DECISION SUMMARY - PCB AREAS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE
CARTERVILLE, ILLINOIS

I. SITE NAME, LOCATION AND DESCRIPTION

Sangamo Electric Dump / Crab Orchard National Wildlife Refuge
Carterville, Illinois

The Crab Orchard National Wildlife Refuge (the Refuge) site lies near Marion, Carterville and Carbondale, Illinois, primarily within Williamson County, extending into Jackson, Union and Johnson Counties in southern Illinois (See Figure 1 in Appendix A). The Refuge consists of approximately 43,000 acres of multiple-use land. The land is used as a wildlife refuge, and also for recreational, agricultural and industrial purposes.

The western end of the Refuge around Crab Orchard Lake is used for recreational purposes while the eastern end is used for manufacturing facilities. Access to the eastern portion is closed to the public, except for limited access to workers at the industrial sites and restricted access to hunters. The study sites which were the focus of the Remedial Investigation (RI) and Feasibility Study (FS) are located in the eastern, closed portion of the Refuge (See Figure 2 in Appendix A).

There are twelve lakes, including Crab Orchard Lake located within the Refuge. Crab Orchard Lake supports a large population of sports fish and is used as a drinking water source for the Refuge and nearby Marion Federal Penitentiary. Wetlands are found in some areas adjacent to the lakes. Wildlife on the Refuge include many game and non-game species. The Refuge has habitat suitable for one endangered species, the Indiana bat, and definitely houses another, with two active bald eagle nests.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Crab Orchard National Wildlife Refuge is owned by the U.S. government and is currently administered by the U.S. Fish and Wildlife Service (FWS) a bureau of the Department of the Interior (DOI). The Refuge was previously administered by the Department of Defense (DOD). During the DOD administration portions of the Refuge were leased to industrial tenants, primarily for the purpose of munitions and explosives manufacturing. In 1947, the DOD transferred the Refuge to the DOI. Several other industries moved onto the site to occupy buildings formerly used by the wartime industries. The production of explosives continued to be the principal industry on the Refuge. Other industries included the manufacturing of PCB transformers and capacitors, automobile parts, fiberglass boats, corrugated boxes, plated metal parts, tape, flares and jet engine starters. Manufacturing, primarily munitions, continues at the Site.

Congress, in passing the law that created the Crab Orchard National Wildlife Refuge, mandated a continuing industrial presence on Refuge property. Congress required that the lands must be used in a manner

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consistent with the needs of industry, as well as those of agriculture, recreation, and wildlife conservation. The accompanying legislative history indicates that Congress viewed the industrial development of the Crab Orchard National Wildlife Refuge as central to the viability of the Refuge.

Disposal activities at the site apparently included dumping of waste material in unused areas of the site, and landfilling of waste materials in unlined landfills which were covered with earth. Other disposal might have included discharge of liquid material to surface water bodies and impoundments. The types of materials disposed of at the Refuge reflect the broad range of substances used in the various industrial and Refuge activities. There are no good estimates of the total volume of disposed material.

The site was proposed for the National Priorities List (NPL) in 1984 and finalized on the NPL in July 1987. The relative roles and responsibilities of other Federal Agencies and the United States Environmental Protection Agency (U.S. EPA) at Federal Facilities like Crab Orchard National Wildlife Refuge are prescribed in Section 120 of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), as amended, and Executive Order Number 12580. DOI is responsible for remedial action and compliance with CERCLA. The U.S. EPA is responsible for providing assistance and oversight to DOI for actions at the site taken pursuant to CERCLA. In addition, U.S. EPA, after consultation with DOI, is responsible for final remedy selection at the Site.

In addition to the roles and responsibilities of the DOI and U.S. EPA at the Refuge discussed above, DOD may have some responsibility for some of the hazardous substances at the Site, in accordance with Section 107 of CERCLA and under the Defense Environmental Restoration Program. Various other private parties may have responsibility for the hazardous substances at the Refuge in accordance with Section 107 of CERCLA.

In February 1986, the U.S. EPA and FWS entered into a Federal Facility Initial Compliance Agreement, which required the performance of a Remedial Investigation and Feasibility Study (RI/FS). The FWS, in conjunction with Sangamo Weston, Inc., a potentially responsible party (PRP) at the site, began an RI/FS at the Refuge in May 1986. In August 1988, an RI Report was finalized and made available to the public. In August 1989, the FS Report and proposed plans for the first two operable units (the Metals Areas and the PCB Areas) were made available to the public. On March 30, 1990, a Record of Decision (ROD) selecting the final remedy for the Metals Areas operable unit was signed by U.S. EPA, with the concurrence of DOI. The U.S. EPA served as the supporting agency during the RI/FS, and was lead Agency for the development of the proposed plans and the Metals Areas ROD and this ROD. The Illinois Environmental Protection Agency (IEPA) served as a supporting agency for the FS, proposed plans and this ROD.

A draft Interagency Agreement (IAG), pursuant to CERCLA Section 120(e)(2) is currently being developed between U.S. EPA, DOI, DOD and IEPA. The Department of the Army (DA) may participate in the IAG. Negotiations on this IAG were started in August 1989, and are expected to delineate Agency roles and responsibilities for future activities and will stipulate schedules for completion of the remedial action specified in this ROD and remedial action for other operable units.

In July 1989, DOI issued letters to approximately sixty individuals and entities pursuant to CERCLA Section 104(e), to request information relating to the identification, nature and quantity of materials treated, stored or disposed of at the Refuge, or transported to the Refuge; the nature or extent of any releases or threatened releases of a hazardous substance at the Refuge; and information relating to the recipient's ability to pay for a cleanup. DOI and U.S. EPA are jointly reviewing the responses to these letters to determine whether any of the respondents would be considered PRPs at the site. Special notice letters have not been issued to any PRPs at the site to date.

III. COMMUNITY RELATIONS HISTORY

Public participation requirements under CERCLA Sections 113(k)(2)(B) and 117 were satisfied during the RI/FS process. U.S. EPA has been primarily responsible for conducting the community relations program for this Site, with the assistance of FWS. The following public participation activities were conducted during the RI/FS:

- Establishment of Administrative Record repositories at the Southern Illinois University's Morris Library in Carbondale, Illinois and at U.S. EPA, Region V Office in Chicago, Illinois.

- Establishment of additional information repositories at Marion Carnegie Public Library in Marion, Illinois; Crab Orchard National Wildlife Refuge Headquarters in Carterville, Illinois; and Marion Federal Penitentiary in Marion, Illinois.

- Development of a mailing list of interested citizens, organizations, news media, and elected officials in local, county, state and federal government. Periodic mailings of Fact Sheets and other information to all persons or entities on the mailing list.

- Periodic news releases announcing various on-site activities and results of investigations.

- A Fact Sheet in August 1988, explaining the results of the remedial investigation. The Remedial Investigation Report was also released at this time.

- Paid newspaper advertisements announcing the RI public meeting and the FS and proposed plan availability sessions and public hearings.

- A public meeting in August 1988, to meet concerned citizens and discuss the results of the remedial investigation. Approximately 100 people attended the meeting.

- A Fact Sheet in January 1989, explaining the Feasibility Study and proposed plan process, discussing remedial technologies under consideration, and announcing a tentative schedule.

- A Fact Sheet in August 1989, explaining U.S. EPA's preferred alternatives for two operable units at the site, and discussing the availability of the FS and proposed plans for those operable units. This Fact Sheet also outlined the other remedial alternatives, announced the public comment period and solicited comment on the alternatives.

- An availability session in August 1989, to informally answer citizens' questions about the FS and proposed plans. Questions were answered by representatives of U.S. EPA, FWS and IEPA.

- A public hearing on August 30, 1989, on the proposed plans and the FS. Comments were taken on the record. Approximately 140 people attended. Presentations were made, and questions were answered by representatives of U.S. EPA, FWS and IEPA.

- A public comment period of thirty days was originally planned, running from August 18, 1989, to September 16, 1989. The public comment period was announced in the proposed plan for the operable unit, in the Fact Sheet of August 1989, and through paid newspaper advertisements in the Southern Illinoisan and the Marion Daily Republic. Based on comment taken at the public hearing on August 30, 1989, and letters received, the comment period for this operable unit was extended three times, until December 1, 1990, for a total comment period of 105 days. The extensions were announced by letters to the individuals and groups on the mailing list, at public meetings and by press releases.

- A second public hearing on October 3, 1989, specifically on the proposed plan and remedial alternatives for the PCB Areas operable unit. Additional public comment was taken on the record. Presentations were made, and questions were answered by representatives of U.S. EPA.

A Responsiveness Summary addressing comments and questions received during the public comment period on the RI/FS and proposed plan is included with this Record of Decision as the third section.

This decision document presents the selected remedial action for the PCB Areas operable unit at the Crab Orchard National Wildlife Refuge Superfund site, in Carterville, Illinois, chosen in accordance with CERCLA, as amended by SARA and the National Contingency Plan. The decision for this operable unit at the site is based on the Administrative Record.

IV. SCOPE AND ROLE OF OPERABLE UNIT

The first step in the RI process was a review of available Refuge files and old analytical results to target "study sites" to be investigated in depth. Thirty-three study sites were investigated during the RI, with seven of these carried into the FS for evaluation of remedial alternatives.

As with many Superfund Sites, the problems at the Refuge are complex. The results of the investigations of the study sites indicated that the Refuge consists of several geographically distinct areas with markedly different characteristics. These include differences in the contaminants, in the parties responsible for the contamination, and in the remedial actions and schedules that would be appropriate. Consequently, the Agency decided to address these areas individually as "operable units" of an overall site remedy. The following four operable units have been created:

> PCB Areas - those areas contaminated with PCBs, which may also be contaminated with other materials, such as lead and cadmium, including study sites 17, 28, 32 and 33.
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> Metals Areas - those areas primarily contaminated with heavy metals, including study sites 15, 22 and 29;
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> Explosive/ Munitions Areas (formerly designated as "DOD Areas") - those areas thought to be contaminated with chemicals from explosive or munitions manufacturing, including study sites 3, 4, 5 and 19; and
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> Miscellaneous Areas - those areas that are thought to require no further work or that will need further investigation, monitoring or maintenance, including sites 7, 7A, 8, 9, 10, 11, 11A, 12, 13, 14, 16, 18, 20, 21, 24, 25, 26, 27, 30, 31, 34, and 35.

Under the National Contingency Plan, response actions may be conducted in operable units, provided such units are consistent with achieving a permanent remedy. Further, implementation of operable units should begin before selection of a final remedial action for the Site "when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of total site cleanup" [40 CFR 300.430(a)(1)(ii)]. These conditions are satisfied in this case. First, the proposed operable units are consistent with achieving a permanent remedy at the Site since they will, in fact, provide permanent remedies for the designated areas. Second, proceeding by operable units is sensible in this case because the nature of the problems in the different areas requires a phased approach given the size and complexity of the Site and the fact that the

implementation of remedies for the operable units will expedite Site cleanup and the reduction of risks from the operable units.

This Record of Decision addresses the PCB Areas operable unit. The four study sites comprising this operable unit are: the Job Corps Landfill (site 17); the Water Tower Landfill (site 28); the Area 9 Landfill (site 32); and the Area 9 Building Complex (site 33) (See Figure 2 in Appendix A). The remedy selected will address the principal threats of soil and sediment contamination at all four sites comprising the operable unit and will mitigate future surface water and groundwater contamination.

The remedy for the PCB Areas operable unit is the second of at least four operable units planned at the Site. The PCB Areas operable unit fits into the overall Site strategy by addressing the principal threats from the four sites contaminated with PCBs. (Lead is a co-contaminant at three of these sites). The waste materials will be treated to destroy the PCBs, and the metal-bearing residue will be contained on-site. Since the PCB Areas pose some of the most significant risks currently identified at the Refuge, remedial action for those areas should be initiated as quickly as possible.

Each of the other operable units is on a separate schedule. The schedule for each operable unit will be established in an upcoming revised Interagency Agreement among the U.S. EPA, DOI, DOD and IEPA, which is expected to be completed in September 1990. Depending on additional information, other operable units may be created or combined, as appropriate.

A Proposed Plan for the Metals Areas operable unit was released by U.S. EPA at the same time (August 1989) as the Proposed Plan for the PCB Areas operable unit. The Proposed Plan and required publication of notice occurred concurrently for the PCB Areas and Metals Areas operable units. Because of public concern about the incineration component of the preferred alternative, the public comment period for the PCB Areas was extended three times for a total of one hundred and five (105) days of public comment. A final remedy selection for the Metals Areas operable unit was made on March 30, 1990.

V. SITE CHARACTERISTICS

The RI/FS was conducted to identify the types, quantities and locations of contaminants at the Site and to develop ways of solving the problems they present. Because of the size of the Site, the first step in the RI process was a review of available Refuge files and old analytical results to target "study sites" to be investigated in depth. The nature and extent of actual or potential contamination related to the study sites was determined by a series of field investigations, including:

- geophysical surveys;
- surface soil sampling;
- exploratory test pit installation and sampling;
- installation and sampling of groundwater monitoring wells;

- surface water sampling; and
- sediment sampling.

Soil and sediment sampling in the four areas comprising the PCB Areas operable unit indicate the non-uniform presence of PCBs and lead, and the less consistent presence of other organic and inorganic contaminants. The four areas are all located in the portion of the Refuge where visitor access is restricted, so human exposure to the contaminants is sporadic and occasional. However, the areas are wooded and it is likely that wildlife are currently exposed to the contaminants.

The Job Corps Landfill site (study site 17) is comprised of an approximately one-acre landfill adjacent to a man-made pond which has been drained since the completion of the RI in 1988 (see Figures 3, 4 and 5 in Appendix A). Aerial photographs indicate that the area was used over an extended period for dumping, and became inactive sometime prior to 1960. The pond was created in the mid-1960's by damming a drainageway leading to Crab Orchard Lake. Soil samples from the landfill and sediment samples from the Job Corps Pond indicate the presence of PCBs, lead and cadmium, with other organic and inorganic contaminants of less concern found in the soil, sediments, pond water and groundwater. There are an estimated 1400 cubic yards of soil and sediment contaminated with PCBs. Approximately 620 cubic yards of this material are thought to be co-contaminated with metals.

The Water Tower Landfill (study site 28) consists of an open field which gradually slopes to the northeast. The sloping northeast face is heavily overgrown and slopes down to a wooded area. The fill area is approximately one acre, located north of the Water Tower (see Figures 6 and 7 in Appendix A). Aerial photographs indicate that the area was used intermittently over an extended period for dumping, and became inactive sometime prior to 1971. Down-slope drainage areas were also investigated. Soil sampling at the Water Tower Landfill showed some localized spots with PCB and lead contamination primarily below the surface. An estimated 1000 cubic yards of soil are contaminated with lead and PCBs. Other inorganic and organic contamination found in soil and groundwater at this study site will be addressed during confirmation sampling, or as part of remedial activities.

Area 9 is a manufacturing site on the Refuge. The Area 9 Landfill (study site 32) is located about 100 yards south of Crab Orchard Lake and 100 yards east of the Area 9 Building Complex (study site 33). The landfill is approximately 2.5 acres with an estimated depth of 6 to 10 feet (see Figures 8 and 9 in Appendix A). The landfill was reportedly used from the 1950s until 1964, and during the active life of the landfill a variety of industrial wastes were burned, compacted in a swale and covered. Runoff from the landfill can drain into an intermittent creek and into Crab Orchard Lake. The Area 9 Building Complex (see Figures 9 and 10) has been occupied by several industrial tenants, including Sangamo Weston, Inc. from 1946 to 1962. It is currently occupied by Olin, Corporation, and access to some areas has been closed. The contamination in the building complex primarily centered around two

buildings, numbers 1-1-2 and 1-1-23, and in two drainage ditches which receive runoff from the building complex. Approximately 36,000 cubic yards of soil and sediments in Area 9 are contaminated primarily with PCBs. Of these, approximately 2000 cubic yards are co-contaminated with lead. In addition, soil, sediment and groundwater at this study site showed some other inorganic and organic contamination of less concern.

VI. SUMMARY OF SITE RISKS

This Record of Decision addresses the PCB Areas operable unit. The RI Report included a risk assessment to define the actual or potential threat that the Site-related contaminants pose to human health and/or the environment. Since the Site is a National Wildlife Refuge, particular attention was paid to the potential impact on wildlife.

The DOI, as trustee for Refuge lands and for fish and wildlife on those lands, must ensure that remedies adequately protect and restore those trustee resources. Doing so, in many cases, requires standards more stringent than or different from those that may apply primarily for human health reasons for some contaminants. In promulgating the regulations for Natural Resource Damage Assessment (43 CFR Part 11; Type B Regulations, Final Rule, 51 FR 27673-27753, August 1, 1986) DOI addressed the difference in standards for natural resource damage assessment and remediation for human health purposes. The trustee can only agree to a covenant not to sue under Section 122(j) of CERCLA if a PRP agrees to undertake appropriate actions necessary to protect and restore natural resources damaged by actual or threatened releases of hazardous substances.

Damage assessment and restoration are carried out for the purpose of compensation to the public for damaged public natural resources. Comparison is made to "baseline" conditions which represent conditions in the absence of the contamination. In this case, because human health standards may not be sufficient to be protective of wildlife or may interfere with the Site's primary purpose as a wildlife refuge, restoration beyond human health standards is necessary to adequately compensate for the injuries to the public natural resources. Because standards for wildlife have not yet been promulgated, a risk assessment was carried out by the Fish and Wildlife Service that identified the levels necessary for restoration of the area as suitable wildlife habitat. For example, as a result of the risk assessment for the PCB Areas, a concentration of 1 milligram PCBs per kilogram of dry soil (mg/kg) has been determined by DOI to be protective of wildlife, as well as meeting the mission of the Refuge.

The choice of animal species for a risk assessment was dependent upon the availability of information on toxicity, life history, exposure and physiology. Sufficient information was not always available for species that are conspicuous Departmental trust resources. Small mammals are used in assessments for small contaminated areas because these mammals are frequently at greatest risk. Their limited home range as well as available toxicity information, reduce uncertainties in the resultant

assessment. There are no standards for wildlife exposure and wildlife contaminant residues, so risk assessments were used and exposures compared to toxicity information on other species.

The results of the risk assessment conducted as part of the RI focus on the contaminants which pose the highest risks of exposure to humans and the environment, even though other contaminants (posing lesser risks) may have been found at the site. Overall, the risk assessment indicates that the following problems present the greatest threat to human health and/or the environment from the four study sites that comprise the PCB Areas operable unit:

- Surface soils at the Job Corps Landfill, the Area 9 Landfill and the Area 9 Building Complex to both humans and wildlife;

- Subsurface soils at all four study sites, especially to burrowing wildlife;

- Sediments at the Job Corps Landfill and Area 9 to wildlife directly and to humans through food chain accumulation; and

- Exposures of small and burrowing wildlife to contaminated air at all four study sites.

Although contaminants were found in other media (groundwater and surface water) at the study sites comprising this operable unit, the risk assessment does not indicate that these contaminants currently pose a threat to human health and/or the environment. However, potential future groundwater contamination is of great concern because the aquifer is potentially usable and may discharge to a sensitive ecosystem, for example, a wetland. Also, the potential that runoff will adversely impact surface water is of concern particularly because Crab Orchard Lake is used as a drinking water source. The areas comprising the PCB Areas operable unit are within the portion of the Refuge where human access is currently restricted. However, if the restriction were relaxed in the future, the risks to humans could be higher unless remedial action has been taken. It is infeasible to restrict all wildlife access to contaminated areas.

A summary of the risk assessment from the RI Report for each of the sites comprising the PCB Areas operable unit follows:

A. SITE 17: JOB CORPS LANDFILL AND POND

1. <u>Contaminant Identification</u>

Sampling was done on the soil, sediment, groundwater, pond water and fish from the pond. Results indicated that the soil and sediment contained PCBs at 0.08 to 50,000 milligrams per kilogram (mg/kg), lead in a range of from less than 6 to 17,414

mg/kg, and cadmium in a range of from less than 1 to 57 mg/kg. Some of the contaminated soil is hazardous by the Resource Conservation and Recovery Act (RCRA) characteristic test for leachable metals (EP Toxicity). The pond water contained PCBs at 0.032 to 0.058 micrograms per liter (ug/L), which exceeds the Ambient Water Quality Criteria (AWQC) for freshwater aquatic life and human health. The ground water contained PCBs ranging from 0.01 to 15 ug/L, with these samples, exceeding the AWQC for freshwater aquatic life and human health and two samples exceeding the proposed Maximum Contaminant Level (MCL) of 0.5 ug/L. In addition, limited groundwater samples contained chloroform at 12 ug/L, which exceeds the AWQC for human health, pentachlorophenol at 19 ug/L which exceeds the AWQC for freshwater aquatic life, lead at 55 ug/L, which exceeds the MCL, and chromium at 74 and 139 ug/L, which exceeds the MCL.

2. Exposure Assessment

The exposure assessment conducted as part of the RI concluded that several media could be impacted by the contaminants at this site, and that there were several potential exposure routes for contamination. Mean and worst case levels of PCB contamination in soil were used to conduct the risk assessment. Also, upper bound estimates of soil contamination with lead and N-nitrosodimethylamine were used to estimate risk. Cadmium was assessed qualitatively.

The proximity of the pond and vegetative cover on the landfill make the site an attractive denning habitat. Exposure was quantified for deer, mallard ducks, rabbit, mouse, mink, heron and otter. Exposure of wildlife to contaminants would occur through ingestion, inhalation, and absorption through the skin or gills. Animals on the site would be exposed to contaminants through ingestion of soil, sediment and water as well as through consumption of contaminants that bioaccumulate (PCBs and cadmium) in vegetation and prey. Grooming and inhalation of contaminated dust and vapor also expose animals (especially burrowing animals) to contaminants in sediment or soil. Dermal or peropercular absorption is a primary exposure route for aquatic organisms such as fish and macroinvertebrates, and is also an exposure route for animals that maintain skin contact with contaminated soil or sediment. Calculations for the inhalation route included factors relating to active (one hour/day) and inactive periods.

Although access to humans is restricted, the exposure assessment indicates that there is the potential for occasional recreational users to be exposed via inhalation or ingestion of the contaminants, and through potential food chain accumulation. The exposure assessment assumed limited human access of three visits per year for four hours per visit. It

was also assumed that a human might inadvertently consume 100 mg of contaminated soil or sediment per visit by ingestion. (Ingestion of soil is a standard pathway for exposure in humans and wildlife risk assessments.) Inhalation exposure would be commonly assumed for FWS personnel on worksites or for incidental visitors to the contaminated sites.

3. Toxicity Assessment

Cadmium is highly toxic with a broad range of systemic effects, particularly to the respiratory, renal and reproductive systems. It is considered a probable human carcinogen by the inhalation route of exposure. Cadmium can bioaccumulate extensively in exposed individuals. Cadmium is particularly toxic to fish, even at low concentrations. It has also been demonstrated to cause birth defects in animals.

Lead has been shown to distribute in the blood of humans, and can adversely effect the central nervous system, the gastrointestinal tract, the kidneys and blood forming systems. Growing children are particularly sensitive to its impact upon the central nervous system. U.S. EPA has not assessed the carcinogenicity of lead, however, there are studies which have shown lead to be carcinogenic. Lead causes spinal deformities and reduced reproduction in aquatic organisms. Lead is active biochemically and reduces hemoglobin, hematocrit and other blood parameters in birds and other wildlife. Lead exposure also causes reduction in avian growth rates. Behavioral changes have been found in birds because of the impact of lead on the central nervous system.

N-nitrosodimethylamine is a suspected human carcinogen, based on animal data which demonstrates liver, kidney and lung tumors in some species. The compound has been shown to be mutagenic in a variety of tests, and has also been demonstrated to produce liver damage. A variety of animal species have shown increased incidence of cancer and other adverse impacts after exposure to the compound.

PCBs have a high affinity for fat, resist metabolic destruction and tend to accumulate in the fatty tissues of exposed individuals. PCBs are a probable human carcinogen, and are associated with reproductive and central nervous system problems, liver damage, and skin disfigurement. Animals exposed to PCBs exhibit many of the same adverse effects, including cancer, reproductive impairment, birth defects, and damage to liver, stomach, skin and other organs. The combination of stability and high bioconcentration potential is significant to Refuge ecosystems because it causes PCBs to be accumulated in toxic concentrations in fish and wildlife which feed on organisms living in or feeding on soil or sediment.

4. Risk Characterization

Using a unit risk factor of 7.7 $(mg/kg/day)^{-1}$ for human exposure to PCBs, the unremediated site shows a potential increased cancer risk of 1.1×10^{-3}. Using a comparison to estimated cancer risk, the human exposure to N-nitrosodimethylamine would result in an excess cancer risk of 2×10^{-7}. This risk would be additive with the risk from PCB exposure, resulting in a current risk exceeding U.S. EPA's guidelines for "acceptable risk". This assessment is based on very limited human exposure, as discussed above, and represents current risk from the unremediated site. If future use were to allow greater access to the Site, the risk from the unremediated Site would be greater. The qualitative assessment conducted for cadmium concludes that chronic human exposure to cadmium-contaminated soil should be investigated quantitatively. The risk characterization indicates that no chronic or acute systemic health effects to humans would result from exposure to the lead contamination at the site under current access limitations.

Since the Refuge was established to protect wildlife, the risk assessment also considered risk to wildlife as a primary factor in the selection of the remedy. Small mammals are used in assessments for small contaminated areas because these mammals are frequently at greatest risk, and their small home range and available toxicity information reduces uncertainties in the resultant assessment.

The risk characterization for wildlife compared estimated exposures to PCBs for deer, mallards, rabbits, mice, mink, heron and otter to data from laboratory tests. The conclusion is that the fish-eating species may be the most affected, and that the unremediated site may present concerns for reproductive and teratogenic effects, possible overt lethality, and other systemic toxicity in vertebrate species. It is reasonable to assume that predators and omnivores could be at great risk, through consumption of organisms with bioaccumulated levels. A small animal, such as a mouse or rabbit, will consume a proportionally very high amount of PCBs which could have adverse effects on the animal. In addition, burrowing animals potentially receive levels of exposure to PCBs, lead, and N-nitrosodimethylamine which could result in a variety of adverse effects, including carcinogenic response, reproductive impairment, and other impacts.

B. SITE 28: WATER TOWER LANDFILL

1. Contaminant Identification

Most of the information characterizing the waste at this site is a result of the test pit sampling done for the RI. There

was no evidence of containers or containerized wastes in the investigation. The surface soil of the site generally appears to be free of contamination. However, subsurface soil was found to be contaminated at some locations. Results indicated that soil is contaminated with PCBs (from less than 0.01 to 8,900 mg/kg) and lead (from 13 to 4,300 mg/kg). Inorganic compounds of in concentrations of less concern than lead were also detected in some soil samples. The lead levels are thought to be high enough that the soil would be considered RCRA hazardous waste for the characteristic of EP Toxicity. Unfiltered groundwater samples exceeded the MCLs for iron (from 425 to 94,600 ug/L) and manganese (from 357 to 2780 ug/L); however, the MCLs for iron and manganese are secondary MCLs, based on odor or taste. One unfiltered groundwater sample also contained chromium (165 ug/L) and lead (76 ug/L) in exceedance of their MCLs, but the dissolved metal concentrations were below these standards (dissolved levels may be more representative of contaminant movement than total unfiltered levels).

2. Exposure Assessment

The exposure assessment conducted as part of the RI concluded that, in general, impact on environmental components is limited where the contaminants are found at depth. However, exposures could result if burrowing mammals dug dens or raceways in the fill material, or if the site experienced erosion or other disturbance.

3. Toxicity Assessment

The toxicity of PCBs and lead are discussed in paragraph A.2 above.

4. Risk Characterization

Quantitative risk assessment was not completed for this study site due to the limited routes of current exposure. Since the exposure assessment concluded that the wastes are found only at depth in isolated patches, there is currently no potential route by which human receptors may be exposed. Some uncertainties which were not addressed would be the future use of the land and the resultant fate and transport of contaminated groundwater.

The risk assessment concluded that exposure to humans and surface-dwelling wildlife was likely to be minimal because clean soil provides a barrier to contamination from subsurface soil. However, animals burrowing into the fill material would be exposed to lead and PCBs and could receive potential levels of exposure which could result in a variety of adverse effects,

including carcinogenic response, reproductive impairment and other impacts.

C. SITE 32: AREA 9 LANDFILL

1. Contaminant Identification

Analysis of soil on the surface and at depth in this landfill and in soil samples downgradient of the landfill indicate that lead (from 11 to 20,500 mg/kg) and PCBs (from less than 0.5 to 88,000 mg/kg) were found. Further analysis of the soil was conducted to assess the presence of chlorinated dibenzo-p-dioxin (DD) and dibenzofuran (DF) isomers. These compounds are typically found as co-contaminants where PCBs are manufactured. In this case, they may be elevated beyond expected levels due to uncontrolled burning of PCB products. Soil analysis showed elevated levels in some samples of tetrachloroDF (from 0.14 to 26.3 micrograms per kilogram (ug/kg)), pentachloroDF (0.34 ug/kg) and octachloroDD (from 0.6 to 20.6 ug/kg). Sediment samples taken from the drainage channel up and down stream of the landfill showed contamination with PCBs (from less than 0.5 to 11 mg/kg) and lead (from 11 to 29 mg/kg). PCBs were also found in lake sediment samples (from less than 0.5 to 4.09 mg/kg). The groundwater contained PCBs in some wells above the ambient water quality criteria for human health (from less than 0.005 to 0.044 ug/L). In addition, chromium was found in one unfiltered sample above the MCL (92 ug/L). However, the dissolved level in this sample was below the MCL (1.2 ug/L) and dissolved levels may be more representative of contaminant movement than total levels.

2. Exposure Assessment

The exposure assessment conducted as part of the RI concluded that several media could be impacted by the contaminants at this site, and that there were several potential transport routes. The viable exposure routes for humans evaluated in the risk assessment include air, surface water (including the bioaccumulation of contaminants in edible fish tissues) and direct contact. A mean level of PCB contamination in soil of 3,200 mg/kg was used to conduct the risk assessment. In addition, a representative intermediate concentration of 4,000 mg/kg for lead was used in the assessment.

Although access to humans is restricted, the exposure assessment indicates that there is the potential for occasional recreational users to be exposed via inhalation or ingestion of the contaminants, and through potential food chain accumulation. The exposure assessment assumed limited human access of three visits per year for four hours per visit. It was also assumed that a human might inadvertently consume 100 mg of contaminated soil or sediment per visit by ingestion.

(Ingestion of soil is a standard pathway for exposure in humans and wildlife risk assessments.) Inhalation exposure would be commonly assumed for FWS personnel on worksites or for incidental visitors to the contaminated sites.

The presence of contaminants in surface soils and sediments indicates that direct contact by wildlife could result in exposure through ingestion of the soil, sediment or water, and through potential consumption of contaminated vegetation and prey because potential food chain exposure is particularly likely with PCBs; through inhalation, especially by burrowing animals; and through direct exposure of aquatic organisms or ingestion of water, sediments and organisms associated with surface water as the contaminants migrate toward Crab Orchard Lake. To assess potential wildlife exposure, an assumption of one hour of active burrowing per day was weighted with a resting exposure estimate including breathing, feeding and grooming activities.

3. Toxicity Assessment

The toxicity of PCBs and lead are discussed in paragraph A.2 above.

Polychlorinated dibenzo-p-dioxins and dibenzofurans are of concern because two members of these classes, 2,3,7,8 - tetrachloro DD and 2,3,7,8 - tetrachloro DF, are highly toxic with acute and chronic exposure and produce a number of chronic disorders including immunotoxicity, teratogenicity, reproductive toxicity and suspected human carcinogenicity. Although other isomers are also toxic, removal or addition of chlorine atoms decreases toxicity, as does substitution to other positions.

4. Risk Characterization

Using estimates of exposure to lead, an occasional visitor to the contaminated area could be exposed to 8.7 ug/kg/visit. This is below a chronic, no-effect level of 0.32 mg/kg/day for human exposure to ingested lead, therefore the unremediated Area 9 Landfill site would not result in exposure to lead that would result in toxic effects under the current access limitations. This assessment is based on very limited human exposure, as discussed above, and represents current risk from the unremediated site. If future use were to allow greater access to the Site, the risk from the unremediated Site would be greater.

An estimate of exposure from inadvertent ingestion and inhalation of PCBs indicates an exposure rate for humans of 7 ug/kg/visit could occur. Compared to the estimate of exposure of 11 ug/kg/visit at the Job Corps Pond, this exposure to the

unremediated site shows a potential increased cancer risk of 7×10^{-4}. This assessment is based on very limited human exposure, as discussed above, and represents current risk from the unremediated site. If future use were to allow greater access to the Site, the risk to humans from the unremediated Site would be greater. Additionally, a variety of human exposure scenarios for PCB-contaminated fish from Crab Orchard Lake result in a range of potential increased cancer risk as high as 2×10^{-3} (see Table 1).

Significant wildlife exposure is likely. The risk characterization for wildlife compared estimated chronic PCB exposures for mallard ducks, rabbits and mice to U.S. EPA chronic no-effect levels based on rat studies. The conclusion is that the fish-eating species may be the most affected, and that the unremediated site may present risks for behavioral, immunological and other systemic toxicity in vertebrate species. It is reasonable to assume that predators and omnivores could be at great risk, through consumption of organisms with bioaccumulated levels. A small animal, such as a mouse or rabbit, will consume a proportionally very high level of PCBs which could have adverse effects on the animal. In addition, burrowing animals and other terrestrial wildlife receive potential levels of exposure to lead which could result in a variety of adverse effects, including behavioral, reproductive impairment, and other impacts. The conclusion is that the unremediated site would pose a risk to wildlife of chronic, toxic effects from lead.

D. SITE 33: AREA 9 BUILDING COMPLEX

1. Contaminant Identification

Analysis of soil within this building complex indicates that contamination primarily centered around two buildings, numbers 1-1-2 and 1-1-23, and in two drainage ditches which receive runoff from the building complex. Soil in the building complex and sediment in the drainage ditches were contaminated with PCBs (from less than 1 to 120,000 mg/kg). Further analysis of the soil was conducted to assess the presence of chlorinated dibenzodioxin (DD) and dibenzofuran (DF) isomers. As discussed in paragraph C.1 above, these compounds are found as co-contaminants of PCBs. Soil analysis showed elevated levels around building 1-1-23, with DF isomers ranging from 28 to 249 ug/kg. The highest concentrations were associated with hexachloroDF (249 ug/kg) and pentachloroDF (158 ug/kg), and the lowest concentrations associated with tetrachloroDF (28 ug/kg). Dioxins range from less than 0.11 ug/kg for tetrachloroDD to 169 ug/kg for octachloroDD. A few limited soil samples were contaminated with 1,2,4 - trichlorobenzene (23.5 mg/kg) and 2 - chloronapthalene (6820 mg/kg). The groundwater in the building complex contained PCBs above the ambient water quality

criteria for human health (from 0.006 to 0.144 ug/L). Chromium was found in two unfiltered samples above the MCL (from 50 and 113 ug/L). However, the dissolved levels in these samples were below the MCL (1 and 1.3 ug/L, respectively) and dissolved levels may be more representative of contaminant movement than total levels. In addition, trichloroethene was found in one well above the ambient water quality criteria for protection of human health (906 ug/L).

2. Exposure Assessment

The exposure assessment conducted as part of the RI concluded that several media could be impacted by the contaminants at this site, and that there were currently three functional transport routes for human exposure including groundwater, surface water and direct contact. However, because there are no current users of groundwater and because of the relatively low mobility of the contaminants, the risk assessment concluded that the groundwater exposure route is not currently functional. The assessment further concluded that the air route of exposure was non-functional because of the restrictions to employees only. Levels of PCB contamination in soil of 5,000 mg/kg and in sediments of 200 mg/kg were used to conduct the risk assessment. Access to humans is restricted at the building complex to employees, therefore the exposure assessment only considered inadvertent exposures to sediments in the drainage ditches downgradient of the building. A further assessment should be done to consider potential (including inadvertent) exposures to employees at the building, as well as future use scenarios.

The presence of contaminants in surface soils and sediments indicates that direct contact by wildlife could result in exposure through ingestion of the soil, sediment or water, and through potential consumption of contaminated vegetation and prey because potential food chain exposure is particularly likely with PCBs; and through inhalation, especially by burrowing animals. However, the exposure assessment concluded that due to the industrial nature and restricted access to the site, the diversity and abundance of wildlife would be less than at other areas of the Refuge. To assess potential wildlife exposure, an assumption of one hour of active burrowing per day was weighted with a resting exposure estimate including breathing, feeding and grooming activities.

3. Toxicity Assessment

The toxicity of PCBs is discussed in paragraph A.3 above.

The toxicity of polychlorinated dibenzodioxins and dibenzofurans is discussed in paragraph C.3 above.

4. Risk Characterization

Using estimates of exposure to PCBs in ditch sediment only, an occasional visitor to the contaminated area could be exposed to 0.29 ug/kg/visit. This is below acute or sub-acute threshold criteria, therefore the unremediated Area 9 Building Complex site would not result in exposure to PCBs that would result in systemic toxic effects. Compared to the estimate of exposure of 11 ug/kg/visit at the Job Corps Pond, this exposure to the unremediated site shows a potential increased cancer risk of 3×10^{-5}. This assessment is based on extremely limited human exposure, as discussed above, and represents current risk assessed only for the relatively low levels of PCB contamination outside the fenced area. The risk within the fenced areas would be substantially higher. If future use were to allow greater access to the Site, the risk from the unremediated Site would be greater. A further risk characterization should include a quantitative assessment of the risk from the polychlorinated DD and DF isomers.

The risk characterization for wildlife compared estimated chronic PCB exposures for rabbits and mice to U.S. EPA chronic no-effect levels based on rat studies. The conclusion is that the unremediated site may present concerns for behavioral, immunological and other systemic toxicities in vertebrate species. It is reasonable to assume that predators and omnivores could be at great risk, through consumption of organisms with bioaccumulated levels. A small animal, such as a mouse or rabbit, will consume a proportionally very high amount of PCBs which could have adverse effects on the individual.

While potential adverse impacts were identified, the RI did not measure any actual, current impacts on wildlife. Research done by the FWS has indicated the potential for adverse impacts on wildlife above the Site-specific cleanup criteria established by the FWS. There is on-going research by the FWS, Southern Illinois University and others to continue to assess the impacts of contaminants at the Refuge to wildlife. The Refuge provides suitable habitat for an endangered species, the Indiana bat. Also, the Refuge definitely houses another endangered species, the bald eagle.

Actual or threatened releases of hazardous substances from the sites comprising this operable unit, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, wildlife, or the environment.

VII. DESCRIPTION OF ALTERNATIVES

During the Feasibility Study (FS), the FWS and Sangamo Weston, Inc. identified and evaluated a list of alternatives that could be used to

address the threats and/or potential threats identified at the study sites within the operable unit. The FWS and Sangamo Weston, Inc. screened the list of alternatives based on their effectiveness (i.e. protection of human health and/or the environment, reliability), implementability (i.e. technical feasibility, compliance with identified State and Federal regulations) and relative costs (i.e. capital, operation and maintenance).

In the Proposed Plan, eight remedial technologies, which were combined into thirty-four (34) alternatives in the FS, were described. The alternatives presented in the FS ranged from containment of the waste in place to treatment to the maximum extent possible. Various combinations of the eight remedial technologies outlined below were considered for one or more of the four study sites comprising the PCB Areas operable unit. Several of the thirty-four alternatives presented in the FS incorporate two or more of these technologies in the alternative. Finally, some of these eight technologies were incorporated into "consolidated remedial alternatives" which are unique because they are the only alternatives to address all of the study sites together. Public comment was solicited on the four "consolidated remedial alternatives" which were presented in the Proposed Plan, on the thirty four alternatives discussed in the FS, and on the eight technologies which were combined to create the various alternatives.

Below is a brief description of the eight remedial technologies which were incorporated in the RI/FS into remedial alternatives; and the four "consolidated remedial alternatives," as well as the "no action alternative" presented in the Proposed Plan:

A. <u>CONTAINMENT REMEDIAL TECHNOLOGIES</u>

i. Industrial Landfill - Contaminated soils and sediments would be excavated and placed in an industrial landfill. This "industrial landfill" would be a solid waste landfill as regulated by Subtitle D of RCRA and 35 Illinois Administrative Code Part 807. The landfill would be constructed, at a minimum, with a single compacted soil liner and drainage layer. After placement of the contaminated soil and sediment, the landfill would be covered with a cap constructed of compacted soil, a drainage layer, gravel, soil fill and topsoil. Upon completion, the landfill would be vegetated. Groundwater and leachate monitoring, and routine maintenance would be elements of the long-term requirements. Variations include construction of the industrial landfill either on-site or off-site.

ii. TSCA Landfill - The Toxic Substances Control Act (TSCA) regulates certain activities involving PCB contamination. A TSCA Landfill is one that meets the design criteria required by this law. PCB-contaminated soils and sediments would be excavated and placed in a TSCA landfill. The landfill would be constructed of a compacted soil liner, a drainage layer, a synthetic membrane liner, and a second drainage layer. After placement of the

contaminated material, the TSCA landfill would be covered with a cap constructed of compacted soil, a synthetic membrane, a drainage layer, gravel, soil fill, and topsoil. Upon completion, the TSCA landfill would be vegetated. Groundwater and leachate monitoring, and routine maintenance would be elements of the long-term requirements. Variations include construction of the TSCA landfill either on-site or off-site.

iii. TSCA Cap - PCB-contaminated soils and sediments would be left in place and covered with a low permeability TSCA cap. The cap would be constructed of compacted soil, a synthetic membrane, a drainage layer, gravel, soil fill and topsoil. Prior to construction of the cap, sediments would be dewatered and allowed to dry, and the contaminated area would be sloped and graded to provide drainage and a good construction surface. Groundwater monitoring and routine maintenance would be part of the long-term requirements.

iv. Slurry Wall - Certain remedial alternatives which involve the construction of a TSCA cap also require the construction of a slurry wall for more complete containment. A slurry wall is a vertical barrier around the contaminated area. The slurry wall is typically constructed of a cement or bentonite mixture with a very low permeability. The slurry wall acts as a barrier to the movement of contaminated groundwater. This containment system is coupled with groundwater extraction wells to remove the contaminated groundwater for treatment. This technology is considered to provide additional safeguards against potential future groundwater contamination if waste is left in place. The risk assessment did not indicate that contaminated groundwater currently poses a risk. A slurry wall is considered in alternative 3C for the Water Tower Landfill (Section 5 of the FS) and alternatives 2E and 3B for Area 9 (Section 7 of the FS). However, since slurry wall technology is not feasible for all of the PCB-contaminated sites, it was not incorporated into any of the consolidated alternatives presented in the Proposed Plan.

v. Low Permeability Cap - Areas where contamination is below the excavation criteria, or from where contaminated soil and sediment have been excavated would be closed and covered with a low permeability cap. The cap would be constructed of compacted soil, a drainage layer, soil fill and topsoil. Routine maintenance of the cover, as well as groundwater monitoring would be part of the long-term operation and maintenance requirements.

B. <u>TREATMENT REMEDIAL TECHNOLOGIES</u>

vi. Incineration/Thermal Destruction - Contaminated soils and sediments would be excavated and treated by incineration/ thermal destruction in a TSCA compliant incinerator. High temperatures would permanently destroy the PCBs and other organic chemicals. Any metal contamination would not be destroyed by incineration/

thermal destruction, but would be captured in the ash residue. If the ash is determined to be uncontaminated with the constituents of concern, it would be replaced in the excavated areas. If the ash is contaminated it would be contained in an industrial landfill (remedial technology i). The incinerator/ thermal treatment unit would be either on-site or off-site. During operation, air pollution control measures would be used to prevent contamination from being released to the air.

vii. Stabilization/Fixation - Contaminated soils and sediments and contaminated incinerator ash would be treated with bonding agents which fix contaminants within the stabilized waste. This treatment makes the contaminants more resistant to leaching. Cement-based and lime-based stabilization processes are commonly used for fixation of metals and have also been used for treatment of PCB wastes. The stabilized material would be contained in an industrial landfill (remedial technology i) or a TSCA landfill (remedial technology ii).

viii. In situ Vitrification (ISV) - Vitrification is a fixation process which would seal the contaminated soils and sediments in a glass or synthetic silicate mineral material. An electric current generates high temperatures which pyrolyzes organic chemicals, such as PCBs and encapsulates inorganic compounds, such as metals. The contaminated materials would be treated in place and covered with clean soil. This technology would be considered innovative treatment for the contaminated material. In situ vitrification is considered in alternative 1C for the Water Tower Landfill (Section 5 of the FS) and alternatives 1C and 2C for Area 9 (Section 7 of the FS). However, since this technology is not feasible for all of the PCB-contaminated material without excavation and consolidation of soil and sediment from geographically distinct study sites, it was not incorporated into any of the consolidated alternatives below.

C. CONSOLIDATED REMEDIAL ALTERNATIVES

The FS presents several consolidated remedial alternatives which incorporate the above remedial technologies to achieve a cleanup for all of the study sites comprising the PCB Areas operable unit. The advantages to a consolidated remedy are that the cleanup can progress more quickly and efficiently and that some costs can be saved.

In reviewing the PCB Areas operable unit Proposed Plan, the public was asked to consider the consolidated remedial alternatives, and site-specific remedial alternatives discussed in the FS, as well as other possible combinations of the eight remedial technologies listed above. These consolidated alternatives are discussed in Section 8 of the FS. The consolidated alternatives also include some actions which affect the Metals Areas operable unit, which were addressed in the March

1990 ROD for those areas. In outlining the consolidated alternatives below, only the actions which effect the PCB Areas operable unit are discussed.

Consolidated Alternative 1

Estimated Total Remedial Cost: $25,195,035 present worth
Estimated Time to Implement: 2.5 to 5 years

Consolidated Alternative 1 includes the following components:

Excavation of Soil and Sediment - Contaminated soil and sediment would be excavated using conventional equipment. The excavated material would be moved to a storage area on-site, where it would be stored until it was treated or disposed.

Incineration - Soils and sediments which are contaminated with PCBs, but with no excessive metal contamination would be incinerated on-site, as described in remedial technology vi. Non-contaminated incinerator ash would be backfilled in the excavated areas.

Stabilization/Fixation - Soils, sediments and incinerator residues which are contaminated with both PCBs and metals would be treated by stabilization/fixation, as described in remedial technology vii.

TSCA Landfill - Materials which are treated by stabilization/fixation would be disposed of in an on-site TSCA landfill, as described in remedial technology ii. This alternative proposes using an existing five-million gallon concrete tank now on the Site, which would be retrofitted to meet the required design standards.

TSCA Cap - In Area 9, some contaminated soil would be left in place. This area would be covered with a TSCA cap, as described in remedial technology iii.

Low Permeability Caps - Soils and sediments which do not exceed the cleanup standards at each of the four study sites would be covered in place with a low permeability cap, as described in remedial technology v.

Consolidated Alternative 2

Estimated Total Remedial Cost: $6,156,161 present worth
Estimated Time to Implement: 2 years

Consolidated Alternative 2 includes the following components:

Excavation of Soil and Sediment - Same as described in Consolidated Alternative 1.

Stabilization/Fixation - Soils and sediments which are contaminated with high levels of PCBs (greater than 1000 parts per million, or 0.1 percent) and heavy metals would be treated by stabilization/fixation, as described in remedial technology vii.

TSCA Landfills - Two TSCA Landfills, as described in remedial technology ii, would be constructed on-site. The first would involve retrofitting an existing concrete tank to meet the design standards. This landfill would be used to contain the majority of the wastes treated by stabilization/fixation. The second would be newly constructed near Area 9 and would contain all treated waste that did not fit in the first landfill and untreated contaminated soil and sediment.

TSCA Cap - Same as described in Consolidated Alternative 1.

Low Permeability Caps - Same as described in Consolidated Alternative 1.

Consolidated Alternative 3

Estimated Total Remedial Cost: $8,910,700 present worth
Estimated Time to Implement: 2.5 to 3 years

Consolidated Alternative 3 includes the following components:

Excavation of Soil and Sediment - Same as described in Consolidated Alternative 1.

Incineration - Soils and sediments which are contaminated with "non-sorbed PCBs" would be incinerated on-site, as described in remedial technology vi. Non-sorbed PCBs are those which are not chemically bound to the soil or sediment, and which may be more available to move. Non-sorbed PCBs are estimated to be found in soils or sediments with contamination higher than 5000 parts per million (or 0.5 percent). Before incinerating the soils and sediments, tests would be completed to determine the precise levels at which PCBs are sorbed, and thus, which soils and sediments would require incineration. Non-contaminated incinerator residue might be backfilled in the excavated areas.

Stabilization/Fixation - Soils and sediments which are contaminated with high levels of PCBs (greater than 1000 parts per million, or 0.1 percent), which have not been incinerated, (and which are co-contaminated with metals) would be treated by stabilization/fixation, as described in remedial technology vii.

TSCA Landfills - Same as described in Consolidated Alternative 2.

TSCA Caps - Same as described in Consolidated Alternative 1.

Low Permeability Caps - Same as described in Consolidated Alternative 1.

Consolidated Alternative 4

Estimated Total Remedial Cost: $23,858,330 present worth
Estimated Time to Implement: 2 years

Consolidated Alternative 4 includes the following components:

Excavation of Soil and Sediment - Same as described in Consolidated Alternative 1.

Stabilization/Fixation - Soils and sediments which are contaminated with "free PCBs" (and co-contaminated with metals) would be treated on-site by stabilization/fixation, as describe in remedial technology vii. As described in consolidated alternative 3, free (or non-sorbed) PCBs are those which are not chemically bound to the soil or sediment.

Off-Site TSCA Landfill - Both treated and untreated contaminated soils and sediments would be taken off the Refuge and disposed of in a TSCA landfill, as described in remedial technology ii.

TSCA Cap - Same as described in Consolidated Alternative 1.

Low Permeability Caps - Same as described in Consolidated Alternative 1.

D. NO ACTION REMEDIAL ALTERNATIVES

Estimated Total Remedial Cost: $657,724
Estimated Time to Implement: less than 1 year

The National Contingency Plan (NCP) which contains the codified regulations of the Superfund program, requires that the "no action" alternative be considered at every site. Under this alternative, action at any of the contaminated areas is generally limited to monitoring of site conditions. All wastes, routes of contaminant migration, and long-term human and environmental exposure pathways will remain unchanged. This alternative would not reduce the threats and potential threats to human health and/or the environment identified at the site.

VIII. THE SELECTED REMEDY

The Selected Remedy, as outlined below, will permanently remediate the four study sites comprising the PCB Areas operable unit. The Selected Remedy is divided into three major components: 1) treatment, 2) containment, and 3) general operation and maintenance. However, the Selected Remedy allows for the treatment and containment components to be modified based on a stringent demonstration of the performance of an

alternative treatment technology, in situ vitrification or ISV. Unless otherwise specified, the term "Selected Remedy" when used in this document refers to the use of in situ vitrification only if a successful demonstration of the technology is made.

The Selected Remedy will address the principal threats to human health and the environment that currently exist at the four study sites comprising the operable unit, and will prevent future threats and environmental degradation. The treatment processes selected for the contaminated soil and sediment constitute treatment to the maximum extent practicable. Containment of any metal-bearing waste or treatment residue will allow safe long-term control of this material. The labor and equipment necessary to implement the Selected Remedy are, or will be demonstrated to be, currently available. Specific details on various aspects of the Selected Remedy follow.

A. MAJOR COMPONENTS OF SELECTED REMEDY

The Selected Remedy for PCB Areas operable unit at the Crab Orchard National Wildlife Refuge is an alternative which was not specifically outlined in the FS, but which includes the Preferred Alternative in the Proposed Plan and is a combination of technologies identified in the FS. The Selected Remedy allows for the modification of the selected treatment and containment components by substituting an alternative, innovative treatment technology, in situ vitrification, for incineration, based on the demonstration outlined in Section 3 below. If this demonstration is not satisfactorily completed as described, the remedy as outlined in Section 1 below will be implemented. The Selected Remedy, if incineration is used as the treatment technology, will take an estimated 3 to 5 years to implement. If ISV technology is implemented in the Selected Remedy, implementation will require an estimated two years.

1. Selected Remedy (with incineration)

Excavation of Soil and Sediment - Soil and sediment which is contaminated above the remediation goals presented in Section B below, will be excavated using conventional equipment. The excavated material will be moved to a storage area on-site, where it will be stored until it is treated or disposed. Design of the project will require methods to prevent contaminated sediment from moving into surface water and methods to minimize dust. Design will also include considerations to ensure compliance with applicable or relevant and appropriate requirements (ARARs), listed below in Section X.B. The excavated material will be sampled to determine whether it is hazardous as defined by RCRA, and hazardous and non-hazardous material will be stored separately.

Incineration/ Thermal Destruction - All excavated soil and sediment which is contaminated with PCBs in excess of the PCB remediation goals will be treated by incineration/ thermal destruction. The incinerator will be a temporary, mobile unit brought on-Site for the duration of the project. After completion of the incineration of

the PCB-contaminated soil and sediment, the incinerator will be decontaminated and removed from the Site. Prior to full operation, a trial burn of the incinerator will be used to establish the operating conditions, and on-going monitoring of the unit will be performed to establish that the remediation goals and incinerator performance standards are being met. Non-contaminated incinerator residue will be backfilled in the excavated areas.

Stabilization/ Fixation - Soils, sediments and any incinerator residue which is considered RCRA hazardous because of the characteristic to leach metals (EP Toxicity or Toxicity Characteristic Leaching Procedure (TCLP), whichever is the approved regulatory test at the time of the remedial action) will be treated by stabilization/ fixation. Stabilization/ fixation is a treatment process where contaminated soils and sediments will be treated with bonding agents which fix contaminants within the stabilized waste. This treatment makes the contaminants more resistant to leaching. Cement-based and lime-based stabilization processes are commonly used for fixation of metals. During the remedial design process, appropriate mixtures of treatment materials will be evaluated to assess their ability to immobilize the contaminants at the Site and to effectively render the material non-hazardous and the most effective mixture(s) will be chosen. Also, a treatment quality assurance plan will be developed to document the performance of the full scale treatment process.

Industrial Landfill - Excavated treated waste and untreated non-hazardous materials which exceed the remediation goals will be disposed of in an on-Site industrial landfill. This "industrial landfill" will be a solid waste landfill as regulated by Subtitle D of RCRA and 35 IAC Part 807. The landfill will be constructed, at a minimum, with a single compacted soil liner and drainage layer. After placement of the contaminated soil and sediment, the landfill will be covered with a cap constructed, at a minimum, of compacted soil, a drainage layer, a barrier to prevent burrowing animals, soil fill and topsoil. The final design will be determined by site-specific characteristics, the object being to provide adequate containment of the waste material. The final location of the on-Site landfill will be determined by investigations (including hydrogeologic) conducted during the remedial design phase to establish acceptable siting characteristics. Upon completion, the landfill will be covered and vegetated. Groundwater and leachate monitoring, and routine maintenance will be part of the long term requirements.

Backfill Excavation - Clean soil will be placed in the areas where contaminated material had been removed.

Low Permeability Caps - Areas where contamination is below the excavation criteria, or from where contaminated soil and sediment have been excavated would be closed and covered with low permeability caps. The caps would be constructed of compacted soil,

a drainage layer, soil fill and topsoil. Routine maintenance of the cover would be part of the long-term requirements.

Monitoring and Maintenance - The on-Site landfill and excavated areas will require monitoring of groundwater and surface water. Long-term maintenance will be required for the landfill and the low permeability caps.

Institutional Controls - The Refuge is currently under the management of the DOI, and access restrictions are in place. The Interagency Agreement which is required by Section 120 of CERCLA and which is expected to be completed by September 30, 1990, will incorporate land use and transfer restrictions to be imposed at the Site.

The components of this Selected Remedy are conceptual, and are based on specific remediation goals, performance standards and ARARs. As a result of the remedial design and construction processes, some minor changes may be made to the design features outlined above.

2. Selected Remedy (with Alternative Treatment Technology, ISV)

Excavation and/or Consolidation of Soil and Sediment - Contaminated soil and sediment will be consolidated in one of the existing areas of contamination (most likely Area 9). Contaminated soil and sediment from geographically distinct study sites will be excavated using conventional equipment and consolidated into the selected area. Design of the project will require methods to prevent contaminated sediment from moving into surface water and methods to minimize dust. Design will also ensure compliance with ARARs.

In situ Vitrification - Vitrification would be used to treat all contaminated soil and sediment which had been consolidated into a single area of contamination. No separation of soil and sediment contaminated with heavy metals will occur. The process would use electrodes to generate an electric current through blocks of the contaminated material to create a glass or synthetic silicate mineral material. The electric current would generate high temperatures which will pyrolyze the PCBs and other organic chemicals. The inorganic compounds, such as lead will be encapsulated in the glassy matrix. The area of contamination which is selected to be the site of consolidation of the waste will be determined by site-specific characteristics, the purpose being to provide adequate containment of the waste material and to minimize impacts on any sensitive ecosystem. The final location of the vitrified site will be determined by investigations conducted during the remedial design phase to establish acceptable siting characteristics.

Backfill Excavation - Clean soil will be placed in the areas where contaminated material had been removed.

Low Permeability Caps - Both the vitrified area and other areas where contamination is below the excavation threshold criteria, or from where contaminated soil and sediment have been excavated, would be closed and covered with low permeability caps. The caps would be constructed of compacted soil, a drainage layer, soil fill and topsoil. Routine maintenance of the cover would be part of the long-term requirements.

Monitoring and Maintenance - The vitrified area and excavated areas will require monitoring of groundwater and surface water. Long-term maintenance will be required for the low permeability caps.

Institutional Controls - The Refuge is currently under the management of the DOI, and access restrictions are in place. The Interagency Agreement which is required by Section 120 of CERCLA and which is expected to be completed by September 30, 1990, will incorporate land use and transfer restrictions to be imposed at the site.

The components of the Selected Remedy using this Alternative Treatment Technology, are conceptual, and are based on specific remediation goals, performance standards and ARARs. As a result of the remedial design and construction processes, some minor changes may be made to the design features outlined above. The Alternative Treatment Technology will only be implemented as part of the Selected Remedy if certain demonstrations and conditions, as outlined in Section 3 below, are met.

3. Demonstration to Allow Alternative Treatment Technology to be Implemented as Part of the Selected Remedy

In order for the Alternative Treatment Technology outlined in Section 2 to be implemented rather than the Selected Remedy in Section 1, certain conditions and demonstrations must be met, and approved by U.S. EPA. The components of the demonstration are outlined below.

a. Within the negotiation period (not to exceed 120 days) pursuant to Section 122(e) of CERCLA and following the issuance of a special notice letter relating to the performance of remedial design and remedial action for the PCB Areas Operable Unit at the Refuge, the potentially responsible party (PRP) in receipt of such special notice letter must inform the U.S. EPA in writing as to whether it intends to perform the treatability test for the Alternative Treatment Technology (ISV).

b. The party responsible for implementing the Selected Remedy, (DOI, or other parties in accordance with the Interagency Agreement due to be signed on or before September 30, 1990 or with the Consent Decree covering the remedial design and remedial action for the PCB Areas Operable Unit, if any) if they so wish to perform the demonstration of the Alternative Treatment Technology described above, must submit to U.S. EPA a workplan for the performance of treatability testing for the vitrification process within 180 days

of the date on which U.S. EPA issues special notice letters to any PRPs relating to the performance of remedial design and remedial action on the PCB Areas Operable Unit at the Refuge.

c. Upon approval by U.S. EPA of the treatability testing workplan, the responsible party(ies) must complete the work required within the schedule specified in the workplan.

d. If a treatability testing workplan is not submitted within the time period specified in b., above, or if U.S. EPA does not approve the treatability testing work plan, the Selected Remedy as outlined in Section VIII.A.1., above, must be implemented.

e. If a treatability testing workplan is implemented, the party responsible for implementing the Selected Remedy must submit to U.S. EPA, on or before the date that treatability testing results are due, a demonstration that there is a commercial vendor (or vendors), of the vitrification process that is able and available to implement the work on the scale and within the schedule required. If no such vendors are available, then the Selected Remedy as outlined in Section 1, above, must be implemented.

f. If a treatability testing workplan is implemented, the results of the performance evaluation for the vitrification process will be assessed by U.S. EPA. All of the following performance standards must be demonstrated (and the conditions above must be met), in order for U.S. EPA to find that the Alternative Treatment Technology (ISV) may be implemented rather than the incineration technology as outlined in the Selected Remedy:

(1) A comprehensive evaluation of the destruction of PCBs and co-contaminant dioxins and furans by the vitrification process must be made. Vitrification must be able to match or exceed the destruction and removal efficiency of 99.9999 % for the PCBs and organic co-contaminants;

(2) Vitrification must be able to meet or exceed the 1 milligram per kilogram dry soil remediation goal for PCBs as required in Section B below;

(3) A comprehensive evaluation of vitrification's ability to immobilize metals which are RCRA hazardous waste constituents must be made. Vitrification must be shown to render non-hazardous all material which is hazardous because of the characteristic to leach metals as measure by the TCLP test;

(4) Leachability testing results for the vitrified waste must be combined with hydrogeologic modelling to demonstrate that none of the groundwater cleanup standards required in Section B below, will be exceeded at the point of compliance (which would be the vertical plane through the downgradient boundary of the area of contamination to be vitrified);

(5) Treatability testing results, combined with appropriate modeling, must demonstrate that the surface water remediation goals required in Section B below, will be met;

(6) A comprehensive evaluation of the air emissions from the vitrification process must be made. Vitrification must be shown

to meet or exceed the air emission standards required in Section X.B below; and

(7) The treatability testing results must demonstrate that vitrification will meet the requirements of 40 CFR 761.60(e) pertaining to performance of treatment alternatives to incineration under TSCA.

g. If U.S. EPA finds that any of the performance standards set forth in (e), above, cannot be demonstrated, or that any other condition listed above in Section VIII.A.3 has not been met, then the Selected Remedy, as outlined in Section 1, above, must be implemented. If U.S. EPA finds that all of the performance standards set forth in (e), above, can be demonstrated and that all the other conditions listed above have been met, U.S. EPA will send a notice in writing to that effect to the party responsible for implementing the Selected Remedy. Within 30 days of receipt of such notice, the party responsible for implementing the Selected Remedy must inform U.S. EPA in writing as to whether it will implement the Alternative Treatment Technology (ISV) or the incineration technology as outlined in the Selected Remedy.

B. REMEDIATION GOALS

Remediation goals have been established for the study sites comprising the PCB Areas operable unit. The goals are based on the risk assessment performed in the RI Report, which evaluates potential risk to human health and the environment. The goals were then further refined to reflect DOI's specific concerns and statutory mandates for the protection of fish and wildlife at the Refuge, and U.S. EPA's regional and national policies in establishing remediation goals. Further refinement of the remediation goals, particularly with respect to sufficient clean soil cover to prevent translocation of contaminants by burrowing animals, may be necessary as a result of additional risk assessment evaluations. The remediation goals for the study sites in the PCB Areas operable unit are discussed briefly below. Since, under the Selected Alternative, some compounds will remain at the Refuge in an on-site landfill, the effectiveness of the remedial action will have to be re-evaluated at least every five years. Similarly, under the Alternative Treatment Technology, some contaminants will remain immobilized in the treated area of contamination, so a five-year review, pursuant to Section 121(c) of CERCLA will be necessary.

1. SOIL AND SEDIMENT REMEDIATION GOALS

Contaminated soil and sediment at all of the study sites comprising the operable unit will be remediated to the following specific levels: lead to 450 milligrams (mg) per kilogram (kg) dry soil (1 mg per kg is equivalent to 1 part per million); cadmium to 10 mg per kg dry soil; PCBs in the top foot (12 inches) of soil to 1 mg per kg dry soil; PCBs in soil below one foot depth to 25 mg per kg dry soil; and PCBs in sediments to 0.5 mg per kg dry sediments. It is believed that a remedial action which meets these criteria will address all of the other contaminants at the sites. However, the risk from all of the chemical contaminants present above naturally occurring background levels established for the Site in the soil and sediment shall not exceed an excess cancer risk of one in one million (10^{-6}) and shall not exceed concentrations determined to produce any non-cancer chronic health effects.

In addition to being treated to levels protective of wildlife and of human health by direct contact, the PCB- and lead-contaminated soils and sediments shall be treated to a level that is protective of the groundwater. The soil remediation goals shall be established at levels that will not allow leaching to the groundwater and create groundwater contamination in exceedance of the groundwater remediation goals established in Paragraph 2 below. The method for calculating the soil remediation goals shall be approved by U.S. EPA. Methods for the development of soil remediation goals can be found in "Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples" (EPA, October, 1989). The method must be compatible with the site soil conditions and contaminants.

2. GROUNDWATER REMEDIATION GOALS

The groundwater at each of the study sites will be monitored during and after construction of the remedial action. The monitoring results will be evaluated to assure that after completion of the remediation of the contaminated soils and sediments, the risk from all of the contaminants in the groundwater (measured at the source of contamination) above naturally occurring background levels shall not exceed any excess human health risk or any standard. If, at any time, groundwater at any of the remediated study sites exceeds a 10^{-6} cumulative life-time cancer risk, or MCLs for carcinogens, whichever is more stringent; and MCLs, maximum contaminant level goals (MCLGs), or a hazard index of 1.0, whichever is more stringent, for non-carcinogens, additional remedial work as determined by U.S. EPA, shall be performed. The risk assessment shall follow procedures established in the "Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual" (RAGS) (EPA/540/1-89/002) or any amendments thereof.

3. SURFACE WATER REMEDIATION GOALS

The surface water of the Job Corps Pond will be monitored during and after construction of the remedial action, if appropriate. Since this pond was created by damming a creek, it is likely that there will be no water in the pond during active remediation, and no decision has been made whether this pond will continue to exist after remediation. Any surface water at this site will be monitored and the results will be evaluated to assure that after completion of the remedial action of the contaminated soils and sediments, the cumulative risk from all of the contaminants in surface water above naturally occurring background levels established for the site must not exceed an excess cancer risk of one in one million (10^{-6}) and must not exceed any non-cancer chronic health effects. In addition, after the remedial action is complete, the water in the Job Corps pond must show no degradation and must meet all chemical-specific ARARs established for this site (see Section X.B. below).

The surface water at Area 9 will also be monitored during and after construction of the remedial action. The results will be evaluated to assure that after completion of the remedial action for the contaminated soils and sediments, the cumulative risk from all of the contaminants in surface water above naturally occurring background levels established for the site shall not exceed an excess cancer risk of one in one million (10^{-6}) and shall not exceed any non-cancer chronic health effects. In addition, after construction of the remedial action, the water in the Area 9 Embayment of Crab Orchard Lake must show no degradation and must meet all chemical-specific applicable or relevant and appropriate regulations (ARARs) established for this site.

C. COST

The following are cost estimates for the Selected Alternative and the Selected Alternative with the modification of the Alternative Treatment Technology. The major cost differences are found in direct capital costs because of the differences in the treatment and containment components as a result of implementing the Alternative Treatment Technology. For example, direct costs of implementing incineration include excavation and handling of contaminated soils and sediments, as well as stabilization/fixation of materials contaminated with heavy metals. In situ vitrification would likely require excavation and handling of a smaller volume of contaminated material and no further stabilization/fixation after treatment.

1. Selected Alternative

a. Direct Capital Costs

The direct capital cost estimates include site preparation, excavation, treatment, placement, landfill construction, cover construction, backfilling of excavated areas, verification sampling, construction health and safety, and installation of fencing and monitoring wells. The breakdown for each study site follows:

Site 17: 1390 cubic yards	$1,073,877
Site 28: 1000 cubic yards	$752,375
Sites 32 and 33: 36,000 cubic yards	$14,908,820

b. Indirect Capital Costs

The indirect capital cost estimates include a contingency allowance of 25 percent, engineering fees of 15 percent, and legal fees of 5 percent of the direct capital costs. The breakdown for each study site follows:

Site 17:	$483,245
Site 28:	$338,569
Sites 32 and 33:	$6,708,968

c. Operation and Maintenance Costs

Operation and maintenance cost estimates include site maintenance and inspection, sampling and analysis, and a reserve fund and insurance. The breakdown for annual costs for operation and maintenance for each study site follows:

Site 17:	$34,978
Site 28:	$28,047
Sites 32 and 33:	$316,676

d. Total Present Value Cost

The total present value cost estimate includes all of the costs listed above for each of the sites, and estimates an operation and maintenance period of thirty years with a five percent interest rate. The total present worth cost estimate for the selected alternative is approximately $25,000,000.

2. Alternative Treatment Technology

The costs for the Alternative Treatment Technology are taken from the costs for Alternative 1C from Chapter 7 of the FS. These costs represent the costs for vitrification of the Area 9 contamination. Vitrification costs were not estimated for each of the study sites. Since Area 9 is expected to contribute over

95% of the mass of contaminated soil and sediments, the costs listed here are expected to be reasonable estimates. However, the cost of the Alternative Treatment Technology may be higher because there will be costs related to excavation and handling of contaminated materials from other study sites. Also site-specific soil characteristics can affect the cost estimates.

a. Direct Capital Costs

The direct capital cost estimates include site preparation, treatment by vitrification, cover construction, verification sampling, construction health and safety, and installation of fencing and monitoring wells.

The cost estimate is $9,240,000.

b. Indirect Capital Costs

The indirect capital cost estimates include a contingency allowance of 25 percent, engineering fees of 15 percent, and legal fees of 5 percent of the direct capital costs.

The cost estimate is $4,338,045.

c. Operation and Maintenance Costs

Operation and maintenance cost estimates include site maintenance and inspection, sampling and analysis, and a reserve fund and insurance.

The estimate for annual costs is $201,800.

d. Total Present Value Cost

The total present value cost estimate includes all of the costs listed above for each of the sites, and estimates an operation and maintenance period of thirty years with a five percent interest rate. The total present worth cost estimate for the selected remedy is $17,080,215.

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The Selected Remedy for the PCB Areas operable unit at the Crab Orchard National Wildlife Refuge includes treatment technology (incineration) and an alternative treatment technology (in situ vitrification) which could be implemented based on a strict performance demonstration. The Selected Remedy involves excavation and/or consolidation of PCB and metal-contaminated soil and sediment, treatment of organic contamination by incineration or vitrification, treatment of hazardous materials by stabilization/ fixation or vitrification to render it non-hazardous, and residue management in either an on-site industrial landfill or in the vitrified area of containment. Based on current information and assuming

the Selected Remedy using in situ vitrification has been demonstrated as set forth above in Section VIII.A.3, the Selected Remedy provides the best balance among the nine criteria that U.S. EPA uses to evaluate alternatives. This section provides a summary of the comparative analysis of the alternatives for the PCB Areas operable unit.

Overall Protection. Each alternative, with the exception of the no-action alternative, would provide adequate protection of human health and the environment for those sites specifically addressed. Protection would result by eliminating, reducing, or controlling risk through treatment, engineering controls, or institutional controls. However, those alternatives which address only one or two of the four study sites comprising the PCB Areas operable unit eliminate, reduce or control risk only for those study sites addressed, and not the whole operable unit. In order to meet the threshold criterion of protectiveness, the Alternatives which address only one or two of the study sites would have to be combined to provide overall protection for the operable unit. The Selected Remedy addresses the principal threats to public health and the environment for all of the study sites by treatment to the maximum extent practicable of contaminated soil and sediment and containment of the residues.

Compliance with ARARs. All alternatives would meet all applicable or relevant and appropriate requirements of Federal and State environmental laws. Potential ARARs for each alternative are extensively discussed in the FS report. The ARARs for the Selected Remedy are presented in Section X.B, below.

Long-term Effectiveness and Permanence. The Selected Remedy would provide the greatest long-term effectiveness and permanence. Both treatment technologies in the Selected Remedy involve excavation and/or removal or consolidation of approximately 36,000 cubic yards of PCB-contaminated soil and sediment, of which approximately 3,620 cubic yards are estimated to be co-contaminated with metals. Treatment will provide that all of the organic compounds will be permanently destroyed, for the maximum long-term effectiveness. Of the 3,620 cubic yards of metal-contaminated material, approximately 1,250 cubic yards is thought to be RCRA-hazardous. The hazardous inorganic metals will be treated by stabilization/ fixation or by vitrification to render the material non-hazardous, with secure containment of the residues and the non-hazardous metal-bearing material to provide the maximum long-term effectiveness and permanence for the metal contamination. Contaminated soil and sediment constitutes the principal threat from this operable unit. The Selected Remedy also addresses the threat from surface water and groundwater by removing the material that could contaminate the water.

The alternatives developed in the FS and the Consolidated Alternatives differ in whether treatment will be utilized, the

types of treatment utilized, the volumes of soil and sediment to be treated, and ultimate disposal location. Each of the Consolidated Alternatives proposes to leave levels of PCBs above the remediation goals in the deep soils of Area 9 Building Complex, and to contain them in place. This containment is not as permanent as treatment, and the effectiveness will depend on the long-term operation and maintenance and institutional controls. Each of the four Consolidated Alternatives includes treatment by stabilization/ fixation for some of the PCB-contaminated waste. The long-term effectiveness and permanence of this treatment has not been proven for PCBs. Consolidated Alternatives 1 and 3 utilize incineration to permanently destroy PCBs, however, neither alternative proposes to use incineration on all of the material contaminated with PCBs.

For all of the alternatives, the long-term risks associated with exposure to and migration of the remaining wastes and treatment residues will be reduced (by varying degrees) by ensuring operation and maintenance of the landfills, maintenance of the caps/covers, groundwater monitoring and monitoring of drainageways and Crab Orchard Lake.

Reduction of Toxicity, Mobility, or Volume. The Selected Remedy will reduce toxicity, mobility, and volume to the maximum extent for PCBs and other organic chemicals. By permanently destroying these compounds, the volume of the hazardous materials is reduced and toxicity and mobility are eliminated. The mobility of the metals is reduced by stabilization/ fixation and containment, or by vitrification. Although stabilization/ fixation increases the volume of the treated material, it does not increase the mass of the hazardous components. Vitrification would reduce the volume of the contaminated soil, but would not effect the mass of the hazardous metal components.

All of the Consolidated Alternatives include varying degrees of treatment by stabilization/ fixation. This treatment would reduce the mobility of the treated contaminants, which would include both PCBs and metals. Stabilization/ fixation would not reduce toxicity or volume of the contaminants. Because they incinerate portions of the contaminated material, Consolidated Alternatives 1 and 3 would reduce toxicity, mobility, and volume of some PCBs by permanent destruction of lesser amounts of the contamination. None of the other alternatives would reduce toxicity, mobility or volume to the degree of the Selected Remedy.

Short-term Effectiveness. All of the alternatives under consideration could present a threat to workers and the environment during the construction/ implementation phase of the remedial action because of the potential for dust generation or the movement of contaminated sediments in surface water. The

utilization of various protective measures will minimize these threats.

Consolidated Alternatives 2 and 4 and the Selected Remedy using ISV would take the least amount of time to implement (approximately 2 years), Consolidated Alternative 3 would take slightly longer (approximately 2 to 3 years), and Consolidated Alternative 1 and the Selected Remedy using incineration would take the most time to implement (approximately 3 to 5 years). The difference in time is primarily based on the availability of incineration/ thermal destruction equipment. The availability of in situ vitrification equipment is also questionable. Protective measures would be used for the entire time the action is occurring.

Implementability. All Consolidated Alternatives and the Selected Remedy (using incineration) use standard, reliable technologies which are feasible for implementation. The availability of a mobile incinerator is a potential difficulty which could affect the implementability of the Selected Remedy and Consolidated Alternatives 1 and 3. However, this equipment is currently available. The availability of a commercial vitrification process that could meet the remediation goals and performance standards for the Site is a concern. However, this issue is one which must be addressed before the Alternative Treatment Technology (ISV) could be implemented.

Cost. For the Selected Remedy (using incineration and using ISV), and each Consolidated Alternative, the total remedial costs (capital plus operation and maintenance) in present net worth are:

-	Selected Remedy (incineration)	$25,000,000
-	Selected Remedy (ISV)	17,080,215#
-	Consolidated Alternative 1	25,195,035*
-	Consolidated Alternative 2	6,156,161*
-	Consolidated Alternative 3	8,910,700*
-	Consolidated Alternative 4	23,858,330*

As previously explained, the costs for the Alternative Treatment Technology (ISV) are taken from the costs for Alternative 1C from Chapter 7 of the FS. These costs represent the costs for vitrification of the Area 9 contamination. Since Area 9 is expected to contribute over 95% of the mass of contaminated soil and sediments, the cost listed here is a reasonable estimate, but may be greater.

* Each of the consolidated alternatives includes some costs for remediation of the Metals Areas operable unit. The costs listed above would be approximately 5 to 15 percent less for only the PCB Areas operable unit.

Support Agency Acceptance. The DOI, the current owner of the site, concurred on the proposed plan for the PCB Areas Operable Unit. At this time, the Department has not concurred on the final selected remedy.

The State of Illinois concurs with the treatment component for contaminated soils and sediments in the selected remedy (see Appendix C).

Community Acceptance. A thirty-day public comment period was originally scheduled to run from August 18, 1989, to September 16, 1989. Based on concerns expressed at the public hearing on August 30, 1989, and in letters to the U.S. EPA, the comment period was extended three times until December 1, 1989. This allowed for a total public comment period of 105 days. In addition, a second public hearing was held on October 3, 1989, when additional comment was taken.

A number of commentors presented oral comments at one or both of the public hearings. Numerous written comments relating to the PCB Areas operable unit were also received during the official public comment period, including letters from organizations and political entities. The comments related to the Superfund decisionmaking process and/or the technical merits of the alternative preferred in the Proposed Plan. Commentors focussed especially on the incineration component of the preferred alternative. Additionally, approximately 700-800 signatures were submitted on petitions opposing incineration. The comments received have been summarized and addressed in the Responsiveness Summary portion of this ROD.

The comments received during the public comment period are one measure of the community's acceptance of U.S. EPA's proposed Selected Remedy. The vast majority of comments submitted on the PCB Areas Proposed Plan either opposed the incineration treatment process or expressed concern with the safety of its implementation. Most commentors that opposed incineration stated that there was a clear need for remediation of the contaminated areas, but that they were concerned with the "safety" of an incinerator. Along with the vocal opposition to the incineration treatment, there was extensive concern expressed that the public needs to be involved in the implementation of the remedy. As expressed in the Responsiveness Summary portion of this ROD, U.S. EPA strongly supports the active involvement of the community in the continued Superfund activities at the Site.

Another measure of community acceptance is the organization of diverse elements of the community into the Crab Orchard Response Team (CORT). This group organized as a response to concerns from many sectors of the community and is becoming involved as a focal point to express continued community concerns. The comments

received from CORT are included as official documents in the Administrative Record.

In conclusion, the community near the Refuge has expressed opposition to the incineration component of the Selected Remedy, or is concerned that the implementation of the incineration process must ensure the safety of the local communities. In addition, the community is generally dissatisfied with the Superfund decisionmaking process, and individuals and groups feel that they need far more involvement in on-going activities.

In summary, at this time the Selected Remedy represents the best balance among the alternatives of the evaluation criteria used to evaluate remedies. The Selected Remedy emphasizes long-term effectiveness and permanence and reduction of toxicity, mobility and volume. The Selected Remedy is safe and provides short-term effectiveness, and is implementable. The demonstration to allow an Alternative Treatment Technology (ISV) is an attempt to keep the same balance of the evaluation criteria, and at the same time to address community concerns.

X. STATUTORY DETERMINATIONS

A. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Remedy (using incineration or, if successfully demonstrated, in situ vitrification) is protective of human health and the environment for the four study sites comprising the PCB Areas operable unit. Also, the Selected Remedy is consistent with the mission of the Refuge, which is to provide a safe and protective setting for wildlife. The Selected Remedy provides adequate protection by a combination of treatment of contaminated soil and sediment by incineration to destroy the organic contaminants, stabilization/ fixation of the RCRA characteristic metal-bearing material to render it non-hazardous, the engineered control of an on-site solid waste landfill for the treated and untreated contaminated residues, and institutional controls by continuing to restrict public access, particularly to the constructed landfill.

The Alternative Treatment Technology (ISV) would provide the same degree of protectiveness by destruction of the organic material and immobilization of the metal-bearing material by in situ vitrification, the engineered control of a low-permeability cap over the treated residues, and institutional controls. The remedial alternatives, including on-site landfills, were developed with the understanding that the Site would continue to be a wildlife refuge, with restricted public access in order to protect the wildlife. An interagency agreement will require DOI to maintain the on-site landfill and to impose access restrictions for the landfill, if the land use were to change in the future.

The remediation goals for the study sites comprising the operable unit have been established so that human exposure levels will be reduced for

the sum of all contaminants to no greater than a 10^{-6} excess cancer risk level. In addition, the non-carcinogenic hazard indices for the sum of all contaminants shall be less than one. Also, chemical-specific remediation goals have been established by the FWS which are believed to be protective of wildlife at this site. The remediation goals established in this document are consistent with DOI's concerns and statutory mandates. Implementation of the selected remedy will not pose unacceptable short-term risks and will not cause cross-media impacts.

The Selected Remedy would remediate the four study sites that comprise the operable unit so that future access restrictions to those areas would not be needed (although the vitrified masses may require limited restrictions). Because the Selected Remedy will leave contaminants at the site in either an on-site landfill or in the vitrified area of contamination, CERCLA Section 121(c) requires that the remedy be reviewed at least every five years to ensure that it continues to be protective to public health and the environment.

B. COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy will comply with all Federal and any more stringent State ARARs. The major ARARs that will be attained by the components of the Selected Remedy are listed below. The list of ARARs below is intended to be comprehensive, however, implementation of the ARARs will be determined, and identification of ARARs may require further refinement, during remedial design and remedial action.

1. Surface Water Discharge

Clean Water Act

- If pond or stream water from site 17 or stream or ditch water from Area 9 (sites 32 and 33) must be discharged to a surface water body during site preparation, the discharge shall meet the effluent standards and prohibitions and water quality standards established under Sections 301, 302, 303, 307, 318 and 405 of the Clean Water Act (40 CFR 122.41 and 122.44).

2. Excavation of Soil and Sediment

Resource Conservation and Recovery Act, Subtitle C

- Excavated material which is RCRA hazardous will be handled and stored in accordance with the substantive technical standards applicable to generators of hazardous waste and for owners and operators of hazardous waste storage facilities (40 CFR 262.34; and 264, Subparts B, C, I, J, and L).

- Excavated material which is RCRA hazardous will be handled and stored in accordance with the land disposal restrictions (40 CFR 268).

- The excavation activities, when completed shall meet the closure performance standards for clean closure (40 CFR 264, Subpart G) for the specific hazardous waste constituents.

- The excavation and storage activities must also meet any more stringent State of Illinois equivalent provisions (35 IAC Part 724 design requirements).

Toxic Substances Control Act

- Excavated material which contains PCBs at concentrations greater than 50 parts per million will be handled and stored in accordance with the requirements of 40 CFR 761.65.

Clean Air Act

- During excavation the national ambient air quality standards (NAAQS) for particulate matter and lead shall not be exceeded (40 CFR 50.6 and 50.12).

3. Incineration of Soil and Sediment

Toxic Substances Control Act

- All contaminated soil and sediment that contains PCBs above the remediation goal shall be disposed of in accordance with the disposal requirements of 40 CFR 761.60(a)(4)(i) and (d).

- The design and operation of the on-site mobile incinerator will meet the substantive technical requirements of the TSCA incineration regulations (40 CFR 761.70).

Resource Conservation and Recovery Act, Subtitle C

- The design and operation of the on-site mobile incinerator will meet the substantive technical requirements of the RCRA, Subtitle C incineration regulations (40 CFR 264, Subpart O).

- The incinerator ash will be analyzed to determine if it is a RCRA characteristic waste in accordance with 40 CFR 262.11.

- Incinerator ash which is RCRA hazardous will be handled and stored in accordance with the substantive technical standards applicable to generators of hazardous waste and for owners and operators of hazardous waste storage facilities (40 CFR 262.34; and 264, Subparts B, C, I, J, and L).

- Incinerator ash which is RCRA hazardous will be handled and stored in accordance with the land disposal restrictions (40 CFR 268).

Clean Air Act

- During incineration the national ambient air quality standards (NAAQS) for particulate matter and lead shall not be exceeded (40 CFR 50.6 and 50.12).

4. Vitrification

Toxic Substances Control Act

- All contaminated soil and sediment that contains PCBs above the remediation goal shall be disposed of in accordance with the substantive technical disposal requirements of 40 CFR 761.60(d) and (e).

- The design and operation of the on-site vitrification unit will meet the substantive technical performance standards of the TSCA incineration regulations (40 CFR 761.70).

Resource Conservation and Recovery Act, Subtitle C

- The design and operation of the on-site vitrification unit will meet the substantive technical requirements of the RCRA, Subtitle C miscellaneous unit regulations (40 CFR 264, Subpart X).

- RCRA characteristic waste may only be consolidated in a non-contiguous area of contamination if the substantive technical requirements of 40 CFR 264.301(b) and 268.6 have been met.

- If the final rulemaking specifies a specific treatment technology for metal-bearing characteristic waste, the substantive technical requirements of 40 CFR 268.42(b) will be met, if required.

Clean Air Act

- During treatment the NAAQS for particulate matter and lead shall not be exceeded (40 CFR 50.6 and 50.12).

5. Stabilization/ Fixation

Resource Conservation and Recovery Act, Subtitle C

- RCRA hazardous material will be treated by this process to render it non-hazardous. The treatment shall be in accordance with any promulgated treatment standards for waste which is EP Toxic for cadmium and/or lead (40 CFR 268 for D006 and/or D008 waste).

- Treatment shall be in units designed to meet the substantive technical requirements for either containers, tanks, waste piles or miscellaneous units (40 CFR 264, Subparts I, J, L or X).

- Treatment units must meet any more stringent regulatory design standards of the State of Illinois (35 IAC Part 724).

Clean Air Act

- During treatment the NAAQS for particulate matter and lead shall not be exceeded (40 CFR 50.6 and 50.12).

6. Disposal or Decontamination of Equipment

Resource Conservation and Recovery Act, Subtitle C

- During remediation and closure all equipment, structures and soils that are used on/with RCRA hazardous materials must be properly decontaminated or disposed of (40 CFR 264.114).

- Decontamination of equipment structures and soils that are used on/with RCRA hazardous materials must meet any more stringent regulatory decontamination or disposal standards of the State of Illinois (35 IAC Part 724).

Toxic Substances Control Act

- During remediation and closure all equipment, structures and soils that are used on/with TSCA regulated PCB-contaminated soil and sediment must be properly decontaminated (40 CFR 761.79).

7. Industrial Landfill or Caps

Solid Waste Disposal Act as amended by RCRA Subtitle D

- The design and operation of the on-site solid waste disposal cell or the cap over the vitrified area of contamination will meet the substantive technical requirements of the RCRA, Subtitle D guidelines for the land disposal of solid waste (40 CFR 241, Subpart B).

- Since all of the RCRA hazardous material will be rendered non-hazardous prior to placement in the landfill, the requirements of the land disposal regulations of 40 CFR 268 do not apply, nor are they relevant or appropriate.

- The design and operation of the landfill will meet any more stringent technical regulations of the State of Illinois (35 IAC Part 807).

8. Backfill Excavation

Clean Air Act

- During backfilling activities the NAAQS for particulate matter shall not be exceeded (40 CFR 50.6).

9. Monitoring and Maintenance

Resource Conservation and Recovery Act, Subtitle C

- Groundwater monitoring for the remediated study sites shall be in accordance with the groundwater monitoring requirements of RCRA (40 CFR 264, Subpart F).

Solid Waste Disposal Act as amended by RCRA Subtitle D

- Groundwater and leachate monitoring for the on-site landfill shall be in accordance with the RCRA Subtitle D, solid waste landfill requirements (40 CFR 241.204).

- Groundwater and leachate monitoring for the on-site landfill will meet any more stringent technical regulations of the State of Illinois (35 IAC Part 807).

10. Personnel Protection

Occupational Safety and Health Act (OSHA)

- During all remedial activities the requirements of the Occupational Safety and Health Act for the training and safety of workers will be observed (29 CFR 1910.120 and 1926, Subparts C, D, E, and P).

11. Remediation Goals

Crab Orchard Enabling Legislation (16 U.S.C. 666f and g)

National Wildlife Refuge Administration Act (16 U.S.C. 668dd)

Eagle Protection Act of 1940 (16 U.S.C. 668a)

Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-711), as amended

- The chemical specific remediation goals which have been established for the study sites comprising the PCB Areas, and any others that will be established for this operable unit will be consistent with the statutory requirements cited above.

For implementation of the Selected Remedy, U.S. EPA, DOI and IEPA have agreed to consider a number of procedures as guidance. These include, but are not limited to: U.S. EPA's Risk Assessment Guidance for

Superfund; U.S. EPA's Superfund Remedial Design and Remedial Action Guidance; U.S. EPA's RCRA Technical Enforcement Guidance Document; U.S. EPA's proposed MCL for PCBs; any proposed revisions to U.S. EPA's design standards for RCRA Subtitle D landfills, which are available before remedial design; the State of Illinois Waste Management Facilities Design Criteria; and State of Illinois Monitoring Well Construction and Installation Criteria.

C. COST EFFECTIVENESS

The Selected Remedy for this operable unit appears to be cost-effective. The costs are reasonable for the overall effectiveness of the chosen remedy. Other Alternatives which were less costly provided less long-term effectiveness and permanence; less reduction of toxicity, mobility or volume; or less implementability.

D. UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The Selected Remedy for the PCB Areas operable unit utilizes permanent solutions and treatment technologies to the maximum extent practicable.

The evaluation of the five primary balancing criteria is discussed in Part IX., above. The analysis of the criteria supports the Selected Alternative and the Alternative Treatment Technology, as providing the best balance among the developed Alternatives. The analysis of the criteria demonstrates that the Selected Remedy utilizes permanent solutions to the maximum extent practicable. The Selected Remedy was chosen as the final remedial action for the PCB Areas operable unit because it provides the greatest long-term effectiveness and permanence and reduction of toxicity, mobility and volume through treatment.

The Alternative Treatment Technology (ISV) is included to allow the party(ies) responsible for the implementation of the remedy to demonstrate that vitrification, an alternative treatment technology, is as effective as incineration, which is a proven technology for PCB contamination. If the demonstration allowed in Part VIII.A.3 indicates that the required treatment and performance standards can be met by vitrification, then the treatment component of the Selected Remedy may include this Alternative Treatment Technology.

E. PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The Selected Alternative uses treatment as a principal element to address the threats posed by the sites comprising the PCB Areas operable unit. The results of the risk assessment conducted as part of the RI indicate that the greatest threats to human health and/or the environment are from contaminated soil and sediment, and potential surface water and food chain contamination resulting from run-off from the uncontrolled areas. The Selected Alternative requires that the organic contaminants in the soil and sediment (principally PCBs) be permanently destroyed by incineration or vitrification. The soil, sediment and any incinerator

residue which is hazardous because of the characteristic to leach metals be treated by stabilization/ fixation or vitrification to render the material non-hazardous and to reduce mobility of the contaminants. Incineration and stabilization/ fixation treatment technologies have been demonstrated to be extremely effective for soil and sediment contaminated with PCBs and metals respectively. Vitrification has not been fully demonstrated for the principal contaminants, but is a promising alternative treatment technology.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

A. ORIGINAL PREFERRED ALTERNATIVE

The Proposed Plan for the PCB Areas operable unit was made available to the public on August 18, 1989. The preferred alternative identified in the Proposed Plan was a consolidated remedial alternative which included the following components:

Excavation of Soil and Sediment - Contaminated soil and sediment would be excavated using conventional equipment. The excavated material would be moved to a storage area on-site, where it would be stored until it was treated or disposed.

Incineration/ Thermal Destruction - All excavated soil and sediment which is contaminated with PCBs would be treated by incineration/ thermal destruction. Non-contaminated incinerator residue would be backfilled in the excavated areas.

Stabilization/Fixation - Residues from incineration/ thermal destruction, and non-incinerated soil and sediment which contain metals at levels which are hazardous because of the characteristic for leachable metals, as defined by RCRA, would be treated by stabilization/fixation.

Industrial Landfill - Contaminated residues from incineration/ thermal destruction and materials treated by stabilization/ fixation would be disposed of in an on-site industrial landfill, meeting at a minimum, the applicable or relevant and appropriate requirements of Subtitle D of RCRA and 35 IAC Part 807.

Low Permeability Caps - Areas where contamination is below the excavation criteria, or from where contaminated soil and sediment have been excavated would be closed and covered with a low permeability cap. The cap would be constructed of compacted soil, a drainage layer, soil fill and topsoil. Routine maintenance of the cover would be part of the long term requirements.

Backfill Excavation - Clean soil would be placed in the areas where contaminated material had been removed.

Monitoring and Maintenance - Groundwater and surface water monitoring would be conducted around the on-site landfill and

excavated areas. Inspection and maintenance of the landfill would also be required.

B. DESCRIPTION OF SIGNIFICANT CHANGES

The only significant change which has been made to the Selected Remedy from the Preferred Alternative discussed in the Proposed Plan for the PCB Areas operable unit is that the remedy selected in this Record of Decision allows a demonstration to select an Alternative Treatment Technology, if specific criteria can be met. This change would allow the party(ies) responsible for the implementation of the remedy to perform a treatability study to demonstrate that in situ vitrification, an innovative technology for PCB-contaminated soil and sediment, will meet specific requirements. The Selected Remedy is the same as the Preferred Alternative in the Proposed Plan unless the Alternative Treatment Technology is utilized. The Alternative Treatment Technology and the demonstration required in order to implement it are discussed extensively in Sections VIII.A.2 and 3, respectively.

C. REASON FOR CHANGES

On March 8, 1990, the National Contingency Plan (NCP) was revised. The revised NCP is the regulatory framework for the implementation of CERCLA. The revised NCP continues to emphasize treatment of contaminated material as a principal element of Superfund remedies. In addition, the revised NCP provides for the utilization of innovative or alternative treatment technologies, where appropriate. U.S. EPA, in selecting final remedies for sites or operable units, must balance a number of statutory mandates. These mandates are discussed in Part X. above. The revised NCP provides guidance in the application of the statutory determinations for remedy selection.

U.S. EPA is considering using the innovative technology described because it offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.

For the PCB Areas operable unit at the Refuge, U.S. EPA believes that treatment of the principal threats is required. Further, U.S. EPA believes that the Selected Remedy will accomplish this goal, will meet all of the statutory mandates, and will provide the best balance among the remedy evaluation criteria. However, in order to accommodate the revised NCP's emphasis on innovative technology, and to try to respond to community concern, an Alternative Treatment Technology (ISV) has been included in the Selected Remedy. This alternative treatment may only be implemented if a demonstration successfully shows that the innovative treatment can meet the remediation goals for the PCB Areas operable unit.

CRAB ORCHARD NATIONAL WILDLIFE REFUGE
PCB AREAS OPERABLE UNIT ROD

APPENDIX A
FIGURES

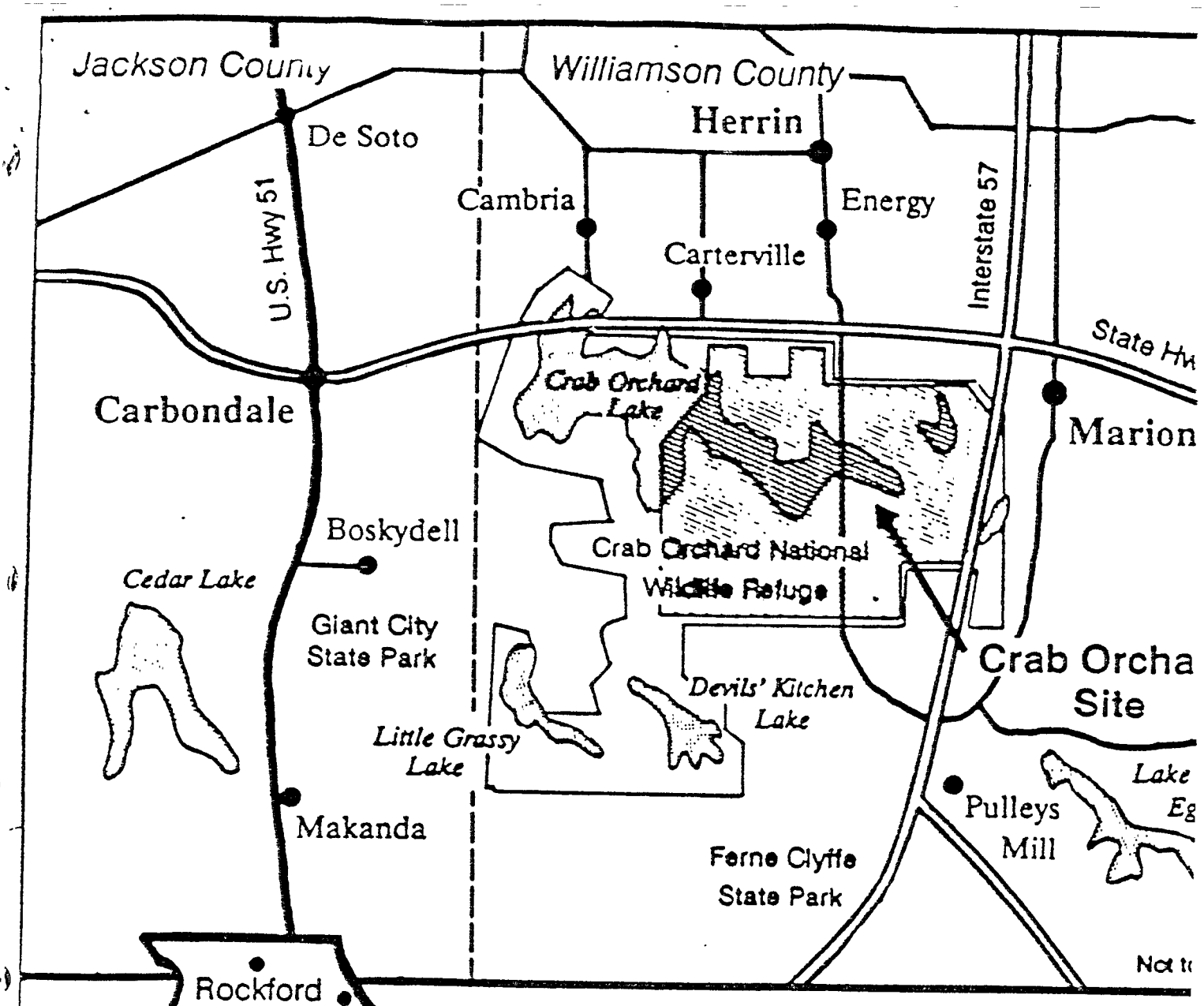
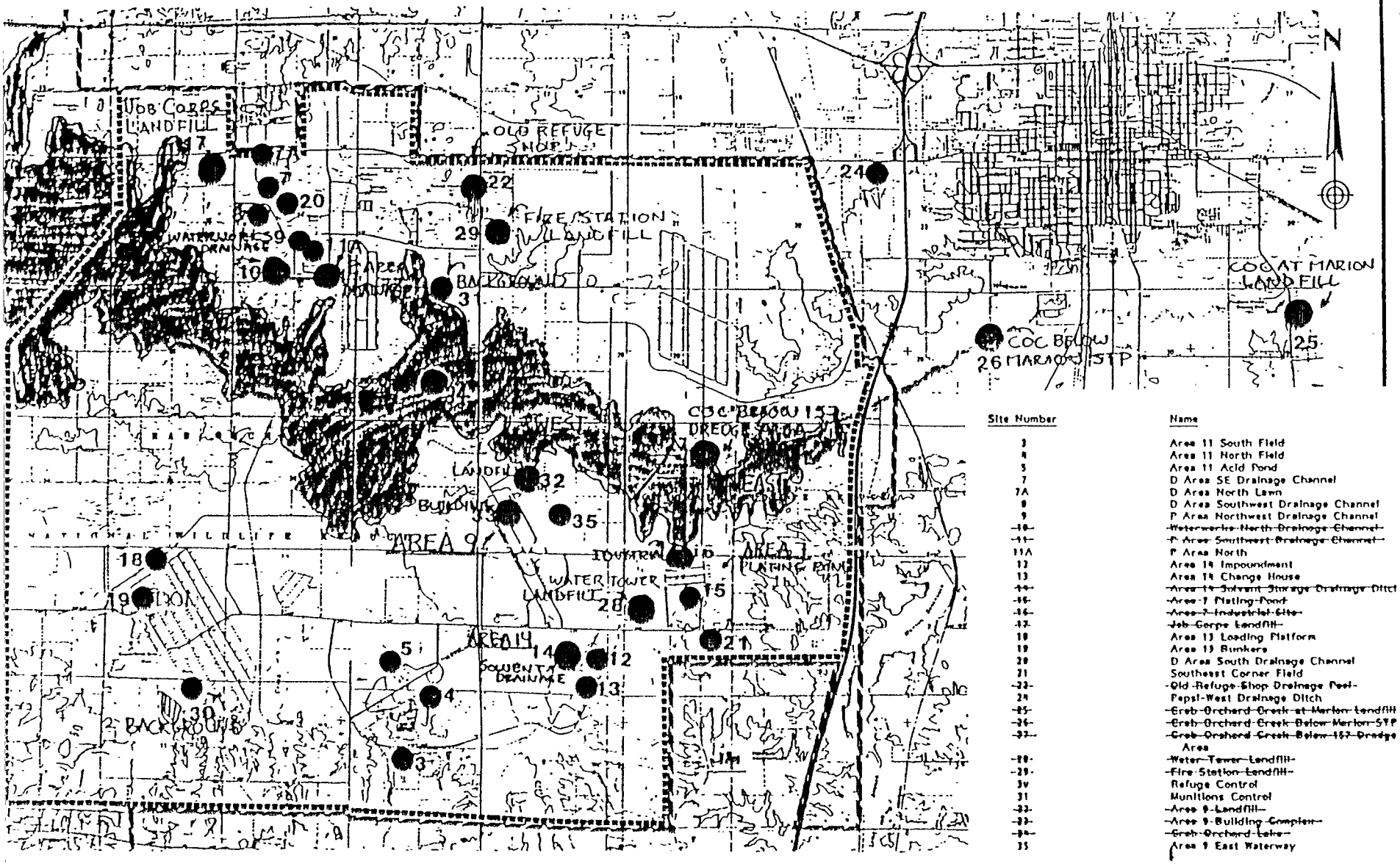


Figure 1
Site Area Map
Crab Orchard Site
Williamson County, Illinois

Refuge Boundary
Closed Site Area
Surface Water

FIGURE 2

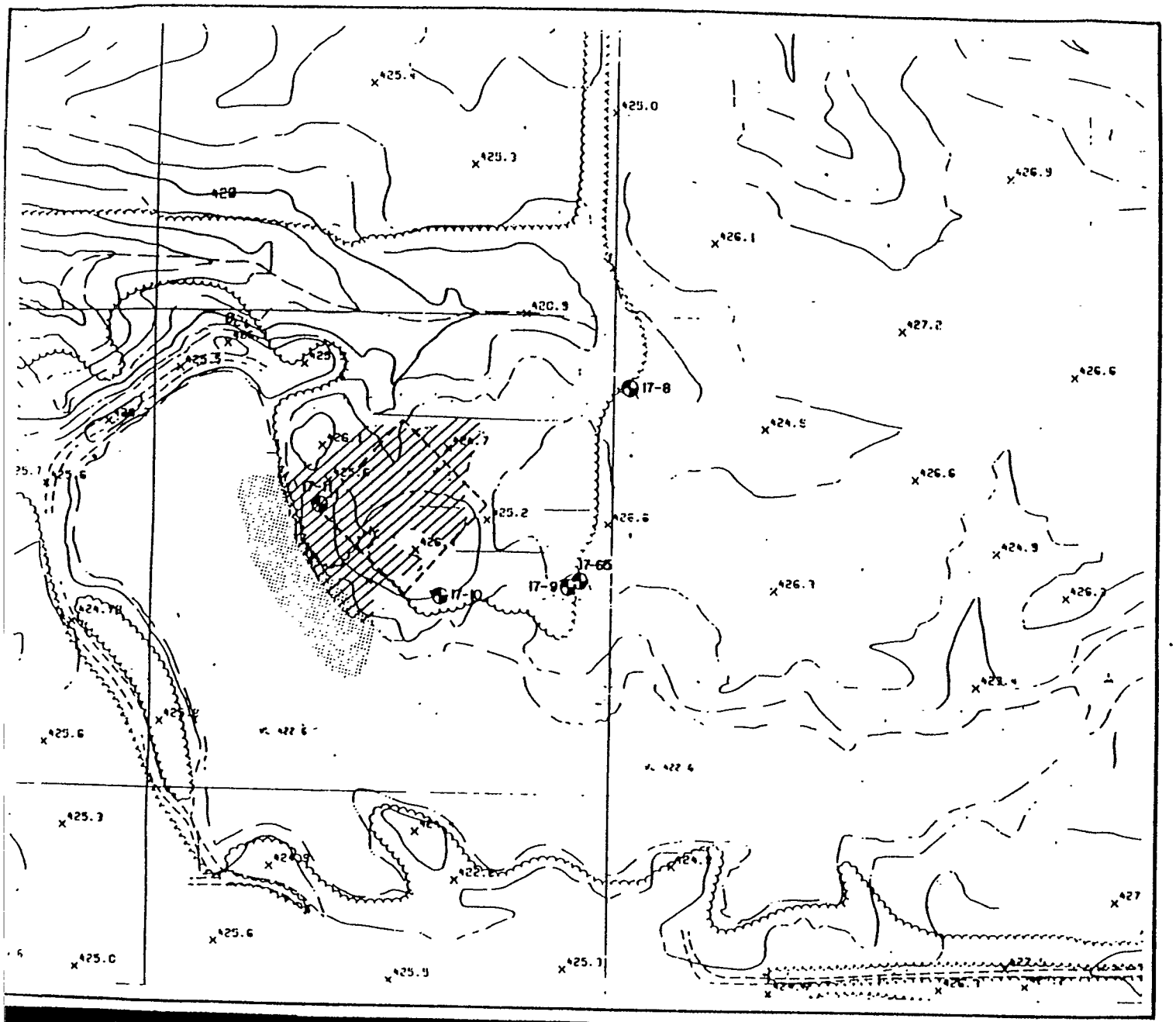


Site Number	Name
3	Area 11 South Field
4	Area 11 North Field
5	Area 11 Acid Pond
7	D Area SE Drainage Channel
7A	D Area North Lawn
8	D Area Southwest Drainage Channel
9	P Area Northwest Drainage Channel
~~10~~	~~Waterworks North Drainage Channel~~
~~11~~	~~P Area Southwest Drainage Channel~~
11A	P Area North
12	Area 14 Impoundment
13	Area 14 Change House
~~14~~	~~Area 14 Solvent Storage Drainage Ditch~~
~~15~~	~~Area 1 Plating Pond~~
~~16~~	~~Area 1 Industrial Site~~
~~17~~	~~Job Corps Landfill~~
18	Area 13 Loading Platform
19	Area 13 Bunkers
20	D Area South Drainage Channel
21	Southeast Corner Field
~~22~~	~~Old Refuge Shop Drainage Pool~~
24	Pepsi-West Drainage Ditch
~~25~~	~~Crab Orchard Creek at Marion Landfill~~
~~26~~	~~Crab Orchard Creek Below Marion STP~~
~~27~~	~~Crab Orchard Creek Below 157 Dredge Area~~
~~28~~	~~Water Tower Landfill~~
~~29~~	~~Fire Station Landfill~~
30	Refuge Control
31	Munitions Control
~~32~~	~~Area 9 Landfill~~
~~33~~	~~Area 9 Building Complex~~
~~34~~	~~Crab Orchard Lake~~
35	Area 9 East Waterway

CRAB ORCHARD NATIONAL WILDLIFE REFUGE
LOCATIONS OF SAMPLING SITES

O'BRIEN & GERE

FIGURE 3



CRAB ORCHARD NATIONAL WILDLIFE REFUGE

SITE 17 FEASIBILITY STUDY

LEGEND

- PROPOSED REMEDIATION AREA (SOIL) > 50 PPM PCI
- PROPOSED REMEDIATION AREA (SEDIMENT) > 50 PPM
- GROUNDWATER MONITORIN WELL

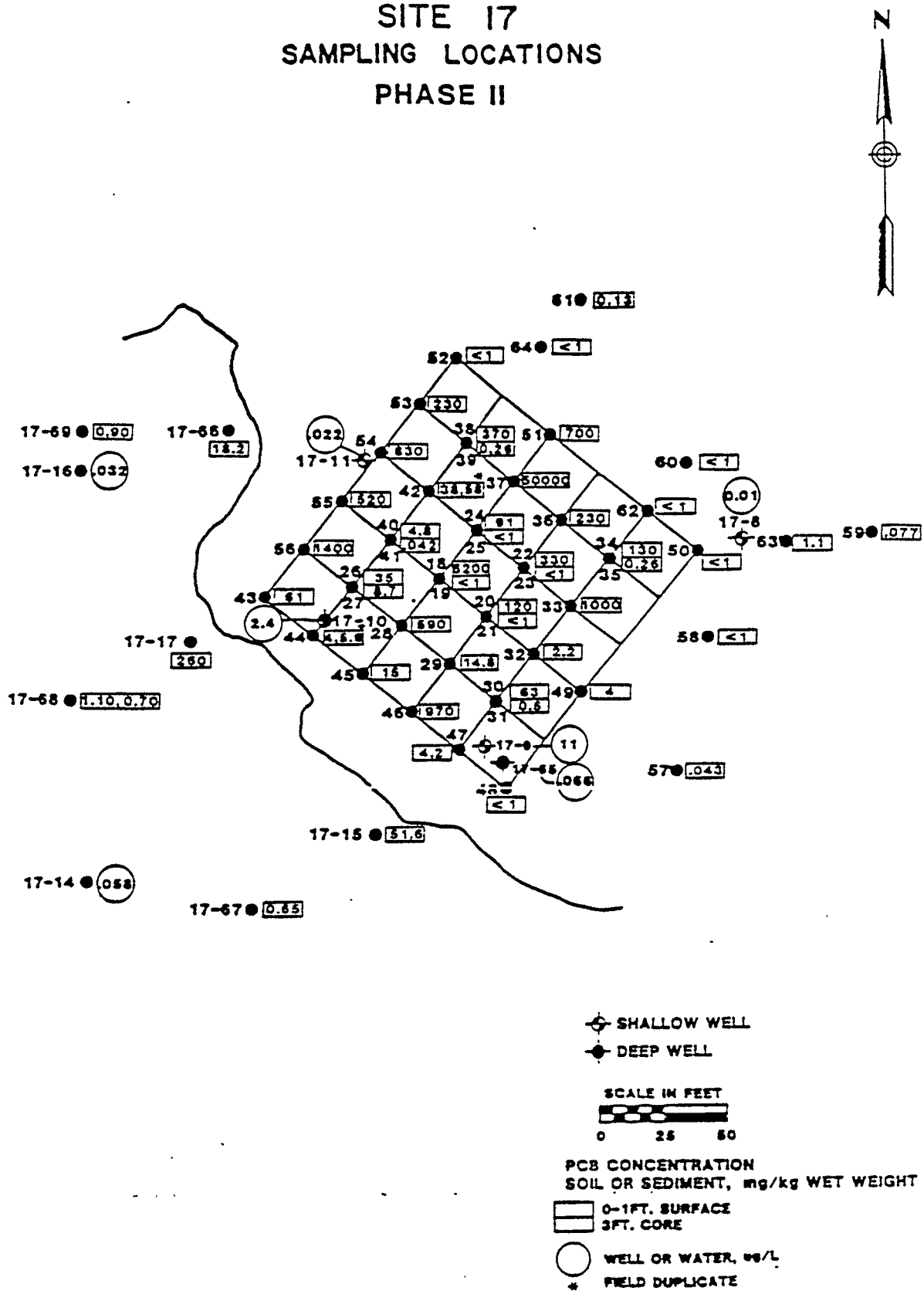
SCALE IN FEET

0 100 200

O'BRIEN & GERE

FIGURE 4

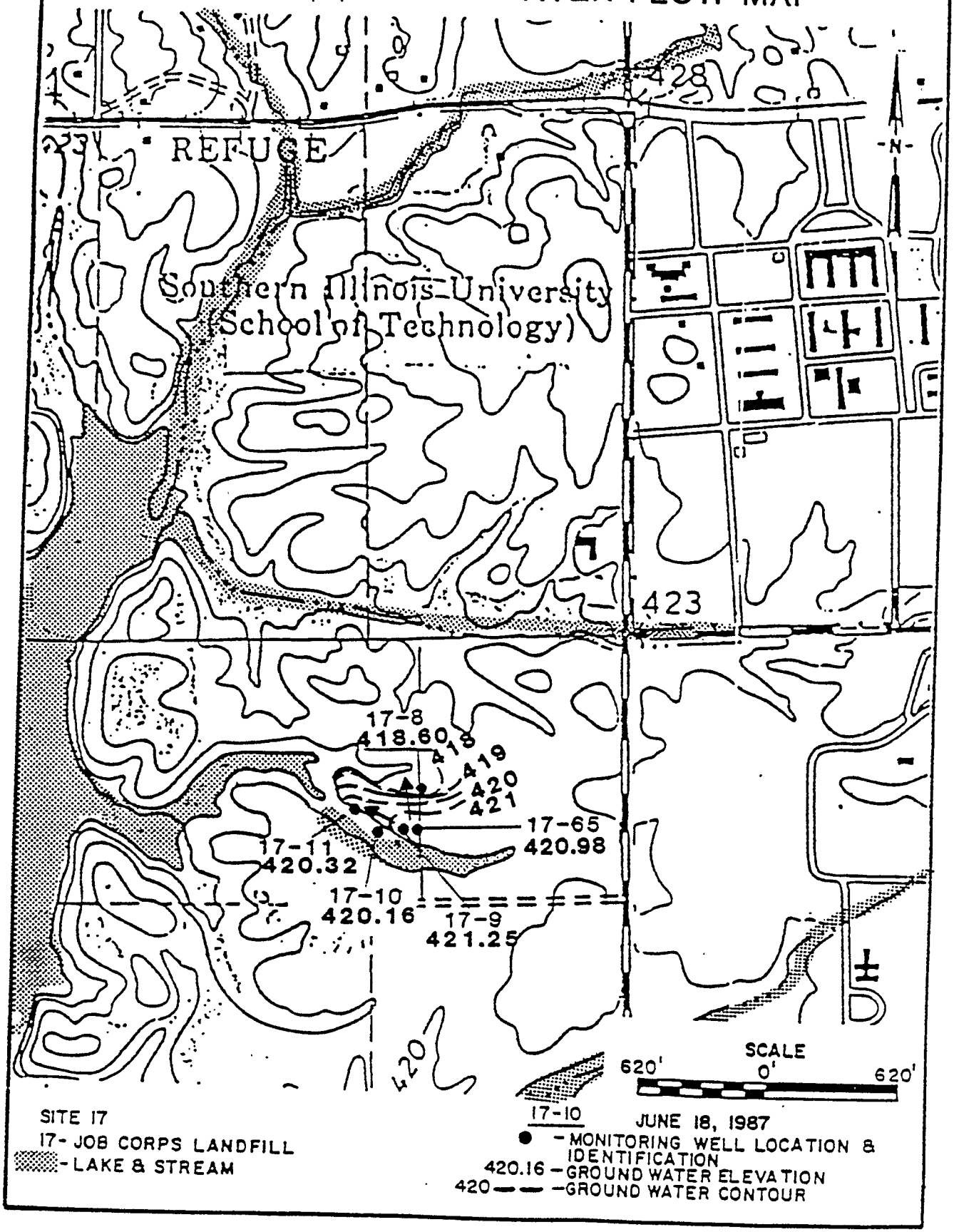
SITE 17
SAMPLING LOCATIONS
PHASE II



O'BRIEN&GERE

FIGURE 5

SITE 17 GROUNDWATER FLOW MAP



O'BRIEN & GERE

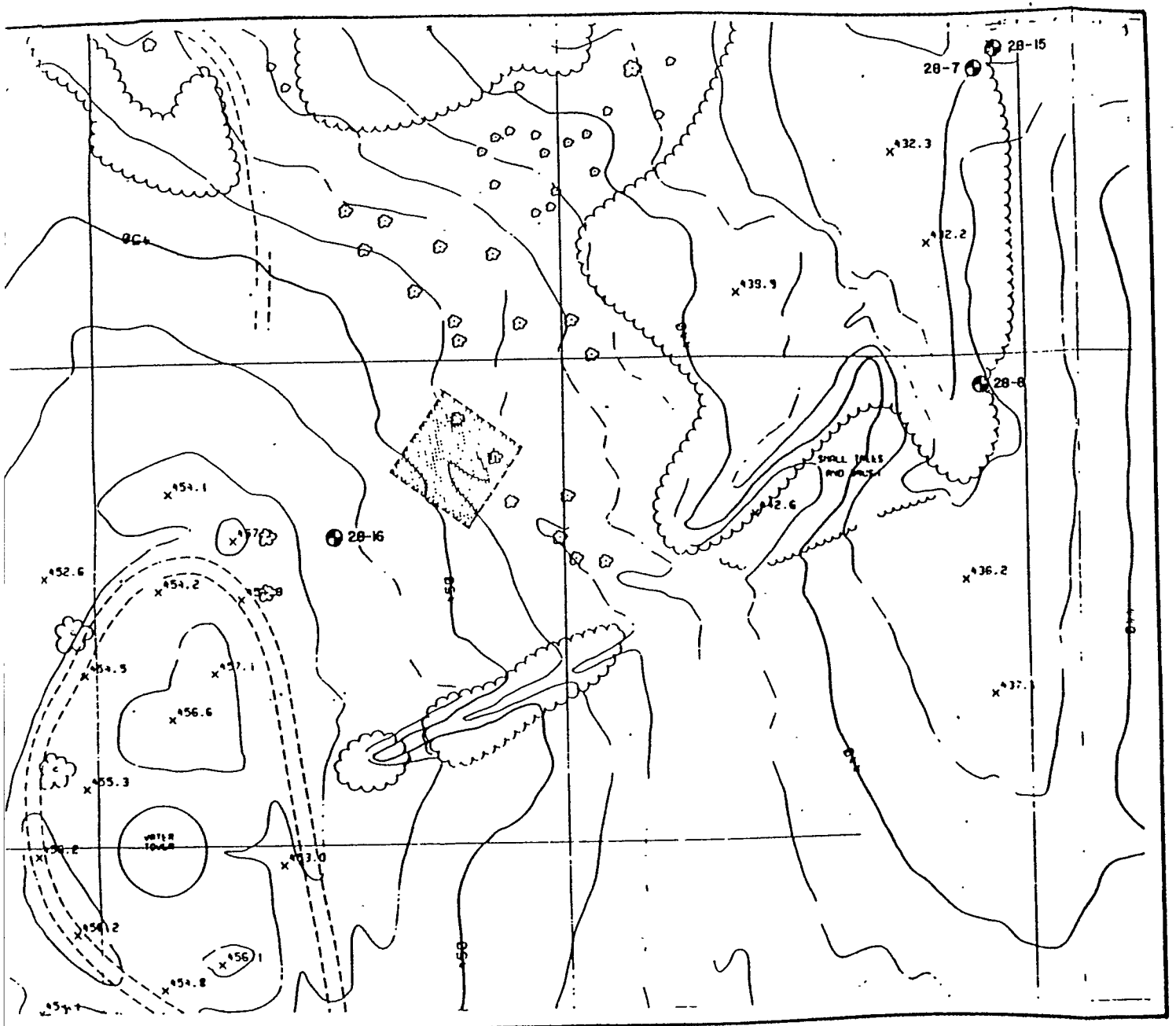


FIGURE 6

N

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

SITE 28
FEASIBILITY STUDY

LEGEND

- PROPOSED REMEDIATION AI
- GROUNDWATER MONITORIN WELL

SCALE IN FEET

0 50 100

OBRIEN & GERE

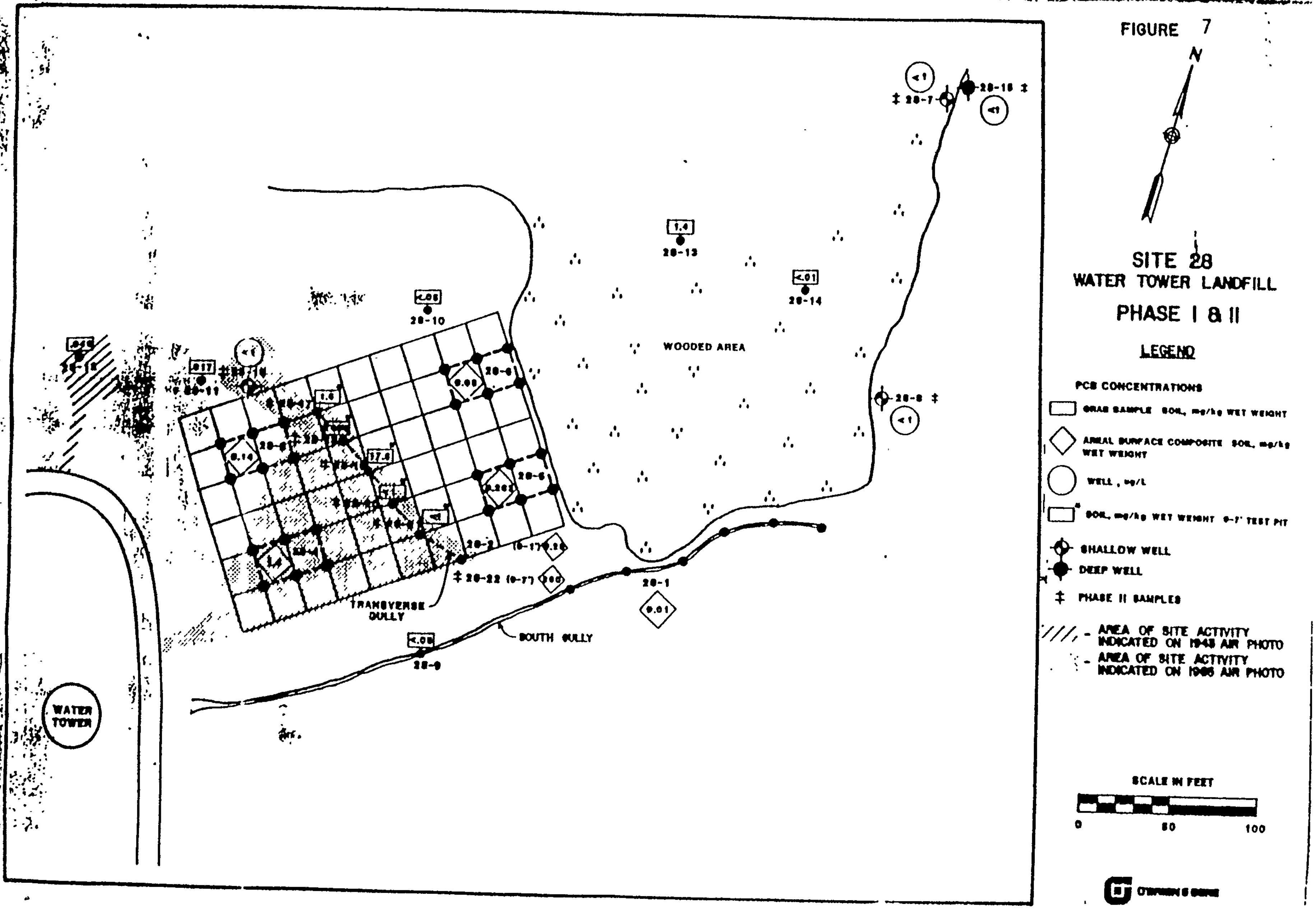
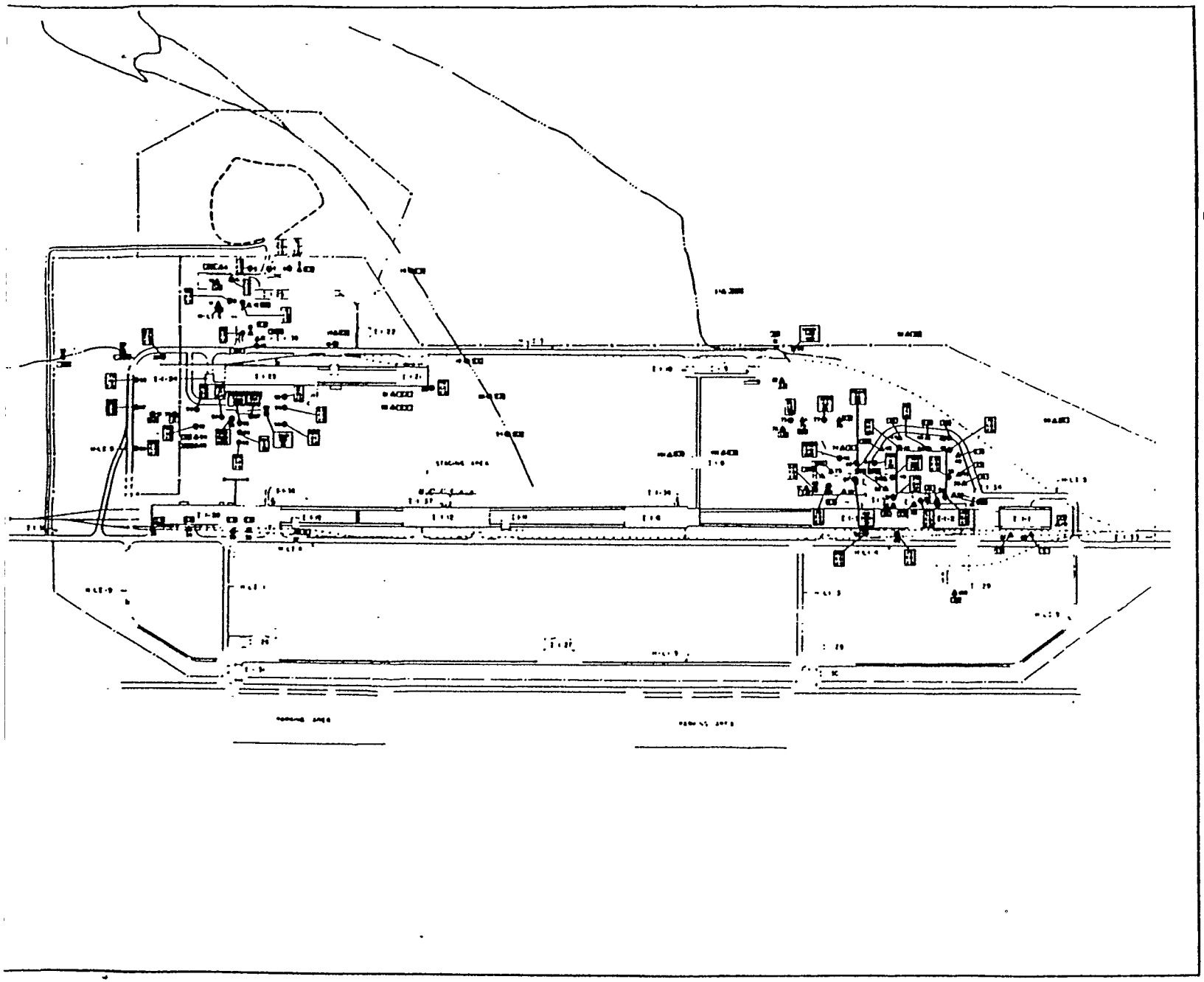


FIGURE 7

SITE 28
WATER TOWER LANDFILL
PHASE I & II

FIGURE 8



SITE 33

PHASE I SAMPLING LOCATIONS

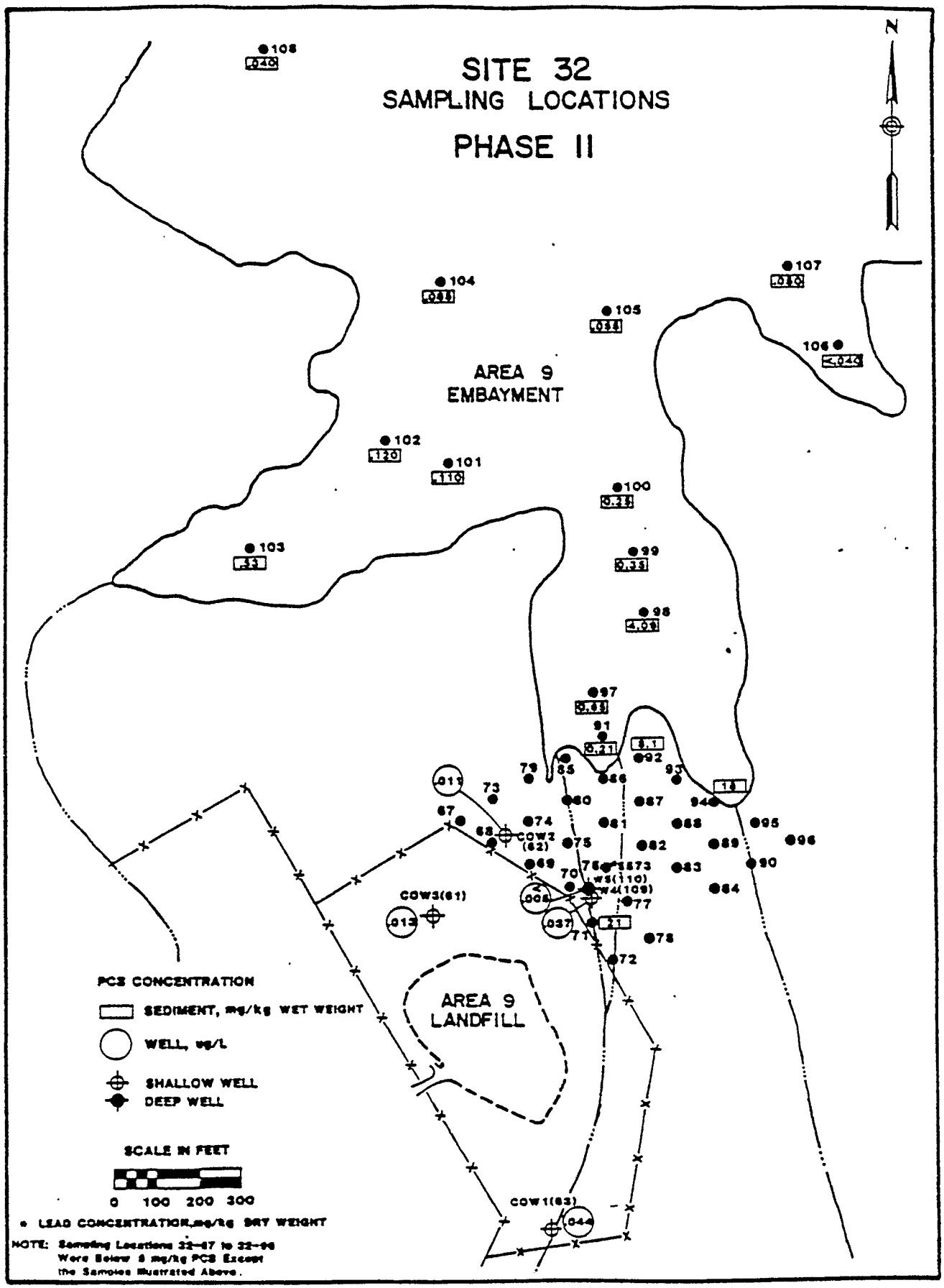
LEGEND

- SURFACE COMPOSITE
- SURFACE SOIL SAMPLE
- 2 FT. SOIL CORE (0-1, 1-1, 2-3 FT.)
- DITCH
- PCB CONCENTRATIONS IN SOIL, mg/kg WET WEIGHT AT EACH DEPTH

APPROXIMATE SCALE IN FEET

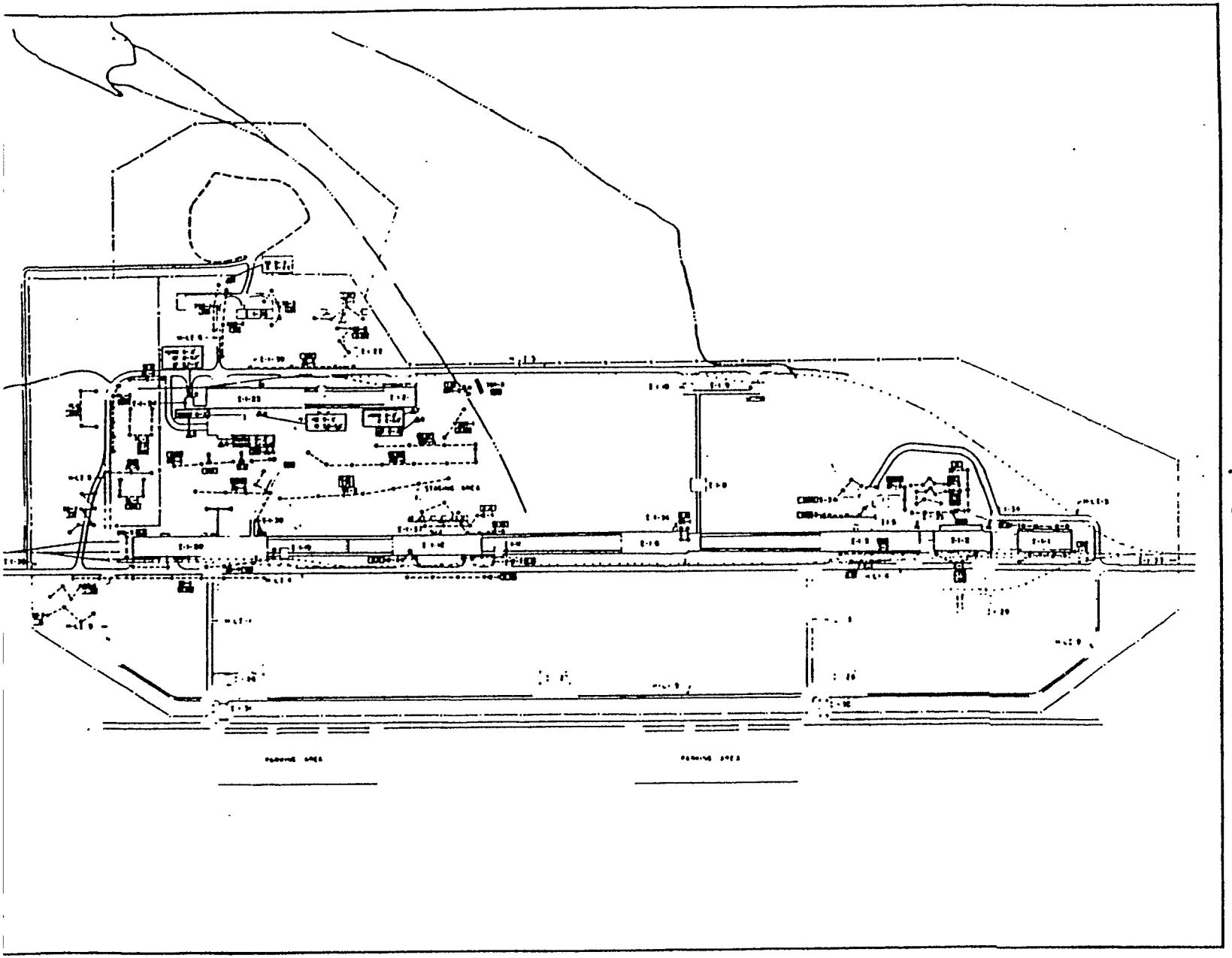
O'BRIEN & GERE

FIGURE 9



O'BRIEN & GERE

FIGURE 10



SITE 33

AREA 9 BUILDING COMPLEX
(OLIN DATA)

LEGEND

- SHYPOSITIVE SOIL SAMPLE JULY 2-4, 1984
- SHYPOSITIVE SOIL SAMPLE JULY 10-20, 1984
- SAMPLE NUMBER
- PCE CONCENTRATION, mg/kg WET WEIGHT

APPROXIMATE SCALE IN FEET

O'BRIEN & GERE

CRAB ORCHARD NATIONAL WILDLIFE REFUGE
PCBS AREAS OPERABLE UNIT ROD

APPENDIX B
TABLE

TABLE 1
CRAB ORCHARD LAKE

ESTIMATED RISK TO HUMANS
DUE TO CONSUMPTION OF FISH TISSUE

ASSUMPTIONS:
- 100 % of fish diet is captured at Crab Orchard Lake.
- Consumption of Crab Orchard fish continues over a 70-year lifetime, or during a 10-year or 5-year period.
- Undetected values are calculated as one half the analytical detection limit (0.2 mg/kg for RI data).
- Cancer unit risk factor of 7.7 $(mg/kg/day)^{-1}$ for Aroclor 1260 (*)
- East/West division denoted by Wolf Creek (200 fishable acres on eastern area, 7000 fishable acres total for lake.)

SCENARIO	AVERAGE PCB CONCENTRATION (mg/kg ww) (1)	(2)	<------ RISK LEVELS+ ------> 70-year Lifetime	10-year Exposure	5-year Exposure
I. Average Fisherman (6.5 g fish per day or 10-20 meals per year)					
a) 95% West Bass/5% East Bass	0.34	0.20	2.5E-04	3.5E-05	1.8E-05
b) 100% West Catfish/Bullhead	0.32	0.08	2.3E-04	3.3E-05	1.6E-05
c) 95% West /5% East Catfish	0.61	0.51	4.3E-04	6.1E-05	3.0E-05
d) Creel Census (4)	0.30	--	1.7E-04	2.4E-05	1.2E-05
e) National Average (5,#) 1976-1979	0.29	--	2.1E-04	3.0E-05	1.5E-05
f) National Average (6,#) 1980-1981	0.18	--	1.3E-04	1.8E-05	9.2E-06
II. Sports Fisherman (30 g fish per day or 50-100 meals per year)					
a) 95% West Bass/5% East Bass	0.34	0.20	1.2E-03	1.6E-04	8.3E-05
b) 100% West Catfish/Bullhead	0.32	0.08	1.1E-03	1.5E-04	7.4E-05
c) 95% West /5% East Catfish	0.61	0.51	2.0E-03	2.8E-04	1.4E-04
d) Creel Census (4)	0.30	--	7.8E-04	1.1E-04	5.6E-05
e) National Average (5,#) 1976-1979	0.29	--	9.6E-04	1.4E-04	6.8E-05
f) National Average (6,#) 1980-1981	0.18	--	5.9E-04	8.5E-05	4.2E-05

NOTES & REFERENCES:

(1) Averages are calculated assuming fish without detected PCB residues contain such residues at one half the analytical detection limit.
(2) Averages are calculated assuming fish without detected PCB residues are free of such residues.
(3) Derived using a 1976 Creel Census survey and average concentrations in fish species detected in the RI and in monitoring studies conducted by the State of Illinois (see Section 2.7). Based on the Creel Census data, the relative catch per boat expedition at Crab Orchard Lake is comprised of roughly, 35% bass, 31% bluegill sunfish, 14% catfish, 12% crappie and 8% bullhead.
(4) ATSDR (November, 1987). Draft Toxicological Profile on PCBs.
(5) Schmidt, CJ et al. (1985). National Pesticide Monitoring Program. Arch. Environ. Contam. Toxicol.; 14:225-60.

(#) Fillet residues calculated as one third reported whole body residue.
(*) The potency factor of 7.7 $(mg/kg/day)^{-1}$ is based on studies using Aroclor 1260; only Aroclor 1254 residues were detected at Crab Orchard Lake. Available data neither demonstrate nor preclude the carcinogenicity of Aroclor 1254.
(+) Additive risks due to PCB/TCDF residues in fish might be obtained by adding 15 percent to risk level noted for PCBs.

CRAB ORCHARD NATIONAL WILDLIFE REFUGE
PCBS AREAS OPERABLE UNIT ROD

APPENDIX C
SUPPORT AGENCY CONCURRENCE

Illinois Environmental Protection Agency · P. O. Box 19276, Springfield, IL 62794-9276

IEPA Record of Decision Declaration for the PCB Operable Unit
at the Crab Orchard National Wildlife Refuge
NPL Site near Marion, Illinois

With the exception of the specified landfill design, the selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate for this remedial action, and is cost-effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining on site, U.S. EPA is expected to conduct a review no less than five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

The adequacy of the U.S. EPA landfill design continues to be an outstanding issue with the State of Illinois and becomes the primary issue for complete concurrence at this time. Based on this information, the IEPA selectively concurs with the decision the U.S. EPA has made in selecting this remedy.

7/19/90
Date

Bernard P. Killian
Bernard P. Killian
Director
Illinois Environmental Protection Agency

BPK:SD:sap/2534n,60