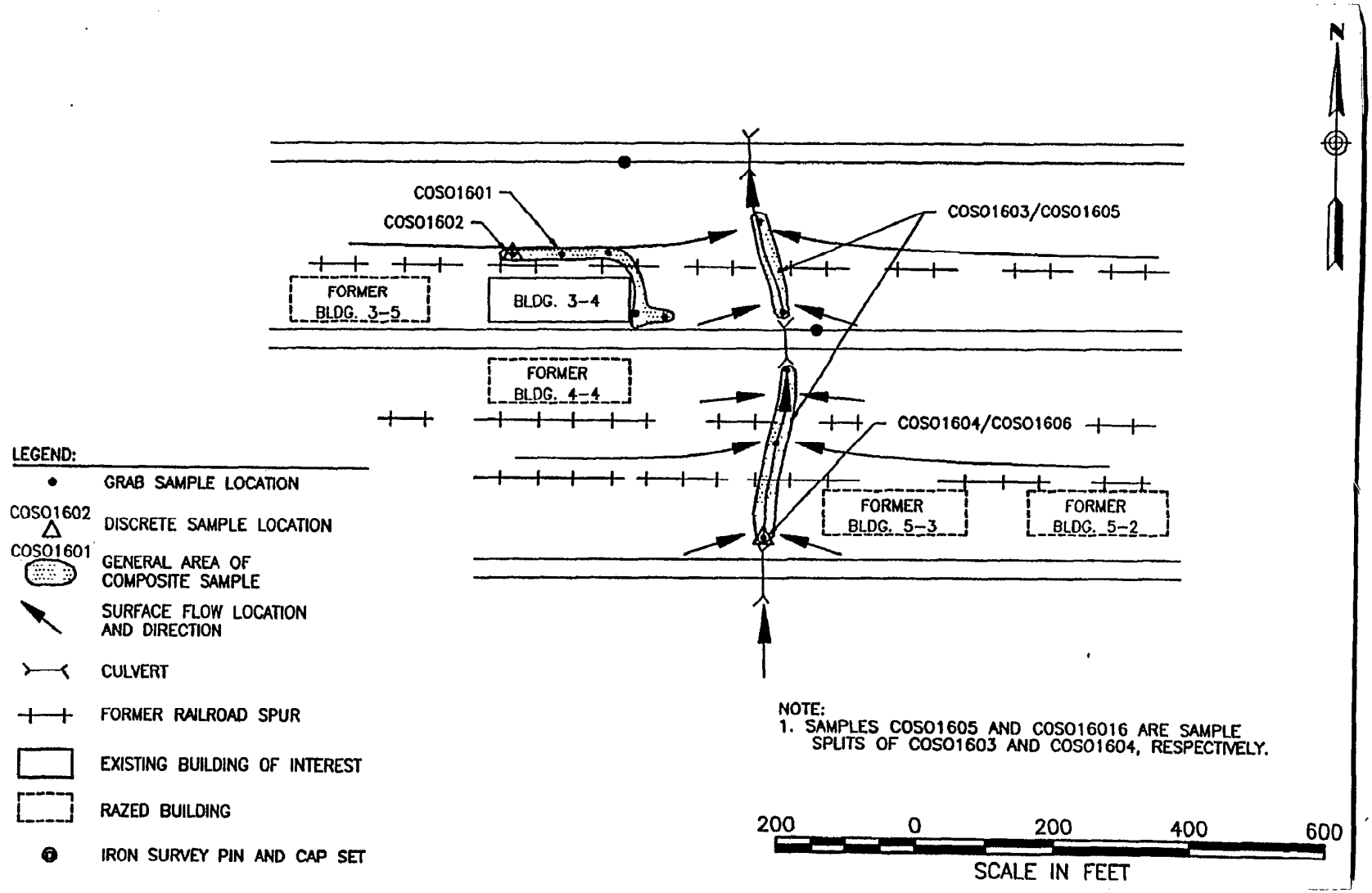
SCALE IN FEET

0 1400 2800

REFERENCE: FIGURE 23-1 FROM
1988 RI (O'BRIEN & GERE, 1988)

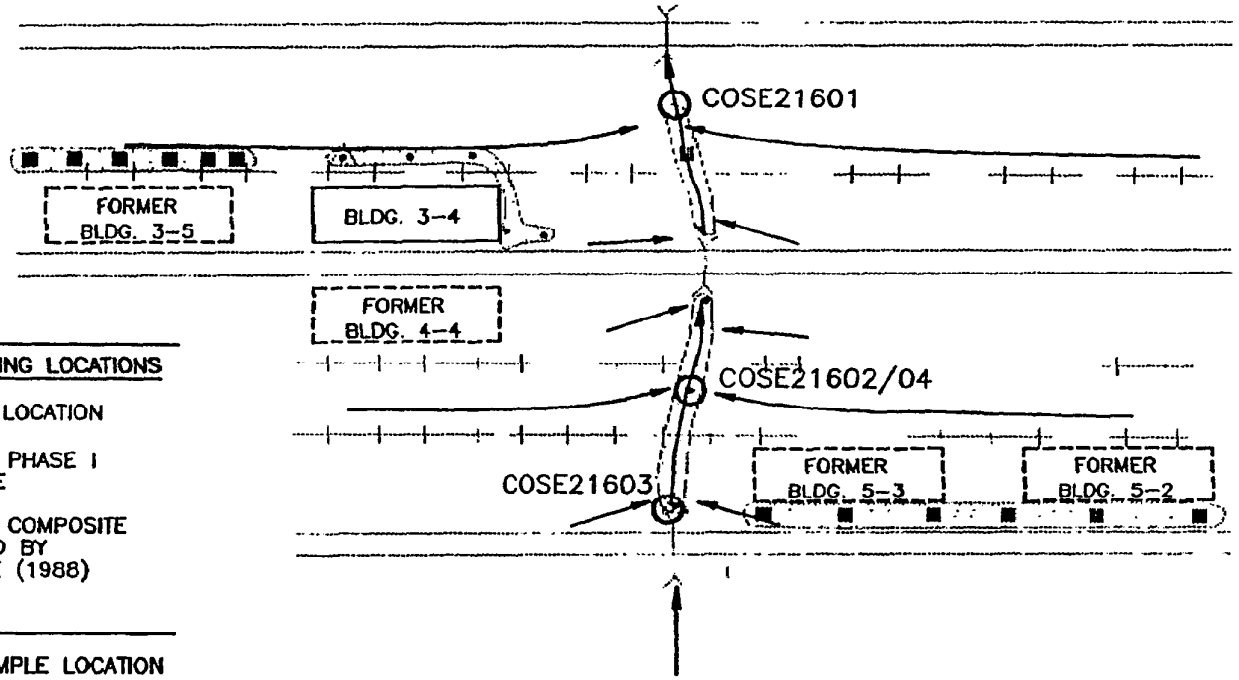
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 16 Additional Sampling Locations	FIG. NO. E-7

File: E:\232000026.00\PA-SI REPORT-AUS OU\TITLE BLOCKS FOR CUT AND PASTE\FIG E-15.DWG Last edited: SEP. 11, 01 @ 1:15 p.m. URS Corp.



REFERENCE: FIGURE 2-8 FROM 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 16 Phase-I Sample Locations	FIG. NO. E-8



LEGEND:

PHASE I AND PREVIOUS SAMPLING LOCATIONS

- DISCRETE SAMPLE LOCATION
- GENERAL AREA OF PHASE I COMPOSITE SAMPLE
- GENERAL AREA OF COMPOSITE SAMPLE COLLECTED BY O'BRIEN AND GERE (1988)

PHASE II SAMPLING LOCATIONS

- DISCRETE SOIL SAMPLE LOCATION
- SURFACE FLOW DIRECTION
- CULVERT
- FORMER RAILROAD SPUR
- EXISTING BUILDING OF INTEREST
- RAZED BUILDING OF INTEREST

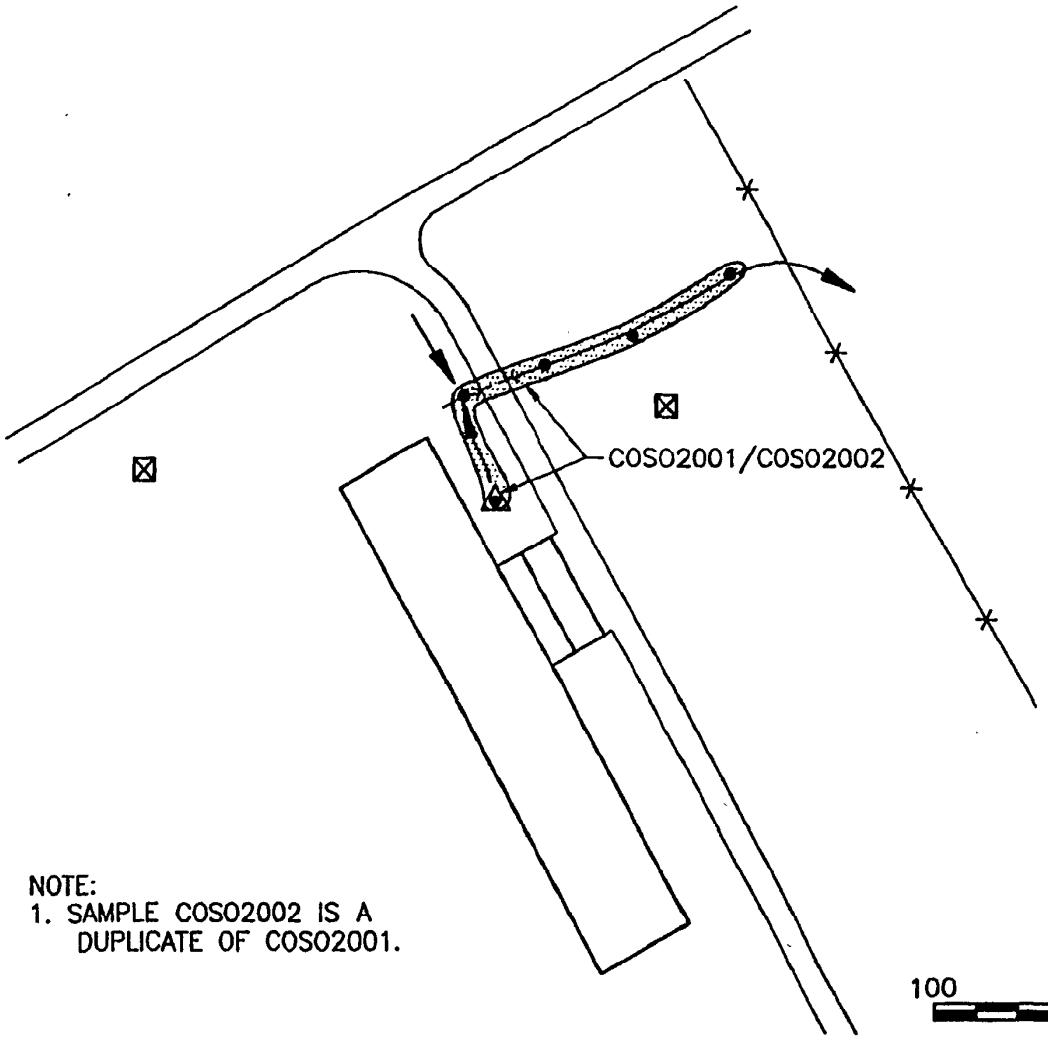
NOTE:
1. COSE21602/04 INDICATES A DUPLICATE SAMPLE (COSE21604) WAS COLLECTED WITH THE INVESTIGATIVE SAMPLE (COSE21602).

200 0 200

SCALE IN FEET

REFERENCE: FIGURE 2-9 FROM
1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 16 Phase II Sampling Locations	FIG. NO. E-9



NOTE:
1. SAMPLE COSO2002 IS A DUPLICATE OF COSO2001.

N

LEGEND:

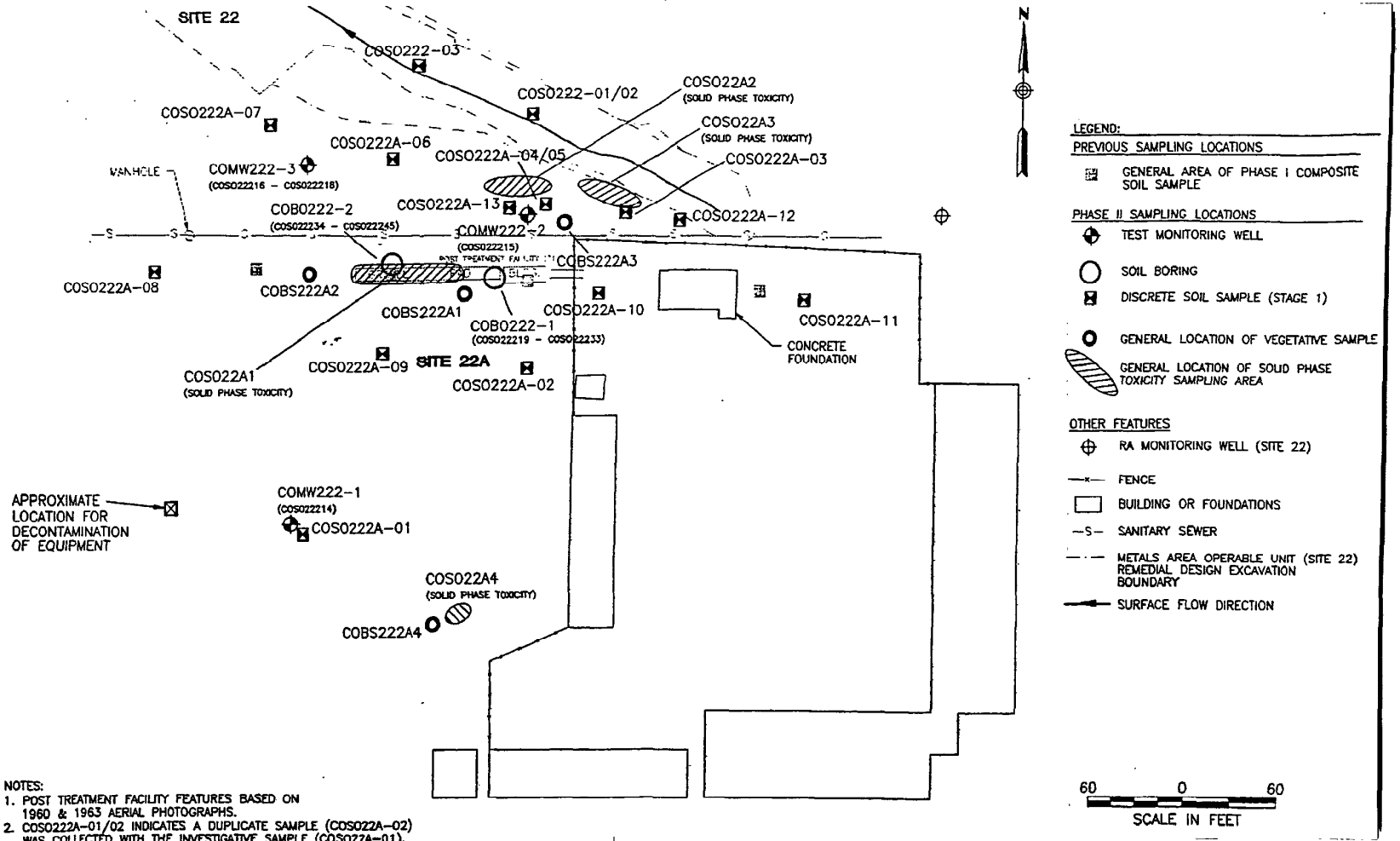
- GRAB SAMPLE LOCATION
- COSO2001 DISCRETE SAMPLE LOCATION
- COSO2001 GENERAL AREA OF COMPOSITE SAMPLE CONSISTING OF FIVE GRAB SAMPLES
- WOOD SURVEY HUB AND TACK SET
- FENCE
- BUILDING/STRUCTURE
- ROAD
- CULVERT
- SURFACE FLOW LOCATION AND DIRECTION

100 0 100 200 300

SCALE IN FEET

REFERENCE: FIGURE 2-10 FROM 1996 PHASE II RI (W-C, 1996)

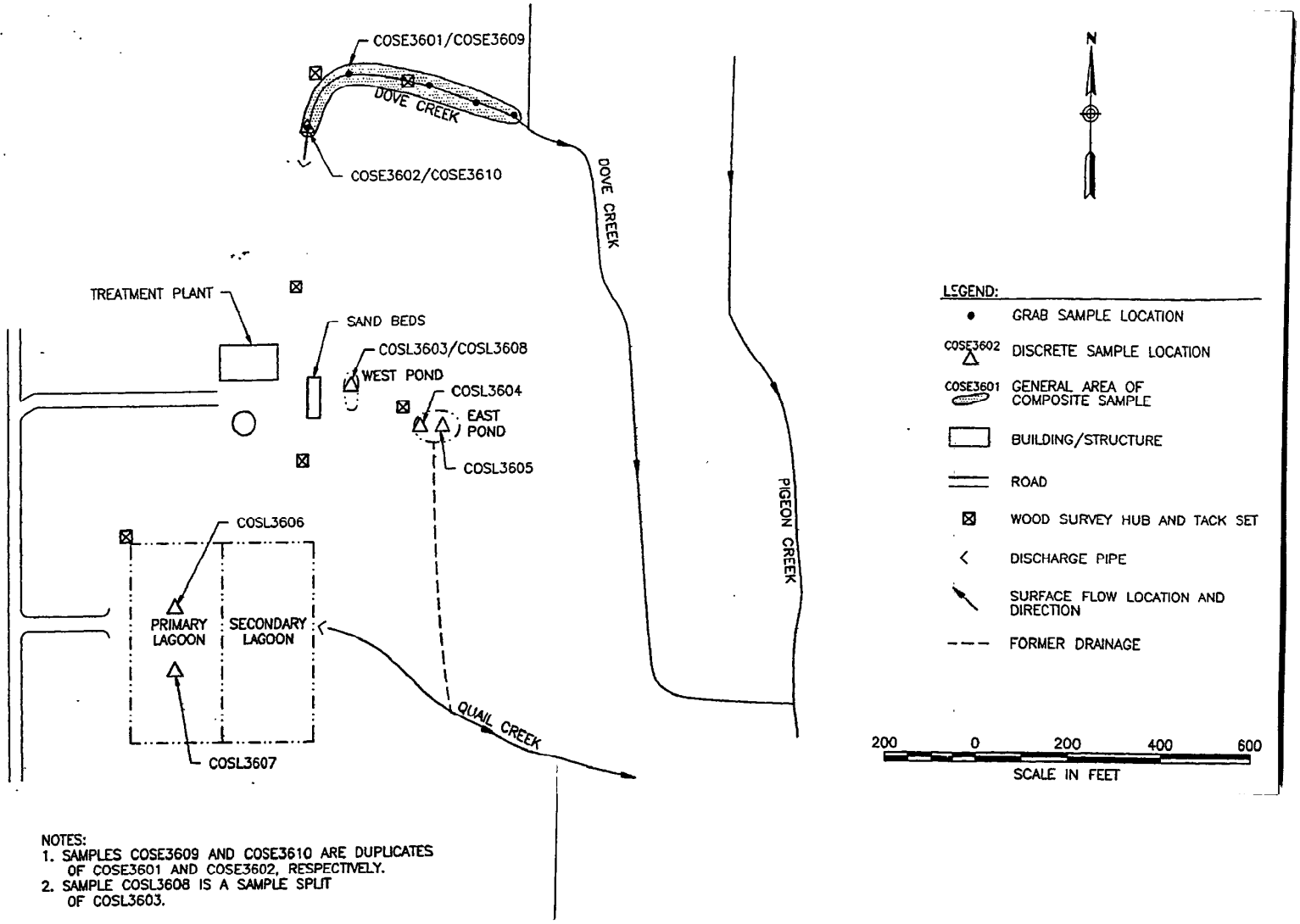
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 20 Phase-I Sample Locations	FIG. NO. E-10



NOTES:
1. POST TREATMENT FACILITY FEATURES BASED ON 1960 & 1963 AERIAL PHOTOGRAPHS.
2. COSO222A-01/02 INDICATES A DUPLICATE SAMPLE (COSO22A-02) WAS COLLECTED WITH THE INVESTIGATIVE SAMPLE (COSO22A-01).
3. (COSO22214-COSO22233) INDICATES SUBSURFACE SOIL SAMPLES COLLECTED FROM WELL OR SOIL BORINGS.
4. BASE MAP FROM DRAWING CER 61-400E, SHEET REF. NO. C4, DATED FEB., 1993, BY WOODWARD-CLYDE CONSULTANTS FOR U.S. ARMY CORPS OF ENGINEERS, OMAHA, NEBRASKA.

REFERENCE: FIGURE 2-12 FROM 1996 PHASE II RI (W-C, 1996)

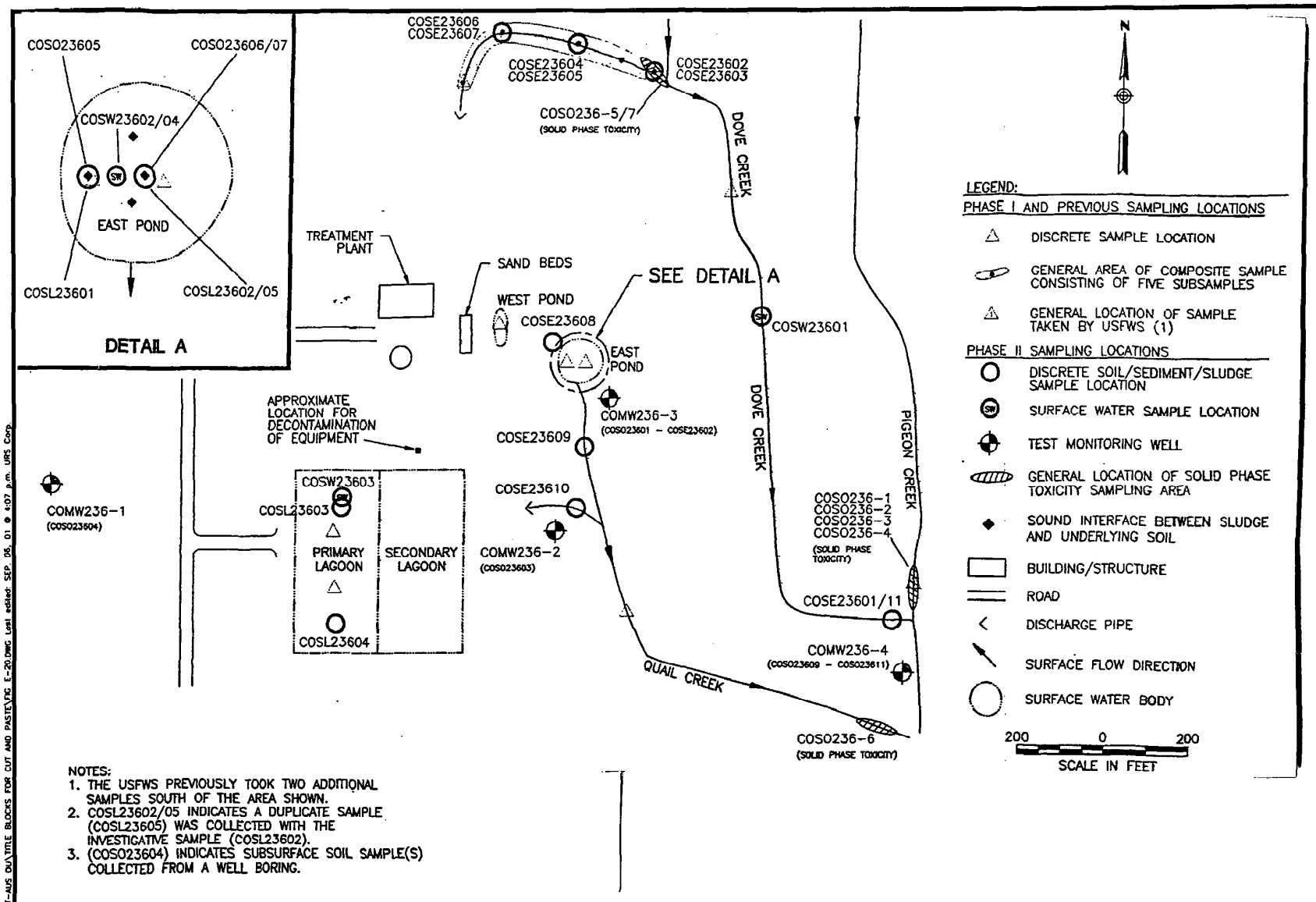
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Post Treatment Facility (Site 22A) Phase II Sample Locations	FIG. NO. E-11



NOTES:
1. SAMPLES COSE3609 AND COSE3610 ARE DUPLICATES OF COSE3601 AND COSE3602, RESPECTIVELY.
2. SAMPLE COSL3608 IS A SAMPLE SPLIT OF COSL3603.

REFERENCE: FIGURE 2-13 FROM 1996 PHASE II RI (W-C, 1996)

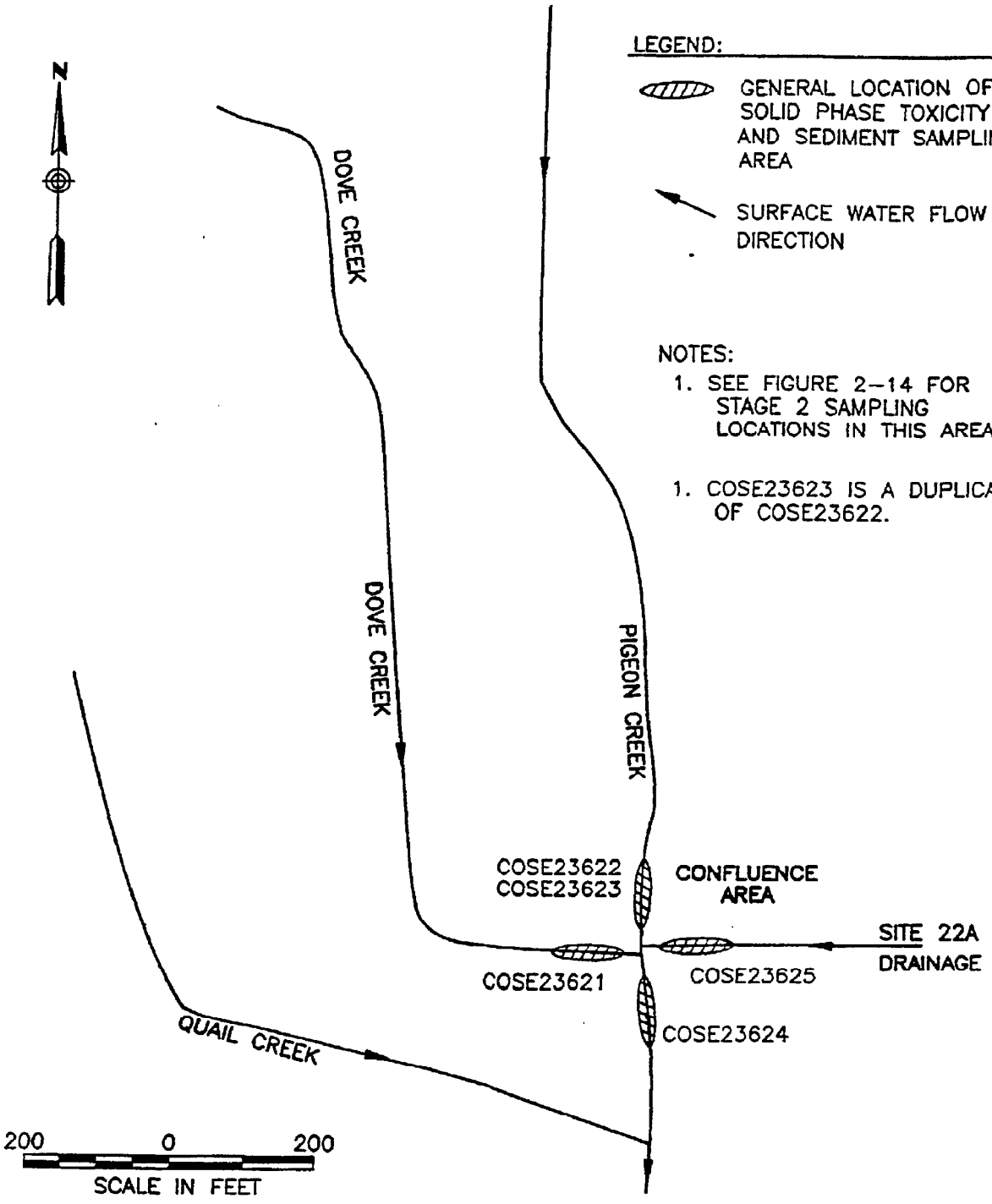
Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 36 Phase-I Sample Locations	FIG. NO. E-12



NOTES:
1. THE USFWS PREVIOUSLY TOOK TWO ADDITIONAL SAMPLES SOUTH OF THE AREA SHOWN.
2. COSL23602/05 INDICATES A DUPLICATE SAMPLE (COSL23605) WAS COLLECTED WITH THE INVESTIGATIVE SAMPLE (COSL23602).
3. (COSO23604) INDICATES SUBSURFACE SOIL SAMPLE(S) COLLECTED FROM A WELL BORING.

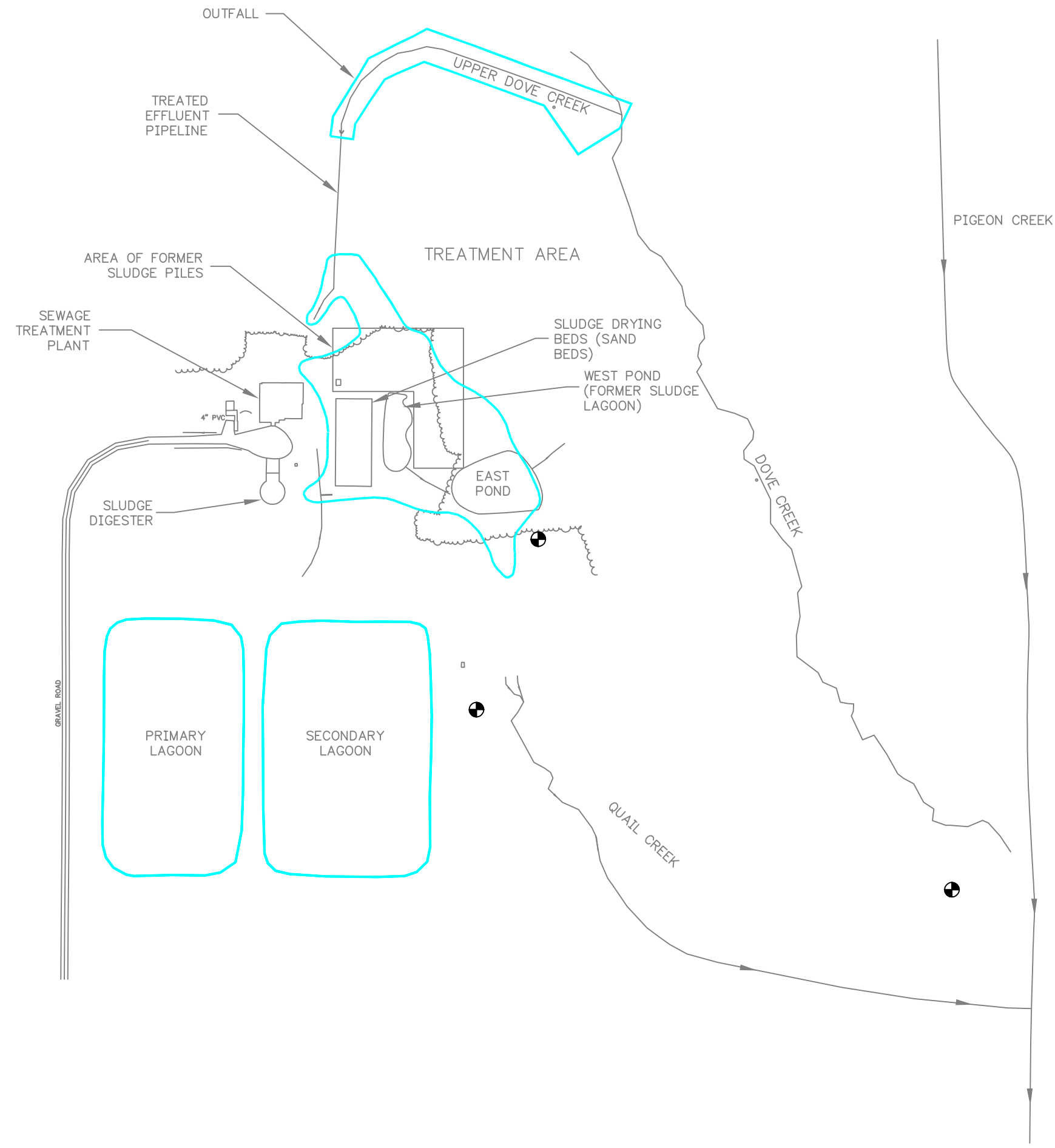
REFERENCE: FIGURE 2-14 FROM 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Site 36 Phase-II Stages 1 & 2 Sampling Locations	FIG. NO. E-13



REFERENCE: FIGURE 2-15 FROM 1996 PHASE II RI (W-C, 1996)

Record of Decision Site 36-MISCA OU Crab Orchard NWR Marion, Illinois	Sites 36, Phase II Stage 3 Sampling Locations in Confluence Area	FIG. NO. E-14



Record of Decision Site 36–MISCA OU Crab Orchard NWR Marion, Illinois	Lateral Extent of Contamination at Site 36	FIG. NO. E–15

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APPENDIX A

RESPONSIVENESS SUMMARY

No Responsiveness Summary is included because no comments were received.

APPENDIX B

SELECTED REMEDY COST ESTIMATE

TABLE B-1

Selected Alternative
Excavation and Disposal

COST ESTIMATE SUMMARY

Site: Crab Orchard N.W.R.
Location: Marion, Illinois
Phase: Feasibility Study (-30% to +50%)

Description: Alternative 2 includes excavation and disposal of contaminated soil and on-site treatment for surface water.

CAPITAL COSTS (Year 0):

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
1. Mobilization / Demobilization					
a. Excavation	1	LS	$69,929.87	$69,930	15% of site work
b. Treatment Train	1	LS	$5,700.00	$5,700	15% of capital costs ($38,000)
c. Submittals / Implementation Plans	1	LS	$5,000.00	$5,000	
d. Mobilization/Demob for demolition	1	LS	$20,199.00	$20,199	15% demo/demo site work costs
SUBTOTAL				$100,829	
2. Monitoring, Sampling, Testing, and Analysis					
a. Confirmation Sampling - Soil	60	EA	$1,240.00	$74,400	60 samples analyzed each COPEC
b. Verification Sampling - Soil	179	EA	$275.00	$49,225	
c. Verification Sampling - Surface water	60	EA	$2,145.00	$128,700	
SUBTOTAL				$252,325	
3. Site Work					
a. Site Preparation	1	LS	$10,000.00	$10,000	Fencing, Outhouse, Parking, etc
b. Clear and Grub	1	ACRE	$20,000.00	$10,000	
c. Excavate and Stockpile Clean Soil	11,795	CY	$5.00	$58,975	For grading plan
d. Excavate and Load Non-TSCA Soil/Sludge	16,019	CY	$7.00	$112,133	
e. Excavate and Load TSCA Soil/Sludge	1,162	CY	$7.00	$8,134	
f. Backfill, Spread, Compact, Grade	14,912	CY	$8.00	$119,296	Grade lagoon, east pond, dove creek
g. Revegetate	20	ACRE	$650.00	$13,000	Planting plus lime&fertilizer
h. Building Demolition, treatment building	71,400	CF	$0.32	$22,848	
I. Building Demolition, digestor	36,916	CF	$0.32	$11,813	
j. Restore site/grade, for treatment area	10,000	SF	$10.00	$100,000	
SUBTOTAL				$466,199	
4. On-Site Water Treatment					
a. Alum	10	TON	$250.00	$2,500	Metal Floc
b. Filter Chamber	1	EA	$4,000.00	$4,000	Remove Metal Floc and PCBs
c. Oil/Water Separator	1	EA	$2,500.00	$2,500	Remove Oil/Grease
d. GAC Unit	1	EA	$2,000.00	$2,000	Polisher
e. Pumps	2	EA	$8,000.00	$16,000	Influent/Effluent Pumps
f. Holding Tanks	2	EA	$3,000.00	$6,000	Holding Tanks
g. Piping and Hoses	500	LF	$10.00	$5,000	Mechanical Piping
h. Treat Water	512,000	GAL	$1.00	$512,000	
SUBTOTAL				$550,000	
5 Off-Site Treatment / Disposal					
a. Haul Non-TSCA Soil / Sludge	23,272	TON	$15.00	$349,080	
b. Haul TSCA Soil/Sludge	1,611	TON	$125.00	$201,375	
c. Dispose Non-TSCA Soil/Sludge	23,272	TON	$40.00	$930,880	
d. Dispose TSCA Soil/Sludge	1,611	TON	$150.00	$241,650	
e. Haul demolition debris	1,100	CY	$15.00	$16,500	
f. Dispose demolition debris	1,096	CY	$40.00	$43,840	
SUBTOTAL				$1,783,325	
6. Pre-design Sampling	1	LS	$150,000.00	$150,000.00	Sampling described in Section 6.
SUBTOTAL				$3,302,678	
7. Contingency (% of Subtotal)		35%		$1,155,937	25% scope + 10% bid
8 Project Management and Support (% of Subtotal)					
a. Project Management		5%		$165,134	
b. Remedial Design		8%		$264,214	
c. Construction Management		6%		$198,161	
SUBTOTAL				$627,509	
TOTAL CAPITAL COST - Year 0				**$5,086,124**	

TABLE B-1

Selected Alternative
Excavation and Disposal

COST ESTIMATE SUMMARY

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
1. Monitoring, Sampling, Testing, and Analysis					
a. Groundwater monitoring	4	EA	$2,552.00	$10,208	
SUBTOTAL				$10,208	
SUBTOTAL				$10,208	
7. Contingency (% of Subtotal)		25%		$2,552.00	25% scope + 10% bid
8. Project Management and Support (% of Subtotal)					
a. Project Management		5%		$510.40	
b. Technical Support		10%		$1,020.80	
SUBTOTAL				$1,531	
TOTAL ANNUAL O&M COST				**$14,291**	

PRESENT WORTH ANALYSIS:

YEAR	CAPITAL COST	ANNUAL O&M COST	TOTAL COST	DISCOUNT FACTOR (7%)	PRESENT WORTH	NOTES
0	$5,086,124		5,086,124	1.000	$5,086,124	
1		$14,291	14,291	0.935	$13,356	
2		$14,291	14,291	0.873	$12,482	
3		$14,291	14,291	0.816	$11,666	
4		$14,291	14,291	0.763	$10,903	
5		$14,291	14,291	0.713	$10,189	
6		$14,291	14,291	0.666	$9,523	
7		$14,291	14,291	0.623	$8,900	
8		$14,291	14,291	0.582	$8,318	
9		$14,291	14,291	0.544	$7,773	
10		$14,291	14,291	0.508	$7,265	
11		$14,291	14,291	0.475	$6,790	
12		$14,291	14,291	0.444	$6,345	
13		$14,291	14,291	0.415	$5,930	
14		$14,291	14,291	0.388	$5,542	
15		$14,291	14,291	0.362	$5,180	
16		$14,291	14,291	0.339	$4,841	
17		$14,291	14,291	0.317	$4,524	
18		$14,291	14,291	0.296	$4,228	
19		$14,291	14,291	0.277	$3,952	
20		$14,291	14,291	0.258	$3,693	
21		$14,291	14,291	0.242	$3,452	
22		$14,291	14,291	0.226	$3,226	
23		$14,291	14,291	0.211	$3,015	
24		$14,291	14,291	0.197	$2,817	
25		$14,291	14,291	0.184	$2,633	
26		$14,291	14,291	0.172	$2,461	
27		$14,291	14,291	0.161	$2,300	
28		$14,291	14,291	0.150	$2,149	
29		$14,291	14,291	0.141	$2,009	
30		$14,291	14,291	0.131	$1,877	
TOTALS	$5,086,124	$0	5,086,124		$5,263,464	

TOTAL PRESENT WORTH COST **$5,263,464**

GENERAL NOTES:

1. Expected accuracy range of cost estimate = -30% to +50%.
2. Base year of estimate = 2000. Costs from pre-2000 sources have been escalated to 2000.
3. Capital costs are incurred in Year 0 (initial construction).
4. Annual O&M costs are incurred for 30 years at a constant amount.