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DEPARTMENT OF THE INTERIOR

Final Preliminary Assessment/Site Inspection Report

Additional and Uncharacterized Sites Operable Unit
Crab Orchard National Wildlife Refuge NPL Site
Marion, Illinois (Williamson County)

June 2003

This Final PA/SI Report is identical to the "Draft-Final" Report issued in September 2001.

VOLUME II

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ACRONYM LIST
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ACRONYM	DEFINITION
$3S_b$	Mean plus three standard deviations
A.N.	Ammonium Nitrate
ARAR	Applicable, Relevant and Appropriate Requirements
AOC	Area of Concern
AST	Aboveground Storage Tank
ASTER	Assessment Tools for the Management of Risk (USEPA database)
AUS OU	Additional Uncharacterized Sites Operable Unit
BGS	Below Ground Surface
BNA	Base-Neutral Acids
BOD	Biological Oxygen Demand
BOR	U.S. Bureau of Reclamation
BRA	Baseline Risk Assessment
BTAG	Biological Technical Assistance Group
BTOC	Below Top of Casing
BWT	Below Water Table
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980 (a.k.a. Superfund)
CIA	Central Intelligence Agency
CIPS	Central Illinois Public Service
CLP	Contract Laboratory Program
CM/SEC	Centimeters per Second
COC	Chain-of-Custody
COC	Chemical of Concern
COC	Crab Orchard Cemetery
COI	Chemical of Interest
COL	Crab Orchard Lake
CONWR	Crab Orchard National Wildlife Refuge
COP	Crab Orchard Pond
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSC	Commercial Solvents Corporation
CSEQGs	Canadian Sediment Quality Guidelines
CSOQGs	Canadian Soil Quality Guidelines
CTI	Central Technologies Incorporated
CVOC	Chlorinated Volatile Organic Compounds
CWQG	Canadian Water Quality Guidelines
DAF	Dilution Attenuation Factor
DEHP	bis(2-ethylhexyl)phthalate
DERP	Defense Environmental Restoration Program
DGOLs	New Dutchlist Groundwater Optimum Levels
DNT	Dinitrotoluene
DOD	Department of Defense
DOI	U.S. Department of the Interior

ACRONYM LIST
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ACRONYM	DEFINITION
DQCR	Daily Quality Control Reports
DQO	Data Quality Objective
DRO	Diesel Range Organics
DSOLs	New Dutchlist Soil Optimum Levels
DTW	Depth to water
DU	Depleted Uranium
EMMA OU	Explosives and Munitions Manufacturing Area Operable Unit
EPA	U.S. Environmental Protection Agency
EqP	Equilibrium Partitioning
ERL	Effects-Range Low
ERM	Effects-Range Medium
ESV	Ecological Screening Value
FDAP	Field Director of Ammunition Plants
FFA	Federal Facility Agreement
FID	Flame Ionization Detector
FOIA	Freedom of Information Act
FNH	Flashless Non-hydroscopic Powder
FS	Feasibility Study
FSP	Field Sampling Plan
FT	feet or foot
FWS	U.S. Fish and Wildlife Service
GPS	Global Positioning System
GRO	Gasoline Range Organics
GSA	General Services Administration
GW	Ground Water
HBX	High Blast Explosives
HE	High Explosives
HEDP	High Explosive Detonation Product
HEI	High Explosives Igniter
HMX	Her Majesty's Explosive (Cyclotetramethylenetetranitramine)
HQ	Hazard Quotient
HSA	Hollow Stem Auger
HSP	Health and Safety Plan
IAC	Illinois Administrative Code
IDW	Investigation Derived Waste
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
IOP	Illinois Ordnance Plant
K_{ow}	Octanol-to-Water Partitioning Coefficient
LAW	Light Antitank Weapon
LOEC	Lowest Observed Effects Concentration
MAOU	Metals Area Operable Unit
MATC	Maximum Acceptable Toxicant Concentration

ACRONYM LIST
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ACRONYM	DEFINITION
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MG/KG	milligrams per kilogram
MG/L	milligrams per liter
MHSPE	Ministry of Housing, Spatial Planning, and the Environment
MISCA OU	Miscellaneous Areas Operable Unit
MM	millimeter
MOCA	4,4' - Methylenebis (2-chloroaniline)
MSDS	Material Safety Data Sheets
MSL	Mean Sea Level
MW	Monitoring Well
NA	Not analyzed
NA	Not applicable
NAPL	Non-aqueous Phase Liquid
NEC	No Effect Concentration
NCP	National Contingency Plan
ND	Not detected
NG	Nitroglycerin
NG/KG	Nanograms per kilogram
NOAA	National Oceanic and Atmospheric Administration
NaOH	Caustic Soda
NOEC	No-observed-effect concentration
NPL	National Priorities List
OD	Outside Diameter
OE	Ordnance and Explosives
OEW	Ordnance and Explosive Waste
OFDAP	Ordnance Field Director of Ammunition Plants
OU	Operable Unit
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbons
PA/SI	Preliminary Assessment/Site Investigation
PBX	Plastic Bonded Explosives
PCB	Poly-chlorinated Biphenyl
PCB OU	PCB Operable Unit
PCE	Tetrachloroethylene
PEC	Probable Effect Concentration
PEL	Probable Effect Level
PETN	Pentaerythritol Tetranitrate
PID	Photo Ionization Detector
PLC	Preliminary Levels of Concern
PM	Project Manager
PPB	Parts Per Billion
PPE	Personnel Protection Equipment

ACRONYM LIST
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ACRONYM	DEFINITION
PPM	Parts Per Million
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
R&D	Research & Development
RAGS	Risk Assessment Guidance for Superfund (USEPA document)
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive (Cyclonite)
RI	Remedial Investigation
RI/FS	Remedial Investigation / Feasibility Study
RL	Reporting Limit
ROD	Record of Decision
RR	Railroad
RRTC	Railroad Tank Car
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act (1986)
SI	Site Investigation
SIU	Southern Illinois University
SMCL	Secondary Maximum Contaminant Level
SMDP	Scientific Management Decision Point
SOP	Standard Operating Procedure
SPO	Solid Propellant Operations
SSLs	Soil Screening Levels (USEPA)
SVOC	Semi-volatile Organic Compound
SWDC	Sherwin Williams Defense Corporation
TACO	Tiered Approach to Corrective Action Objectives
TAL	Target Analyte List
TBD	To Be Determined
TCDD	Tetrachlorodibenzo-p-Dioxin
TCE	Trichloroethylene
TCL	Target Compound List
TDS	Total Dissolved Solids
TEC	Threshold Effect Concentration
TEL	Threshold Effect Level
TEQ	Toxicity Equivalent for Dioxins/Furans
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TRV	Toxicity Reference Value

ACRONYM LIST
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ACRONYM	DEFINITION
TSS	Total Suspended Solids
UET	Upper Effect Threshold
UG/KG	micrograms per kilogram
UG/L	micrograms per liter
UMC	Universal Match Corporation
USACE	U.S. Army Corp of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
ECOTOX	Ecological Toxicity Database
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VJ Day	Victory over Japan day (August 15, 1945)
VOCs	Volatile Organic Compounds
WAA	War Assets Administration
WSA	West Shop Area
WWII	World War II
WWTP	Wastewater Treatment Plant

AREA 2

Area 2, which covers a little less than one square mile, is located on the east side of Wolf Creek Road, north of Crab Orchard Lake. Historically, Area 2 was divided into four separate areas (2B, 2D, 2F, and 2P) based on activities at the Illinois Ordnance Plant (IOP) during World War II (WWII). Area 2 sites and their Additional and Uncharacterized Sites Operable Unit (AUS OU) descriptions are addressed in this volume of the report as follows (Figure 3-1):

Section 3--Area 2B— IOP Booster Load Line (AUS-0A2B),

Section 4--Area 2D—IOP Detonator Load Line (AUS-0A2D),

Section 5--Area 2F—IOP Fuse Load Line (AUS-0A2F),

Section 6--Area 2P—IOP Primer Load Line (AUS-0A2P), and

Section 7--Area 2R—Olin/Primex/General Dynamics Ordnance and Tactical Systems, Inc. Railroad Spur (AUS-0A2R).

The entrance to Areas 2B, 2D, and 2F is located on the south side of Post Oak Road 0.3 miles east of Wolf Creek Road. The entrance to Area 2P is located on the north side of Stringtown Road, 0.7 miles east of Wolf Creek Road. These areas are current industrial facilities. They are bounded by six-foot (ft) chain link fences with controlled entrances. Access is restricted by the industrial tenant, now General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS).

AUS Original Site Designations

Three of the original sites designated in 1997 to 1999 by the United States Fish & Wildlife Service (USFWS) as part of the AUS OU were located entirely or partly in Area 2B: AUS-0006, AUS-007, and AUS-008.

3.1 HISTORIC SEARCH INFORMATION

3.1.1 Site Description

Originally Area 2B contained 17 buildings, although one boiler building and two testing buildings included in Area 2B were actually closer to Area 2D.[1] The original layout of Area 2B is shown in Figure 3-2. Seven of the original buildings have been demolished over the years including the entire southern portion of the building group.[2] The current layout of Area 2B is shown in Figure 3-3. Table 3-1 lists the buildings in Area 2B and their uses over the years.

Until the 1970s, industrial tenants at the Refuge were allowed to move existing buildings, construct new buildings, and raze old buildings in the areas that they occupied, and often the Refuge would not have complete records of this activity. Sometimes the new buildings were

[1] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 1 (Plan No. 6544-101.62).

[2] Changes to the original structure of Area 2 were observed during the site reconnaissance on April 13, 1999.

assigned new building numbers; sometimes they were assigned a number that had been used previously for a different building. In this report, where the same building number was used more than once, a prefix has been added to the building number based on the tenant it was assumed built the building (e.g., IOP Building B-2-3, UMC Building B-2-3). Prefixes are not used when the building number is unique.

3.1.2 Operational History and Waste Characteristics

Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department), operated the Booster Load Line during World War II, from 1942 through 1945. Since the early 1950s, industrial tenants, primarily Universal Match Corporation (UMC), and later Olin and its successors, have continuously occupied the area. In addition, the USFWS maintained an office for their Refuge division[3] in Building B-2-10 until 1956.[4]

UMC (later Crane/Unidynamics-Phoenix, now Crane Co.) leased buildings in this area beginning sometime after 1952 and continuing until 1963.[5,6,7] In 1963, UMC left the Refuge and moved operations to Phoenix, Arizona.

After UMC left, several former UMC employees formed Central Technologies, Inc. (CTI),. CTI's operations in all of Area 2 (2B, 2D, and 2F) appear to be small and short-lived. According to a former UMC employee who also worked for CTI, Vic Modglin, CTI was initially located in Herrin, Illinois, and moved its operations to the Refuge in 1968.[8] While the main production was apparently in Herrin at first, Refuge records indicate that in 1963 the newly formed CTI had also leased 5,290 square ft from the Refuge and was interested in leasing more.[9] At the beginning of 1966, CTI leased 4,056 square ft and employed four people; at the end of that year it leased 8,777 square ft and employed 12.[10] (It is likely that most of this employment was in Area 8. See Section 12.). Modglin also reported that CTI occupied buildings in Areas 2B, 2D, 2F, and "9-south."[11] A former CTI Vice President, Thomas Throgmorton, said that he worked at the Herrin Plant from 1963 to 1965, then was fired along with the other vice presidents.[12] Mr. Throgmorton

[3] Originally US FWS had two separate divisions managing the Refuge. One was the industrial division that managed the industrial tenant functions like the fire department and railway services. The other was the Refuge division that managed non-industrial activities including recreational and farming leases at the Refuge.
[4] Deposition of Harry Stiles, November 18, 1997, Page 23.
[5] Deposition of Harvey Pitt, November 19, 1997, Pages 44-46.
[6] Harvey Pitt, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-20.
[7] CRO 000056. Excerpt from: Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May through August, 1963, Page 27.
[8] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[9] CRO 000057. Excerpt from: Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May through August, 1963, Page 28.
[10] Olin, by comparison, leased over 172,000 square ft and employed 417 people at the Refuge at the beginning of 1966[10]. CRO 000096 – Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Narrative Report, 1966, Crab Orchard National Wildlife Refuge, Table No. 1.
[11] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18. The "9-south" was either an error by Modglin or a transcription error and should be 8-south. Area 9 was referred to as the "I" Area.
[12] Thomas Throgmorton, personal interview, November 9, 1999.

was rehired in 1968 and worked for CTI in Area 8 until they filed for bankruptcy in September 1970[13]. CTI's two leases (one beginning in 1963 and one beginning in 1969) were cancelled in November 1970 due to non-payment. The lease beginning in 1969 was for Area 8; presumably the lease beginning in 1963 was for Area 2; in any case, CTI was no longer a Refuge tenant after 1970.[14] Mr. John Miller, a former Olin chemist and manager, stated that CTI had a burn pad in Area 2B.[15] No other information was found to confirm this.

Olin Corporation (formerly Olin Mathieson Chemical Corp.) began leasing some of the buildings in Area 2B in 1963.[16] After CTI left in 1970, Olin was the sole lessee in Area 2B until its ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end of 1996. In January 2001, General Dynamics Corporation acquired Primex. Primex became a wholly owned subsidiary of General Dynamics and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (hereafter referred to as GDO&TS).[17,18] GDO&TS is the current tenant in Area 2B.[19] There have been several other possible tenants identified for Area 2, but no information was found regarding the buildings they leased. Table 3-2 lists all of the operators/lessees identified in Area 2.

3.1.2.1 Area 2B Products and Constituents

IOP Products and Constituents

Boosters are secondary explosives used to "detonate material that is too insensitive to be detonated by the relatively weak initiator or to ensure complete detonation of the main charge."[20] During World War II, boosters contained the explosive tetryl (2,4,6-tetranitro-N-methyl aniline). Tetryl was not synthesized at the IOP; it was shipped to the facility.[21] Tetryl processing on the booster loading line included screening and blending, pressing and finally loading. It was not determined what materials were mixed with tetryl to produce booster pellets during World War II. One former employee reported that SWDC/War Department used mercury fulminate to

[13] Thomas Throgmorton, personal interview, November 9, 1999. Throgmorton's date of September 1970 is in agreement with the Refuge annual report for 1970 (CRO-000124).
[14] CRO 000317. Fish and Wildlife Service, Letter to Central Technology Inc., regarding the cancellation of two leases and one special use permit for various buildings on the Crab Orchard National Wildlife Refuge, dated November 30, 1970.
[15] Deposition of John Miller, April 9, 1998, Page 74.
[16] DOI 001455 – DOI 001460. Tenth Amendment of Lease Contract No. 14-19-0008-2675, by and between Olin Mathieson Chemical Corporation and the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service, dated November 1, 1963. *Note that Tract F is referring to Area 2B.*
[17] General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.
[18] Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.
[19] During the site reconnaissance on April 13, 1999 it was observed that the fence line for Area 2B has changed and some of the buildings originally in Area 2B are now south of the fence. These buildings have all been razed and only their foundations and some building debris remain.
[20] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 3-1.
[21] Environmental Science & Engineering, Inc., Crab Orchard National Wildlife Refuge, Uncharacterized Sites Report, dated March 9, 1992.

sensitize the tetryl in the boosters produced in Area 2B.[22] He said that he had learned this by seeing the package of mercury fulminate being handled by an SWDC/War Department employee and asking what its purpose was.[23] It is presumed that a small amount of binding agent (e.g., graphite, stearic acid, or magnesium stearate) was mixed with the tetryl during the screening and blending phase of production to produce a mixture amenable to pressing into pellets or similar grains.[24]

UMC Products and Constituents

UMC leased buildings in this area beginning sometime after 1952 and continuing until 1963.[25, 26,27] Information on UMC's production activities in Area 2B is limited. Table 3-3 provides a general list of products manufactured at the Refuge by UMC. According to UMC's Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) Section 104(e) response, they used buildings in Area 2B to manufacture propellants. According to Mr. Harvey Pitt, a former UMC employee who later worked as an Olin manager, UMC performed tetryl-pelleting operations, manufactured gas generators and delayed fuses and loaded large explosive devices in Area 2B.[28] According to Vic Modglin, UMC manufactured and tested pyrotechnic devices in Areas 2B, 2D, and 2F. The pyrotechnic devices included explosive switches, ignitors, detonators, flares, and atomic bomb burst simulators. Modglin also reported that small amounts of isopropyl alcohol, toluene and trichloroethylene (TCE) were dumped in Areas 2B, 2D and 2F.[29]

CTI Products and Constituents

As discussed above, CTI's tenure in Area 2B was brief and limited. Vic Modglin reported that CTI manufactured and tested pyrotechnic devices in Areas 2B, 2D, and 2F, as had UMC. According to Modglin, the pyrotechnic devices included explosive switches, igniters, detonators, flares, and atomic bomb burst simulators.[30] CTI reportedly produced the following products at the Refuge: pyrotechnic devices for the military, cannon net cartridges, recoilless cannon net traps and Mark II ground burst simulators.[31] It is not known which, if any of these products were manufactured in Area 2B. Vic Modglin reported that CTI manufactured infrared flares at the

[22] Thomas Throgmorton, personal interview, November 9, 1999.
[23] Thomas Throgmorton, personal interview, November 9, 1999.
[24] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 8-55.
[25] Deposition of Harvey Pitt, November 19, 1997, Pages 44-46.
[26] CRO 000056. Excerpt from: Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May through August, 1963, Page 27.
[27] Harvey Pitt, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-20.
[28] Deposition of Harvey Pitt, November 19, 1997, Pages 45, 76-77.
[29] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[30] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-17.
[31] CRO 000124. U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Narrative Report, 1970, Crab Orchard National Wildlife Refuge, Page 44.

Refuge which reportedly contained magnesium powder, Teflon® powder, rubber, and solvents.[32] George Wisely, a former Olin manager and engineer, reported that CTI manufactured infrared flares in some buildings just east of the B Area (Area 2B).[33]

Olin/Primex/GDO&TS Products and Constituents

Olin has used the northern portion of Area 2B (see Table 3-1) for making various ammonium nitrate propellant and ammonium oxalate inhibitor and insulator mixtures (see Table 3-4 for a list of Olin propellants).[34,35,36] A 1986 Olin map indicated explosive quantities and types located in Area 2B buildings as well as the classification of these explosives. Table 3-1A summarizes the information from this map.

These northernmost buildings are located closer to Area 2D process buildings than to Area 2B buildings and are sometimes included with Area 2D buildings.[37]

3.1.2.2 Area 2B Processes and Operations

This section discusses Area 2B processes and operations during the IOP and Olin eras, building-by-building. UMC and CTI are the principal tenants discussed in this introductory section. Where there is building-specific information available for other tenants, it is also included.

UMC was reported to have occupied Area 2B from 1952 through 1963, as discussed above.[38] They may or may not have occupied all of the buildings in Area 2B at that time. UMC reportedly manufactured propellants, gas generators and delayed fuses; they also had a tetryl pelleting operation and loaded large explosive devices in Area 2B. A general list of UMC products manufactured at the Refuge is found in Table 3-3.

The specific locations of CTI's processes and operations in Area 2B were not determined.

Building B-2-1

During IOP operations, tetryl pellets were made in the B Area by compressing the blended tetryl into shape using a press machine. The pellets were then transferred from Building B-2-5 (Tetryl Pelleting Rest House) to Buildings B-2-1 and B-2-2 (Assembly Pack and Shipping Buildings)[39]

[32] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[33] Deposition of George Wisely, June 28, 1999, Page 99.
[34] Rudy Okolski, personal interview, June 30, 1999.
[35] Paul Moore, personal interview, July 14, 1999.
[36] PRI-016328 - PRI-016329. Olin inter office memo entitled *B-2-13 and B-2-15 Cleanup Operations*, dated April 27, 1983.
[37] This may be done because the majority of solid propellant assembly operations are in Area 2D.
[38] CRO 000056. Excerpt from: Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May through August, 1963, Page 27.
[39] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (Plan No. 6544-101.34), Part 1 Section 8 Page 1, and Part II Section 4 Sheet 7.

for loading into booster sleeves and subsequent distribution to the loading lines for insertion into bombs and pancake mines, as appropriate.[40,41,42] There were ten presses in Building B-2-1.[43]

A former UMC employee reported that Buildings B-2-1, B-2-2, and B-2-6 were all involved in the loading of PETN [pentaerythritol tetranitrate] in various devices.[44] A 1960 aerial photograph of the area (during UMC's tenure) identified an unusual ground scar to the west of Building B-2-1.[45] The cause of the scar was not determined and the scar was gone by 1965.

In 1975, Olin reportedly used Building B-2-1 for machining operations and a quality assurance laboratory.[46,47] George Wisely stated that solvents were used in the quality control laboratory.[48] According to one Olin internal memorandum, there was a sump associated with this laboratory in 1981.[49] Paul Moore, a former Olin employee, stated that some of the Light Antitank Weapon (LAW) production took place in Building B-2-1.[50]

This building had a boiler that was blown down daily.[51] Blow down from a boiler is water from the boiler that is occasionally released through a valve. Heavy metals contamination is possible in the area of the boiler blow down. There were six chemicals or materials Olin periodically added to the water in the boilers: phosphate, alkaline solution, sulphite, ammonia, zeolite and salt brine.[52]

In a 1985 Olin air source inventory document, a trichloroethane vapor degreaser was noted at the southern end of the Building B-2-1.[53,54]

In May 1988, Olin reported that Building B-2-1 was used as an Office Building.[55] There were inert Apilas anti-tank rockets stored in the ballroom area at this time.[56]

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[40] All information on the manufacturing process for tetryl boosters was determined from the logical order of manufacture and the Booster Loading Line plan documents from the 1944 Facilities Inventory.
[41] Deposition of Harvey Pitt, November 19, 1997, Pages 46-47.
[42] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 8-55.
[43] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III Section 2 Page 5.
[44] Thomas Throgmorton, personal interview, November 9, 1999.
[45] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Page 1 and Figure 2. The Entech reports analyze historic aerial overflight photographs of industrial areas at the Refuge, from 1943 to 1993 (except in Area 2, which was analyzed from 1960-1993). The photos were obtained from the National Archives and Records Administration (NARA) and the U.S. Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS).
[46] Paul Moore, personal interview, July 14, 1999.
[47] PRI-002647. 1975 Safety Performance Technical Systems Operation, Marion, Illinois, from the Olin files collection.
[48] Deposition of George T. Wisely, July 15, 1999, Page 17 with Exhibit 22.
[49] PRI-016249. Olin inter office memo entitled *TSO Water Discharges*, dated March 18, 1981.
[50] Paul Moore, personal interview, July 14, 1999.
[51] PRI-016297 - PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Pages 1 and 2.
[52] PRI-016299. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 3.
[53] DPRA Document No. 00026949/PRI-006609. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00001.
[54] DPRA Document No. 00026963/PRI-006631. Olin, Attachment 13 as part of 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985.

Primex leased Building B-2-1 from 1997 to 2001 for cold storage.[57] GDO&TS is the current tenant.[58]

Building B-2-2

During IOP operations, tetryl pellets were made in the B Area by compressing the blended tetryl into shape using a press machine. The pellets were then transferred from Building B-2-5 (Tetryl Pelleting Rest House) to Buildings B-2-1 and B-2-2 (Assembly Pack and Shipping Buildings)[59] for loading into booster sleeves and subsequent distribution to the loading lines for insertion into bombs and pancake mines as appropriate.[60,61,62] There were two presses in Building B-2-2.[63]

A former UMC employee reported that Buildings B-2-1, B-2-2, and B-2-6 were all involved in the loading of PETN in various devices.[64]

An explosion in 1968 reportedly destroyed building B-2-6.[65] In his deposition, Harvey Pitt said that CTI "completely obliterated" Building B-2-2 or B-2-6 and one person was killed[66]. This would indicate that CTI likely manufactured or handled explosives in this building.

Olin used Building B-2-2 as an inert storage warehouse.[67,68] In May 1988, Olin reported that Building B-2-2 was used for Propellant Storage.[69] In 1985, Olin likely housed up to 100,000 pounds of explosives in this building.[70]

Primex leased Building B-2-2 from 1997 to 2001 for cold storage.[71] GDO&TS is the current tenant.[72]

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[55] PRI-009228. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
[56] PRI-009228. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
[57] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[58] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[59] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (Plan No. 6544-101.34), Part 1, Section 7, Page 15, Part 1 Section 8 Page 1, and Part II Section 4 Sheet 7.
[60] All information on the manufacturing process for tetryl boosters was determined from the logical order of manufacture and the Booster Loading Line plan documents in the 1944 Facilities Inventory.
[61] Deposition of Harvey Pitt, November 19, 1997, Pages 46-47.
[62] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 8-55.
[63] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III Section 2 Page 6.
[64] Thomas Throgmorton, personal interview, November 9, 1999.
[65] U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Narrative Report, 1968, Crab Orchard National Wildlife Refuge, Page 54.
[66] Deposition of Harvey Pitt, November 19, 1997, Page 154.
[67] PRI-002647. 1975 Safety Performance Technical Systems Operation, Marion, Illinois, from the Olin files collection.
[68] Deposition of George T. Wisely, July 15, 1999, Pages 13- 14 with Exhibit 22.
[69] PRI-009228. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
[70] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.

IOP Building B-2-3

IOP Building B-2-3, a Detonator Service Magazine, was originally east of Building B-2-2.[73] The building was later moved to a location between Buildings B-2-1 and B-2-2, just north of Building B-2-2.

According to an original IOP map of Area 2B containing notes by Refuge personnel, IOP Building B-2-3 was noted as "moved – salvaged"[74] to an unidentified location, sometime before 1960.[75]

UMC Building B-2-3

UMC Building B-2-3 (Figure 3-3) appeared in Area 2B before 1960,[76] likely placed there by UMC since it was not one of the original IOP buildings and UMC was the only other tenant in this area before 1960.

Refuge information indicates that Building P-1-4 was moved from Area 2P to the location between Building B-2-1 and B-2-2.[77,78] Therefore, it is likely that former Building P-1-4 is UMC Building B-2-3. This building appeared in Area 2B sometime between 1951 and 1960.[79]

In 1985, Olin noted a boiler was located in Building B-2-3.[80] In May 1988, Olin reported that there was a boiler house present on site between Buildings B-2-1 and B-2-2,[81] however they did not specify the building number. It is assumed that this reference is to UMC Building B-2-3 since this building is still on site in this area.

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71 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
72 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
73 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34) and Part II Section 4 Sheet 7.
74 Original IOP Plan No.6544-101.34, last revision, December 9, 1945 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
75 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 2.
76 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 2.
77 Original IOP Plan No.6544-101.34, last revision, December 9, 1945 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
78 Undated USFWS map of Area 2-B with notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
79 1951 aerial photograph from the National Archives and Records Administration, College Park, Maryland; and, 1960 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
80 DPRA Document No. 00026949/PRI-006609. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00002.
81 PRI-009228. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.

Primex leased Building B-2-3 from 1997 to 2001. This building is either a ramp, hallway, utility system, or boiler room, not used as part of manufacturing or cold storage.[82]

GDO&TS is the current tenant in this building.[83]

IOP Building B-2-4

IOP Building B-2-4 was originally northeast of Building B-2-1 and was used as a Detonator Service Magazine.[84] This building appears to have been razed before 1960.[85]

Olin Building B-2-4

Olin referenced a Building B-2-4 that contained a boiler, but the location was not determined.[86]

Building B-2-5

Building B-2-5 was designated on IOP drawings as a Tetryl Pelleting Rest House.[87] Tetryl pellets, which were pressed in Building B-2-6 (Tetryl Pelleting Building), were then brought to Building B-2-5 prior to taking them to Buildings B-2-1 and B-2-2 for loading into booster sleeves. Building B-2-5 had three Pellet Rest Rooms that were separated by 1-ft thick concrete walls,[88] for explosion control.

Olin occupied Building B-2-5 from at least 1963[89] to 1982.[90] From 1963 to 1971, Olin used Building B-2-5 for materials storage, laboratory testing, and for the production of magnesium-Teflon flares, resulting in teflon and magnesium contamination in the building.[91] The building

[82] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 2, and 10.

[83] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[84] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34) and Part II Section 4 Sheet 7.

[85] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 2.

[86] DPRA Document No. 00015583/PRI-006598. Olin-Marion Wastewater Discharges/Sources: Group A Status Report 11 November 1985.

[87] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34), Part 1 Section 8 Page 1, and Part II Section 4 Sheet 7.

[88] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 19.

[89] DOI 003443. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, Page 3.

[90] DOI 001627. Amendment No. 2 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated May 1, 1982.

[91] DOI 003443. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, Page 3.

also contained equipment used in propellant production that was contaminated with nitroglycerin, nitrocellulose, ammonium perchlorate and other pyrotechnic components.[92]

Olin petitioned for and received a variance to burn Building B-2-5 and its contents. The burning which was performed on April 21, 1982[93,94] involved the use of black powder and possibly fuel oil, and some materials were flashed on the ground on both the north and east sides of the building.[95] As observed during the site reconnaissance, a small building (Building B-2-20) was constructed on the concrete foundation of Building B-2-5.

Building B-2-6

During the IOP era, after the booster components were mixed in Building B-2-8 (Tetryl Screen and Blend Building), the blended tetryl was brought into Building B-2-6 (Tetryl Pelleting Building)[96] for pressing. The Tetryl Pelleting Building (Building B-2-6) was a long compartmentalized building with five pellet and press areas that were separated by 12-inch thick concrete walls[97] for explosion control. Tetryl pellets were made by compressing the blended tetryl into shape using press machines. There were twelve presses located in this building.[98]

According to Mr. Harvey Pitt, UMC used Building B-2-6 for the loading of large explosive devices (one device was described as containing 75 pounds (lbs) of Trinitrotoluene (TNT)) because of its structure and remoteness.[99] These devices contained TNT, barytol and tetryl.[100] UMC performed tetryl-pelleting operations in Building B-2-6.[101] In addition, UMC used melting and casting processes on baratol (barium nitrate and TNT mixture) in Building B-2-6.[102] A former UMC employee reported that Buildings B-2-1, B-2-2, and B-2-6 were all involved in the

[92] DOI 003443. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, Page 3.
[93] DOI 003441 – DOI 003457. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, and attached Exhibits A and B.
[94] DOI 0003403. Olin, Letter to EPA regarding the burning of Buildings B-2-5, B-2-8, and an open burn located at the test range facility, dated May 24, 1982.
[95] PRI-017530 – PIR-017531. Olin, Standard Operating Procedure, Special Procedure – Opening Burning CTI and Pits, dated August 4, 1981, Pages 2-3.
[96] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34), Part 1 Section 7 Page 16, Part 1 Section 8 Page 1, and Part II Section 4 Sheet 7.
[97] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 20.
[98] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III Section 2 Page 6.
[99] Deposition of Harvey Pitt, November 19, 1997, Page 46.
[100] Deposition of Harvey Pitt, November 19, 1997, Page 46.
[101] Deposition of Harvey Pitt, November 19, 1997, Page 46.
[102] Deposition of Harvey Pitt, November 19, 1997, Page 46.

loading of PETN in various devices.[103] Another former employee reported that Building "B-26" was used to detonate explosives and measure the parameters.[104]

An explosion in 1968 reportedly destroyed building B-2-6.[105] In his deposition, Harvey Pitt said that CTI "completely obliterated" Building B-2-2 or B-2-6 and one person was killed[106]. This would indicate that CTI likely manufactured or handled explosives in this building. Thomas Throgmorton also reported that a man was killed in an explosion in Building B-2-6.[107]

It was not determined if Olin used Building B-2-6. This building appears to be partially razed in a 1971 aerial photograph, apparently the result of the 1968 explosion. Five compartments are clearly visible in the aerial photograph, which are presumably the five pellet and press areas that were separated by 12-inch thick concrete walls.[108]

Building B-2-7

Building B-2-7 was an IOP Blended Tetryl Rest House.[109] The tetryl came to this building from Building B-2-8 where it had been blended. From the Blended Tetryl Rest House, it went to the Tetryl Pelleting Building (Building B-2-6).

There were no Olin operations identified during the historic records search for Building B-2-7. The building appeared to be present on site in 1980, but has since been removed.[110]

Building B-2-8

During the IOP operations, tetryl and other components (such as binders) presumably were brought from Building B-2-9 (Tetryl Service Magazine) into Building B-2-8 (the Tetryl Screening & Blending Building),[111] as needed. The tetryl was screened using a sifter[112] on the second floor,[113] and then the booster components were mixed together in a powder blender[114]

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103 Thomas Throgmorton, personal interview, November 9, 1999.
104 Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-17. Note that there is no Building B-26; Modglin presumably said "Building Bee-two-six" and it was recorded as B-26 rather than B-2-6.
105 U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Narrative Report, 1968, Crab Orchard National Wildlife Refuge, Page 54.
106 Deposition of Harvey Pitt, November 19, 1997, Page 154.
107 Thomas Throgmorton, personal interview, November 9, 1999.
108 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 3.
109 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34), Part II Section 4 Sheet 7.
110 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 4.
111 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34), Part 1 Section 7 Page 16, Part 1 Section 8 Page 1, and Part II Section 4 Sheet 7.
112 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III Section 2 Page 6.
113 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois,Part III Section 1 Page 20.

located on the first floor of this building (Building B-2-8).[115] Mixing operations were controlled from an adjacent building (Building B-2-16 – Tetryl Screen Control Building), since the mixing operations were dangerous.

Olin occupied Building B-2-8 from at least 1960[116] to 1982.[117] From 1960 to 1963, Olin manufactured items containing Composition B (40% TNT / 60% RDX [Royal Demolition Explosive]) in this building; and from 1963 to 1971, Olin used Building B-2-8 to manufacture magnesium-teflon flares – all of which resulted in the building being contaminated with teflon, magnesium, TNT, RDX, and Composition B.[118]

Olin petitioned for and received a variance to burn Building B-2-8 and its contents. The burning which was performed on April 13, 1982,[119,120] involved the use of black powder and fuel oil.[121] According to Mr. Richard Altekruse, a former engineer and manager for Olin, this building was burned down with the approval of USFWS.[122]

IOP Building B-2-9

During the IOP era, purchased tetryl was unloaded and stored in Building B-2-9 (Tetryl Service Magazine).[123]

According to Refuge personnel, Building B-2-9 was moved to the Refuge boat dock.[124] According to aerial photographic interpretation, this building was moved sometime prior to 1960.[125]

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[114] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III Section 2 Page 6.
[115] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 21 and Part III Section 1 Page 20.
[116] DOI 003444. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, Page 4.
[117] DOI 001627. Amendment No. 2 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated May 1, 1982.
[118] DOI 003444. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, Page 4.
[119] DOI 003441 – DOI 003457. Olin Corporation, Petition for Variance, State of Illinois, Pollution Control Board, Olin Corporation, A Virginia Corporation, Petitioner, vs. The State of Illinois, Environmental Protection Agency, Respondent, dated July 14, 1981, and attached Exhibits A and B.
[120] DOI 0003403. Olin, Letter to EPA regarding the burning of Buildings B-2-5, B-2-8, and an open burn located at the test range facility, dated May 24, 1982.
[121] PIR-017531. Olin, Standard Operating Procedure, Special Procedure – Opening Burning CTI and Pits, dated August 4, 1981, Page 3.
[122] Richard Altekruse, personal interview, July 14, 1999.
[123] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 15 (plan no. 6544-101.34) and Part II Section 4 Sheet 7.
[124] Original IOP Plan No.6544-101.34, last revision, December 9, 1945 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[125] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 2.

Thomas Throgmorton, a former UMC engineer, reported that UMC used the pad at the former building B-2-9 as a burning pad where they burned ignitable wastes and products which failed QA/QC inspections. At one point UMC had an explosion on the burn pad that scattered debris for approximately one hundred yards around the burn pad. This debris had to be picked up by hand.[126] During CTI's operations in Area 2B, they reportedly operated their own burning pad at the bottom end of Area 2B.[127] It was probably the same burn pad (Building B-2-9) that was previously used by UMC. The 1960 through 1971 aerial photographs showed some ground scarring around this foundation,[128] which may have resulted from burning activities.

The aerial photographs also identified a small pond, southwest of former Building B-2-9. The pond shrank considerably between 1960 and 1971, and was dry in the 1980 aerial photograph.

Olin Building B-2-9

This building was built at the previous location of IOP Building B-2-4, sometime between 1971 and 1980[129]. In 1985, Olin used this building for residual chemical storage.[130]

Olin Building B-2-9 was shown on a map of Area 2B in a 1996 Primex document on emergency procedures.[131] The same document listed Building B-2-9 as an area where hazardous wastes are accumulated on-site for less than 90 days.

Lease records indicate that Primex leased a Building B-2-9 from 1997 to 2001 for cold storage.[132] The location of this building has not been determined.

GDO&TS is the current tenant in Building B-2-9.[133]

Building B-2-10

Building B-2-10 was designated on IOP drawings as the Change House for Area 2B.[134] Wash waters from this building may have contained explosives/organic solvent residues. Wash waters from this building either drained into the sewer system or into drainage ditches that were located nearby the building.

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[126] Thomas Throgmorton, personal interview, November 9, 1999.
[127] Deposition of John Miller, November 19, 1997, Page 74.
[128] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 2 and 3.
[129] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 3 and 4.
[130] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
[131] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[132] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[133] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[134] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 page 15 (plan no. 6544-101.34), Part I Section 8 Page 2, and Part II Section 4 Sheet 7.

As noted above, the USFWS maintained an office for their Refuge division[135,136] in Building B-2-10 from at least 1949[137] to 1956.[138] This building was also used for grain storage in 1949.[139]

Vic Modglin, reported that UMC burned scraps from explosives on a concrete pad behind Building "B-210."[140]

Olin has used Building B-2-10 (former IOP Change House) as an administration building.[141,142] Primex leased Building B-2-10 from 1997 to 2001 for cold storage.[143] GDO&TS is the current tenant in this building.[144]

Building B-2-11

Building B-2-11 was the IOP Timekeepers Building for Area 2B.[145]

E-Bee Business Systems Company began leasing Building B-2-11 in December of 1949[146] and they continued leasing it through September of 1953.[147] They used this building for manufacturing office supplies.[148]

This building was razed in 1982.

[135] Originally US FWS had two separate divisions managing the Refuge. One was the industrial division that managed the industrial tenant functions like the fire department and railway services. The other was the Refuge division that managed non-industrial activities including recreational and farming leases at the Refuge.
[136] Deposition of Harry Stiles on November 18, 1997, Page 23.
[137] DPRA Document No. 00009059. CONWR, Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, dated April 12, 1949.
[138] Deposition of Harry Stiles on November 18, 1997, Page 23.
[139] DPRA Document No. 00009059. CONWR, Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, dated April 12, 1949.
[140] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18. Note that there is no Building B-210; Modglin presumably said "Building Bee-two-ten" and it was recorded as B-210 rather than B-2-10.
[141] Deposition of Charles Funk, April 9, 1998, Page 14.
[142] PRI-002647. 1975 Safety Performance Technical Systems Operation, Marion, Illinois, from the Olin files collection.
[143] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[144] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[145] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 page 15 (plan no. 6544-101.34), Part I Section 8 Page 2, and Part II Section 4 Sheet 7.
[146] DPRA Document No. 00009075. Undated Refuge lease information document showing new leases up until 10/1/49, from the CONWR files.
[147] CRO 000211. Crab Orchard National Wildlife Refuge Industrial Unit, March 18, 1955; Analysis of Industrial Tenants Employing Labor.
[148] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.

IOP Building B-2-12

Building B-2-12 was the IOP Boiler House for Area 2B.[149] Initially, there were two coal-fired boilers located in this building and a blow-off basin was located along the north side of the building.[150] The original IOP plans do not identify any underground storage tanks (USTs) associated with this boiler house.[151]

This building was razed before 1960.[152] Sometime between 1960 and 1965, an aboveground storage tank (AST) was constructed in this area[153] and it was reported to contain fuel. A berm surrounds the fuel AST.

Olin Building B-2-12

Olin Building B-2-12 is located just east of Building B-2-1. In 1997, Primex assumed Olin's lease for this building which is either a ramp, hallway, utility system, or boiler room, and is not used as part of manufacturing or cold storage.[154] GDO&TS is the current tenant.[155]

Building B-2-13

Building B-2-13 was the IOP Central Test Building.[156] The southernmost portion of the building contained a Detonator Test-Sensitivity Test Room, a Detonator and Booster Preparation Room, and a Chronograph Test & Specific Gravity Test Room.[157] The northernmost portion of the Building (the T-shaped portion) contained a Disassembly Room, a Jolt & Jumble Preparation Room (in the center of the T-shape), and six Jolt and Jumble Rooms.[158]

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[149] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 page 15 (plan no. 6544-101.34), Part I Section 7 Page 17, Part I Section 8 Page 1, and Part II Section 4 Sheet 7.
[150] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 22.
[151] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 22.
[152] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5. The 1960 aerial photograph shows Building B-2-12 included in Area 2D. However, this building is included in Area 2B.
[153] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 5 and 6. The 1960 and 1965 aerial photographs show Building B-2-12 included in Area 2D. However, this building is included in Area 2B.
[154] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 2, and 10.
[155] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[156] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 page 15 (plan no. 6544-101.34), Part I Section 8 Page 1, and Part II Section 4 Sheet 7.
[157] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 23.
[158] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8 Page 23.

In 1977, Olin stored ammonium nitrate and guanidine nitrate in Building B-2-13 and also used hexane in this building.[159] At that time, Olin planned to remove a 50-gallon mixer from Building B-2-13 and install a new mixer at a location 130 ft from the building.[160] At the same time they planned to discontinue chemical storage at Building B-2-13.[161] Rudy Okolski, a former Olin employee, reported that hexane was stored in a 500-gallon "sphere" behind B-2-13, which was still in use at the time of the interview in 1999. It was used to "gel down" c-rubber for use as a binder.[162]

Olin also used Building B-2-13 for making various ammonium nitrate propellants such as OMAX propellant.[163,164,165] A 1985 Olin report listed receipt of 44,000 pounds of ammonium nitrate being unloaded at B-2-13.[166] Table 3-4 lists the constituents used to make various ammonium nitrate propellants. This building is located closer to Area 2D process buildings than it is to the 2B area and it is sometimes included with Area 2D buildings.

Olin stored guanidine nitrate in B-2-13.[167,168] This oxidizer[169] was used by Olin in their gas generator program[170] and was a constituent in many of Olin's propellant mixes, including OMAX[171].

In 1984, Bay A of this building contained a 200-gallon mixer for gas generator propellant.[172] Bay B was used for material preparation for raw materials of gas generator propellants (ammonium nitrate, ammonium oxalate, and guanidine nitrate).[173] The materials were ground with a hammer mill to reduce the size.[174] Bay B contained three floor drains that would have received wash waters containing ammonium nitrate dust.[175] These floor drains in this building

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[159] PRI-006700. Olin inter office memo entitled *B-2-13 Suggested Hazard Corrections (Ref. N.J. Wilkaitis – Hazard Analysis 12-20-76)*, dated April 18, 1977, Page 2.
[160] PRI-006699, PRI-006704, and PRI-006705. Olin inter office memo entitled *B-2-13 Suggested Hazard Corrections (Ref. N.J. Wilkaitis – Hazard Analysis 12-20-76)*, dated April 18, 1977, Page 1 and attached maps.
[161] PRI-006703. Olin inter office memo entitled *B-2-13 Suggested Hazard Corrections (Ref. N.J. Wilkaitis – Hazard Analysis 12-20-76)*, dated April 18, 1977, Page 4.
[162] Rudy Okolski, personal interview, June 30, 1999.
[163] Rudy Okolski, personal interview, June 30, 1999.
[164] Paul Moore, personal interview, July 14, 1999.
[165] PRI-016328. Olin inter office memo entitled *B-2-13 and B-2-15 Cleanup Operations*, dated April 27, 1983, Page 1.
[166] DPRA Document No. 00012470/PRI-003031. Olin, Receiving Report for 44,000 (880 bags) of ammonium nitrate being unloaded at B-2-13, dated November 1, 1985.
[167] DPRA Document No. 00015520/PRI-006700. Olin, Inter Office Memo entitled "B-2-13 Suggested Hazard Corrections," dated April 18, 1977, Page 2.
[168] DPRA Document No. 00011698/PRI-012444. Olin Defense Systems Ordnance, Receiving Report for guanadine nitrate, dated July 20, 1987.
[169] DPRA Document No. 00012338/PRI-003617. Olin Corporation, Hazardous Material Shipping Manifest for Intra-Plant Transfer, Rev. E 5/83, Page 2.
[170] DPRA Document No. 00011723/PRI-012463. Olin, Letter to Hummel Chemical Company regarding Olin's purchase of guanidine nitrate, dated July 16, 1987.
[171] DPRA Document No. 00026520/PRI-016329. Olin, Inter Office Memo entitled *B-2-13 and B-2-15 Cleanup Operations*, dated April 27, 1983, Page 2.
[172] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[173] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[174] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[175] PRI-016717. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

were closed in 1985.[176] In Bay C, N-28 propellant for the Sidewinder and Paveway Gas Generators was sent through a knife mill for granulation.[177] Propellants for Trident IA and IIA, Minuteman and MX were previously handled in this building.[178] In 1985, Olin likely housed up to 26,000 pounds of explosives and 20,000 pounds of oxidizers in this building.[179]In the Olin mix buildings in Area 2B (Buildings B-2-13 and B-2-15), the standard cleaning procedure for a number of years was to wash down the mixer bays every Friday afternoon using a hose and a mop and allowing the wash waters to flow out the doors to the surrounding grounds.[180,181] In previous Olin documents, it was reported that outside of Building B-2-13, propellant was evident both north and east of the building with up to 4 inches of propellant near the north exit door.[182] By January 1986, the landscape around this building was changed so that rainwater flowed away from the building.[183] In May 1987, waste explosives (scrap) that were generated in Building B-2-13, were staged/accumulated at any available location near the dock area.[184]

Primex leased Building B-2-13 from 1997 to 2001 for manufacturing purposes,[185] and also as an area where hazardous wastes were accumulated on-site for less than 90 days.[186]

GDO&TS is the current tenant.[187]

IOP Building B-2-14

Building B-2-14 was designated on IOP drawings as the Fragmentation Test Building.

This building was razed prior to 1960. [188] The Entech aerial photograph interpretation for 1960 identified the former location of IOP Building B-2-14 as a possible open storage area. Sometime

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[176] PRI-006598. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group A, Status Report, dated November 11, 1985.
[177] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[178] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[179] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
[180] Paul Moore, personal interview, July 14, 1999.
[181] PRI-016328 and PRI-016329. Olin inter office memo entitled *B-2-13 and B-2-15 Cleanup Operations*, dated April 27, 1983, Pages 1 and 2.
[182] PRI-016329. Olin inter office memo entitled *B-2-13 and B-2-15 Cleanup Operations*, dated April 27, 1983, Page 2.
[183] PRI-016549. Olin-Marion Wastewater Discharges/Sources: Group A, Status Report, dated January 16, 1986.
[184] PRI-016553. Olin inter office memo entitled *Request for Assistance, 1.) B-2-13 Scrap, 2.) D Area Sumps*, dated May 1, 1987, Page 1.
[185] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[186] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[187] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[188] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5. The 1960 aerial photograph shows the location for IOP Building B-2-14 included in Area 2D. However, this building is included in Area 2B.

between 1960 and 1965, a partially contained AST was constructed near this location. [189] Olin may have built this AST, which is reported to be a hexane tank.

Olin Building B-2-14

Olin Building B-2-14, used for testing, was constructed sometime between 1971 and 1980 in an area where no structures had been built before (Figure 3-3).[190] This building had a boiler that was blown down daily onto the ground surface.[191] By June 1987, this boiler blowdown was connected to the sewer system.[192] Heavy metals contamination is possible in the area of the boiler blow down. Six chemicals or materials were periodically added by Olin to the water in the boilers: phosphate, alkaline solution, sulphite, ammonia, zeolite and salt brine.[193] This building is located closer to Area 2D process buildings than it is to Area 2B and it is sometimes included with Area 2D buildings. Olin likely housed explosives in this building. [194]Primex leased Building B-2-14 from 1997 to 2001. This building is either a ramp, hallway, utility system, or boiler room, and is not used as part of manufacturing or cold storage.[195] GDO&TS is the current tenant.[196]

IOP Building B-2-15

Building B-2-15 was an IOP Pump House that was associated with Building B-2-6 (Tetryl Pelleting Building). [197]

Based on aerial photographs, this building was removed before 1971.[198]

Olin Building B-2-15

Olin Building B-2-15 was constructed sometime between 1971 and 1980 in a location different than the IOP Building B-2-15 (Figure 3-3).[199] Olin used Building B-2-15 for making ammonium

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[189] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 5 and 6. The 1960 and 1965 aerial photographs show the location for IOP Building B-2-14 included in Area 2D. However, this building is included in Area 2B.

[190] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8. The 1971 and 1980 aerial photographs show the location for Olin Building B-2-14 included in Area 2D. However, this building is included in Area 2B.

[191] PRI-016297 - PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Pages 1 and 2.

[192] PRI-016550. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.

[193] PRI-016299. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 3.

[194] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.

[195] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 2, and 10.

[196] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[197] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34) and Part II Section 4 Sheet 7.

[198] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 3.

nitrate propellant and ammonium oxalate inhibitor and insulator mixtures such as N-28 Propellant, F-1 Inhibitor Mix and F-21D Insulation Mix.[200] Table 3-4 lists the constituents that were used in these mixes. Building B-2-15 contained one 50-gallon mixer[201,202] that was used for mixing N-28 propellant for the Sidewinder and Paveway Gas Generators.[203] This mixer was also used for mixing F21-D insulation for the Trident and Minuteman Generators.[204] This building is located closer to Area 2D process buildings than it is to Area 2B and it is sometimes included with Area 2D buildings.

The previous cleaning procedures for Buildings B-2-13 and B-2-15 are described under Building B-2-13, above.

The mix bay in this building has a floor drain.[205] In November 1983, Olin noted that the mix in this building contained asbestos fibers.[206] These fibers were likely picked up by the dehumidification system; therefore the asbestos ends up in the water from this system which overflows to the floor drain in this building and discharges back to the Refuge Treatment Plant.[207] In 1983, Olin tested the water from this dehumidification system and asbestos was present in the water at significant levels.[208]

In 1985, Olin noted wipe samples taken from the walls of this building detected "2,4-Dinitrophenoxyethanal" and "1-Chloro-12,4-Dinithrobenzene," and recommended action be taken to remove these from the walls.[209]

Primex leased Building B-2-15 from 1997 to 2001 for manufacturing purposes.[210] GDO&TS is the current tenant in this building.[211]

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[199] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8. The 1971 and 1980 aerial photographs show the location for Olin Building B-2-15 included in Area 2D. However, this building is included in Area 2B.

[200] PRI-016328. Olin inter office memo entitled *B-2-13 and B-2-15 Cleanup Operations*, dated April 27, 1983, Page 1.

[201] PRI-00249. Document from the Olin files entitled "*B & D Area Dust Collectors,*" Page 2.

[202] PRI-003633. Olin inter office memo entitled *B-2-15/B-2-13 Mixhouses*, Page 2.

[203] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[204] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[205] PRI-016355. Olin inter office memo entitled *Point Source Discharges*, dated November 10, 1983.

[206] PRI-016355. Olin inter office memo entitled *Point Source Discharges*, dated November 10, 1983.

[207] PRI-016355. Olin inter office memo entitled *Point Source Discharges*, dated November 10, 1983.

[208] PRI-016333, PRI-016337, and PRI-016338. Environmental analysis for Olin by ARDL Incorporated for samples collected during 1983.

[209] DPRA Document No. 00026909/PRI-016526. Olin, Inter Office Memo entitled "Wipe samples (walls – B-2-15)," dated May 28, 1985.

[210] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[211] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

IOP Building B-2-16

IOP mixing operations for booster components were conducted in Building B-2-8 (Tetryl Screen and Blend Building), and these operations were controlled from an adjacent building (Building B-2-16 – Tetryl Screen Control Building),[212] since the mixing operations were dangerous.

Based on aerial photographs, this building was removed before 1971.[213]

Olin Building B-2-16

The first Olin Building B-2-16 was constructed sometime between 1971 and 1980 at a location different from IOP Building B-2-16 (Figure 3-3).[214] This building ("former Olin B-2-16" on Figure 3-3) was razed and a new Olin Building B-2-16 was built to the east of Olin Building B-2-15.[215] It was used for casting.[216] In 1985, Olin likely housed up to 20,000 pounds of explosives in this building.[217] This building is located closer to Area 2D process buildings than it is to the B area and it is sometimes included with Area 2D buildings.[218]Primex leased Building B-2-16 from 1997 to 2001 for manufacturing purposes.[219]

GDO&TS is the current tenant in this building.[220]

IOP Building B-2-17

IOP Building B-2-17 is next to IOP Building B-2-15 and was identified as a Ladies Restroom.[221]

Based on aerial photographs, this building was removed before 1971.[222]

Olin Building B-2-17

Olin Building B-2-17 was constructed sometime between 1971 and 1980 at a location different than the IOP Building B-2-17 (Figure 3-3).[223] In Bay B of this building, Olin raw materials for

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[212] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34).
[213] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 3.
[214] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8. The 1971 and 1980 aerial photographs show the location for Olin Building B-2-16 included in Area 2D. However, this building is included in Area 2B.
[215] PRI-016806. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86.
[216] PRI-009229. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
[217] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
[218] This may be done because the majority of solid propellant assembly operations are in Area 2D.
[219] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[220] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[221] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 5 Page 15 (plan no. 6544-101.34) and Part II Section 4 Sheet 7.
[222] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 3.

gas generator propellants (ammonium nitrate, ammonium oxalate, guanidine nitrate) were ground with a hammer mill to reduce particle size; and N-28 propellant and was moved through a knife mill for granulation in Bay C.[224] There was a drench coil unit present in this building that dehumidified Bays B and C of Building B-1-13.[225]

This building is located closer to Area 2D process buildings than it is to the B area and is sometimes included with Area 2D buildings.

Primex leased Building B-2-17 from 1997 to 2001 (building is either a ramp, hallway, utility system, or boiler room, not used as part of manufacturing or cold storage).[226]

GDO&TS is the current tenant in this building.[227]

Building B-2-18

Building B-2-18 was reportedly used for storage of scrap HEDPs [High Explosive Detonation Product].[228] In 1984, this building contained a drench coil unit that dehumidified Bay A of Building B-2-13, which contained a 200-gallon mixer for gas generator propellants.[229]

In 1985, this building was located on the western perimeter road in Area 2B.[230] By 1986, it was located adjacent to Building B-2-13.[231]

Primex leased Building B-2-18 from 1997 to 2001 for cold storage.[232] GDO&TS is the current tenant in this building.[233]

Building B-2-19

Building B-2-19 was used for propellant storage (i.e. Minuteman, Trident, Vickers, Sidewinder and Titan propellants).[234] In 1985, Olin likely housed up to 100,000 pounds of explosives in this building.[235]

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[223] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8. The 1971 and 1980 aerial photographs show the location for Olin Building B-2-17 included in Area 2D. However, this building is included in Area 2B.
[224] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[225] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[226] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 2, and 10.
[227] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[228] PRI-009228. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
[229] PRI-016713. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[230] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
[231] PRI-016806. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86.
[232] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[233] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[234] PRI-009229. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.

Primex leased Building B-2-19 from 1997 to 2001 for cold storage.[236] GDO&TS is the current tenant in Building B-2-19.[237]

Building B-2-20

Olin began using Building B-2-20 in 1983 and called it a Rework Building.[238] Later, Olin used B-2-20 as a "Spin Test Building."[239] In 1985, this building was located on the pad of former Building B-2-6 and was noted as the Supervisor Granulator Building[240] It housed HE/HEI pellets.[241] It is currently located on the foundation of former IOP Building B-2-5. Primex leased Building B-2-20 from 1997 to 2001 for manufacturing purposes.[242] GDO&TS is the current tenant.[243]

Building B-2-20N

Building B-2-20N is a smaller building that was built on a portion of the foundation of Building B-2-6, sometime since 1980. No other information was found regarding this building.

Building B-2-21

Olin used Building B-2-21 as an Inert Control Room,[244] also called a Control Building. Olin's use of this building began in 1983.[245] In 1985, this building was located on the pad of former IOP Building B-2-5.[246] Later, another building, B-2-20 was located on the pad of former IOP Building B-2-5. It is unknown where Building B-2-21 is currently located.

Primex leased Building B-2-21 from 1997 to 2001 for manufacturing purposes.[247] GDO&TS is the current tenant.[248]

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235 DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
236 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
237 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
238 DPRA Document No. 00018990/DOI 001743. Olin, Building Usage, Lease #14-19-008-2675, April-June 1983.
239 PRI-009228. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
240 DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
241 DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
242 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
243 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
244 DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
245 DPRA Document No. 00018990/DOI 001743. Olin, Building Usage, Lease #14-19-008-2675, April-June 1983.
246 DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.
247 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

Buildings B-2-22 and B-2-23

The current location of these buildings was not determined; however, in 1985, they were located adjacent to Building B-2-13.[249] According to an Olin building usage document, Olin began using these structures as humidity control buildings in 1983.[250]

Primex leased these buildings from 1997 to 2001. They were described as either a ramps, hallways, utility systems, or boiler rooms, and were not used as part of manufacturing or cold storage.[251] GDO&TS is the current tenant in both buildings.[252]

Building B-2-25 and Building B-2-26

These two buildings, located north of Olin Building B-2-14,[253] were used by Primex as areas where hazardous wastes were accumulated on-site for less than 90 days.[254]

Building B-2-27

This building is southwest of Olin Building B-2-14 and appears on site after 1993. Primex leased it from 1997 to 2001 for cold storage.[255] GDO&TS is the current tenant.[256]

3.1.2.3 Miscellaneous Area 2B Information

Containerized Materials Storage Area

Containerized-materials storage and a mound of probable earthen waste material was observed in historical 1943 aerial photographs, south of AUS-0A2B (Area 2B) along Wolf Creek Road.[257] This site is shown as Location 02 in Figure 43-5 of this report. This site appears to have been used only by the IOP but it does not appear to be related to production in Area 2 since it is not

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[248] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[249] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.

[250] DPRA Document No. 00018990/DOI 001743. Olin, Building Usage, Lease #14-19-008-2675, April-June 1983.

[251] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 2, and 10.

[252] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[253] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 15.

[254] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 12.

[255] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[256] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[257] Entech, Inc., August 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacaterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion, Illinois, Volume I: Text, Page 3-11.

included in any of the Area 2 load lines.[258] It also does not have any roads (other than Wolf Creek Road) connecting it with the production facilities for the four load lines in Area 2.[259]

IOP Decontamination

After the IOP operations ended at the Refuge, the IOP was to be decontaminated in accordance with a manual developed by the Ordnance Field Director of Ammunition Plants (OFDAP), called "*Shut-Down and Decontamination Procedures for F.D.A.P Facilities*."[260] This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.[261] According to this document, there were several cleaning compounds used for desensitizing various explosives. These were as follows:[262]

Explosive Material	Cleaning Compound
Black Powder	Water
Explosive D	Water
TNT	Steam and Sellite
Pentolite	Steam and Sellite
Composition B	Steam and Sellite
Tetryl	Acetone or Sellite
Lead Azide	Cerric Ammonium Nitrate or a mixture of Sodium Nitrate and Nitric Acid
Fulminate of Mercury	Hypo
Pyrotechnics	Petroleum Fractionation Stoddard Solvent
Tritonal	Steam
Smokeless Powder	Water and Acetone
Picric Acid and Ammonium Picrate	Water
Nitroglycerin	Nitroglycerin Remover

[258] Entech, Inc., August 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacaterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion, Illinois, Volume II: Maps, Page E.
[259] Entech, Inc., August 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacaterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion, Illinois, Volume II: Maps, Page E.
[260] ACO 005047 - ACO 005109. Office of Field Director of Ammunition Plants, Shut-Down and Decontamination Procedures for F.D.A.P. Facilities.
[261] ACO 004979 – ACO 004980. CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.
[262] ACO 005070. Office of Field Director of Ammunition Plants, "Shut-Down and Decontamination Procedures for F.D.A.P. Facilities," Page 19.

Environmental Science & Engineering, Inc. (ESE) investigated these cleaning compounds, and their findings were as follows:[263]

- Sellite – complex sodium salts of nitroaromatic compounds
- Hypo – likely Hypochlorite – a component of bleach
- Petroleum Fraction Stoddard Solvents – a petroleum distillate product referred to as petroleum ether
- Nitroglycerin Remover – a strong base/solvent mixture such as sodium hydroxide with methanol or potassium hydroxide with ethanol.

It was also reported that stainless steel valves were to be cleaned by immersion in toluene.[264]

Post-World War II military records are inadequate to determine if this area was decontaminated and, if so, whether it was adequately decontaminated, and if decontamination instructions were followed.

Other Potential Releases

In many cases, solvent wastes in the early days of industrial activity at the Refuge were probably disposed of by dumping. Statements by former employees of both UMC and Olin indicate that dumping of organic chemicals (solvents) onto the grounds surrounding process buildings was common.[265,266] It is likely that this type of activity was also prevalent during the IOP operational period. Solvents reportedly used and/or dumped by industrial tenants include methylene chloride, methyl ethyl ketone, acetone, trichloroethylene, and hexane.[267,268,269] Rudy Okolski reported that TCE was the universal cleaning agent from 1964 through 1980, and that it was dropped off everywhere in 55-gallon drums.[270]

During regular cleaning activities in buildings not containing sumps, water was used to hose down the building interiors in at least some cases. The wash water was then allowed to drain out the door onto the surrounding grounds and ditches.[271,272] Wash waters as well as process and cleaning solvents drained to the sumps in the buildings that had sumps (no sumps were noted during the site reconnaissance or on the drawings in Area 2B).

Also, John Miller stated that upon his arrival at the refuge in 1957, burning was the principal means of disposal of solid and hazardous waste.[273] Liquid waste was poured into saw dust and then burned.[274]

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[263] Environmental Science & Engineering, Inc., 1992, Uncharacterized Sites Report, Page 6.
[264] Environmental Science & Engineering, Inc., 1992, Uncharacterized Sites Report, Page 6.
[265] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[266] Paul Moore, personal interview, July 14, 1999.
[267] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[268] Rudy Okolski, personal interview, June 30, 1999.
[269] Deposition of George Wisely, June 28, 1999, Page 178.
[270] Rudy Okolski, personal interview, June 30, 1999.
[271] Paul Moore, personal interview, July 14, 1999.
[272] NAR 0766. Sanitary Survey conducted by the Sixth Service Command, dated April 12, 1943.
[273] Deposition of John Miller, April 9, 1998, Page 76.

He also stated that he was not aware of other tenants using Olin's hazardous waste burn areas; they were "Olin exclusive."[275]

Explosive Scrap Pickup

There was one explosive scrap pickup point identified by Olin in 1975, in Area 2B: B-2-13 – Propellant.[276] The explosive scrap was presumably collected from this point and transported to the burning grounds for disposal.

Polychlorinated Biphenyls (PCBs)

Electrical transformers have been located in Area 2B from as far back as the IOP days. In 1946, IOP documented six pole-mounted transformers, and a substation consisting of six ground-elevation transformers in Area 2B:[277,278]

- one three-phase transformer bank of three (3) 5-KVA pole-mounted transformers located southwest of Building B-2-10;
- one three-phase transformer bank of three (3) 37.5-KVA pole-mounted transformers located southeast of Building B-2-1; and,
- one ground-elevation substation consisting of three (3) 100-KVA transformers, and three (3) 25-KVA transformers located southwest of Building B-2-13.

By 1979, Olin began to inventory their "PCB transformers" at the Refuge, including a listing of transformers in Area 2B.[279] The following table is a summary of the history of these transformers and their replacements.

[274] Deposition of John Miller, April 9, 1998, Page 76.
[275] Deposition of John Miller, April 9, 1998, Page 120.
[276] PRI-002629. 1975 Safety Performance Technical Systems Operation, Marion, Illinois, from the Olin files collection.
[277] DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Pages 19 and 20.
[278] DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Plan No. 6544-502.75, Plate No. 10, Page 102.
[279] PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
B-2-1	?	?	37.5	?	• Only noted once in a 1979 Olin document; was located inside B-2-1; no other information has been found[280]
West of **B-2-13**	25670	Pole	25	134 ppm	• Documented as early as 1979[281] • 1981 – transformer removed; stored in F-2-3; replaced with one of the following: S/NL835088YDLA, L782288Y74AA, or L806535YCLA[282] • 1981 – transformer stored in F-2-2[283] • 1983 – transformer stored in F-2-4[284] • 1983 – transformer content analytical results indicate "134" but the laboratory document does not show if this value is in ppm[285] (an Olin Hazardous Waste Manifiest indicates this value is at ppm)[286] • 1984 – transformer in transport for disposal[287] • 1985 – transformer received by CECOS International for disposal[288]
West of **B-2-13**	25672	Pole	50	181 ppm	• Documented as early as 1979[289] • 1981 – transformer removed; stored in F-2-3; replaced with one of the following: S/NL835088YDLA, L782288Y74AA, or L806535YCLA[290] • 1981 – transformer stored in F-2-2[291] • 1983 – transformer stored in F-2-4[292] • 1983 – transformer content analytical results indicate "181" but the laboratory document does not show if this value is in ppm[293] (an Olin Hazardous Waste Manifiest indicates this value is at ppm) [294] • 1984 – transformer in transport for disposal[295] • 1985 – transformer received by CECOS International for disposal[296]

[280] PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
[281] PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
[282] ACO 002491. Olin, 1981 PCB Annual Document, dated June 22, 1982.
[283] DOI 004335. Olin, 1981 PCB Inventory, F-Area Storage.
[284] DOI 004358. Olin, 1983 PCB Annual Document "PCBs and PCB Items in Service or Projected for Disposal," Table I – F-2-4 Olin-Marion Storage for Olin-Marion Transformers.
[285] DOI 004385. Applied Research & Development Laboratory, report regarding PCB transformer samples, dated January 18, 1984.
[286] DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
[287] DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
[288] DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
West of **B-2-13**	25677	Pole	25	115 ppm	• Documented as early as 1979[297] • 1981 – transformer removed; stored in F-2-3; replaced with one of the following: S/NL835088YDLA, L782288Y74AA, or L806535YCLA[298] • 1981 – transformer stored in F-2-2[299] • 1983 – transformer stored in F-2-4[300] • 1983 – transformer content analytical results indicate "115" but the laboratory document does not show if this value is in ppm[301] (an Olin Hazardous Waste Manifiest indicates this value is at ppm) [302] • 1984 – transformer in transport for disposal[303] • 1985 – transformer received by CECOS International for disposal[304]
West of **B-2-13** (east of B-2-14)	L782288Y74AA	Pole	50	5 ppm[a]	• 1981 – taken from unknown storage location and used to replace either 25670, 25672, or 25677[305] • 1986 – noted in service[306]

289 PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
290 ACO 002491. Olin, 1981 PCB Annual Document, dated June 22, 1982.
291 DOI 004335. Olin, 1981 PCB Inventory, F-Area Storage.
292 DOI 004358. Olin, 1983 PCB Annual Document "PCBs and PCB Items in Service or Projected for Disposal," Table I – F-2-4 Olin-Marion Storage for Olin-Marion Transformers.
293 DOI 004385. Applied Research & Development Laboratory, report regarding PCB transformer samples, dated January 18, 1984.
294 DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
295 DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
296 DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
297 PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
298 ACO 002491. Olin, 1981 PCB Annual Document, dated June 22, 1982.
299 DOI 004335. Olin, 1981 PCB Inventory, F-Area Storage.
300 DOI 004358. Olin, 1983 PCB Annual Document "PCBs and PCB Items in Service or Projected for Disposal," Table I – F-2-4 Olin-Marion Storage for Olin-Marion Transformers.
301 DOI 004385. Applied Research & Development Laboratory, report regarding PCB transformer samples, dated January 18, 1984.
302 DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
303 DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
304 DOI 004382A. Olin, Uniform Hazardous Waste Manifest Number IL 11495313, dated December 1984.
305 ACO 002491. Olin, 1981 PCB Annual Document, dated June 22, 1982.
306 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
West of **B-2-13** (east of B-2-14)	L806535YCLA	Pole	50	5 ppm[a]	• 1981 – taken from unknown storage location and used to replace either 25670, 25672, or 25677[307] • 1986 – noted in service[308]
West of **B-2-13** (east of B-2-14)	L83588YDLA	Pole	50	5 ppm[a]	• 1981 – taken from unknown storage location and used to replace either 25670, 25672, or 25677[309] • 1986 – noted in service[310]
South of **B-2-13**	504578	Ground	167	5 ppm[a]	• Documented as early as 1979[311] • 1986 - noted in service (noted as 5U4578 but was probably a typographical error)[312]
South of **B-2-13**	504579	Ground	167	5 ppm[a]	• Documented as early as 1979[313] • 1986 - noted in service (noted as 5U4579 but was probably a typographical error)[314]
South of **B-2-13**	504580	Ground	167	5 ppm[a]	• Documented as early as 1979[315] • 1986 – transformer stored in F-2-2 (noted as 5U4580 but was probably a typographical error) [316]
North of **B-2-13**	275021	Pole	10	59 ppm	• Documented as early as 1979[317] • 1984 – transformer contents analytical results indicate 59 ppm as Aroclor 1260.[318] • 1985 - transformer removed from service and stored in F-2-4; replaced with S/N 84DM2718201P3[319] • 1985 - transformer received by CECOS international for disposal[320]

307 ACO 002491. Olin, 1981 PCB Annual Document, dated June 22, 1982.
308 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
309 ACO 002491. Olin, 1981 PCB Annual Document, dated June 22, 1982.
310 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
311 PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
312 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
313 PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
314 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
315 PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
316 DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
317 PRI-00622. Olin, "Oct. 1979 PCB Transformer Inventory, (B-Area)."
318 DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984.
319 DOI 004412 and DOI 004415. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00001 and 00004.
320 DOI 004394. Olin, Uniform Hazardous Waste Manifest Number IL 1310998, May 2, 1985.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
East of **B-2-13**	84DM2718201P3	Pole	?	0 ppm[a]	• 1985 – replaced S/N 275021[321] • 1986 – noted in service[322]
South of **B-2-13**	N326650YGTA	Ground	100	0 ppm[a]	• 1982 – new transformer installed on ground south of B-2-13[323] • 1986 – noted in service[324]
South of **B-2-13**	N306624YFTA	Ground	100	0 ppm[a]	• 1982 – new transformer installed on ground south of B-2-13[325] • 1986 – noted in service[326]
South of **B-2-13**	F669615-67P	Ground	100	210 ppm[a]	• 1982 – new transformer installed on ground south of B-2-13[327] • 1985 – transformer removed from service and stored in F-2-4; replaced with S/N E483853-60Y[328] • 1985 – transformer received by CECOS international for disposal[329]
South of **B-2-13**	E483853-60Y	Ground	100	10 ppm[a]	• 1985 – replaced S/N F669615-67P[330] • 1986 – noted in service[331]
East of **B-2-13**	10654	Ground	150	5 ppm[a]	• 1985 – first documentation of this transformer – installed in April 1985[332] • 1986 – noted in service[333]
South of **B-2-13**	781050563	Ground	167	1 ppm[a]	• 1986 – noted in service[334]

[a] PCB content values and other information described above was found in an Olin transformer inventory document.[335] Some of the PCB values were followed by the letters "LT." However, it is unclear what this means. This document contained a column for entries regarding PCB certification by either "Letter" or "Analysis," but the document did not indicate the origin of the letter or who performed the analysis. No other documentation was found to substantiate these PCB values.

[321] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[322] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[323] DOI 002493. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[324] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[325] DOI 002493. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[326] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[327] DOI 002493. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[328] DOI 004412 and DOI 004415. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00001 and 00004.
[329] DOI 004398. Olin, Uniform Hazardous Waste Manifest Number IL 1311047, November 20, 1985.
[330] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[331] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[332] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[333] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[334] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[335] DOI 004412 – DOI 004425. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986.

Note, the only transformers in Area 2B with documentation of their transport and arrival at landfills were S/N numbers 25670, 25672, 25677, 275021, and F669615-67P. No other information was found to indicate if the rest remain in service, in storage, or were disposed of.

The Olin transformer inventory document also noted that Central Illinois Public Service (CIPS) had six pole-mounted transformers in Area 2B: three southwest of B-2-10 and three southeast of B-2-1.[336] No other information was found regarding these transformers.

Other Olin/Primex/GDO&TS Chemicals of Concern

The following chemicals, among others, were listed on an obsolete Olin MSDS list.[337]

- Trichloroethylene
- Toluene
- Xylene
- Boron
- Barium nitrate
- Chromic acid, solid
- Mercury
- Copper sulfate
- Zinc oxide
- Acetone
- Methyl isobutyl ketone
- Methyl ethyl ketone
- Trichlorotrifluoroethane
- Methylene chloride
- Chloroform
- Benzene
- 4,4-methylene bis(2-chloroanaline)
- Pyridine
- Triethylamine
- Aniline
- Cresol
- Carbon tetrachloride
- Carbon disulfide
- Diethyl ether
- Dimethyl ether
- Toluene-2,4-di-isocyanate
- Ethylene diamine
- Perchloroethylene
- Di-(2ethylhexyl)phthalate
- Dimethyl phthalate
- Dibutyl phthalate
- Cobalt (6%) naphthenate solution

[336] DOI 004418. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986.
[337] DOI-001780 through DOI-001782. This is an obsolete MSDS list from Olin's file. It contains an index of chemicals on file prior to the OSHA hazard communication law.

The following wastes, among others, were identified in a 1981 letter from J.E. Redden, Vice President of Olin's Technical Systems Operations to USFWS Refuge Manager Wayne Adams.[338] Redden indicates that the information was being provided as requested by Mr. Adams, and listed wastes "which it may be necessary to store in Refuge buildings pending arrangements for disposal":

- RCRA Code F002, Spent hologinated (sic) solvent, maximum 1,000 lbs
- RCRA Code U102, Dimethyl phthalate, maximum 50 lbs.
- RCRA Code U107, Di-n-octyl phthalate, maximum 50 lbs
- RCRA Code U160, Methyl ethyl ketone peroxide, maximum 50 lbs
- RCRA Code U196, Pyridine, maximum 50 lbs
- RCRA Code U223, Toluene di-isocyanate, maximum 50 lbs
- RCRA Code U002, Acetone, maximum 200 lbs
- RCRA Code U226, 1-1-1 Trichloroethane, maximum 150 lbs
- RCRA Code U228, Trichloroethane, maximum 150 lbs
- RCRA Code P015, Beryllium dust, maximum 50 lbs
- RCRA Code D005, Barium salts, maximum 500 lbs
- RCRA Code D006, Cadmium salts, maximum 50 lbs
- RCRA Code D007, Chromium salts, maximum 50 lbs
- RCRA Code D008, Lead salts, maximum 100 lbs
- RCRA Code D009, Mercury salts, maximum 50 lbs
- RCRA Code D010, Selenium salts, maximum 5 lbs
- RCRA Code D011, Silver salts, maximum 50 lbs.

In a 1983 Generator Annual Hazardous Waste Report to the State of Illinois, Olin listed the following wastes, among others:[339]

- RCRA Code F005, Spent pyridine, solidified (Karl Fisher), 55 gallons
- RCRA Code D006, Cadmium and lead/debris from fired generator/Ajax ash, 55 gallons
- RCRA Code D001, Ignitable and spent toluene and spent methyl isobutyl ketone (spent thinner and adhesive mixture, solidified), 55 gallons
- RCRA Code U158, 4,4'-methylene bis (2-chloroaniline), 110 gallons
- RCRA Code D009, Mercury/lab pack/mercury contaminated material, 55 gallons.

The following constituents of waste explosive compounds and compositions, among others, were listed in another Olin document:[340]

- Ammonium dichromate
- Barium nitrate
- 2-nitrodiphenylamine (described as a constituent of Fluid Ball Powder Type A and Type B)

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[338] FWM 000098 - FWM 000099. Olin Corporation, Letter to Crab Orchard National Wildlife Refuge regarding special Wastes and the possibility of storing them in refuge buildings, dated May 8, 1981.
[339] DOI 002359. Olin Corporation, Illinois Environmental Protection Agency, Generator Annual Hazardous Waste Report, dated February 23, 1984, Page 002.
[340] DOI 002616. Olin Corporation, Hazardous Waste Facility Closure Plan, Ordill Industrial Area, S.O.P. 90,356, REV. K 9/88, dated October 4, 1988, Page 39.

Area East of Load Line

There was a ground-scarred area identified in the 1980 aerial photographs that resembled a north-south oriented ridge.[341] It is possible that something may have been buried at this location. There is some evidence of erosion to the south-southeast of the ridge.[342] The approximate location of these features is shown on Figures 3-4, 3-5, and 3-6.

3.1.3 Area 2B Previous Sampling Results

USEPA Sampling, 1998

The United States Environmental Protection Agency (USEPA) collected seven samples (AUS 6-1 through 6-7) from AUS-0006 (Booster Loading Line – Area 2B). Sample locations are shown in Figures 3-4, 3-5, and 3-6. The results for all detected constituents are listed in Table 3-4A. The following semi-volatile organic compounds (SVOCs) were detected at the site above either USEPA Soil Screening Levels (SSLs) and/or Canadian Soil Quality Guidelines (CSOQGs): benzo[a]anthracene (0.26 milligrams per kilogram (mg/kg), benzo[a]pyrene (0.29 mg/kg), benzo[b]fluoranthene (1.1 mg/kg), benzo[k]fluoranthene (1.1 mg/kg), and dibenz[a,h]anthracene (2.3 mg/kg). Barium (16,000 mg/kg), cadmium (7.4 mg/kg), mercury (0.12 mg/kg), nickel (120 mg/kg), and silver (84 mg/kg) exceeded USEPA SSLs and Refuge background levels.[343] Lead (2,300 mg/kg), zinc (1,500 mg/kg), copper (3,400 mg/kg), and cobalt (70 mg/kg) exceeded New Dutchlist Soil Optimum Levels (DSOLs) and Refuge background levels. Chromium (8,000 mg/kg) exceeded CSOQG and Refuge background level.

3.1.4 Observations During Site Visit

The site visit was done in the spring of 1999.

Drainage ditches paralleled many of the roadways in this area. The northern portion of Area 2B generally drains to the north and the southern portion of Area 2B generally drains to the south. There were some ponded areas located in the southeast corner of the Area 2B load line.

Approximately 10 to 20 drums were observed next to the foundation of former Building B-2-9 (which was reportedly a former burn pad). The drums have been abandoned and are empty. Debris that might have been pyrotechnic material was also present on the foundation and in the area surrounding the foundation.

Concrete foundations are all that remain at several of the former IOP building locations. One of these former building locations is Building B-2-8. The foundation for this building was observed on site and a 4-inch drain was observed in this foundation.

Two sewer manholes were observed, south of Building B-2-10 (former IOP Change House).

[341] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 4.
[342] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 4.
[343] See Table 1-11 of this report for Refuge background soil values used for the PA.

3.1.5 Recommendations Based on Preliminary Assessment

Based on the historic search, all potential releases from Area 2B have not been previously addressed. The only previous CERCLA-related investigation at Area 2B was the sampling done by USEPA in 1998. Based on the lack of previous investigation and the exceedances of Preliminary Assessment (PA) screening levels in the USEPA 1998 results, Area 2B (Site AUS-0A2B) was included in the Site Investigation (SI).

3.2 SITE INVESTIGATION INFORMATION

URS conducted an SI at AUS-0A2B from March 20 through March 29, 2000 and on May 15, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)[344] for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 3.1) has been updated to include that information. The sampling locations discussed below are based on the information that was available at the time the FSP was developed, and may not address all areas of potential releases.

AUS OU SI sample locations are shown on Figures 3-4, 3-5, and 3-6. Survey coordinates for all sample locations in Area 2B are listed in Table 3-5. Table 3-8 lists the sample locations and the matrix sampled at that location. All samples are soil unless otherwise noted. Groundwater samples were taken at all the wells installed.

3.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. The field investigation is summarized in this section, following the same order of description of site features as Section 3.1.2.2 of this report.

Building B-2-1

There were four sample locations (0A2B-007, 0A2B-008, 0A2B-012 and 0A2B-020) in the area surrounding Building B-2-1.

Samples 0A2B-007 (east of building) and 0A2B-020 (north of building) were collected from areas that may have received discharge of cleaning fluids from the building. Solvent use in this building is likely since there were ten presses present in this building during the IOP, and subsequent tenant use likely involved solvents. This building was used by IOP for loading booster sleeves with blended tetryl, by Olin for machining operations, by Olin for Light Anti-Tank Weapon (LAW) production and by Olin for a quality assurance laboratory. UMC and/or CTI may also have used it for explosives-related operations.

Sample 0A2B-012 is in a ditch near a scarred area west of the building that was identified on historical aerial photographs.

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[344] U.S. Fish & Wildlife Service, Department of the Interior, March 2000, Draft Final Field Sampling Plan Site Inspection, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County), prepared by URS Corporation.

Sample 0A2B-008 is northwest of Building B-2-1 in a drainage ditch that appears to receive runoff from the northern half of the main part of Area 2B (areas surrounding Building B-2-1, Olin Building B-2-3, Building B-2-4 and Building B-2-5).

Building B-2-2

There were two sample locations (0A2B-006 and 0A2B-019) in the area around former Building B-2-2. Samples 0A2B-006 (planned location was east of building) and 0A2B-019 (west of building, in a drainage ditch) were collected from next to the building in areas that may have received discharge of cleaning fluids from the building. Solvent use in this building is likely since there were two presses present in this building during the IOP, and subsequent tenant use likely involved solvents. This building was used by IOP for loading booster sleeves with blended tetryl, by UMC for loading of PETN in various devices, and by Olin for storage. UMC and/or CTI may also have used it for explosives-related operations. As noted above, the sample location 0A2B-006 was planned to be located on the east side of Building B-2-2, however it was actually located next to the southeast corner of IOP Building B-2-3.

Building B-2-5

Sample location 0A2B-018 is in a drainage ditch to the northeast of former Building B-2-5. This drainage ditch likely receives drainage from the area surrounding this building. This building was used by the IOP for the storage of tetryl pellets and UMC, CTI, and/or by Olin for manufacturing magnesium-teflon flares.

Building B-2-6

Sample 0A2B-004 was located in a drainage ditch to the east of Building B-2-6. This drainage ditch may have received discharge of cleaning fluids from the building. Solvent use in this building is likely since there were twelve presses present in this building during the IOP and subsequent tenant use likely involved solvents. The building was historically used by the IOP as a Tetryl Pelleting Building, and it included five pellet and press areas. UMC reportedly used melting and casting processes on baratol, had a tetryl pelleting operation, and loaded large explosive devices in Building B-2-6. CTI and/or Olin may have also used this building for various explosives-related activities.

Building B-2-7

Sample 0A2B-017 is located in a small drainage ditch to the north of former Building B-2-7 (Blended Tetryl Rest House) and to the south of former Building B-2-6. The ditch may have received drainage from the either of these building areas. UMC, CTI and/or Olin may have also used this building for various explosives-related activities.

Building B-2-8

There were three samples (0A2B-003, 0A2B-016 and 0A2B-W01) in the area surrounding former Building B-2-8. Sample 0A2B-003 was located on the east side of the building (near the doorway to the building) and Sample 0A2B-016 was located in a drainage ditch to the west of the building. This building was used by the IOP for screening tetryl and blending booster components in a powder blender. UMC and CTI may have also used this building for various explosives-related activities. Olin used this building for manufacturing magnesium –teflon flares and items containing Composition B.

Building B-2-9

There were four sample locations (0A2B-001, 0A2B-002, 0A2B-005 and 0A2B-015) in the area near former Building B-2-9. Both a soil and a drum sample were taken at Location 0A2B-002, and both soil and surface water were sampled at Location 0A2B-015.

This building was used by the IOP for storing purchased tetryl. UMC may have also used the building at some point. UMC (and later, CTI) may have used the foundation of this building as a burn pad for tetryl, TNT and/or other explosive materials. There was some ground scarring identified in historical aerial photographs in this area, during both UMC and CTI's tenure at the site. This scarring may have been a result of burning operations. Sample 0A2B-005 was located in the historic ground-scarred area, east of former Building B-2-9. Sample 0A2B-002 was located along the west side of the building foundation, in an area of approximately 10 to 15 abandoned, empty drums. Sample 0A2B-001 was located in a drainage ditch southwest of this building that appears to receive runoff from the southern portion of Area 2B. Monitoring well 0A2B-W01 was located to the southeast of former Building B-2-9, next to a ponded area. This ponded area appears to receive drainage from the eastern portion of the load line. Also, sample 0A2B-015 was located southwest of former Building B-2-9, in an area that historically contained a pond. This pond either dried up or was drained at around the same time that activity in Area 2B decreased, so it may have been related to activities in this area.

Building B-2-12

No evidence was found of USTs associated with the former IOP Boiler House, Building B-2-12. Sometime between 1960 and 1965, an AST was constructed in this area and it was reported to contain fuel. Monitoring well 0A2B-W03 was located in the loading area for this fuel AST.

Building B-2-13

There were four samples (0A2B-010, 0A2B-011, 0A2B-021 and 0A2B-022) located in the area surrounding Building B-2-13. This building was used by the IOP as a central testing facility and Olin used it for making various ammonium nitrate propellant and ammonium oxalate inhibitor and insulator mixtures. This building contained two mixers for the production of ignition and propellant mixes. The mixer bays were washed down every Friday afternoon and the wash waters flowed out the doors onto the surrounding grounds. Outside of Building B-2-13 propellant was evident both north and east of the building with up to 4 inches of propellant evident near the north exit door. Sample 0A2B-021 was located next to the northernmost exit of the building. Samples 0A2B-010, 0A2B-011 and 0A2B-022 were all located next to exit doors that were near mixer bays, since these locations would have likely received discharge of wash waters during cleaning operations.

IOP Building B-2-14

Monitoring well 0A2B-W02 was located in the loading area for a hexane AST to detect any potential contamination associated with the tank as a result of leakage or spillage of hexane. The hexane AST appears to coincide with the location of former IOP Building B-2-14. Former IOP Building B-2-14 was used for fragmentation testing. IOP Building B-2-14 was razed sometime prior to 1960 and the hexane AST was constructed sometime between 1960 and 1965.

Olin Building B-2-15

Sample (0A2B-009) was located along the west side of Building B-2-15. Olin used this building for making ammonium nitrate propellant, ammonium oxalate inhibitor, and insulator mixtures. This building contained one mixer for the production of ignition and propellant mixes. The mixer bay was washed down every Friday afternoon and the wash waters flowed out the doors onto the surrounding grounds. By April of 1983, it was noted that propellant was evident on the ground to the west of Building B-2-15 for 10 to 15 ft. The propellant is no longer evident on the ground surface in this area, however an attempt was made to collect the sample from this area.

Area East of Load Line

There was a ground-scarred area identified in the aerial photographs that resembled a north-south oriented ridge. The approximate location of these features is shown on Figure 3-6. A magnetometer survey was done in this area in April 2000, at the approximate location shown in Figure 3-6. Sample 0A2B-013 was placed at the location of a magnetic anomaly found during the survey.

Sample 0A2B-014 was collected from a drainageway that appeared to receive runoff from the ridge discussed above.

3.2.2 Field Results

3.2.2.1 Site Conditions

3.2.2.1.1 Geologic Conditions

Three monitoring wells were installed at this site. Figure 3-7 is a geologic cross-section that was developed from the soil boring information from the monitoring wells. Figure 3-6 shows the location of the geologic cross-section. Boring logs and monitoring well construction diagrams are included in Appendices A and B, respectively. Boring depths ranged from 19 to 24 ft below ground surface (bgs).

As shown in the geologic cross-section in Figure 3-7, one to two feet (ft) of fill material and topsoil overlays the site. Below the fill, there is a 7 to 13.5-ft thick layer of low plastic silty clay and silt loess. The loess overlies an 8 to 10-ft thick layer of glacial till consisting of low to high plastic silty clay with sand and gravel. Note that from 8 to 14 ft bgs in 0A2B-W03, the headspace readings were elevated and there was a petroleum odor detected within that range. The boring for Well 0A2B-W01 encountered sandy clay in the bottom 6 inches of the boring.

3.2.2.1.2 *Hydrogeologic Conditions*

At AUS-0A2B groundwater was encountered in all three soil borings during drilling at depths ranging from 6.5 to 19 ft bgs (elevations ranging from 407.38 to 427.69 ft msl), as shown in Figure 3-7. Figure 3-8 is a groundwater contour map of Area 2 based on data from the 18 monitoring wells installed at Area 2, obtained during October 2000. Table 3-7 presents the groundwater elevations measured in the Area 2 wells in May, July, September, and October 2000. As shown in this groundwater contour map, the overall flow direction of the groundwater in Area 2 appears to be towards the Lake (generally to the southwest). Slug tests were performed on each of the three wells that were installed within Area 2B during the AUS OU investigation, resulting in hydraulic conductivity values that ranged from 2.35E-06 to 2.32E-05 centimeters per second (cm/sec). Slug test results are presented in Table 3-6. Slug tests are included in Appendix C.

Hydraulic conductivity values from slug tests are less than the trigger values for State of Illinois Class I Groundwater (Title 35 of the Illinois Administrative Code (35 IAC) 620.210(a)(4)(B)(ii)). Based on the borings at the site, the aquifer does not appear to meet any of the other criteria for Class I Groundwater (35 IAC 620), although one trigger criterion has not been measured. That criterion is "sustained groundwater yield, from up to a 12 inch borehole, of 150 gallons per day or more from a thickness of 15 ft or less" (35 IAC 620.210(a)(4)(A)). Based on the slow recovery of wells at this site, yields that would indicate Class I groundwater by that criterion would definitely not be expected. In accordance with 35 IAC 620.220, groundwater that does not meet the criteria for Class I, III, or IV is classified as Class II. Based on the available data, the groundwater at this site appears to be Class II as defined by the State of Illinois. This classification could change based on additional data.

3.2.2.1.3 *Hydrologic Conditions*

Area 2B was a gently sloping hilltop that was leveled as part of the construction for the IOP. Perimeter ditches surround the roadways and the graded area. See Figure 3-4.

The area drains to intermittent streams to the northwest and southeast that lead to Crab Orchard Lake. See Figure 3-1.

3.2.2.2 <u>Chemical Results</u>

The sample analytical results are summarized in the following tables:

- Table 3-9 -- soil samples results,
- Table 3-10 -- drum samples results,
- Table 3-11 -- groundwater results, and
- Table 3-12 -- surface water samples results.

These tables list all the chemicals detected in Area 2B during this investigation, along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report (QCSR).

Sample results are presented on the following figures:

- Figure 3-4 -- organic results for soil and drum samples,
- Figure 3-5 -- inorganic results for soil and drum samples, and
- Figure 3-6 – all results for surface water and groundwater samples at this site.

3.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 3-13 through 3-19 as follows:

- Table 3-13--human health risk screening for soils,
- Table 3-14--human health risk screening for drum samples,
- Table 3-15--human health risk screening for groundwater,
- Table 3-16--human health risk screening for surface water,
- Table 3-17--ecological risk screening for soils,
- Table 3-18--ecological risk screening for drum samples, and
- Table 3-19--ecological risk screening for surface water.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A2B. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

Chemicals that are shaded in the tables are those that exceeded the screening criteria, and are identified as chemicals of potential concern (COPCs) for human health risk, and chemicals of potential ecological concern (COPECs) for ecological risk. The only COPCs/COPECs not shaded in the table are those inorganic constituents that exceeded the screening criteria but were detected at levels below Refuge background.

In cases where the chemical was analyzed but not detected, the HQ is the ratio between the maximum reporting limit and the screening concentration. Chemicals not detected are identified with a "U" qualifier in the qualifier column. When these HQ values exceed one, they are not shaded. These constituents are not identified as COPCs/COPECs, but rather as uncertainties.

In Figures 3-4 through 3-6, the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 3-20 and 3-20A (human health risk), and 3-21 and 3-21A (ecological risk) list all the analytes and corresponding media sampled and indicate whether each is a COPC (or COPEC), not a COPC (or COPEC), or an uncertainty. The codes in the tables indicate the rationale for each classification. All COPCs (Tables 3-20 and 3-20A) and COPECs (Tables 3-21 and 3-21A) are shaded in the tables.

3.3.1 Human Health Risk

3.3.1.1 Soil/Drum

Human health screening results for soil and drum samples are presented in Tables 3-13 and 3-14, respectively. Soil screening values were conservatively used to screen the drum samples.

For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil Preliminary Remediation Goals (PRGs) as screening values. The cancer risk was derived by calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values. These ratios were then multiplied by 1×10^{-6}. In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (Dilution Attenuation Factor (DAF)=1), the Illinois Tiered Approach to Corrective Action Objectives (TACO) Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

3.3.1.2 Groundwater

Human health screening results for groundwater are presented in Table 3-15. The maximum groundwater concentrations from AUS-0A2B were screened against maximum contaminant levels (MCLs) and Illinois Class I groundwater standards. These values may be conservative since the groundwater at the site may be Class II.

3.3.1.3 Surface Water

Human health risk screening results for chemicals in surface water at AUS-0A2B are presented in Table 3-16. The maximum concentrations from AUS-0A2B were screened against the Illinois Environmental Protection Agency (IEPA) General Use Surface Water Quality Criteria – Human Health.

3.3.2 Ecological Risk

3.3.2.1 Soil/Drum

Ecological screening results for soil and drum samples are presented in Tables 3-17 and 3-18, respectively. Soil screening values were used to screen the drum samples.

Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[345]
- Environment Canada (1995)[346]

[345] USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.
[346] Environment Canada. 1995. Toxicity Testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Guidelines Division, Evaluation and interpretation Branch, Environmental Conservation Directorate, Environment Canada. Hull, Quebec.

- Talmage *et al.* (1999)[347]
- Efroymson *et al.* (1997a, 1997b)[348]
- CCME (1999)[349]
- MHSPE (1994)[350]
- Other sources

A detailed discussion of the screening concentration selection is presented in Appendix G.

The screening approach for ingestion pathway exposures was based on the potential for a chemical to bioaccumulate. The potential for a chemical to bioaccumulate was based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. The document *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991)[351] used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

3.3.2.2 Surface Water

Ecological screening results for surface water samples are presented in Table 3-19. TRVs for direct exposure by aquatic organisms in surface water were obtained from:

- Illinois water quality standards
- National Recommended Ambient Water Quality Criteria (USEPA 1999a)[352]
- EcoTox (USEPA 1996)[353]
- USEPA Region IV Freshwater Screening Values (1999b)[354]

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347 Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E Welsh, F. M. Cretella, P.H. Reno, and F. B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev Environ. Contam. Toxicol 161:1-156.

348 Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-126/R2.

349 Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

350 Ministry of Housing, Spatial Planning, and the Environment (MHSPE). 1994. *Intervention Values and Target Values – Soil Quality Standards.* Directorate General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

351 USEPA 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

352 USEPA. 1999a. National Recommended Water Quality Criteria--Correction. Office of Water. EPA 822-Z-99-001. April.

353 USEPA. 1996. ECO Update: Ecotox Thresholds. EPA-540/F-95/038. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. 12pp.

354 USEPA. 1999b. Region IV Ecological Risk Assessment Bulletins – Supplement to RAGS. Available at http://www.epa.gov/region4/waste/oftecser/ecolbul.htm.

- Maximum Acceptable Toxicant Concentrations (MATCs) or lowest observed effect concentrations (LOECs) obtained from the USEPA Assessment Tools for the Evaluation of Risk database (ASTER 2000)[355]
- Other sources.

The Illinois water quality standards are believed to be the most relevant, followed by national recommended ambient water quality criteria. EcoTox reports values based on ambient water quality criteria, and Tier II water quality criteria have been developed in the absence of sufficient information to support a national recommended water quality criterion using guidelines outlined in the Great Lakes Water Quality Initiative. Remaining sources were prioritized based on relevance to the area and professional judgment. The detailed discussion of the approach for selecting a single ecological screening criteria (ESV) from among the multiple sources is presented in Appendix G.

The screening approach for ingestion pathway exposures was the same as for soils as presented in Section 3.3.2.1.

3.4 SCIENTIFIC MANAGEMENT DECISION POINT

A Remedial Investigation (RI) is recommended for Site AUS-0A2B, based on exceedances of the SI screening criteria.

This report recommends that inorganic constituents that exceeded project screening criteria but were within Refuge background levels not be retained as COPCs/COPECs for further evaluation. These are the constituents coded with "D" on the COPC list for drum samples, Table 3-20A; and on the COPEC list for drum samples, Table 3-21A. COPCs in this category include antimony and arsenic. COPECs coded with "D" on Table 3-21A include manganese. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method; if new information on site usage suggests they should be evaluated; or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 3-22.

Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. These issues will be addressed in the work plan for the RI. The discussion of past usage included in this section should be carefully reviewed during work plan development, since this information was updated after the field investigation, and all potential release areas at this site may not have been investigated in the SI.

[355] ASTER. 2000. Assessment Tools for Evaluation of Risk Database. United States Environmental Protection Agency, Office of Research and Development.

TABLE 3-1
AREA 2B OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/ Lessee	Product Line or Use
Building B-2-1	1942-1945	SWDC/War Dep't	Tetryl Booster Assembly Packing and Shipping Building
	1952-1963 (likely)	UMC	Loading of PETN into various devices
	? – 1997	Olin	Machining operations, Q.A. laboratory (1975), LAW production, building contained a boiler and a trichlorethane degreaser; office building (1988)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building B-2-2	1942-1945	SWDC/War Dep't	Tetryl Booster Assembly Packing and Shipping Building
	1952-1963 (likely)	UMC	Loading PETN into various devices
	?	CTI (possibly)	Likely handling/manufacturing of explosives
	? – 1997	Olin	Inert storage warehouse (1975), propellant storage (1985, 1988)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
IOP Building B-2-3	1942-1945	SWDC/War Dep't	Detonator Service Magazine
UMC Building B-2-3	1960	UMC	Unknown
	?	Olin	Use unknown, building contained a boiler
	1997-2001	Primex	This is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
IOP Building B-2-4	1942-1945	SWDC/War Dep't	Detonator Service Magazine
Olin Building B-2-4	?	Olin	Use unknown, building contained a boiler
Building B-2-5	1942-1945	SWDC/War Dep't	Tetryl Pelleting Rest House
	1963-1971	Olin	Materials storage, Testing Laboratory, Production of Magnesium-Teflon Flares
	1971-1982	Olin	Unknown
Building B-2-6	1942-1945	SWDC/War Dep't	Tetryl Pelleting Building
	1952-1963 (likely)	UMC	Loading of large explosive devices, tetryl pelleting & TNT, and baratol melting & casting, PETN loading into various devices
	?	CTI (possibly)	Likely handling/manufacturing of explosives
Building B-2-7	1942-1945	SWDC/War Dep't	Blended Tetryl Rest House
Building B-2-8	1942-1945	SWDC/War Dep't	Tetryl Screening and Blending Building
	1960-1963	Olin	Production using Composition B
	1963-1971	Olin	Production of Magnesium-Teflon Flares
	1971-1982	Olin	Unknown

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TABLE 3-1
AREA 2B OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/ Lessee	Product Line or Use
IOP Building B-2-9	1942-1945	SWDC/War Dep't	Tetryl Service Magazine
	1952-1963 (likely)	UMC	Used foundation of this building for burning ignitable wastes
	1963-1970	CTI	May have used foundation of this building for burning
Olin Building B-2-9	?-1997	Olin	Residual chemical storage (1985)
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building B-2-10	1942-1945	SWDC/War Dep't	Change House
	1949-1956	USFWS	Refuge Division Office/Storage of Grain
	?-1997	Olin	Administration Building (1975)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building B-2-11	1942-1945	SWDC/War Dep't	Timekeeping Building (Guard Shack)
	1949-1953	E-Bee Business Systems Co.	Manufacturing office supplies
IOP Building B-2-12	1942-1945	SWDC/War Dep't	Boiler House
Olin Building B-2-12	?	CTI and/or Olin	Fuel AST in the former location of this building
	1997-2001	Primex	This is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building B-2-13	1942-1945	SWDC/War Dep't	Central Test Facility
	?-1997	Olin	AN propellant mixing and chemical storage and some testing (1976), ammonium nitrate and guanidine nitrate storage (1977), propellant scrap pickup (1987)
	1997-2001	Primex	Unspecified manufacturing/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
IOP Building B-2-14	1942-1945	SWDC/War Dep't	Fragmentation Test Building
	?	CTI and/or Olin	Hexane AST in the former location of this building
Olin Building B-2-14	?-1997	Olin	Testing (1988), building contained a boiler
	1997-2001	Primex	This is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
IOP Building B-2-15	1942-1945	SWDC/War Dep't	Pump House
Olin Building B-2-15	?-1997	Olin	Making AN propellant, AO inhibitor, and insulator mixtures (1975)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown

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TABLE 3-1
AREA 2B OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/ Lessee	Product Line or Use
IOP Building B-2-16	1942-1945	SWDC/War Dep't	Tetryl Screening Control Building
Olin Building B-2-16	?	Olin	Casting (1988)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
IOP Building B-2-17	1942-1945	SWDC/War Dep't	Ladies restroom
Olin Building B-2-17	?-1997	Olin	Grounding of raw materials for propellants (1984)
	1997-2001	Primex	This is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building B-2-18	?-1997	Olin	Storage of Scrap HEDPs (1984), mixing of gas generator propellants (1984
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building B-2-19	?	Olin	Propellant storage (1988)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building B-2-20	?-1997	Olin	Rework building/spin test building/supervisor granulator building (1980s), housed HE/HEI pellets (1985)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building B-2-20N	2001	GDO&TS	Unknown
Building B-2-21	?-1997	Olin	Inert Control Room/Control Building (1983)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building B-2-22	?-1997	Olin	Humidity Control Building (1983)
	1997-2001	Primex	This is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown

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TABLE 3-1
AREA 2B OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/ Lessee	Product Line or Use
Building B-2-23	?-1997	Olin	Humidity Control Building (1983)
	1997-2001	Primex	This is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building B-2-25	1997	Primex	90-day hazardous waste accumulation area
Building B-2-26	1997	Primex	90-day hazardous waste accumulation area
Building B-2-27	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown

Sheet 4 of 4

References for this information are found in the associated text.

TABLE 3-1A
OLIN EXPLOSIVES LOCATIONS IN AREA 2B (1985) [356]

Building		Product	Department of Transportation (DOT) Classification[357]	Net Explosive Weight (in pounds)[358]
B-2-1	Storage A	Explosives	1.3	5
	Chem. Lab	Explosives	1.1, 1.3	5, 5
	Rec/Insp	Explosives	1.3	5
	Rec & Pickup	Explosives	1.3	5
B-2-2	Bay A	Explosives	1.3	50,000
	Bay B	Explosives	1.3	50,000
B-2-9		Residual Chemical Storage	Various	N/A
B-2-13	A	Explosives	1.3	5,100
	B	Explosives	1.3	3,000
	1-B	Explosives	1.3	1,000
	C	Explosives	1.3	8,400
	Oven	Explosives	1.3	2,000
	D	Explosives	1.4	500
	E	Explosives	1.4	6,000
	G	Oxidizers	1.4	20,000
	Quality	Explosives	1.3	1
B-2-14		Explosives	1.3	5
B-2-15		Explosives	1.3	600
B-2-16		Explosives	1.3, 1.4	600, 20,000
B-2-18		Explosives	1.3	1,000
B-2-19		Explosives	1.3	100,000
B-2-20	Bay A	HE/HEI Pellets	1.1	45
	Bay B	Storage	1.1	600

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DOT Classifications:

1.1 Explosives characterized with a mass explosion hazard.
1.2 Explosives characterized with a dangerous projections hazard.
1.3 Explosives characterized with a radiant heat or violent burning, or both hazard, but no blast or projection hazard.
1.4 Explosives characterized with a small hazard with no mass explosion and no project of fragments of appreciable size or range.
N/A = This left blank on source document.

[356] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985. This map was likely developed to indicate explosives allowances in buildings and to ensure safe distances between these buildings based on the type of explosive and the amount present.
[357] These classifications were obtained from the Department of Transportation Hazmat Transport Regulations, 49 CFR 173.58: Assignment of class and division for new explosives.
[358] This indicated either the maximum amount allowed in a particular building/bay, or it indicated the amount that was actually located in these buildings at the time the map was created.

TABLE 3-2
AREA 2 OPERATORS/LESSEES

Operator/Lessee	Area	Years of Operation	Operations
Central Technologies, Inc.	Area 2B	1963-1970	Manufacturing of pyrotechnics and explosives
E-Bee Business Systems Co.	Area 2B	1949-1953	Manufacturing office supplies
E.T. Simonds	Area 2R	1976	Unspecified storage
Job Corps	Area 2F	Unknown	Auto mechanic work; gymnasium
Olin/Primex/GDO&TS	Areas 2B, 2D, 2F, 2P and 2R (not in all locations at all times)	1957-Present	Research, development and manufacturing of explosives
Ordill Foundry & Mfg. Co. (sold to Wood Corporation in 1953)	Area 2F	1947-1953	Manufacturing iron castings
Sherwin Williams Defense Corporation/War Department	Areas 2B, 2D, 2F, 2P and 2R	1942-1945	Booster, detonator, fuse and artillery primer loading lines
Straitline Freight Co.	Area 2R?	1950	Trucking
Universal Match Corporation	Areas 2B, 2D and 2F	2B: 1952-1963 2D: 1953-1962 2F: 1959-1961	Testing and manufacturing of primary and secondary explosives
U.S. Fish and Wildlife Service	Area 2B	1948-1956	Refuge division office/storage of grain

Sheet 1 of 1

References for this information are found in the associated text in Sections 3 through 7.

TABLE 3-3
UMC PRODUCTS

Products	**Examples**	**Constituents**	**Purpose**
Pyrotechnics	M112 Photoflash Shells	Aluminum Powder	fuel
		Potassium Perchlorate	
		Barium nitrate	
	M123 Photoflash Shells	Potassium Perchlorate	oxidizer
		Aluminum Powder	
		Barium Nitrate	
	T-73 Parachute Flare	Ammonium Perchlorate	oxidizer
		Smokeless Powder	
		Black Powder	
	Navy Float Signal	Barium Nitrate	oxidizer
		Red Phosphorus	
		Iron Dioxide	
		Linseed Oil	
		Manganese Powder	
	Hi-burst Signal	Red Phosphorus	fuel
		Linseed Oil	binder/retardant
		Iron Oxide	oxidizer
		Smokeless Powder	
		Black Powder	
		Manganese Powder	Fuel
		Magnesium Powder	fuel
Fuse trains	Unknown	Red Lead Oxide	oxidizer
		Barium Chromate	fuel
		Anthraquinone Dyes	smoke dye
		Lead Azide	detonator
		Lead Styphnate	detonator
Gas Generators	Unknown	Nitroglycerin	fuel
		Lead Styphnate	
		Nitrocellulose	fuel

Sheet 1 of 2

TABLE 3-3
UMC PRODUCTS

Products	Examples	Constituents	Purpose
Navy Practice bombs	Unknown	Smokeless Powder	explosive
		Red Phosphorus	fuel
		Zinc Oxide	oxidizer
		Pittman Cement	binder
		Varnish Sealer	sealant
Explosive Devices	Unknown	HMX	explosive
		HBX	explosive
		RDX	explosive
		Tetryl	booster
		TNT	explosive

Sheet 2 of 2

References:
1. Harvey Pitt Deposition, November 19, 1997.
2. Affidavit of former UMC employee, John Hempler. Submitted as a part of UMC's CERCLA Section 104e request.

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Explosive	Smoke Candles	First Fire LUU-10/B	fuel
		Smoke Mix LUU-10/B	fuel
Explosive	Smoke Mix LUU-10/B	TEGDN	
		Ethyl Centralite	fuel
		Red Dye	dye
		Sodium Picrate	
		Nitrocellulose	fuel
		Di-Octylphthalate	smoke generator
		Lead Stearate	binder
		Graphite	lubricator
Ammunition	120mm Combustible Cases	Nitrocellulose	fuel
		Cellulose Wood Pulp	fuel
		N-Methyl-N-N-Diphenylurea	
		Polyurethane Resin	binder
Ammunition	20mm Cartridge Case	Copper Alloy	body
		20mm Primer	detonator
Explosive	HE/HEI (H761) Mix	RDX with 3% Wax (Comp A-4)	explosive
		Aluminum Powder	fuel
		Graphite	lubricator
		Calcium Stearate	binder
Ammunition	20mm HEI Projectile	Carbon Steel	Body
		HEI MIX	Explosive
		M505 Fuze	Detonator
Ammunition	20mm HEI-T Projectile	Carbon Steel	body
		HEI MIX	explosive
Ammunition	20mm HEI-T Projectile	R-505 Tracer Mix	tracer
		I-548 Igniter Mix	fuel
		I-547 Igniter Mix	fuel
		M505 Fuze	explosive

Sheet 1 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Ammunition	20mm HEIT-SD Projectile	Carbon Steel	projectile
		HEI Propellant	explosive
		R-505 Tracer Mix	tracer
		I-548 Igniter Mix	fuel
		M505 Fuze	fuze
Ammunition	20mm Tp-t Projectile	Carbon Steel	body
		R-505 Tracer Mix	tracer
		I-548 Igniter Mix	fuel
		I-547 Igniter Mix	fuel
Ammunition	20mm API Projectile	Carbon Steel	projectile
Ammunition	20mm API Nosecone	20mm API Nosecone Aluminum Alloy	projectile body
		API #136	projectile
		API #68	projectile
Explosive	M505 Fuze	Steel	body
		HMX	explosive
		Graphite	burn rate modifier
		Calcium Resinate	binder
Ammunition	25mm Cartridge	Copper Alloy	body
		25mm Primer	primer
Ammunition	25mm Primer	Copper Alloy	body
		Lead Styphnate	detonator
		Calcium Silicide	
		Barium Nitrate	oxidizer
Ammunition	25mm HEI Projectile	Carbon Steel	body
		HEI Mix	explosive
		M505 Fuze	detonator
Ammunition	30mm Cartridge Case	Aluminum Alloy	body
		30mm Primer	detonator
		Flashtube	detonator

Sheet 2 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Ammunition	30mm Primer	Copper Alloy	body
		Barium Nitrate	oxidizer
		Lead Styphnate	detonator
		Calcium Silicide	
		Trinitroresorcinol	
		Gum Arabic	binder
		Acetylene Black	fuel
Ammunition	30mm HEI Projectile	Steel	body
		HEI MIX	explosive
		M505 Fuze	explosive
Ammunition	30mm Flashtube	Clad Steel Copper Alloy	body
		IB-52 Pellets	igniter
Ammunition	40mm Cartridge Case	Aluminum Alloy	body
		40mm primer	primer
Ammunition	40mm Cartridge	Aluminum Alloy	case
		40mm Primer	primer
		Propellant	projectile
Ammunition	40mm Primers	Copper Alloy	primer
		Barium Nitrate	oxidizer
		Lead Styphnate	detonator
		Antimony Silicide	
		Calcium Silicide	
		Tetracine	
Explosive	Igniter	Steel	body
		IB-50	explosive
		IB-51	explosive
		Boron Potassium Nitrate Pellets	
		Black Powder	fuel

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Ammunition	.50 Cal M17 Tracer Projectiles	Steel Brass Plated Body	body
		I-508 Tracer Mix	tracer
		R-256 Tracer Mix	tracer
		R-284 Tracer Mix	tracer
Ammunition	.50 Cal MPC Projectile	Steel Body w/Copper Jacket	body
		RS-41	explosive
		Comp. A-4	explosive
		Zirconium	
Ammunition	.50 Cal Primed Cases	Brass	body
		Copper Alloy	detonator
		Lead Styphnate	detonator
		Calcium Silicide	
		Barium Nitrate	oxidizer
Ammunition	.50 Cal M17 tracer cartridges	.50 cal Tracer Projectile	tracer
		Propellant	projectile
		Cartridge Case, Primed	case
Ammunition	.50 Cal MPC Cartridge	.50 cal Tracer Projectile	tracer
		.50 Cal Primed Case	case
		Propellant	projectile
Ammunition	20mm MPC Nosecone	Aluminum	body
		RS-41	explosive
Ammunition	20mm MPC Projectiles	steel	body
		RS-41	explosive
		RS-40	explosive
		Comp A-4	explosive
		Zirconium	
Ammunition	.50 Cal MPC Charge Core Body	Steel Body w/Tungsten Core	body
		Comp A-4	explosive
		Zirconium	

Sheet 4 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Ammunition	.50 Cal SLAP Tracer Projectile	Plastic Sabot/Tungsten Penetrator	body
		I-276F Igniter Mix	fuel
		R-284CF Tracer Mix	tracer
Ammunition	.50 Cal SLAP Tracer Cartridge	.50 Cal SLAP Tracer Projectile	
	Cartridge	.50 Cal Primed Case	case
		Propellant	projectile
Ammunition	20mm MP-T-SD (XM940)	Carbon Steel	body
	Charged Projectile Body	Comp A-4	explosive
	Assembly	RS-40	explosive
		WI-2 Tracer Mix	tracer
		Propellant	projectile
Ammunition	20mm MP-T-SD Traced Projectile	Carbon Steel	body
	Projectile Body Assembly	I-547 Igniter Mix	Igniter
		I-548 Igniter Mix	Igniter
		WI-2 Tracer Mix	tracer
Ammunition	20mm MP-T-SD Charged nose	Aluminum	cap
	Nose Assembly	RS-41	explosive
		Potassium Chlorate	oxidizer
Ammunition	20mm PGU-30/B Projectiles	Carbon Steel	body
		MTV Tracer Pellets	tracer
Ammunition	5.56mm Cartridges	Brass	case
		Primer Mix 257W	primer
		Propellant	projectile
		R-258 Tracer Mix	tracer
		I-194 Igniter Mix	igniter
Ammunition	5.56MM Trace Primed Case	Brass	cap
		Primer Mix 257W	primer

Sheet 5 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Ammunition	5.56MM Trace Projectile	Copper Coated Steel Jacket	body
		Lead Filler at point	body
		R528 Tracer Mix	tracer
		I194 Igniter Mix	Igniter
Ammunition	30MM HEDP Projectile	Carbon Steel	body
		Copper Rotating Band	body
		PBXN-5	explosive
		Copper Liner	
Explosive	30mm AAH PDM759 Fuze	Aluminum	body
		PBXN-5	explosive
		Primer Mix 257W	primer
		Lead Azide	detonator
		RDX	
Ammunition	120mm Primer	Black Powder	primer
Explosive	PBXN-5	HMX	
		Vinylidene Fluoride	
		Hexafluoropropylene	
Gas Generators	Inhibitor Mix	Acetyl Triethyl Citrate	
		4-Dinitrophenoxy Ethanol	
		Cellulose Acetate	
		Ammonium Oxalate	oxidizer
Propellant	20,25,30,40mm &.50 cal	Nitrocellulose	
		Graphite	
		Potassium Nitrate	oxidizer
		Sodium Sulfate	
		Calcium Carbonate	
		Nitroglycerin	Fuel
		Diphenylamine	
		Dibutylphthalate	
		Tin Dioxide	
		Potassium Sulphate	

Sheet 6 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	20,25,30,40mm &.50 cal	Ethyl Centralite	
	(*continued*)	Barium Nitrate	oxidizer
Propellant	WI-2 Tracer Mix	Magnesium Powder	fuel
		Strontium Nitrate	oxidizer
		Calcium Resinate	
		Oxamide	oxidizer
		Polyethylene	
Propellant	R-256 Tracer	Strontium Peroxide	
		Strontium Oxalate	oxidizer
		Strontium Nitrate	
		Calcium Resinate I	
		Calcium Resinate II	
		Magnesium Powder III	fuel
Propellant	I-276F Igniter Mix	Magnesium	
		Barium Peroxide	
		Zinc Stearate	binder
		Toluidine Red Toner	
Propellant	R-284 Tracer	Strontium Nitrate	oxidizer
		Magnesium Powder Type III	fuel
		Polyvinyl Chloride	
		Silicon Dioxide	
Propellant	R284CF Tracer Comp	Magnesium Powder	
		Strontium Nitrate	oxidizer
		Polyvinyl Chloride	
		Carbon Black	
Propellant	R505 Tracer Mix	Strontium Nitrate	oxidizer
		Magnesium Powder	fuel
		Oxamide	oxidizer
		Calcium Resinate I	
		Polyethylene Powder	fuel

Sheet 7 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	Trace Igniter Mix I-547	Strontium Peroxide	
		Calcium Resinate I	
		Calcium Resinate II	
Propellant	Trace Igniter Mix I-548	Strontium Peroxide	
		Calcium Resinate I	
		Calcium Resinate II	
		Magnesium Powder	fuel
Propellant	I-508 Igniter Mix	Barium Peroxide	
		Toluidine Red Toner, Dry Pigment	
		Zinc Stearate	binder
		Parlon	
		Magnesium Powder Type III	fuel
Propellant	R-528 Tracer Mix	Strontium Nitrate	oxidizer
		Magnesium	
		Polyvinyl Chloride	
Propellant	I-136 Igniter Mix	Strontium Peroxide	
		Calcium Resinate	
Propellant	I-194 Igniter Mix	I-136 Igniter Mix	fuel
		Magnesium	
Propellant	I-548 Igniter Mix	Calcium Resinate I	
		Strontium Peroxide	
		Magnesium Powder	fuel
		Calcium Resinate II	
Propellant	I-547 Igniter Mix	Calcium Resinate I	
		Strontium Peroxide	
		Calcium Resinate II	
Propellant	R-505 Mix	Calcium Resinate II	
		Strontium Nitrate	
		Magnesium Powder	fuel
		Oxamide	oxidizer
		Polyethylene	

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	IB-17 Igniter Mix	Ammonium Perchlorate	oxidizer
		c-Rubber	fuel
		Melamine	
		Carbon Black	
Propellant	IB-50 Igniter Mix	Boron Powder	
		Polyvinyl Acetate	
		Aluminum Powder	fuel
		Potassium Perchlorate	oxidizer
		Graphite	lubricator
		Methylene Chloride	
Propellant	IB-51 Igniter Mix	Graphite	lubricator
		Ammonium Chloride	
		Polyvinyl Acetate	
		Ammonium Perchlorate	oxidizer
		Aluminum Powder	fuel
		Methylene Chloride	
Propellant	IB-43 Mix	Polyvinyl Acetate	
		Potassium Nitrate	oxidizer
		Boron Powder	
		Graphite	lubricator
Propellant	SPI-2 Igniter	Potassium Nitrate	oxidizer
		Silicon	
		c-Rubber	fuel
		Carbon Black	
Propellant	Double Based Propellant	Lead Resorcinol	
		Lead Resorcylate	
		Lead Salicylate	
		Lead Stearate	binder
		Lead 2-Ethyl Hexoate	

Sheet 9 of 15

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	N-28	Cellulose Acetate	
		Acetyl Triethyl Citrate	
		DNPE	
		Carbon Black	
		Sodium Barbiturate	
		Toluene 2-4 Diamine	
		Ammonium Nitrate	
		Ferri-Ferro Cyanide	
		n-Phenyl Morpholine	
		Ammonium Oxalate	oxidizer
Propellant	GAP	Glycidyle Azide Polymer	binder
		Ammonium Nitrate	oxidizer
		Polyethylene Glycol	
		Carbon Black	
		Triaminoguanidine Nitrate	oxidizer
		N-100	curing agent
Propellant	AN	Ammonium Nitrate	oxidizer
		Ammonium Oxalate	oxidizer
		Polyester	
		Polybutadiene Acrylic Acid Copolymer	binder
		Hydroxy Terminated Polybutadiene	
		Cellulose Acetate	
		Acetyl Triethyl Citrate	
		Dinitrophenoxy Ethanol	fuel
		c-Rubber	fuel
		Guanidine Nitrate	oxidizer
		Ferric Oxide	oxidizer
		4' Glycidyloxy-N'N-Diglycidylaniline	
		Chinese Blue	Tracer

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	AN (*continued*)	Isophorone Diisocyanate	
		Toulenediamine	
		Ammonium Ferri-Ferro Cyanide	
		M-Phenylmorphonline	
		Aromatic Tri-Functional Aziridine	
		Chromium Octoate	
		Melamine	
		Sodium Barbiturate	
		Carbon Black	
		2,2' Methylene Bis (4 Methyl-6 Tert.butyl Phenol)	
Propellant	AN-Propellant Grain	Ammonium Nitrate	oxidizer
		Cellulose Acetate	
		Acetyl Triethyl Citrate	
		Dinitrophenoxy Ethanol	fuel
		Sodium Barbiturate	
		Carbon Black	
		Toluenediamine	
		N-phenylmorpholine	
		Ammonium Oxalate	oxidizer
Propellant	JA-2	Nitrocellulose	fuel
		Nitroglycerin	fuel
		N-Methyl-N'-N'-Diphenylurea	
		Diethylene Glycoldinitrate	oxidizer
		Magnesium Oxide	oxidizer
		Graphite	lubricator
Propellant	F21-D	Ammonium Oxalate	oxidizer
		Rubber	
		Polybutadiene Acrylic Acid copolymer	binder
		Asbestos Fiber	binder
		Stearic Acid	

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	BKNO3 Ignition Pellets	Boron	
		Potassium Nitrate	oxidizer
		Laminac	
Propellant	OMAX 400 Series	Ammonium Nitrate	oxidizer
		Polybutadiene Acrylic Acid Copolymer	binder
		Guanidine Nitrate	oxidizer
		Ammonium Oxalate	oxidizer
		Carbon Black	
		Melamine	
		Sodium Barbiturate	
		Ammonium Ferri-Ferro Cyanide (Milori Blue)	tracer
Propellant	OMAX 600 Series	Ammonium Nitrate	oxidizer
		Hydroxy Terminated Polybutadiene	oxidizer
		Isophorone Diisocyanate	
		Ferric Oxide	oxidizer
		Carbon Black	
		2,2' Methylene Bis (4 Methyl, 6-Tert, Butyl Phenol)	fuel
		Aromatic Tri-Functional Aziridine	
		Sodium Barbiturate	
		Chinese Blue	tracer
Propellant	OMAX 700 Series	Ammonium Nitrate	oxidizer
		Polyester (Carboxy Terminated)	
		4,Glycidyloxy-N,N'-Di Glycidyl Aniline	
		Chromium Octoate	
		Carbon Black	
Propellant	OMAX 800 Series and N-28	Ammonium Nitrate	oxidizer
		Cellulose Acetate	
		Acetyl Triethyl Citrate	

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	OMAX 800 Series and N-28 (cont.)	Dinitrophenoxyethanol	fuel
		Sodium Barbiturate	
		Carbon Black	
		N-Phenylmorpholine	
		Ammonium Oxalate	oxidizer
		toluene diamine	
		Ammonium Ferri-Ferro Cyanide (Milori Blue)	tracer
Propellant	RS 40 Mix	Magnesium Aluminum Alloy powder	fuel
		Ammonium Nitrate	oxidizer
		Barium Nitrate	oxidizer
		Calcium Resinate	binder
Propellant	IB-27 Igniter Mix	c-Rubber	fuel
		Ammonium Perchlorate	oxidizer
		Polybutadiene-Acrylic Acid Copolymer	
		Copper Phthalocyanine (Monastral Blue)	tracer
		Carbon Black	
		Hexane	fuel
Propellant	IS-102 Igniter Mix	c-Rubber	Fuel
		Ammonium Nitrate	oxidizer
		Ammonium Perchlorate	oxidizer
		Guanidine Nitrate	oxidizer
		Sodium Barbiturate	
		Carbon Black	
		Polybutadiene Acrylic Acid Copolymer	
		Hexane	binder
Propellant	IB-52 Igniter Mix	Potassium Nitrate	oxidizer
		Type A Fluid Ball (Nitrocellulose and 2-NDPA)	fuel

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	IB-52 Igniter Mix (*continued*)	Boron Powder	
		Polyvinyl Acetate	
		Graphite	lubricator
Propellant	20mm Primer Mix	Lead Styphnate	
		Calcium Silicide	
		Barium Nitrate	oxidizer
Propellant	Comp A4	RDX	explosive
		Wax	binder
Propellant	Fluid Ball Powder Type B	Nitrocellulose	fuel
		Carbon Black	
		Nitroglycerin	fuel
		2-Nitrodiphenylamine	
Propellant	Fluid Ball Powder Type A	Nitrocellulose	
		2-Nitrodiphenylamine	
Propellant	API Mix #68	Magnesium-Aluminum Alloy powder	fuel
		Barium Nitrate	oxidizer
		Ammonium Nitrate	oxidizer
Propellant	API Mix #136 (RS41)	Magnesium-Aluminum Alloy powder	fuel
		Potassium Perchlorate	oxidizer
		Calcium Resinate	binder
Propellant	First Fire LUU-10/B	2-Chloroanthraquinone	
		Sodium Picrate	
Pyrotechnic	Illuminating Flare	Ammonium Perchlorate	oxidizer
		Magnesium	fuel
		Plastic Binder	binder
Pyrotechnic	Illuminating Flare	Sodium Nitrate	oxidizer
		Magnesium	fuel
		Organic Binder	binder
Propellant	MTV Tracer Pellets	Magnesium	
		Viton	

TABLE 3-4
OLIN PRODUCT LIST

Product Type	Product Name	Constituents	Purpose
Propellant	MTV Tracer Pellets (*continued*)	Teflon	
		Strontium Nitrate	
		Graphite	
		Carbon Black	
		Ethyl Cellulose	
MISC	Electric Squibs/Matches	Paper laminated with brass or tin-plated copper or nickel	
		Lead Styphnate	
MISC	Phalanx Ammunition	Depleted Uranium	
MISC	Powder	Manganese Dioxide	

Sheet 15 of 15

Sources:
(1) DPRA Document No. 00014894/PRI-006258. Olin, Inter Office Memo entitled "Chemical Description of Hazardous Waste," dated January 6, 1982.

(2) DPRA Document No. 00014896/PRI-006259-PRI-006263. Attachment to Source #1, referenced above, entitled "Incinerator Disposal."

(3) DPRA Document No. 00014897/PRI-006265-PRI-006268. Attachment to Source #1, referenced above, entitled "Retort Disposal."

(4) DPRA Document No. 00014898/PRI-006269-PRI-006271. Attachment to Source #1, referenced above, entitled "Disposal TBD."

TABLE 3-4A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
6-1	Benzo[b]fluoranthene	1.1J
	Benzo[k]fluoranthene	1.1J
	Dibenz[a,h]anthracene	2.3J
	Aluminum	8,000
	Barium	110
	Beryllium	0.4
	Cadmium	7.4
	Calcium	36,000
	Chromium	30
	Cobalt	5.7
	Copper	24
	Iron	16,000
	Lead	140
	Magnesium	19,000
	Manganese	510
	Mercury	0.06
	Nickel	14
	Potassium	1,300
	Vanadium	21
	Zinc	170
6-2	Aluminum	1,300
	Barium	130
	Beryllium	0.5
	Calcium	14,000
	Chromium	20
	Cobalt	6.8
	Copper	15
	Iron	18,000
	Lead	45
	Magnesium	3,400
	Manganese	680
	Nickel	13
	Potassium	1,400
	Vanadium	30
	Zinc	130
6-3	Benzo[a]anthracene	0.22J
	Benzo[a]pyrene	0.2J
	Benzo[b]fluoranthene	0.38J
	Benzo[k]fluoranthene	0.11J
	Bis(2-Ethylhexyl)phthalate	0.26J
	Chrysene	0.27J
	Fluoranthene	0.56J
	Pyrene	0.37J
	Aluminum	12,000
	Barium	130
	Beryllium	0.6
	Calcium	40,000
	Chromium	19

Sheet 1 of 3

TABLE 3-4A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
6-3	Cobalt	7.4
	Copper	51
	Iron	17,000
	Lead	30
	Magnesium	18,000
	Manganese	660
	Nickel	16
	Potassium	1,400
	Vanadium	30
	Zinc	73
6-4	Benzo[a]anthracene	0.26J
	Benzo[a]pyrene	0.29J
	Benzo[b]fluoranthene	0.52J
	Chrysene	0.31J
	Fluoranthene	0.37J
	Phenanthrene	0.23J
	Pyrene	0.40J
	Aluminum	14,000
	Barium	420
	Beryllium	0.7
	Calcium	980
	Chromium	28
	Cobalt	10
	Copper	15
	Iron	22,000
	Magnesium	3,600
	Manganese	510
	Nickel	20
	Potassium	1,700
	Vanadium	36
	Zinc	51
6-5	Aluminum	11,000
	Barium	8,000
	Beryllium	0.4
	Calcium	3,000
	Chromium	1,600
	Cobalt	24
	Copper	65
	Iron	71,000
	Lead	330
	Magnesium	100,000
	Manganese	530
	Mercury	0.11
	Nickel	24
	Potassium	1,300
	Silver	2.9
	Vanadium	23
	Zinc	78

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TABLE 3-4A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
6-6	Diethylphthalate	3.6
	Aluminum	10,000
	Barium	140
	Beryllium	0.6
	Calcium	1,500
	Chromium	18
	Cobalt	8.3
	Copper	15
	Iron	19,000
	Lead	58
	Magnesium	2,000
	Manganese	940
	Mercury	0.09
	Nickel	17
	Potassium	800
	Vanadium	31
	Zinc	71
6-7	Aluminum	43,000
	Barium	16,000
	Calcium	10,000
	Chromium	8,000
	Cobalt	70
	Copper	3,400
	Iron	30,000
	Lead	2,300
	Magnesium	48,000
	Manganese	610
	Mercury	0.12
	Nickel	120
	Potassium	1,300
	Silver	84
	Zinc	1,500

Sheet 3 of 3

mg/kg = milligrams per kilogram
J = Estimated

TABLE 3-5
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A2B

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A2B-001	384664.0	774958.0	422.56	NA	
0A2B-002	384756.3	774981.7	428.51	NA	
0A2B-003	384779.8	775330.7	426.72	NA	
0A2B-004	385219.7	775370.1	426.00	NA	
0A2B-005	384758.9	775093.3	427.49	NA	
0A2B-006	385205.9	775130.4	426.52	NA	
0A2B-007	385635.6	775062.5	428.48	NA	
0A2B-008	385888.6	774935.9	422.86	NA	
0A2B-009	386257.5	775826.5	432.46	NA	
0A2B-010	386397.0	775659.3	432.07	NA	
0A2B-011	386430.3	775815.3	431.01	NA	
0A2B-012	385691.2	774904.6	425.71	NA	
0A2B-013	385439.3	775539.4	433.89	NA	
0A2B-014	385408.7	775762.6	427.87	NA	
0A2B-015	384630.7	774833.0	420.34	NA	
0A2B-016	384755.3	775269.8	425.68	NA	
0A2B-017	385001.0	775341.8	426.80	NA	
0A2B-018	385534.3	775357.1	427.05	NA	
0A2B-019	385118.6	774947.9	425.47	NA	
0A2B-020	385755.1	774975.7	426.70	NA	
0A2B-021	386565.2	775724.7	431.10	NA	
0A2B-022	386454.1	775766.9	431.06	NA	
0A2B-W01	384725.7	775375.7	426.38	428.94	New monitoring well
0A2B-W02	386402.9	775842.6	434.19	436.84	New monitoring well
0A2B-W03	386307.3	775692.8	435.43	438.08	New monitoring well

Sheet 1 of 1

NA = Not Applicable

TABLE 3-6
SLUG TEST RESULTS

Well ID Number	Hydraulic Conductivity (cm/sec)
0A2B-W01	2.32E-05
0A2B-W02	2.35E-06
0A2B-W03	1.83E-05

Sheet 1 of 1

cm/sec = centimeters per second

TABLE 3-7
AREA 2 WATER LEVEL DATA

Monitoring Well	Ground Surface Elevation (ft MSL)	TOC Elevation (ft MSL)	May-00		Jul-00		September-00		October-00	
			DTW (ft BTOC)	Water Elev. (ft MSL)	DTW (ft BTOC)	Water Elev. (ft MSL)	DTW (ft BTOC)	Water Elev. (ft MSL)	DTW (ft BTOC)	Water Elev. (ft MSL)
A2B-W01	426.38	428.94	6.00	422.94	7.98	420.96	6.23	422.71	15.10	413.84
A2B-W02	434.19	436.84	4.50	432.34	5.05	431.79	6.70	430.14	7.08	429.76
A2B-W03	435.43	438.08	7.11	430.97	7.78	430.30	9.73	428.35	9.82	428.26
A2D-W01	436.43	439.07	7.84	431.23	5.89	433.18	6.48	432.59	6.66	432.41
A2D-W02	435.85	438.35	3.38	434.97	3.91	434.44	4.48	433.87	4.17	434.18
A2D-W03	435.92	438.56	5.81	432.75	6.51	432.05	7.68	430.88	7.55	431.01
A2D-W04	434.65	437.26	6.01	431.25	5.31	431.95	6.45	430.81	7.13	430.13
A2D-W05	432.37	434.93	3.67	431.26	4.43	430.50	6.26	428.67	7.08	427.85
A2D-W06	435.54	438.08	4.36	433.72	4.12	433.96	5.82	432.26	5.95	432.13
A2F-W01	432.41	435.01	6.15	428.86	7.64	427.37	10.27	424.74	9.20	425.81
A2F-W02	431.45	434.13	5.20	428.93	5.73	428.40	8.62	425.51	8.22	425.91
A2F-W03	431.49	434.18	6.32	427.86	6.04	428.14	6.65	427.53	6.08	428.10
A2P-W01	426.36	428.69	12.25	416.44	12.62	416.07	15.29	413.40	15.45	413.24
A2P-W02	425.76	428.34	6.05	422.29	7.51	420.83	11.00	417.34	8.82	419.52
A2P-W03	424.36	427.11	6.61	420.50	7.60	419.51	9.85	417.26	7.85	419.26
A2P-W04	425.50	428.10	8.46	419.64	9.41	418.69	11.35	416.75	9.68	418.42
A2P-W05	425.63	428.24	6.72	421.52	6.79	421.45	12.03	416.21	9.64	418.60
A2P-W06	424.92	427.41	8.90	418.51	9.47	417.94	11.65	415.76	10.53	416.88

Sheet 1 of 1

TOC = Top of Casing
MSL = Mean Sea Level
BTOC = Below Top of Casing
NA = Not Analyzed
DTW = Depth to Water

TABLE 3-8
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A2B

Drum	Soil	Groundwater	Surface Water
AUS-0A2B-002	AUS-0A2B-001*	AUS-0A2B-W01	AUS-0A2B-015
	AUS-0A2B-002	AUS-0A2B-W02	
	AUS-0A2B-003	AUS-0A2B-W03	
	AUS-0A2B-004*		
	AUS-0A2B-005		
	AUS-0A2B-006		
	AUS-0A2B-007*		
	AUS-0A2B-008*		
	AUS-0A2B-009		
	AUS-0A2B-010		
	AUS-0A2B-011		
	AUS-0A2B-012*		
	AUS-0A2B-013		
	AUS-0A2B-014*		
	AUS-0A2B-015*		
	AUS-0A2B-016*		
	AUS-0A2B-017*		
	AUS-0A2B-018*		
	AUS-0A2B-019*		
	AUS-0A2B-020*		
	AUS-0A2B-021*		
	AUS-0A2B-022*		
	AUS-0A2B-W01		
	AUS-0A2B-W02		
	AUS-0A2B-W03		

Sheet 1 of 1

* Note that the samples at this location were originally designated as sediment, but are actually soil samples.

TABLE 3-9
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
Acetone	3/30	38 ug/kg to 48 ug/kg
Tetrachloroethylene (PCE)	1/30	80 ug/kg
Trichloroethylene (TCE)	1/30	150 ug/kg
Semivolatile Organic Compounds		
2-Methylnaphthalene	5/24	55 ug/kg to 250 ug/kg
Anthracene	1/30	57 ug/kg
Benzo(a)Anthracene	7/24	48 ug/kg to 290 ug/kg
Benzo(a)Pyrene	7/24	46 ug/kg to 280 ug/kg
Benzo(b)Fluoranthene	11/24	46 ug/kg to 410 ug/kg
Benzo(g,h,i)Perylene	4/24	73 ug/kg to 180 ug/kg
Benzo(k)Fluoranthene	6/24	87 ug/kg to 170 ug/kg
Benzyl Butyl Phthalate	1/24	48 ug/kg
Bis(2-Ethylhexyl) Phthalate	4/24	49 ug/kg to 240 ug/kg
Carbazole	1/24	42 ug/kg
Chrysene	10/24	50 ug/kg to 350 ug/kg
Dibenz(a,h)Anthracene	1/24	50 ug/kg
Dibenzofuran	4/24	43 ug/kg to 120 ug/kg
Di-N-Butyl Phthalate	3/24	61 ug/kg to 91 ug/kg
Fluoranthene	10/24	50 ug/kg to 600 ug/kg
Indeno(1,2,3-c,d)Pyrene	4/24	76 ug/kg to 190 ug/kg
Naphthalene	1/24	96 ug/kg
Phenanthrene	8/24	61 ug/kg to 320 ug/kg
Pyrene	10/24	56 ug/kg to 480 ug/kg
Other Inorganics		
Total Organic Carbon	2/2	36,100 to 46,900
Metals		
Aluminum	26/26	2,420 to 8,610
Antimony	11/26	0.31 to 55.9 mg/kg
Arsenic	26/26	3.5 to 35.2 mg/kg
Barium	26/26	34.6 to 1,260 mg/kg
Beryllium	7/26	0.05 to 1.3 mg/kg
Boron	5/26	2.9 to 17.5 mg/kg
Cadmium	3/26	0.38 to 1.2 mg/kg
Calcium	26/26	466 to 212,000 mg/kg
Chromium, Total	26/26	5.8 to 104 mg/kg
Cobalt	13/26	1.1 to 25.6 mg/kg
Copper	26/26	4.1 to 1,560 mg/kg
Cyanide	4/7	0.59 to 2.5 mg/kg
Iron	26/26	6,410 to 58,800 mg/kg
Lead	24/26	9.2 to 2,000 mg/kg
Magnesium	26/26	644 to 22,900 mg/kg

Sheet 1 of 2

TABLE 3-9
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Manganese	25/26	170 to 6,350 mg/kg
Mercury	16/26	0.05 to 0.99 mg/kg
Nickel	26/26	3 to 22.9 mg/kg
Potassium	25/26	129 to 906 mg/kg
Selenium	18/26	0.3 to 4.5 mg/kg
Silver	9/26	0.29 to 1.9 mg/kg
Sodium	6/26	142 to 408 mg/kg
Thallium	5/26	0.16 to 1 mg/kg
Vanadium	25/26	6.5 to 74.1 mg/kg
Zinc	26/26	19.5 to 465 mg/kg

Sheet 2 of 2

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/14/01

TABLE 3-10
DRUM SAMPLE ANALYTICAL RESULTS SUMMARY

Constituent	Number of Detections	Range of Detections
Metals		
Aluminum	1/1	9,180 mg/kg
Antimony	1/1	5.4 mg/kg
Arsenic	1/1	6.5 mg/kg
Barium	1/1	1,500 mg/kg
Boron	1/1	143 mg/kg
Calcium	1/1	3,750 mg/kg
Chromium, Total	1/1	191 mg/kg
Cobalt	1/1	11.6 mg/kg
Copper	1/1	75.1 mg/kg
Iron	1/1	34,300 mg/kg
Lead	1/1	291 mg/kg
Magnesium	1/1	4,440 mg/kg
Manganese	1/1	480 mg/kg
Nickel	1/1	23.7 mg/kg
Potassium	1/1	969 mg/kg
Silver	1/1	4 mg/kg
Thallium	1/1	0.17 mg/kg
Vanadium	1/1	23.9 mg/kg
Zinc	1/1	166 mg/kg

Sheet 1 of 1

mg/kg = milligrams per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/14/01

TABLE 3-11
GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
1,1-Dichloroethene	1/3	0.7 ug/L
Cis-1,2-Dichloroethylene	1/3	120 ug/L
Tetrachloroethylene(PCE)	1/3	15 ug/L
Trans-1,2-Dichloroethene	1/3	24 ug/L
Trichloroethylene (TCE)	1/3	47 ug/L
Metals		
Aluminum	1/2	186 ug/L
Barium	2/2	1.8 ug/L to 52ug/L
Calcium	2/2	174 ug/L to 72,500 ug/L
Iron	2/2	17.8 ug/L to 157 ug/L
Magnesium	2/2	28.9 ug/L to 35,500 ug/L
Manganese	2/2	4.8 ug/L to 458 ug/L
Sodium	2/2	90.6 ug/L to 226,000 ug/L
Zinc	1/2	5.1 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

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TABLE 3-12
SURFACE WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Aluminum	1/1	28,400 ug/L
Arsenic	1/1	5.8 ug/L
Barium	1/1	247 ug/L
Calcium	1/1	10,900 ug/L
Chromium, Total	1/1	24.6 ug/L
Iron	1/1	23,300 ug/L
Lead	1/1	22.9 ug/L
Magnesium	1/1	6,170 ug/L
Manganese	1/1	1,450 ug/L
Potassium	1/1	3,920 ug/L
Sodium	1/1	3,770 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/14/01

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Volatile Organic Compounds								
71-55-6	1,1,1-Trichloroethane	10	U	UG/KG			3.00E-06	1.00E-01
79-34-5	1,1,2,2-Tetrachloroethane	10	U	UG/KG		1.11E-08	2.56E-06	5.00E+01
79-00-5	1,1,2-Trichloroethane	10	U	UG/KG		5.26E-09	6.57E-05	1.11E+01
75-34-3	1,1-Dichloroethane	10	U	UG/KG			4.85E-06	1.00E-02
75-35-4	1,1-Dichloroethene	10	U	UG/KG		8.42E-08	1.48E-04	3.33E+00
107-06-2	1,2-Dichloroethane (EDC)	10	U	UG/KG		1.31E-08	2.84E-04	1.00E+01
540-59-0	1,2-Dichloroethene (total)	10	U	UG/KG			6.79E-05	5.00E-01
78-87-5	1,2-Dichloropropane	10	U	UG/KG		1.30E-08	4.69E-04	1.00E+01
78-93-3	2-Butanone (MEK)	20	U	UG/KG			7.22E-07	
591-78-6	2-Hexanone	20	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	20	U	UG/KG			6.93E-06	
67-64-1	Acetone	48	J	UG/KG			7.72E-06	6.00E-02
71-43-2	Benzene	10	U	UG/KG		6.83E-09	4.13E-04	5.00E+00
75-27-4	Bromodichloromethane	10	U	UG/KG		4.24E-09	9.58E-06	3.33E-01
75-25-2	Bromoform	10	U	UG/KG		3.20E-11	5.68E-07	2.50E-01
74-83-9	Bromomethane	10	UJ	UG/KG			7.61E-04	1.00E+00
75-15-0	Carbon disulfide	10	U	UG/KG			8.27E-06	5.00E-03
56-23-5	Carbon tetrachloride	10	U	UG/KG		1.89E-08	1.43E-03	3.33E+00
108-90-7	Chlorobenzene	10	U	UG/KG			1.84E-05	1.43E-01
75-00-3	Chloroethane	10	U	UG/KG		1.54E-09	5.30E-07	
67-66-3	Chloroform	10	U	UG/KG		1.92E-08	7.76E-03	3.33E-01
74-87-3	Chloromethane	10	U	UG/KG		3.76E-09		
156-59-2	cis-1,2-Dichloroethene	10	U	UG/KG			6.79E-05	5.00E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
10061-01-5	cis-1,3-Dichloropropene	10	U	UG/KG		5.62E-08	2.27E-04	
124-48-1	Dibromochloromethane	10	U	UG/KG		3.77E-09	6.28E-06	5.00E-01
100-41-4	Ethylbenzene	10	U	UG/KG			1.67E-06	1.43E-02
75-09-2	Methylene chloride	10	U	UG/KG		4.87E-10	1.02E-06	1.00E+01
110-54-3	N-Hexane	10	U	UG/KG			2.48E-05	
100-42-5	Styrene	10	U	UG/KG			4.89E-07	5.00E-02
127-18-4	Tetrachloroethylene (PCE)	80		UG/KG		4.29E-09	4.70E-05	2.67E+01
108-88-3	Toluene	10	U	UG/KG			5.03E-06	1.67E-02
1330-20-7	total Xylenes	10	U	UG/KG			2.25E-06	1.00E-03
156-60-5	trans-1,2-Dichloroethene	10	U	UG/KG			4.67E-05	3.33E-01
10061-02-6	trans-1,3-Dichloropropene	10	U	UG/KG		5.62E-08	2.27E-04	
79-01-6	Trichloroethylene (TCE)	150		UG/KG		2.45E-08	1.90E-03	5.00E+01
75-01-4	Vinyl chloride	10	U	UG/KG		2.05E-07		1.43E+01
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	600	U	UG/KG			7.88E-05	2.00E+00
95-50-1	1,2-Dichlorobenzene	600	U	UG/KG			1.81E-04	6.67E-01
541-73-1	1,3-Dichlorobenzene	600	U	UG/KG			1.16E-02	
106-46-7	1,4-Dichlorobenzene	600	U	UG/KG		7.38E-08	3.12E-04	6.00E+00
95-95-4	2,4,5-Trichlorophenol	3000	U	UG/KG			3.41E-05	3.00E-01
88-06-2	2,4,6-Trichlorophenol	600	U	UG/KG		2.68E-09		7.50E+01
120-83-2	2,4-Dichlorophenol	600	U	UG/KG			2.27E-04	1.20E+01
105-67-9	2,4-Dimethylphenol	600	U	UG/KG			3.41E-05	1.50E+00
51-28-5	2,4-Dinitrophenol	3000	U	UG/KG			1.70E-03	3.00E+02
91-58-7	2-Chloronaphthalene	600	U	UG/KG			2.20E-05	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
95-57-8	2-Chlorophenol	600	U	UG/KG			2.49E-03	3.00E+00
91-57-6	2-Methylnaphthalene	250	J	UG/KG			4.61E-06	1.25E-03
95-48-7	2-Methylphenol	600	U	UG/KG			1.36E-05	7.50E-01
88-74-4	2-Nitroaniline	3000	U	UG/KG			5.96E-02	
88-75-5	2-Nitrophenol	600	U	UG/KG			8.51E-05	
91-94-1	3,3'-Dichlorobenzidine	600	U	UG/KG		1.09E-07		2.00E+03
99-09-2	3-Nitroaniline	3000	U	UG/KG			5.96E-02	
534-52-1	4,6-Dinitro-2-methylphenol	3000	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	600	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	600	U	UG/KG			1.36E-05	
106-47-8	4-Chloroaniline	1200	U	UG/KG			3.41E-04	4.00E+01
7005-72-3	4-Chlorophenyl phenyl ether	600	U	UG/KG				
106-44-5	4-Methylphenol	600	U	UG/KG			1.36E-04	
100-01-6	4-Nitroaniline	3000	U	UG/KG			5.96E-02	
100-02-7	4-Nitrophenol	3000	U	UG/KG			4.26E-04	
83-32-9	Acenaphthene	600	U	UG/KG			1.56E-05	2.00E-02
208-96-8	Acenaphthylene	600	U	UG/KG			1.11E-05	3.00E-03
120-12-7	Anthracene	57	J	UG/KG			1.46E-07	9.50E-05
56-55-3	Benzo(a)anthracene	290	J	UG/KG		1.00E-07		3.63E+00
50-32-8	Benzo(a)pyrene	280	J	UG/KG		9.70E-07		7.00E-01
205-99-2	Benzo(b)fluoranthene	410		UG/KG		1.42E-07		2.05E+00
191-24-2	Benzo(g,h,i)perylene	180	J	UG/KG			3.32E-06	9.00E-04
207-08-9	Benzo(k)fluoranthene	170	J	UG/KG		5.89E-09		8.50E-02
111-91-1	bis(2-Chloroethoxy)methane	600	U	UG/KG				

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
111-44-4	bis(2-Chloroethyl) ether	600	U	UG/KG		9.68E-07		3.00E+04
108-60-1	bis(2-Chloroisopropyl) ether	600	U	UG/KG		7.43E-08	1.41E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	240	J	UG/KG		1.36E-09	1.36E-05	
85-68-7	Butyl benzyl phthalate	48	J	UG/KG			2.72E-07	6.00E-05
86-74-8	Carbazole	42	J	UG/KG		3.41E-10		1.40E+00
218-01-9	Chrysene	350	J	UG/KG		1.21E-09		4.38E-02
84-74-2	Di-n-butyl phthalate	91	J	UG/KG			1.03E-06	3.03E-04
117-84-0	Di-n-octyl phthalate	600	U	UG/KG			3.41E-05	6.00E-05
53-70-3	Dibenz(a,h)anthracene	50	J	UG/KG		1.73E-07		6.25E-01
132-64-9	Dibenzofuran	120	J	UG/KG			2.37E-05	
84-66-2	Diethyl phthalate	600	U	UG/KG			8.51E-07	
131-11-3	Dimethyl phthalate	600	U	UG/KG			6.81E-08	
206-44-0	Fluoranthene	600		UG/KG			1.99E-05	3.00E-03
86-73-7	Fluorene	600	U	UG/KG			1.81E-05	2.00E-02
118-74-1	Hexachlorobenzene	600	U	UG/KG		3.89E-07	8.51E-04	6.00E+00
87-68-3	Hexachlorobutadiene	600	U	UG/KG		1.90E-08	3.41E-03	6.00E+00
77-47-4	Hexachlorocyclopentadiene	600	U	UG/KG			1.02E-04	3.00E-02
67-72-1	Hexachloroethane	600	U	UG/KG		3.41E-09	6.81E-04	3.00E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	190	J	UG/KG		6.58E-08		2.71E-01
78-59-1	Isophorone	600	U	UG/KG		2.31E-10	3.41E-06	2.00E+01
621-64-7	N-Nitroso-di-n-propylamine	600	U	UG/KG		1.70E-06		3.00E+05
86-30-6	N-Nitrosodiphenylamine	600	U	UG/KG		1.19E-09		1.00E+01
91-20-3	Naphthalene	96	J	UG/KG			5.09E-04	2.40E-02
87-86-5	Pentachlorophenol	3000	U	UG/KG		2.70E-07	2.10E-04	3.00E+03

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
85-01-8	Phenanthrene	320	J	UG/KG			5.90E-06	1.60E-03
108-95-2	Phenol	600	U	UG/KG			1.14E-06	1.20E-01
129-00-0	Pyrene	480		UG/KG			8.85E-06	2.40E-03
Explosives								
99-35-4	1,3,5-Trinitrobenzene	450	U	UG/KG			1.70E-05	
99-65-0	1,3-Dinitrobenzene	450	U	UG/KG			5.11E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	890	U	UG/KG		1.08E-08	2.02E-03	
121-14-2	2,4-Dinitrotoluene	450	U	UG/KG			2.55E-04	1.13E+04
606-20-2	2,6-Dinitrotoluene	600	U	UG/KG			6.81E-04	2.00E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	890	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	890	U	UG/KG				
99-08-1	3-Nitrotoluene	890	U	UG/KG			4.38E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	890	U	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	890	U	UG/KG			4.38E-04	
2691-41-0	HMX	890	U	UG/KG			2.02E-05	
98-95-3	Nitrobenzene	450	U	UG/KG			3.93E-03	
55-63-0	Nitroglycerin	1300	U	UG/KG		7.38E-09		
78-11-5	Pentaerythritol tetranitrate (PETN)	2500	U	UG/KG				
121-82-4	RDX	890	U	UG/KG		3.97E-08	3.37E-04	
479-45-8	Tetryl	1300	U	UG/KG			1.48E-04	
Metals								
7429-90-5	Aluminum	8610		MG/KG	2.99E-01		5.14E-03	
7440-36-0	Antimony	55.9	J	MG/KG	6.73E+01		6.84E-02	1.86E+02
7440-38-2	Arsenic	35.2		MG/KG	2.61E+00	1.29E-05	8.01E-02	3.52E+01

ND = Not Detected   E = Outside of Range   UJ = Estimated Nondetect
J = Estimated   U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-39-3	Barium	1260		MG/KG	6.46E+00		1.01E-02	1.58E+01
7440-41-7	Beryllium	1.3		MG/KG	1.71E+00	5.80E-10	3.52E-04	4.33E-01
7440-42-8	Boron	17.5		MG/KG	3.30E+00		2.21E-04	
7440-43-9	Cadmium	1.2		MG/KG	6.32E+00	4.02E-10	1.48E-03	3.00E+00
7440-70-2	Calcium	212000		MG/KG	8.49E+01			
7440-47-3	Chromium	104		MG/KG	4.13E+00	2.32E-07		5.20E+01
7440-48-4	Cobalt	25.6		MG/KG	1.18E+00		2.09E-04	
7440-50-8	Copper	1560		MG/KG	1.38E+02		2.06E-02	
57-12-5	Cyanide, Total	2.5	J	MG/KG	6.10E+00		1.42E-04	1.25E+00
7439-89-6	Iron	58800		MG/KG	3.05E+00		9.60E-02	
7439-92-1	Lead	2000		MG/KG	8.55E+01			
7439-95-4	Magnesium	22900		MG/KG	1.48E+01			
7439-96-5	Manganese	6350		MG/KG	1.74E+00		1.97E-01	
7439-97-6	Mercury	0.99		MG/KG	1.65E+01			
7440-02-0	Nickel	22.9		MG/KG	1.21E+00		5.60E-04	3.27E+00
2023695	Potassium	906		MG/KG	1.45E+00			
7782-49-2	Selenium	4.5		MG/KG	1.92E+00		4.40E-04	1.50E+01
7440-22-4	Silver	1.9		MG/KG	3.28E+00		1.86E-04	9.50E-01
7440-23-5	Sodium	408		MG/KG	2.40E+00			
7440-28-0	Thallium	1	J	MG/KG	2.44E+00		6.99E-06	
7440-62-2	Vanadium	74.1		MG/KG	1.57E+00		5.18E-03	2.47E-01
7440-66-6	Zinc	465		MG/KG	9.05E+00		7.59E-04	7.75E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Other Parameters								
7601-90-3	Perchlorate	7000	U	UG/KG			6.85E-03	
TOC	TOC	46900		MG/KG	1.49E+00			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	10	U	UG/KG			5.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	10	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	10	U	UG/KG	1.22E-06	1.22E-06	5.00E-01
75-34-3	1,1-Dichloroethane	10	U	UG/KG	5.00E-08	5.00E-08	4.35E-04
75-35-4	1,1-Dichloroethene	10	U	UG/KG	5.56E-07	5.56E-06	1.67E-01
107-06-2	1,2-Dichloroethane (EDC)	10	U	UG/KG	1.59E-04	7.14E-06	5.00E-01
540-59-0	1,2-Dichloroethene (total)	10	U	UG/KG	5.00E-07	5.00E-07	2.50E-02
78-87-5	1,2-Dichloropropane	10	U	UG/KG	1.19E-04	5.56E-06	3.33E-01
78-93-3	2-Butanone (MEK)	20	U	UG/KG			
591-78-6	2-Hexanone	20	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	20	U	UG/KG			
67-64-1	Acetone	48	J	UG/KG	2.40E-07	2.40E-07	3.00E-03
71-43-2	Benzene	10	U	UG/KG	5.00E-05	2.33E-06	3.33E-01
75-27-4	Bromodichloromethane	10	U	UG/KG	1.09E-04	5.00E-06	1.67E-02
75-25-2	Bromoform	10	U	UG/KG	1.39E-05	6.25E-07	1.25E-02
74-83-9	Bromomethane	10	UJ	UG/KG	3.45E-06	1.00E-05	5.00E-02
75-15-0	Carbon disulfide	10	U	UG/KG	5.00E-08	5.00E-07	3.13E-04
56-23-5	Carbon tetrachloride	10	U	UG/KG	2.27E-04	2.44E-05	1.43E-01
108-90-7	Chlorobenzene	10	U	UG/KG	2.44E-07	2.44E-06	1.00E-02
75-00-3	Chloroethane	10	U	UG/KG			
67-66-3	Chloroform	10	U	UG/KG	1.06E-05	5.00E-06	1.67E-02
74-87-3	Chloromethane	10	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	10	U	UG/KG	5.00E-07	5.00E-07	2.50E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
10061-01-5	cis-1,3-Dichloropropene	10	U	UG/KG			
124-48-1	Dibromochloromethane	10	U	UG/KG	2.44E-07	2.44E-07	2.50E-02
100-41-4	Ethylbenzene	10	U	UG/KG	5.00E-08	5.00E-07	7.69E-04
75-09-2	Methylene chloride	10	U	UG/KG	1.32E-05	8.33E-07	5.00E-01
110-54-3	N-Hexane	10	U	UG/KG			
100-42-5	Styrene	10	U	UG/KG	2.44E-08	2.44E-07	2.50E-03
127-18-4	Tetrachloroethylene (PCE)	80		UG/KG	7.27E-04	3.33E-05	1.33E+00
108-88-3	Toluene	10	U	UG/KG	2.44E-08	2.44E-08	8.33E-04
1330-20-7	total Xylenes	10	U	UG/KG	1.00E-08	2.44E-08	6.67E-05
156-60-5	trans-1,2-Dichloroethene	10	U	UG/KG	2.44E-07	2.44E-07	1.43E-02
10061-02-6	trans-1,3-Dichloropropene	10	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	150		UG/KG	2.88E-04	1.25E-04	2.50E+00
75-01-4	Vinyl chloride	10	U	UG/KG	3.33E-03	1.54E-04	1.00E+00
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	600	U	UG/KG	3.00E-05	3.00E-04	1.20E-01
95-50-1	1,2-Dichlorobenzene	600	U	UG/KG	3.33E-06	3.33E-05	3.53E-02
541-73-1	1,3-Dichlorobenzene	600	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	600	U	UG/KG			3.00E-01
95-95-4	2,4,5-Trichlorophenol	3000	U	UG/KG	1.50E-05	1.50E-05	1.11E-02
88-06-2	2,4,6-Trichlorophenol	600	U	UG/KG	1.15E-03	5.45E-05	3.00E+00
120-83-2	2,4-Dichlorophenol	600	U	UG/KG	9.84E-05	9.84E-04	6.00E-01
105-67-9	2,4-Dimethylphenol	600	U	UG/KG	1.46E-05	1.46E-05	6.67E-02
51-28-5	2,4-Dinitrophenol	3000	U	UG/KG	7.32E-04	7.32E-03	1.50E+01
91-58-7	2-Chloronaphthalene	600	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	600	U	UG/KG	6.00E-05	6.00E-05	1.50E-01
91-57-6	2-Methylnaphthalene	250	J	UG/KG	4.10E-06	4.10E-06	5.95E-05
95-48-7	2-Methylphenol	600	U	UG/KG	6.00E-06	6.00E-06	4.00E-02
88-74-4	2-Nitroaniline	3000	U	UG/KG			
88-75-5	2-Nitrophenol	600	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	600	U	UG/KG	4.62E-02	2.14E-03	8.57E+01
99-09-2	3-Nitroaniline	3000	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	3000	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	600	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	600	U	UG/KG			
106-47-8	4-Chloroaniline	1200	U	UG/KG	1.46E-04	1.46E-03	1.71E+00
7005-72-3	4-Chlorophenyl phenyl ether	600	U	UG/KG			
106-44-5	4-Methylphenol	600	U	UG/KG			
100-01-6	4-Nitroaniline	3000	U	UG/KG			
100-02-7	4-Nitrophenol	3000	U	UG/KG			
83-32-9	Acenaphthene	600	U	UG/KG	5.00E-06	5.00E-06	1.05E-03
208-96-8	Acenaphthylene	600	U	UG/KG	9.84E-06	9.84E-06	1.43E-04
120-12-7	Anthracene	57	J	UG/KG	9.34E-08	9.34E-08	4.75E-06
56-55-3	Benzo(a)anthracene	290	J	UG/KG	3.63E-02	1.71E-03	1.45E-01
50-32-8	Benzo(a)pyrene	280	J	UG/KG	3.50E-01	1.65E-02	3.50E-02
205-99-2	Benzo(b)fluoranthene	410		UG/KG	5.13E-02	2.41E-03	8.20E-02
191-24-2	Benzo(g,h,i)perylene	180	J	UG/KG	2.95E-06	2.95E-06	4.29E-05
207-08-9	Benzo(k)fluoranthene	170	J	UG/KG	2.18E-03	1.00E-04	3.47E-03
111-91-1	bis(2-Chloroethoxy)methane	600	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-44-4	bis(2-Chloroethyl) ether	600	U	UG/KG	1.20E-01	8.00E-03	1.50E+03
108-60-1	bis(2-Chloroisopropyl) ether	600	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	240	J	UG/KG	5.85E-04	5.85E-05	6.67E-05
85-68-7	Butyl benzyl phthalate	48	J	UG/KG	1.17E-07	1.17E-07	5.16E-05
86-74-8	Carbazole	42	J	UG/KG	1.45E-04	6.77E-06	7.00E-02
218-01-9	Chrysene	350	J	UG/KG	4.49E-04	2.06E-05	2.19E-03
84-74-2	Di-n-butyl phthalate	91	J	UG/KG	4.55E-07	4.55E-07	3.96E-05
117-84-0	Di-n-octyl phthalate	600	U	UG/KG	1.46E-05	1.46E-04	6.00E-05
53-70-3	Dibenz(a,h)anthracene	50	J	UG/KG	6.25E-02	2.94E-03	2.50E-02
132-64-9	Dibenzofuran	120	J	UG/KG			
84-66-2	Diethyl phthalate	600	U	UG/KG	6.00E-07	6.00E-07	1.28E-03
131-11-3	Dimethyl phthalate	600	U	UG/KG			
206-44-0	Fluoranthene	600		UG/KG	7.32E-06	7.32E-06	1.40E-04
86-73-7	Fluorene	600	U	UG/KG	7.32E-06	7.32E-06	1.07E-03
118-74-1	Hexachlorobenzene	600	U	UG/KG	1.50E-01	7.69E-03	3.00E-01
87-68-3	Hexachlorobutadiene	600	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	600	U	UG/KG	4.29E-05	4.29E-05	1.50E-03
67-72-1	Hexachloroethane	600	U	UG/KG	3.00E-04	3.00E-04	1.20E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	190	J	UG/KG	2.38E-02	1.12E-03	1.36E-02
78-59-1	Isophorone	600	U	UG/KG	1.46E-06	1.46E-06	7.50E-02
621-64-7	N-Nitroso-di-n-propylamine	600	U	UG/KG	7.50E-01	3.33E-02	1.20E+04
86-30-6	N-Nitrosodiphenylamine	600	U	UG/KG	5.00E-04	2.40E-05	6.00E-01
91-20-3	Naphthalene	96	J	UG/KG	1.17E-06	1.17E-05	1.14E-03
87-86-5	Pentachlorophenol	3000	U	UG/KG	1.25E-01	5.77E-03	1.00E+02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
85-01-8	Phenanthrene	320	J	UG/KG	5.25E-06	5.25E-06	7.62E-05
108-95-2	Phenol	600	U	UG/KG	6.00E-07	5.00E-06	6.00E-03
129-00-0	Pyrene	480		UG/KG	7.87E-06	7.87E-06	1.14E-04
Explosives							
99-35-4	1,3,5-Trinitrobenzene	450	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	450	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	890	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	450	U	UG/KG	5.36E-02	2.50E-03	5.63E+02
606-20-2	2,6-Dinitrotoluene	600	U	UG/KG	7.14E-02	3.33E-03	8.57E+02
35572-78-2	2-Amino-4,6-Dinitrotoluene	890	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	890	U	UG/KG			
99-08-1	3-Nitrotoluene	890	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	890	U	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	890	U	UG/KG			
2691-41-0	HMX	890	U	UG/KG			
98-95-3	Nitrobenzene	450	U	UG/KG	4.50E-04	4.50E-04	4.50E+00
55-63-0	Nitroglycerin	1300	U	UG/KG			
78-11-5	Pentaerythritol tetranitrate (PETN)	2500	U	UG/KG			
121-82-4	RDX	890	U	UG/KG			
479-45-8	Tetryl	1300	U	UG/KG			
Metals							
7429-90-5	Aluminum	8610		MG/KG			
7440-36-0	Antimony	55.9	J	MG/KG	6.82E-02	6.82E-01	1.12E+01
7440-38-2	Arsenic	35.2		MG/KG	1.17E+01	5.77E-01	1.26E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-39-3	Barium	1260		MG/KG	9.00E-03	9.00E-02	1.05E+00
7440-41-7	Beryllium	1.3		MG/KG	1.30E+00	4.48E-02	1.97E-01
7440-42-8	Boron	17.5		MG/KG	9.72E-05	9.72E-04	
7440-43-9	Cadmium	1.2		MG/KG	6.00E-04	6.00E-03	3.24E-01
7440-70-2	Calcium	212000		MG/KG			
7440-47-3	Chromium	104		MG/KG	1.04E-02	2.54E-02	3.71E+00
7440-48-4	Cobalt	25.6		MG/KG	2.13E-04	2.13E-03	
7440-50-8	Copper	1560		MG/KG	1.90E-02	1.90E-01	1.42E-01
57-12-5	Cyanide, Total	2.5	J	MG/KG	6.10E-05	6.10E-04	6.25E-02
7439-89-6	Iron	58800		MG/KG			
7439-92-1	Lead	2000		MG/KG	5.00E+00	5.00E+00	
7439-95-4	Magnesium	22900		MG/KG			
7439-96-5	Manganese	6350		MG/KG	6.61E-02	6.61E-01	
7439-97-6	Mercury	0.99		MG/KG	1.62E-03	1.62E-02	6.60E+00
7440-02-0	Nickel	22.9		MG/KG	5.59E-04	5.59E-03	3.01E-01
2023695	Potassium	906		MG/KG			
7782-49-2	Selenium	4.5		MG/KG	4.50E-04	4.50E-03	1.88E+00
7440-22-4	Silver	1.9		MG/KG	1.90E-04	1.90E-03	1.27E+00
7440-23-5	Sodium	408		MG/KG			
7440-28-0	Thallium	1	J	MG/KG	6.25E-03	6.25E-03	4.17E-01
7440-62-2	Vanadium	74.1		MG/KG	5.29E-03	5.29E-02	7.56E-02
7440-66-6	Zinc	465		MG/KG	7.62E-04	7.62E-03	1.29E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-13
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Other Parameters							
7601-90-3	Perchlorate	7000	U	UG/KG			
TOC	TOC	46900		MG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	430	U	UG/KG			5.64E-05	1.43E+00
95-50-1	1,2-Dichlorobenzene	430	U	UG/KG			1.30E-04	4.78E-01
541-73-1	1,3-Dichlorobenzene	430	U	UG/KG			8.31E-03	
106-46-7	1,4-Dichlorobenzene	430	U	UG/KG		5.29E-08	2.24E-04	4.30E+00
95-95-4	2,4,5-Trichlorophenol	2100	U	UG/KG			2.38E-05	2.10E-01
88-06-2	2,4,6-Trichlorophenol	430	U	UG/KG		1.92E-09		5.38E+01
120-83-2	2,4-Dichlorophenol	430	U	UG/KG			1.63E-04	8.60E+00
105-67-9	2,4-Dimethylphenol	430	U	UG/KG			2.44E-05	1.08E+00
51-28-5	2,4-Dinitrophenol	2100	UJ	UG/KG			1.19E-03	2.10E+02
91-58-7	2-Chloronaphthalene	430	U	UG/KG			1.58E-05	
95-57-8	2-Chlorophenol	430	U	UG/KG			1.78E-03	2.15E+00
91-57-6	2-Methylnaphthalene	430	U	UG/KG			7.93E-06	2.15E-03
95-48-7	2-Methylphenol	430	U	UG/KG			9.76E-06	5.38E-01
88-74-4	2-Nitroaniline	2100	U	UG/KG			4.17E-02	
88-75-5	2-Nitrophenol	430	U	UG/KG			6.10E-05	
91-94-1	3,3'-Dichlorobenzidine	430	U	UG/KG		7.84E-08		1.43E+03
99-09-2	3-Nitroaniline	2100	U	UG/KG			4.17E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2100	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	430	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	430	U	UG/KG			9.76E-06	
106-47-8	4-Chloroaniline	850	U	UG/KG			2.41E-04	2.83E+01
7005-72-3	4-Chlorophenyl phenyl ether	430	U	UG/KG				
106-44-5	4-Methylphenol	430	U	UG/KG			9.76E-05	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
100-01-6	4-Nitroaniline	2100	U	UG/KG			4.17E-02	
100-02-7	4-Nitrophenol	2100	U	UG/KG			2.98E-04	
83-32-9	Acenaphthene	430	U	UG/KG			1.12E-05	1.43E-02
208-96-8	Acenaphthylene	430	UJ	UG/KG			7.93E-06	2.15E-03
120-12-7	Anthracene	430	UJ	UG/KG			1.10E-06	7.17E-04
56-55-3	Benzo(a)anthracene	430	U	UG/KG		1.49E-07		5.38E+00
50-32-8	Benzo(a)pyrene	430	U	UG/KG		1.49E-06		1.08E+00
205-99-2	Benzo(b)fluoranthene	430	U	UG/KG		1.49E-07		2.15E+00
191-24-2	Benzo(g,h,i)perylene	430	U	UG/KG			7.93E-06	2.15E-03
207-08-9	Benzo(k)fluoranthene	430	UJ	UG/KG		1.49E-08		2.15E-01
111-91-1	bis(2-Chloroethoxy)methane	430	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	430	U	UG/KG		6.94E-07		2.15E+04
108-60-1	bis(2-Chloroisopropyl) ether	430	U	UG/KG		5.32E-08	1.01E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	430	U	UG/KG		2.44E-09	2.44E-05	
85-68-7	Butyl benzyl phthalate	430	U	UG/KG			2.44E-06	5.38E-04
86-74-8	Carbazole	430	UJ	UG/KG		3.49E-09		1.43E+01
218-01-9	Chrysene	430	U	UG/KG		1.49E-09		5.38E-02
84-74-2	Di-n-butyl phthalate	430	UJ	UG/KG			4.88E-06	1.43E-03
117-84-0	Di-n-octyl phthalate	430	U	UG/KG			2.44E-05	4.30E-05
53-70-3	Dibenz(a,h)anthracene	430	U	UG/KG		1.49E-06		5.38E+00
132-64-9	Dibenzofuran	430	UJ	UG/KG			8.49E-05	
84-66-2	Diethyl phthalate	430	U	UG/KG			6.10E-07	
131-11-3	Dimethyl phthalate	430	U	UG/KG			4.88E-08	
206-44-0	Fluoranthene	430	U	UG/KG			1.43E-05	2.15E-03

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
86-73-7	Fluorene	430	UJ	UG/KG			1.30E-05	1.43E-02
118-74-1	Hexachlorobenzene	430	U	UG/KG		2.79E-07	6.10E-04	4.30E+00
87-68-3	Hexachlorobutadiene	430	U	UG/KG		1.36E-08	2.44E-03	4.30E+00
77-47-4	Hexachlorocyclopentadiene	430	UJ	UG/KG			7.29E-05	2.15E-02
67-72-1	Hexachloroethane	430	U	UG/KG		2.44E-09	4.88E-04	2.15E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	430	U	UG/KG		1.49E-07		6.14E-01
78-59-1	Isophorone	430	U	UG/KG		1.66E-10	2.44E-06	1.43E+01
621-64-7	N-Nitroso-di-n-propylamine	430	U	UG/KG		1.22E-06		2.15E+05
86-30-6	N-Nitrosodiphenylamine	430	U	UG/KG		8.54E-10		7.17E+00
91-20-3	Naphthalene	430	UJ	UG/KG			2.28E-03	1.08E-01
87-86-5	Pentachlorophenol	2100	U	UG/KG		1.89E-07	1.47E-04	2.10E+03
85-01-8	Phenanthrene	430	UJ	UG/KG			7.93E-06	2.15E-03
108-95-2	Phenol	430	U	UG/KG			8.14E-07	8.60E-02
129-00-0	Pyrene	430	U	UG/KG			7.93E-06	2.15E-03
Explosives								
99-35-4	1,3,5-Trinitrobenzene	320	U	UG/KG			1.21E-05	
99-65-0	1,3-Dinitrobenzene	320	U	UG/KG			3.63E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	640	U	UG/KG		7.78E-09	1.45E-03	
121-14-2	2,4-Dinitrotoluene	320	U	UG/KG			1.82E-04	8.00E+03
606-20-2	2,6-Dinitrotoluene	430	U	UG/KG			4.88E-04	1.43E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	640	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	640	U	UG/KG				
99-08-1	3-Nitrotoluene	640	U	UG/KG			3.15E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	640	U	UG/KG				

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
99-99-0	4-Nitrotoluene (PNT)	640	U	UG/KG			3.15E-04	
2691-41-0	HMX	640	U	UG/KG			1.45E-05	
98-95-3	Nitrobenzene	320	U	UG/KG			2.80E-03	
121-82-4	RDX	640	U	UG/KG		2.85E-08	2.42E-04	
479-45-8	Tetryl	960	U	UG/KG			1.09E-04	
Metals								
7429-90-5	Aluminum	9180		MG/KG	3.19E-01		5.48E-03	
7440-36-0	Antimony	5.4		MG/KG	7.71E-01		6.60E-03	1.80E+01
7440-38-2	Arsenic	6.5		MG/KG	4.81E-01	2.38E-06	1.48E-02	6.50E+00
7440-39-3	Barium	1500		MG/KG	7.69E+00		1.20E-02	1.88E+01
7440-41-7	Beryllium	0.64	U	MG/KG	8.42E-01	2.86E-10	1.73E-04	2.13E-01
7440-42-8	Boron	143		MG/KG	2.70E+01		1.81E-03	
7440-43-9	Cadmium	1.1	U	MG/KG	5.79E+00	3.68E-10	1.36E-03	2.75E+00
7440-70-2	Calcium	3750		MG/KG	1.50E+00			
7440-47-3	Chromium	191		MG/KG	7.58E+00	4.26E-07		9.55E+01
7440-48-4	Cobalt	11.6		MG/KG	5.35E-01		9.46E-05	
7440-50-8	Copper	75.1		MG/KG	6.65E+00		9.89E-04	
7439-89-6	Iron	34300		MG/KG	1.78E+00		5.60E-02	
7439-92-1	Lead	291		MG/KG	1.24E+01			
7439-95-4	Magnesium	4440		MG/KG	2.86E+00			
7439-96-5	Manganese	480		MG/KG	1.32E-01		1.49E-02	
7439-97-6	Mercury	0.56	U	MG/KG	9.33E+00			
7440-02-0	Nickel	23.7		MG/KG	1.25E+00		5.80E-04	3.39E+00
2023695	Potassium	969		MG/KG	1.55E+00			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7782-49-2	Selenium	0.64	U	MG/KG	2.74E-01		6.26E-05	2.13E+00
7440-22-4	Silver	4		MG/KG	6.90E+00		3.91E-04	2.00E+00
7440-23-5	Sodium	130	U	MG/KG	7.65E-01			
7440-28-0	Thallium	0.17	J	MG/KG	4.15E-01		1.19E-06	
7440-62-2	Vanadium	23.9		MG/KG	5.06E-01		1.67E-03	7.97E-02
7440-66-6	Zinc	166		MG/KG	3.23E+00		2.71E-04	2.77E-01
Other Parameters								
7601-90-3	Perchlorate	6400	U	UG/KG			6.26E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	430	U	UG/KG	2.15E-05	2.15E-04	8.60E-02
95-50-1	1,2-Dichlorobenzene	430	U	UG/KG	2.39E-06	2.39E-05	2.53E-02
541-73-1	1,3-Dichlorobenzene	430	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	430	U	UG/KG			2.15E-01
95-95-4	2,4,5-Trichlorophenol	2100	U	UG/KG	1.05E-05	1.05E-05	7.78E-03
88-06-2	2,4,6-Trichlorophenol	430	U	UG/KG	8.27E-04	3.91E-05	2.15E+00
120-83-2	2,4-Dichlorophenol	430	U	UG/KG	7.05E-05	7.05E-04	4.30E-01
105-67-9	2,4-Dimethylphenol	430	U	UG/KG	1.05E-05	1.05E-05	4.78E-02
51-28-5	2,4-Dinitrophenol	2100	UJ	UG/KG	5.12E-04	5.12E-03	1.05E+01
91-58-7	2-Chloronaphthalene	430	U	UG/KG			
95-57-8	2-Chlorophenol	430	U	UG/KG	4.30E-05	4.30E-05	1.08E-01
91-57-6	2-Methylnaphthalene	430	U	UG/KG	7.05E-06	7.05E-06	1.02E-04
95-48-7	2-Methylphenol	430	U	UG/KG	4.30E-06	4.30E-06	2.87E-02
88-74-4	2-Nitroaniline	2100	U	UG/KG			
88-75-5	2-Nitrophenol	430	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	430	U	UG/KG	3.31E-02	1.54E-03	6.14E+01
99-09-2	3-Nitroaniline	2100	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2100	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	430	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	430	U	UG/KG			
106-47-8	4-Chloroaniline	850	U	UG/KG	1.04E-04	1.04E-03	1.21E+00
7005-72-3	4-Chlorophenyl phenyl ether	430	U	UG/KG			
106-44-5	4-Methylphenol	430	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
100-01-6	4-Nitroaniline	2100	U	UG/KG			
100-02-7	4-Nitrophenol	2100	U	UG/KG			
83-32-9	Acenaphthene	430	U	UG/KG	3.58E-06	3.58E-06	7.54E-04
208-96-8	Acenaphthylene	430	UJ	UG/KG	7.05E-06	7.05E-06	1.02E-04
120-12-7	Anthracene	430	UJ	UG/KG	7.05E-07	7.05E-07	3.58E-05
56-55-3	Benzo(a)anthracene	430	U	UG/KG	5.38E-02	2.53E-03	2.15E-01
50-32-8	Benzo(a)pyrene	430	U	UG/KG	5.38E-01	2.53E-02	5.38E-02
205-99-2	Benzo(b)fluoranthene	430	U	UG/KG	5.38E-02	2.53E-03	8.60E-02
191-24-2	Benzo(g,h,i)perylene	430	U	UG/KG	7.05E-06	7.05E-06	1.02E-04
207-08-9	Benzo(k)fluoranthene	430	UJ	UG/KG	5.51E-03	2.53E-04	8.78E-03
111-91-1	bis(2-Chloroethoxy)methane	430	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	430	U	UG/KG	8.60E-02	5.73E-03	1.08E+03
108-60-1	bis(2-Chloroisopropyl) ether	430	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	430	U	UG/KG	1.05E-03	1.05E-04	1.19E-04
85-68-7	Butyl benzyl phthalate	430	U	UG/KG	1.05E-06	1.05E-06	4.62E-04
86-74-8	Carbazole	430	UJ	UG/KG	1.48E-03	6.94E-05	7.17E-01
218-01-9	Chrysene	430	U	UG/KG	5.51E-04	2.53E-05	2.69E-03
84-74-2	Di-n-butyl phthalate	430	UJ	UG/KG	2.15E-06	2.15E-06	1.87E-04
117-84-0	Di-n-octyl phthalate	430	U	UG/KG	1.05E-05	1.05E-04	4.30E-05
53-70-3	Dibenz(a,h)anthracene	430	U	UG/KG	5.38E-01	2.53E-02	2.15E-01
132-64-9	Dibenzofuran	430	UJ	UG/KG			
84-66-2	Diethyl phthalate	430	U	UG/KG	4.30E-07	4.30E-07	9.15E-04
131-11-3	Dimethyl phthalate	430	U	UG/KG			
206-44-0	Fluoranthene	430	U	UG/KG	5.24E-06	5.24E-06	1.00E-04

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
86-73-7	Fluorene	430	UJ	UG/KG	5.24E-06	5.24E-06	7.68E-04
118-74-1	Hexachlorobenzene	430	U	UG/KG	1.08E-01	5.51E-03	2.15E-01
87-68-3	Hexachlorobutadiene	430	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	430	UJ	UG/KG	3.07E-05	3.07E-05	1.08E-03
67-72-1	Hexachloroethane	430	U	UG/KG	2.15E-04	2.15E-04	8.60E-01
193-39-5	Indeno(1,2,3-c,d)pyrene	430	U	UG/KG	5.38E-02	2.53E-03	3.07E-02
78-59-1	Isophorone	430	U	UG/KG	1.05E-06	1.05E-06	5.38E-02
621-64-7	N-Nitroso-di-n-propylamine	430	U	UG/KG	5.38E-01	2.39E-02	8.60E+03
86-30-6	N-Nitrosodiphenylamine	430	U	UG/KG	3.58E-04	1.72E-05	4.30E-01
91-20-3	Naphthalene	430	UJ	UG/KG	5.24E-06	5.24E-05	5.12E-03
87-86-5	Pentachlorophenol	2100	U	UG/KG	8.75E-02	4.04E-03	7.00E+01
85-01-8	Phenanthrene	430	UJ	UG/KG	7.05E-06	7.05E-06	1.02E-04
108-95-2	Phenol	430	U	UG/KG	4.30E-07	3.58E-06	4.30E-03
129-00-0	Pyrene	430	U	UG/KG	7.05E-06	7.05E-06	1.02E-04
Explosives							
99-35-4	1,3,5-Trinitrobenzene	320	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	320	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	640	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	320	U	UG/KG	3.81E-02	1.78E-03	4.00E+02
606-20-2	2,6-Dinitrotoluene	430	U	UG/KG	5.12E-02	2.39E-03	6.14E+02
35572-78-2	2-Amino-4,6-Dinitrotoluene	640	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	640	U	UG/KG			
99-08-1	3-Nitrotoluene	640	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	640	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
99-99-0	4-Nitrotoluene (PNT)	640	U	UG/KG			
2691-41-0	HMX	640	U	UG/KG			
98-95-3	Nitrobenzene	320	U	UG/KG	3.20E-04	3.20E-04	3.20E+00
121-82-4	RDX	640	U	UG/KG			
479-45-8	Tetryl	960	U	UG/KG			
Metals							
7429-90-5	Aluminum	9180		MG/KG			
7440-36-0	Antimony	5.4		MG/KG	6.59E-03	6.59E-02	1.08E+00
7440-38-2	Arsenic	6.5		MG/KG	2.17E+00	1.07E-01	2.32E-01
7440-39-3	Barium	1500		MG/KG	1.07E-02	1.07E-01	1.25E+00
7440-41-7	Beryllium	0.64	U	MG/KG	6.40E-01	2.21E-02	9.70E-02
7440-42-8	Boron	143		MG/KG	7.94E-04	7.94E-03	
7440-43-9	Cadmium	1.1	U	MG/KG	5.50E-04	5.50E-03	2.97E-01
7440-70-2	Calcium	3750		MG/KG			
7440-47-3	Chromium	191		MG/KG	1.91E-02	4.66E-02	6.82E+00
7440-48-4	Cobalt	11.6		MG/KG	9.67E-05	9.67E-04	
7440-50-8	Copper	75.1		MG/KG	9.16E-04	9.16E-03	6.83E-03
7439-89-6	Iron	34300		MG/KG			
7439-92-1	Lead	291		MG/KG	7.28E-01	7.28E-01	
7439-95-4	Magnesium	4440		MG/KG			
7439-96-5	Manganese	480		MG/KG	5.00E-03	5.00E-02	
7439-97-6	Mercury	0.56	U	MG/KG	9.18E-04	9.18E-03	3.73E+00
7440-02-0	Nickel	23.7		MG/KG	5.78E-04	5.78E-03	3.12E-01
2023695	Potassium	969		MG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-14
HUMAN HEALTH SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7782-49-2	Selenium	0.64	U	MG/KG	6.40E-05	6.40E-04	2.67E-01
7440-22-4	Silver	4		MG/KG	4.00E-04	4.00E-03	2.67E+00
7440-23-5	Sodium	130	U	MG/KG			
7440-28-0	Thallium	0.17	J	MG/KG	1.06E-03	1.06E-03	7.08E-02
7440-62-2	Vanadium	23.9		MG/KG	1.71E-03	1.71E-02	2.44E-02
7440-66-6	Zinc	166		MG/KG	2.72E-04	2.72E-03	4.61E-02
Other Parameters							
7601-90-3	Perchlorate	6400	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-15
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	1	U	UG/L		1.26E-03	5.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	1	U	UG/L	1.81E-05	2.74E-03	
79-00-5	1,1,2-Trichloroethane	1	U	UG/L	5.01E-06	4.11E-02	2.00E-01
75-34-3	1,1-Dichloroethane	1	U	UG/L		1.23E-03	
75-35-4	1,1-Dichloroethene	0.7	J	UG/L	1.54E-05	1.28E-02	1.00E-01
107-06-2	1,2-Dichloroethane (EDC)	1	U	UG/L	8.12E-06	9.88E-02	2.00E-01
78-87-5	1,2-Dichloropropane	1	U	UG/L	6.07E-06	1.45E-01	2.00E-01
78-93-3	2-Butanone (MEK)	5	U	UG/L		2.63E-03	
591-78-6	2-Hexanone	5	U	UG/L			
108-10-1	4-Methyl-2-pentanone (MIBK)	5	U	UG/L		3.17E-02	
67-64-1	Acetone	5	U	UG/L		8.22E-03	
71-43-2	Benzene	1	U	UG/L	2.44E-06	8.92E-02	2.00E-01
75-27-4	Bromodichloromethane	1	U	UG/L	5.53E-06	8.22E-03	
75-25-2	Bromoform	1	U	UG/L	1.18E-07	1.37E-03	
74-83-9	Bromomethane	1	U	UG/L		1.15E-01	
75-15-0	Carbon disulfide	1	U	UG/L		9.59E-04	
56-23-5	Carbon tetrachloride	1	U	UG/L	5.84E-06	2.35E-01	2.00E-01
108-90-7	Chlorobenzene	1	U	UG/L		9.43E-03	1.00E-02
75-00-3	Chloroethane	1	U	UG/L	2.16E-07	1.16E-04	
67-66-3	Chloroform	1	U	UG/L	6.08E-06	1.60E+00	
74-87-3	Chloromethane	1	U	UG/L	6.62E-07		
156-59-2	cis-1,2-Dichloroethene	120	J	UG/L		1.97E+00	1.71E+00
10061-01-5	cis-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	
124-48-1	Dibromochloromethane	1	U	UG/L	7.50E-06	8.22E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-15
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
100-41-4	Ethylbenzene	1	U	UG/L		7.46E-04	1.43E-03
75-09-2	Methylene chloride	1	U	UG/L	2.34E-07	6.16E-04	2.00E-01
110-54-3	N-Hexane	1	U	UG/L		2.85E-03	
100-42-5	Styrene	1	U	UG/L		6.09E-04	1.00E-02
127-18-4	Tetrachloroethylene (PCE)	15	J	UG/L	1.39E-05	5.91E-02	3.00E+00
108-88-3	Toluene	1	U	UG/L		1.38E-03	1.00E-03
1330-20-7	total Xylenes	1	U	UG/L		6.99E-04	1.00E-04
156-60-5	trans-1,2-Dichloroethene	24	J	UG/L		1.97E-01	2.40E-01
10061-02-6	trans-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	
79-01-6	Trichloroethylene (TCE)	47	J	UG/L	2.87E-05	1.29E+00	9.40E+00
75-01-4	Vinyl chloride	1	U	UG/L	5.06E-05		5.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		5.14E-02	1.43E-01
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		2.70E-02	1.67E-02
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		1.83E+00	
106-46-7	1,4-Dichlorobenzene	10	U	UG/L	1.99E-05	5.48E-02	1.33E-01
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		1.37E-02	
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L	1.64E-06		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		9.13E-02	
105-67-9	2,4-Dimethylphenol	10	U	UG/L		1.37E-02	
51-28-5	2,4-Dinitrophenol	50	U	UG/L		6.85E-01	
91-58-7	2-Chloronaphthalene	10	U	UG/L		2.05E-02	
95-57-8	2-Chlorophenol	10	U	UG/L		3.29E-01	
91-57-6	2-Methylnaphthalene	10	U	UG/L		5.48E-02	
95-48-7	2-Methylphenol	10	U	UG/L		5.48E-03	

ND = Not Detected   E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-15
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
88-74-4	2-Nitroaniline	50	U	UG/L		2.40E+01	
88-75-5	2-Nitrophenol	10	U	UG/L		3.42E-02	
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L	1.34E-04		
99-09-2	3-Nitroaniline	50	U	UG/L		2.40E+01	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L			
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L			
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		5.48E-03	
106-47-8	4-Chloroaniline	20	U	UG/L		1.37E-01	
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L			
106-44-5	4-Methylphenol	10	U	UG/L		5.48E-02	
100-01-6	4-Nitroaniline	50	U	UG/L		2.40E+01	
100-02-7	4-Nitrophenol	50	U	UG/L		1.71E-01	
83-32-9	Acenaphthene	10	U	UG/L		2.74E-02	
208-96-8	Acenaphthylene	10	U	UG/L		5.48E-02	
120-12-7	Anthracene	10	U	UG/L		5.48E-03	
56-55-3	Benzo(a)anthracene	10	U	UG/L	1.09E-04		
50-32-8	Benzo(a)pyrene	10	U	UG/L	1.09E-03		5.00E+01
205-99-2	Benzo(b)fluoranthene	10	U	UG/L	1.09E-04		
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		5.48E-02	
207-08-9	Benzo(k)fluoranthene	10	U	UG/L	1.09E-05		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L			
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L	1.02E-03		
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L	3.64E-05	4.11E-02	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L	2.08E-06	1.37E-02	
85-68-7	Butyl benzyl phthalate	10	U	UG/L		1.37E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-15
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
86-74-8	Carbazole	10	U	UG/L	2.97E-06		
218-01-9	Chrysene	10	U	UG/L	1.09E-06		
84-74-2	Di-n-butyl phthalate	10	U	UG/L		2.74E-03	
117-84-0	Di-n-octyl phthalate	10	U	UG/L		1.37E-02	
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L	1.09E-03		
132-64-9	Dibenzofuran	10	U	UG/L		4.11E-01	
84-66-2	Diethyl phthalate	10	U	UG/L		3.42E-04	
131-11-3	Dimethyl phthalate	10	U	UG/L		2.74E-05	
206-44-0	Fluoranthene	10	U	UG/L		6.85E-03	
86-73-7	Fluorene	10	U	UG/L		4.11E-02	
118-74-1	Hexachlorobenzene	10	U	UG/L	2.38E-04	3.42E-01	1.00E+01
87-68-3	Hexachlorobutadiene	10	U	UG/L	1.16E-05	1.37E+00	
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		3.91E-02	2.00E-01
67-72-1	Hexachloroethane	10	U	UG/L	2.08E-06	2.74E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L	1.09E-04		
78-59-1	Isophorone	10	U	UG/L	1.41E-07	1.37E-03	
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L	1.04E-03		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L	7.29E-07		
91-20-3	Naphthalene	10	U	UG/L		1.61E+00	
87-86-5	Pentachlorophenol	50	U	UG/L	8.92E-05	4.57E-02	5.00E+01
85-01-8	Phenanthrene	10	U	UG/L		5.48E-02	
108-95-2	Phenol	10	U	UG/L		4.57E-04	1.00E-01
129-00-0	Pyrene	10	U	UG/L		5.48E-02	
Explosives							
99-35-4	1,3,5-Trinitrobenzene	0.25	U	UG/L		2.28E-04	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-15
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
99-65-0	1,3-Dinitrobenzene	0.25	UJ	UG/L		6.85E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L	2.23E-07	2.74E-02	
121-14-2	2,4-Dinitrotoluene	0.25	U	UG/L		3.42E-03	
606-20-2	2,6-Dinitrotoluene	0.5	UJ	UG/L		1.37E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L			
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L			
99-08-1	3-Nitrotoluene	0.5	UJ	UG/L		8.22E-03	
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L			
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		8.22E-03	
2691-41-0	HMX	0.5	U	UG/L		2.74E-04	
98-95-3	Nitrobenzene	0.25	UJ	UG/L		7.36E-02	
121-82-4	RDX	0.5	U	UG/L	8.18E-07	4.57E-03	
479-45-8	Tetryl	0.75	U	UG/L		2.05E-03	
Metals							
7429-90-5	Aluminum	186	J	UG/L		5.10E-03	
7440-36-0	Antimony	6	U	UG/L		4.11E-01	1.00E+00
7440-38-2	Arsenic	10	U	UG/L	2.23E-04	9.13E-01	2.00E-01
7440-39-3	Barium	52	J	UG/L		2.04E-02	2.60E-02
7440-41-7	Beryllium	5	U	UG/L		6.85E-02	1.25E+00
7440-42-8	Boron	100	U	UG/L		3.04E-02	5.00E-02
7440-43-9	Cadmium	5	U	UG/L		2.74E-01	1.00E+00
7440-70-2	Calcium	72500		UG/L			
7440-47-3	Chromium	10	U	UG/L			1.00E-01
7440-48-4	Cobalt	50	U	UG/L		2.28E-02	5.00E-02
7440-50-8	Copper	10	U	UG/L		7.38E-03	1.54E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-15
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
7439-89-6	Iron	157		UG/L		1.43E-02	3.14E-02
7439-92-1	Lead	3	U	UG/L			4.00E-01
7439-95-4	Magnesium	35500		UG/L			
7439-96-5	Manganese	458		UG/L		5.23E-01	3.05E+00
7439-97-6	Mercury	0.2	UJ	UG/L			1.00E-01
7440-02-0	Nickel	10	U	UG/L		1.37E-02	1.00E-01
2023695	Potassium	5000	U	UG/L			
7782-49-2	Selenium	5	U	UG/L		2.74E-02	1.00E-01
7440-22-4	Silver	10	U	UG/L		5.48E-02	2.00E-01
7440-23-5	Sodium	226000		UG/L			
7440-28-0	Thallium	10	U	UG/L		3.91E+00	5.00E+00
7440-62-2	Vanadium	50	U	UG/L		1.96E-01	
7440-66-6	Zinc	5.1	J	UG/L		4.66E-04	1.02E-03
Other Parameters							
7601-90-3	Perchlorate	500	U	UG/L		2.74E+01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-16
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
Semivolatile Organic Compounds						
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		
106-46-7	1,4-Dichlorobenzene	10	U	UG/L		
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		
105-67-9	2,4-Dimethylphenol	10	U	UG/L		
51-28-5	2,4-Dinitrophenol	50	UJ	UG/L		
91-58-7	2-Chloronaphthalene	10	U	UG/L		
95-57-8	2-Chlorophenol	10	U	UG/L		
91-57-6	2-Methylnaphthalene	10	U	UG/L		2.86E-03
95-48-7	2-Methylphenol	10	U	UG/L		
88-74-4	2-Nitroaniline	50	U	UG/L		
88-75-5	2-Nitrophenol	10	U	UG/L		
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L		
99-09-2	3-Nitroaniline	50	U	UG/L		
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L		
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L		
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		
106-47-8	4-Chloroaniline	20	U	UG/L		
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L		
106-44-5	4-Methylphenol	10	U	UG/L		
100-01-6	4-Nitroaniline	50	U	UG/L		
100-02-7	4-Nitrophenol	50	U	UG/L		
83-32-9	Acenaphthene	10	U	UG/L		
208-96-8	Acenaphthylene	10	U	UG/L		2.86E-03
120-12-7	Anthracene	10	UJ	UG/L		2.86E-04
56-55-3	Benzo(a)anthracene	10	U	UG/L		1.00E+02
50-32-8	Benzo(a)pyrene	10	U	UG/L		1.00E+03
205-99-2	Benzo(b)fluoranthene	10	U	UG/L		1.00E+02
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		2.86E-03
207-08-9	Benzo(k)fluoranthene	10	U	UG/L		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L		
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L		
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L		
85-68-7	Butyl benzyl phthalate	10	U	UG/L		
86-74-8	Carbazole	10	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-16
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
218-01-9	Chrysene	10	U	UG/L		1.00E+00
84-74-2	Di-n-butyl phthalate	10	UJ	UG/L		
117-84-0	Di-n-octyl phthalate	10	U	UG/L		
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L		
132-64-9	Dibenzofuran	10	U	UG/L		
84-66-2	Diethyl phthalate	10	U	UG/L		
131-11-3	Dimethyl phthalate	10	U	UG/L		
206-44-0	Fluoranthene	10	U	UG/L		8.33E-02
86-73-7	Fluorene	10	U	UG/L		2.22E-03
118-74-1	Hexachlorobenzene	10	U	UG/L		
87-68-3	Hexachlorobutadiene	10	U	UG/L		
77-47-4	Hexachlorocyclopentadiene	10	UJ	UG/L		
67-72-1	Hexachloroethane	10	U	UG/L		
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L		1.00E+02
78-59-1	Isophorone	10	U	UG/L		
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L		
91-20-3	Naphthalene	10	U	UG/L		
87-86-5	Pentachlorophenol	50	U	UG/L		
85-01-8	Phenanthrene	10	UJ	UG/L		2.86E-03
108-95-2	Phenol	10	U	UG/L	1.00E+00	1.00E-01
129-00-0	Pyrene	10	U	UG/L		2.86E-03
Explosives						
99-35-4	1,3,5-Trinitrobenzene	0.25	UJ	UG/L		
99-65-0	1,3-Dinitrobenzene	0.25	UJ	UG/L		
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	UJ	UG/L		
121-14-2	2,4-Dinitrotoluene	0.25	UJ	UG/L		
606-20-2	2,6-Dinitrotoluene	0.5	UJ	UG/L		
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	UJ	UG/L		
88-72-2	2-Nitrotoluene (ONT)	0.5	UJ	UG/L		
99-08-1	3-Nitrotoluene	0.5	UJ	UG/L		
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	UJ	UG/L		
99-99-0	4-Nitrotoluene (PNT)	0.5	UJ	UG/L		
2691-41-0	HMX	0.5	UJ	UG/L		
98-95-3	Nitrobenzene	0.25	UJ	UG/L		
121-82-4	RDX	0.5	UJ	UG/L		
479-45-8	Tetryl	0.75	UJ	UG/L		
Metals						
7429-90-5	Aluminum	28400		UG/L	1.42E+02	
7440-36-0	Antimony	6	U	UG/L	1.00E+00	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-16
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
7440-38-2	Arsenic	5.8	J	UG/L	5.80E-01	
7440-39-3	Barium	247		UG/L	1.09E+01	4.94E-02
7440-41-7	Beryllium	5	U	UG/L	1.00E+00	
7440-42-8	Boron	100	U	UG/L		1.00E-01
7440-43-9	Cadmium	5	U	UG/L	1.00E+00	
7440-70-2	Calcium	10900		UG/L	1.51E+00	
7440-47-3	Chromium	24.6		UG/L	2.46E+00	
7440-48-4	Cobalt	50	U	UG/L	1.00E+00	
7440-50-8	Copper	15	U	UG/L	1.50E+00	
7439-89-6	Iron	23300		UG/L	2.33E+02	2.33E+01
7439-92-1	Lead	22.9		UG/L	1.15E+01	
7439-95-4	Magnesium	6170		UG/L	2.43E+00	
7439-96-5	Manganese	1450		UG/L	2.49E+00	1.45E+00
7439-97-6	Mercury	0.2	U	UG/L	1.00E+00	1.67E+01
7440-02-0	Nickel	10	U	UG/L	1.00E+00	1.00E-02
2023695	Potassium	3920		UG/L	2.43E+00	
7782-49-2	Selenium	5	U	UG/L	1.85E+00	5.00E-03
7440-22-4	Silver	10	U	UG/L	1.00E+00	2.00E+00
7440-23-5	Sodium	3770		UG/L	1.19E+00	
7440-28-0	Thallium	10	U	UG/L	1.00E+00	
7440-62-2	Vanadium	50	U	UG/L	1.00E+00	
7440-66-6	Zinc	82	U	UG/L	4.10E+00	8.20E-02
Other Parameters						
7601-90-3	Perchlorate	500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-17
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		10	U	UG/KG	3.36E-04	
79-34-5	1,1,2,2-Tetrachloroethane		10	U	UG/KG	7.86E-02	
79-00-5	1,1,2-Trichloroethane		10	U	UG/KG	3.50E-04	
75-34-3	1,1-Dichloroethane		10	U	UG/KG	4.98E-04	
75-35-4	1,1-Dichloroethene		10	U	UG/KG	1.21E-03	
107-06-2	1,2-Dichloroethane (EDC)		10	U	UG/KG	4.72E-04	
540-59-0	1,2-Dichloroethene (total)		10	U	UG/KG	1.27E-02	
78-87-5	1,2-Dichloropropane		10	U	UG/KG	1.43E-05	
78-93-3	2-Butanone (MEK)		20	U	UG/KG	2.23E-04	
591-78-6	2-Hexanone		20	U	UG/KG	1.59E-03	
108-10-1	4-Methyl-2-pentanone (MIBK)		20	U	UG/KG	4.51E-05	
67-64-1	Acetone		48	J	UG/KG	1.92E-02	
71-43-2	Benzene		10	U	UG/KG	6.25E-04	
75-27-4	Bromodichloromethane		10	U	UG/KG	1.85E-02	
75-25-2	Bromoform		10	U	UG/KG	6.29E-04	
74-83-9	Bromomethane		10	UJ	UG/KG	4.25E-02	
75-15-0	Carbon disulfide		10	U	UG/KG	1.06E-01	
56-23-5	Carbon tetrachloride		10	U	UG/KG	1.00E-05	
108-90-7	Chlorobenzene		10	U	UG/KG	2.50E-04	
75-00-3	Chloroethane		10	U	UG/KG		
67-66-3	Chloroform		10	U	UG/KG	8.40E-03	
74-87-3	Chloromethane		10	U	UG/KG	9.62E-04	
156-59-2	cis-1,2-Dichloroethene		10	U	UG/KG	1.27E-02	
10061-01-5	cis-1,3-Dichloropropene		10	U	UG/KG	2.51E-02	
124-48-1	Dibromochloromethane		10	U	UG/KG	4.88E-03	
100-41-4	Ethylbenzene		10	U	UG/KG	2.00E-03	
75-09-2	Methylene chloride		10	U	UG/KG	2.47E-03	
110-54-3	N-Hexane		10	U	UG/KG		
100-42-5	Styrene		10	U	UG/KG	3.33E-05	
127-18-4	Tetrachloroethylene (PCE)		80		UG/KG	6.15E-03	
108-88-3	Toluene		10	U	UG/KG	3.33E-03	
1330-20-7	total Xylenes		10	U	UG/KG	1.67E-02	
156-60-5	trans-1,2-Dichloroethene		10	U	UG/KG	1.27E-02	
10061-02-6	trans-1,3-Dichloropropene		10	U	UG/KG	2.51E-02	
79-01-6	Trichloroethylene (TCE)		150		UG/KG	1.67E-02	
75-01-4	Vinyl chloride		10	U	UG/KG	1.55E-02	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		600	U	UG/KG	3.00E-02	
95-50-1	1,2-Dichlorobenzene		600	U	UG/KG	2.03E-01	
541-73-1	1,3-Dichlorobenzene		600	U	UG/KG	1.59E-02	
106-46-7	1,4-Dichlorobenzene		600	U	UG/KG	3.00E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-17
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
95-95-4	2,4,5-Trichlorophenol		3000	U	UG/KG	7.50E-01	
88-06-2	2,4,6-Trichlorophenol		600	U	UG/KG	6.00E-02	
120-83-2	2,4-Dichlorophenol		600	U	UG/KG	6.86E-03	
105-67-9	2,4-Dimethylphenol		600	U	UG/KG	6.00E+01	
51-28-5	2,4-Dinitrophenol		3000	U	UG/KG	1.50E-01	
91-58-7	2-Chloronaphthalene		600	U	UG/KG	4.93E+01	
95-57-8	2-Chlorophenol		600	U	UG/KG	2.47E+00	
91-57-6	2-Methylnaphthalene		250	J	UG/KG	7.72E-02	YES
95-48-7	2-Methylphenol		600	U	UG/KG	1.49E-02	
88-74-4	2-Nitroaniline		3000	U	UG/KG	4.05E-02	
88-75-5	2-Nitrophenol		600	U	UG/KG	3.75E-01	
91-94-1	3,3'-Dichlorobenzidine		600	U	UG/KG	9.28E-01	
99-09-2	3-Nitroaniline		3000	U	UG/KG	9.49E-01	
534-52-1	4,6-Dinitro-2-methylphenol		3000	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		600	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		600	U	UG/KG	7.55E-02	
106-47-8	4-Chloroaniline		1200	U	UG/KG	1.09E+00	
7005-72-3	4-Chlorophenyl phenyl ether		600	U	UG/KG		
106-44-5	4-Methylphenol		600	U	UG/KG	3.68E-03	
100-01-6	4-Nitroaniline		3000	U	UG/KG	1.37E-01	
100-02-7	4-Nitrophenol		3000	U	UG/KG	4.29E-01	
83-32-9	Acenaphthene		600	U	UG/KG	8.79E-04	
208-96-8	Acenaphthylene		600	U	UG/KG	8.79E-04	
120-12-7	Anthracene		57	J	UG/KG	3.85E-05	YES
56-55-3	Benzo(a)anthracene		290	J	UG/KG	5.57E-02	YES
50-32-8	Benzo(a)pyrene		280	J	UG/KG	6.36E-05	YES
205-99-2	Benzo(b)fluoranthene		410		UG/KG	6.86E-03	YES
191-24-2	Benzo(g,h,i)perylene		180	J	UG/KG	1.51E-03	YES
207-08-9	Benzo(k)fluoranthene		170	J	UG/KG	2.84E-03	YES
111-91-1	bis(2-Chloroethoxy)methane		600	U	UG/KG	1.98E+00	
111-44-4	bis(2-Chloroethyl) ether		600	U	UG/KG	2.53E-02	
108-60-1	bis(2-Chloroisopropyl) ether		600	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		240	J	UG/KG	2.59E-01	YES
85-68-7	Butyl benzyl phthalate		48	J	UG/KG	2.01E-01	YES
86-74-8	Carbazole		42	J	UG/KG		YES
218-01-9	Chrysene		350	J	UG/KG	7.40E-02	YES
84-74-2	Di-n-butyl phthalate		91	J	UG/KG	4.55E-04	YES
117-84-0	Di-n-octyl phthalate		600	U	UG/KG	8.46E-04	
53-70-3	Dibenz(a,h)anthracene		50	J	UG/KG	2.72E-03	YES
132-64-9	Dibenzofuran		120	J	UG/KG		YES
84-66-2	Diethyl phthalate		600	U	UG/KG	6.00E-03	
131-11-3	Dimethyl phthalate		600	U	UG/KG	3.00E-03	

ND = Not Detected   E = Outside of Range   UJ = Estimated Nondetect
J = Estimated   U = Nondetect

TABLE 3-17
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
206-44-0	Fluoranthene		600		UG/KG	4.92E-03	YES
86-73-7	Fluorene		600	U	UG/KG	2.00E-02	
118-74-1	Hexachlorobenzene		600	U	UG/KG	6.00E-04	
87-68-3	Hexachlorobutadiene		600	U	UG/KG	1.51E+01	
77-47-4	Hexachlorocyclopentadiene		600	U	UG/KG	6.00E-02	
67-72-1	Hexachloroethane		600	U	UG/KG	1.01E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		190	J	UG/KG	1.74E-03	YES
78-59-1	Isophorone		600	U	UG/KG	4.32E-03	
621-64-7	N-Nitroso-di-n-propylamine		600	U	UG/KG	1.10E+00	
86-30-6	N-Nitrosodiphenylamine		600	U	UG/KG	3.00E-02	
91-20-3	Naphthalene		96	J	UG/KG	3.86E-04	
87-86-5	Pentachlorophenol		3000	U	UG/KG	5.00E-01	
85-01-8	Phenanthrene		320	J	UG/KG	7.00E-03	YES
108-95-2	Phenol		600	U	UG/KG	1.50E-02	
129-00-0	Pyrene		480		UG/KG	6.11E-03	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		450	U	UG/KG	1.20E+00	
99-65-0	1,3-Dinitrobenzene		450	U	UG/KG	6.87E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		890	U	UG/KG	2.97E-02	
121-14-2	2,4-Dinitrotoluene		450	U	UG/KG	3.52E-01	
606-20-2	2,6-Dinitrotoluene		600	U	UG/KG	1.83E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		890	U	UG/KG	1.11E-02	
88-72-2	2-Nitrotoluene (ONT)		890	U	UG/KG		
99-08-1	3-Nitrotoluene		890	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		890	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		890	U	UG/KG		
2691-41-0	HMX		890	U	UG/KG	3.56E-02	
98-95-3	Nitrobenzene		450	U	UG/KG	1.13E-02	
55-63-0	Nitroglycerin		1300	U	UG/KG		
78-11-5	Pentaerythritol tetranitrate (PETN)		2500	U	UG/KG		
121-82-4	RDX		890	U	UG/KG	8.90E-03	
479-45-8	Tetryl		1300	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	8610		MG/KG		
7440-36-0	Antimony	0.83	55.9	J	MG/KG	1.12E+01	
7440-38-2	Arsenic	13.5	35.2		MG/KG	3.91E+00	
7440-39-3	Barium	195	1260		MG/KG	2.52E+00	
7440-41-7	Beryllium	0.76	1.3		MG/KG	1.30E-01	
7440-42-8	Boron	5.3	17.5		MG/KG	3.50E+01	
7440-43-9	Cadmium	0.19	1.2		MG/KG	4.14E-02	
7440-70-2	Calcium	2497	212000		MG/KG		
7440-47-3	Chromium	25.2	104		MG/KG	2.08E+01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-17
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-48-4	Cobalt	21.7	25.6		MG/KG	1.28E+00	
7440-50-8	Copper	11.3	1560		MG/KG	5.03E+01	
57-12-5	Cyanide, Total	0.41	2.5	J	MG/KG	2.78E+00	
7439-89-6	Iron	19306	58800		MG/KG	2.94E+02	
7439-92-1	Lead	23.4	2000		MG/KG	4.62E+00	
7439-95-4	Magnesium	1552	22900		MG/KG		
7439-96-5	Manganese	3640	6350		MG/KG	6.35E+01	
7439-97-6	Mercury	0.06	0.99		MG/KG	1.41E-01	YES
7440-02-0	Nickel	18.9	22.9		MG/KG	7.63E-01	
2023695	Potassium	625	906		MG/KG		
7782-49-2	Selenium	2.34	4.5		MG/KG	4.50E+00	YES
7440-22-4	Silver	0.58	1.9		MG/KG	9.50E-01	
7440-23-5	Sodium	170	408		MG/KG		
7440-28-0	Thallium	0.41	1	J	MG/KG	1.00E+00	
7440-62-2	Vanadium	47.2	74.1		MG/KG	1.61E+00	
7440-66-6	Zinc	51.4	465		MG/KG	3.88E+00	
Other Parameters							
7601-90-3	Perchlorate		7000	U	UG/KG		
TOC	TOC	31393	46900		MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-18
ECOLOGICAL SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		430	U	UG/KG	2.15E-02	
95-50-1	1,2-Dichlorobenzene		430	U	UG/KG	1.45E-01	
541-73-1	1,3-Dichlorobenzene		430	U	UG/KG	1.14E-02	
106-46-7	1,4-Dichlorobenzene		430	U	UG/KG	2.15E-02	
95-95-4	2,4,5-Trichlorophenol		2100	U	UG/KG	5.25E-01	
88-06-2	2,4,6-Trichlorophenol		430	U	UG/KG	4.30E-02	
120-83-2	2,4-Dichlorophenol		430	U	UG/KG	4.91E-03	
105-67-9	2,4-Dimethylphenol		430	U	UG/KG	4.30E+01	
51-28-5	2,4-Dinitrophenol		2100	UJ	UG/KG	1.05E-01	
91-58-7	2-Chloronaphthalene		430	U	UG/KG	3.53E+01	
95-57-8	2-Chlorophenol		430	U	UG/KG	1.77E+00	
91-57-6	2-Methylnaphthalene		430	U	UG/KG	1.33E-01	
95-48-7	2-Methylphenol		430	U	UG/KG	1.06E-02	
88-74-4	2-Nitroaniline		2100	U	UG/KG	2.83E-02	
88-75-5	2-Nitrophenol		430	U	UG/KG	2.69E-01	
91-94-1	3,3'-Dichlorobenzidine		430	U	UG/KG	6.65E-01	
99-09-2	3-Nitroaniline		2100	U	UG/KG	6.65E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2100	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		430	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		430	U	UG/KG	5.41E-02	
106-47-8	4-Chloroaniline		850	U	UG/KG	7.73E-01	
7005-72-3	4-Chlorophenyl phenyl ether		430	U	UG/KG		
106-44-5	4-Methylphenol		430	U	UG/KG	2.64E-03	
100-01-6	4-Nitroaniline		2100	U	UG/KG	9.59E-02	
100-02-7	4-Nitrophenol		2100	U	UG/KG	3.00E-01	
83-32-9	Acenaphthene		430	U	UG/KG	6.30E-04	
208-96-8	Acenaphthylene		430	UJ	UG/KG	6.30E-04	
120-12-7	Anthracene		430	UJ	UG/KG	2.91E-04	
56-55-3	Benzo(a)anthracene		430	U	UG/KG	8.25E-02	
50-32-8	Benzo(a)pyrene		430	U	UG/KG	9.77E-05	
205-99-2	Benzo(b)fluoranthene		430	U	UG/KG	7.19E-03	
191-24-2	Benzo(g,h,i)perylene		430	U	UG/KG	3.61E-03	
207-08-9	Benzo(k)fluoranthene		430	UJ	UG/KG	7.19E-03	
111-91-1	bis(2-Chloroethoxy)methane		430	U	UG/KG	1.42E+00	
111-44-4	bis(2-Chloroethyl) ether		430	U	UG/KG	1.81E-02	
108-60-1	bis(2-Chloroisopropyl) ether		430	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		430	U	UG/KG	4.64E-01	
85-68-7	Butyl benzyl phthalate		430	U	UG/KG	1.80E+00	
86-74-8	Carbazole		430	UJ	UG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-18
ECOLOGICAL SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
218-01-9	Chrysene		430	U	UG/KG	9.09E-02	
84-74-2	Di-n-butyl phthalate		430	UJ	UG/KG	2.15E-03	
117-84-0	Di-n-octyl phthalate		430	U	UG/KG	6.06E-04	
53-70-3	Dibenz(a,h)anthracene		430	U	UG/KG	2.34E-02	
132-64-9	Dibenzofuran		430	UJ	UG/KG		
84-66-2	Diethyl phthalate		430	U	UG/KG	4.30E-03	
131-11-3	Dimethyl phthalate		430	U	UG/KG	2.15E-03	
206-44-0	Fluoranthene		430	U	UG/KG	3.52E-03	
86-73-7	Fluorene		430	UJ	UG/KG	1.43E-02	
118-74-1	Hexachlorobenzene		430	U	UG/KG	4.30E-04	
87-68-3	Hexachlorobutadiene		430	U	UG/KG	1.08E+01	
77-47-4	Hexachlorocyclopentadiene		430	UJ	UG/KG	4.30E-02	
67-72-1	Hexachloroethane		430	U	UG/KG	7.21E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		430	U	UG/KG	3.94E-03	
78-59-1	Isophorone		430	U	UG/KG	3.09E-03	
621-64-7	N-Nitroso-di-n-propylamine		430	U	UG/KG	7.91E-01	
86-30-6	N-Nitrosodiphenylamine		430	U	UG/KG	2.15E-02	
91-20-3	Naphthalene		430	UJ	UG/KG	1.73E-03	
87-86-5	Pentachlorophenol		2100	U	UG/KG	3.50E-01	
85-01-8	Phenanthrene		430	UJ	UG/KG	9.41E-03	
108-95-2	Phenol		430	U	UG/KG	1.08E-02	
129-00-0	Pyrene		430	U	UG/KG	5.48E-03	
Explosives							
99-35-4	1,3,5-Trinitrobenzene		320	U	UG/KG	8.51E-01	
99-65-0	1,3-Dinitrobenzene		320	U	UG/KG	4.89E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		640	U	UG/KG	2.13E-02	
121-14-2	2,4-Dinitrotoluene		320	U	UG/KG	2.50E-01	
606-20-2	2,6-Dinitrotoluene		430	U	UG/KG	1.31E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		640	U	UG/KG	8.00E-03	
88-72-2	2-Nitrotoluene (ONT)		640	U	UG/KG		
99-08-1	3-Nitrotoluene		640	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		640	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		640	U	UG/KG		
2691-41-0	HMX		640	U	UG/KG	2.56E-02	
98-95-3	Nitrobenzene		320	U	UG/KG	8.00E-03	
121-82-4	RDX		640	U	UG/KG	6.40E-03	
479-45-8	Tetryl		960	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	9180		MG/KG		
7440-36-0	Antimony	0.83	5.4		MG/KG	1.08E+00	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-18
ECOLOGICAL SCREENING OF DRUM RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-38-2	Arsenic	13.5	6.5		MG/KG	7.22E-01	
7440-39-3	Barium	195	1500		MG/KG	3.00E+00	
7440-41-7	Beryllium	0.76	0.64	U	MG/KG	6.40E-02	
7440-42-8	Boron	5.3	143		MG/KG	2.86E+02	
7440-43-9	Cadmium	0.19	1.1	U	MG/KG	3.79E-02	
7440-70-2	Calcium	2497	3750		MG/KG		
7440-47-3	Chromium	25.2	191		MG/KG	3.82E+01	
7440-48-4	Cobalt	21.7	11.6		MG/KG	5.80E-01	
7440-50-8	Copper	11.3	75.1		MG/KG	2.42E+00	
7439-89-6	Iron	19306	34300		MG/KG	1.72E+02	
7439-92-1	Lead	23.4	291		MG/KG	6.72E-01	
7439-95-4	Magnesium	1552	4440		MG/KG		
7439-96-5	Manganese	3640	480		MG/KG	4.80E+00	
7439-97-6	Mercury	0.06	0.56	U	MG/KG	8.00E-02	
7440-02-0	Nickel	18.9	23.7		MG/KG	7.90E-01	
2023695	Potassium	625	969		MG/KG		
7782-49-2	Selenium	2.34	0.64	U	MG/KG	6.40E-01	
7440-22-4	Silver	0.58	4		MG/KG	2.00E+00	
7440-23-5	Sodium	170	130	U	MG/KG		
7440-28-0	Thallium	0.41	0.17	J	MG/KG	1.70E-01	
7440-62-2	Vanadium	47.2	23.9		MG/KG	5.20E-01	
7440-66-6	Zinc	51.4	166		MG/KG	1.38E+00	
Other Parameters							
7601-90-3	Perchlorate		6400	U	UG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-19
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		10	U	UG/L	2.23E-01	
95-50-1	1,2-Dichlorobenzene		10	U	UG/L	7.14E-01	
541-73-1	1,3-Dichlorobenzene		10	U	UG/L	1.99E-01	
106-46-7	1,4-Dichlorobenzene		10	U	UG/L	8.93E-01	
95-95-4	2,4,5-Trichlorophenol		50	U	UG/L	7.94E-01	
88-06-2	2,4,6-Trichlorophenol		10	U	UG/L	3.13E+00	
120-83-2	2,4-Dichlorophenol		10	U	UG/L	2.74E-01	
105-67-9	2,4-Dimethylphenol		10	U	UG/L	4.72E-01	
51-28-5	2,4-Dinitrophenol		50	UJ	UG/L	8.06E+00	
91-58-7	2-Chloronaphthalene		10	U	UG/L	3.23E-02	
95-57-8	2-Chlorophenol		10	U	UG/L	2.28E-01	
91-57-6	2-Methylnaphthalene		10	U	UG/L	2.40E-02	
95-48-7	2-Methylphenol		10	U	UG/L	7.69E-01	
88-74-4	2-Nitroaniline		50	U	UG/L	2.16E-03	
88-75-5	2-Nitrophenol		10	U	UG/L	2.90E-03	
91-94-1	3,3'-Dichlorobenzidine		20	U	UG/L	1.90E-01	
99-09-2	3-Nitroaniline		50	U	UG/L	7.32E-04	
534-52-1	4,6-Dinitro-2-methylphenol		50	U	UG/L	2.17E+01	
101-55-3	4-Bromophenyl phenyl ether		10	U	UG/L	6.67E+00	
59-50-7	4-Chloro-3-methylphenol		10	U	UG/L	3.33E+01	
106-47-8	4-Chloroaniline		20	U	UG/L	8.89E-03	
7005-72-3	4-Chlorophenyl phenyl ether		10	U	UG/L	2.17E-01	
106-44-5	4-Methylphenol		10	U	UG/L	4.44E-03	
100-01-6	4-Nitroaniline		50	U	UG/L	1.08E-03	
100-02-7	4-Nitrophenol		50	U	UG/L	6.04E-01	
83-32-9	Acenaphthene		10	U	UG/L	5.88E-01	
208-96-8	Acenaphthylene		10	U	UG/L	1.50E-02	
120-12-7	Anthracene		10	UJ	UG/L	1.67E+00	
56-55-3	Benzo(a)anthracene		10	U	UG/L	3.70E+02	
50-32-8	Benzo(a)pyrene		10	U	UG/L	7.14E+02	
205-99-2	Benzo(b)fluoranthene		10	U	UG/L	1.79E+03	
191-24-2	Benzo(g,h,i)perylene		10	U	UG/L	1.31E+00	
207-08-9	Benzo(k)fluoranthene		10	U	UG/L	1.79E+03	
111-91-1	bis(2-Chloroethoxy)methane		10	U	UG/L	1.56E-03	
111-44-4	bis(2-Chloroethyl) ether		10	U	UG/L	4.20E-03	
108-60-1	bis(2-Chloroisopropyl) ether		10	U	UG/L		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		10	U	UG/L	3.33E+00	
85-68-7	Butyl benzyl phthalate		10	U	UG/L	5.26E-01	
86-74-8	Carbazole		10	U	UG/L	1.12E-02	
218-01-9	Chrysene		10	U	UG/L	6.25E-01	
84-74-2	Di-n-butyl phthalate		10	UJ	UG/L	1.06E+00	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-19
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
117-84-0	Di-n-octyl phthalate		10	U	UG/L	1.41E-02	
53-70-3	Dibenz(a,h)anthracene		10	U	UG/L	6.25E+03	
132-64-9	Dibenzofuran		10	U	UG/L	2.70E+00	
84-66-2	Diethyl phthalate		10	U	UG/L	4.76E-02	
131-11-3	Dimethyl phthalate		10	U	UG/L	3.03E-02	
206-44-0	Fluoranthene		10	U	UG/L	1.23E+00	
86-73-7	Fluorene		10	U	UG/L	2.56E+00	
118-74-1	Hexachlorobenzene		10	U	UG/L	2.72E+00	
87-68-3	Hexachlorobutadiene		10	U	UG/L	1.08E+01	
77-47-4	Hexachlorocyclopentadiene		10	UJ	UG/L	1.43E+02	
67-72-1	Hexachloroethane		10	U	UG/L	1.02E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		10	U	UG/L	2.32E+00	
78-59-1	Isophorone		10	U	UG/L	8.55E-03	
621-64-7	N-Nitroso-di-n-propylamine		10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine		10	U	UG/L	1.71E-01	
91-20-3	Naphthalene		10	U	UG/L	8.33E-01	
87-86-5	Pentachlorophenol		50	U	UG/L	3.33E+00	
85-01-8	Phenanthrene		10	UJ	UG/L	1.59E+00	
108-95-2	Phenol	10	10	U	UG/L	1.00E-01	
129-00-0	Pyrene		10	U	UG/L	1.64E-01	
Explosives							
99-35-4	1,3,5-Trinitrobenzene		0.25	UJ	UG/L	8.33E-03	
99-65-0	1,3-Dinitrobenzene		0.25	UJ	UG/L	1.25E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)		0.5	UJ	UG/L	1.25E-02	
121-14-2	2,4-Dinitrotoluene		0.25	UJ	UG/L	1.09E-03	
606-20-2	2,6-Dinitrotoluene		0.5	UJ	UG/L	1.19E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene		0.5	UJ	UG/L	2.50E-02	
88-72-2	2-Nitrotoluene (ONT)		0.5	UJ	UG/L	6.85E-05	
99-08-1	3-Nitrotoluene		0.5	UJ	UG/L	6.02E-05	
19406-51-0	4-Amino-2,6-Dinitrotoluene		0.5	UJ	UG/L	9.26E-04	
99-99-0	4-Nitrotoluene (PNT)		0.5	UJ	UG/L	7.14E-05	
2691-41-0	HMX		0.5	UJ	UG/L	1.52E-03	
98-95-3	Nitrobenzene		0.25	UJ	UG/L	9.26E-04	
121-82-4	RDX		0.5	UJ	UG/L	2.63E-03	
479-45-8	Tetryl		0.75	UJ	UG/L		
Metals							
7429-90-5	Aluminum	200	28400		UG/L	3.26E+02	
7440-36-0	Antimony	6	6	U	UG/L	2.00E-01	
7440-38-2	Arsenic	10	5.8	J	UG/L	3.05E-02	
7440-39-3	Barium	22.7	247		UG/L	4.94E-02	
7440-41-7	Beryllium	5	5	U	UG/L	9.43E+00	
7440-42-8	Boron		100	U	UG/L	1.00E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-19
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2B (AUS-0A2B)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
7440-43-9	Cadmium	5	5	U	UG/L	4.55E+00	
7440-70-2	Calcium	7197	10900		UG/L	9.40E-02	
7440-47-3	Chromium	10	24.6		UG/L	1.19E-01	
7440-48-4	Cobalt	50	50	U	UG/L	2.17E+01	
7440-50-8	Copper	10	15	U	UG/L	1.27E+00	
7439-89-6	Iron	100	23300		UG/L	2.33E+01	
7439-92-1	Lead	2	22.9		UG/L	1.14E+00	
7439-95-4	Magnesium	2534	6170		UG/L	7.52E-02	
7439-96-5	Manganese	582	1450		UG/L	1.45E+00	
7439-97-6	Mercury	0.2	0.2	U	UG/L	1.54E-01	
7440-02-0	Nickel	10	10	U	UG/L	1.00E-02	
2023695	Potassium	1613	3920		UG/L	7.40E-02	
7782-49-2	Selenium	2.7	5	U	UG/L	5.00E-03	
7440-22-4	Silver	10	10	U	UG/L	2.00E+00	
7440-23-5	Sodium	3169	3770		UG/L	5.54E-03	
7440-28-0	Thallium	10	10	U	UG/L	2.50E+00	
7440-62-2	Vanadium	50	50	U	UG/L	2.63E+00	
7440-66-6	Zinc	20	82	U	UG/L	8.20E-02	
Other Parameters							
7601-90-3	Perchlorate		500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 3-20, AUS-0A2B
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Volatile Organic Compounds								
1,1,1-Trichloroethane	NA	NA	No	A	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1,2-Trichloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1-Dichloroethane	NA	NA	No	A	NA	NA	No	A
1,1-Dichloroethene	NA	NA	Yes	E	NA	NA	Uncertainty	B
1,2-Dichloroethane (EDC)	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2-Butanone (MEK)	NA	NA	No	A	NA	NA	No	A
2-Hexanone	NA	NA	No	C	NA	NA	No	C
4-Methyl-2-pentanone (MIBK)	NA	NA	No	A	NA	NA	No	A
Acetone	NA	NA	No	A	NA	NA	No	F
Benzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Bromodichloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Bromoform	NA	NA	No	A	NA	NA	No	A
Bromomethane	NA	NA	No	A	NA	NA	Uncertainty	B
Carbon disulfide	NA	NA	No	A	NA	NA	No	A
Carbon tetrachloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Chlorobenzene	NA	NA	No	A	NA	NA	No	A
Chloroethane	NA	NA	No	A	NA	NA	No	A
Chloroform	NA	NA	Uncertainty	B	NA	NA	No	A
Chloromethane	NA	NA	No	A	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	Yes	E	NA	NA	No	A
cis-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Dibromochloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Ethylbenzene	NA	NA	No	A	NA	NA	No	A
Methylene chloride	NA	NA	No	A	NA	NA	Uncertainty	B
N-Hexane	NA	NA	No	A	NA	NA	No	A
Styrene	NA	NA	No	A	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	Yes	E	NA	NA	Yes	E
Toluene	NA	NA	No	A	NA	NA	No	A
total Xylenes	NA	NA	No	A	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	No	F	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	Yes	E	NA	NA	Yes	E
Vinyl chloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	No	C	No	A	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	No	C	No	A	NA	NA	No	A
1,3-Dichlorobenzene	No	C	Uncertainty	B	NA	NA	No	A
1,4-Dichlorobenzene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	No	C	No	A	NA	NA	No	A

TABLE 3-20, AUS-0A2B
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trichlorophenol	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2,4-Dichlorophenol	No	C	No	A	NA	NA	Uncertainty	B
2,4-Dimethylphenol	No	C	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	No	C	No	A	NA	NA	Uncertainty	B
2-Chloronaphthalene	No	C	No	A	NA	NA	No	A
2-Chlorophenol	No	C	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	No	A	No	A	NA	NA	No	F
2-Methylphenol	No	C	No	A	NA	NA	No	A
2-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
2-Nitrophenol	No	C	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	No	C	Uncertainty	B	NA	NA	Uncertainty	B
3-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
4,6-Dinitro-2-methylphenol	No	C	No	C	NA	NA	No	C
4-Bromophenyl phenyl ether	No	C	No	C	NA	NA	No	C
4-Chloro-3-methylphenol	No	C	No	A	NA	NA	No	A
4-Chloroaniline	No	C	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	No	C	No	C	NA	NA	No	C
4-Methylphenol	No	C	No	A	NA	NA	No	A
4-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
4-Nitrophenol	No	C	No	A	NA	NA	No	A
Acenaphthene	No	C	No	A	NA	NA	No	A
Acenaphthylene	No	A	No	A	NA	NA	No	A
Anthracene	No	A	No	A	NA	NA	No	F
Benzo(a)anthracene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	J
Benzo(b)fluoranthene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	No	A	No	A	NA	NA	No	F
Benzo(k)fluoranthene	No	C	Uncertainty	B	NA	NA	No	F
bis(2-Chloroethoxy)methane	No	C	No	C	NA	NA	No	C
bis(2-Chloroethyl) ether	No	C	Uncertainty	B	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	No	C	Uncertainty	B	NA	NA	No	A
bis(2-Ethylhexyl) phthalate	No	C	Uncertainty	B	NA	NA	No	F
Butyl benzyl phthalate	No	C	No	A	NA	NA	No	F
Carbazole	No	C	Uncertainty	B	NA	NA	Yes	E
Chrysene	Uncertainty	B	Uncertainty	B	NA	NA	No	F
Di-n-butyl phthalate	No	C	No	A	NA	NA	No	F
Di-n-octyl phthalate	No	C	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	No	C	Uncertainty	B	NA	NA	Yes	J
Dibenzofuran	No	C	No	A	NA	NA	No	F
Diethyl phthalate	No	C	No	A	NA	NA	No	A
Dimethyl phthalate	No	C	No	A	NA	NA	No	A
Fluoranthene	No	A	No	A	NA	NA	No	F

TABLE 3-20, AUS-0A2B
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Fluorene	No	A	No	A	NA	NA	No	A
Hexachlorobenzene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorobutadiene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	No	C	No	A	NA	NA	No	A
Hexachloroethane	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	Uncertainty	B	Uncertainty	B	NA	NA	No	F
Isophorone	No	C	No	A	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	No	C	Uncertainty	B	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	No	C	No	A	NA	NA	Uncertainty	B
Naphthalene	No	C	Uncertainty	B	NA	NA	No	F
Pentachlorophenol	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Phenanthrene	No	A	No	A	NA	NA	No	F
Phenol	No	A	No	A	NA	NA	No	A
Pyrene	No	A	No	A	NA	NA	No	F
Metals and Inorganics								
Aluminum	Uncertainty	G	No	F	NA	NA	No	F
Antimony	No	C	Uncertainty	B	NA	NA	Yes	E
Arsenic	Uncertainty	G	Uncertainty	B	NA	NA	Yes	E
Barium	No	F	No	F	NA	NA	Yes	E
Beryllium	No	C	Uncertainty	B	NA	NA	Yes	E
Boron	No	A	No	A	NA	NA	No	F
Cadmium	No	C	Uncertainty	B	NA	NA	Yes	E
Calcium	No	H	No	H	NA	NA	No	H
Chromium	Uncertainty	G	No	A	NA	NA	Yes	E
Cobalt	No	C	No	A	NA	NA	No	F
Copper	No	C	No	A	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	Yes	E
Iron	Yes	E	No	F	NA	NA	No	F
Lead	Uncertainty	G	No	A	NA	NA	Yes	E
Magnesium	No	H	No	H	NA	NA	No	H
Manganese	Yes	E	Yes	E	NA	NA	No	F
Mercury	Uncertainty	B	No	A	NA	NA	Yes	E
Nickel	No	A	No	A	NA	NA	Yes	E
Potassium	No	H	No	C	NA	NA	No	H
Selenium	No	A	No	A	NA	NA	Yes	E
Silver	Uncertainty	B	No	A	NA	NA	Yes	E
Sodium	No	H	No	H	NA	NA	No	H
Thallium	No	C	Uncertainty	B	NA	NA	No	F
Vanadium	No	C	No	A	NA	NA	No	F
Zinc	No	A	No	F	NA	NA	Yes	J
Explosives								
1,3,5-Trinitrobenzene	No	C	No	A	NA	NA	No	A
1,3-Dinitrobenzene	No	C	No	A	NA	NA	No	A

TABLE 3-20, AUS-0A2B
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	C	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
2-Nitrotoluene (ONT)	No	C	No	C	NA	NA	No	C
3-Nitrotoluene	No	C	No	A	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
4-Nitrotoluene (PNT)	No	C	No	A	NA	NA	No	A
HMX	No	C	No	A	NA	NA	No	A
Nitrobenzene	No	C	No	A	NA	NA	Uncertainty	B
Nitroglycerin	NA	NA	NA	NA	NA	NA	No	A
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	No	C	No	A	NA	NA	No	A
Tetryl	No	C	No	A	NA	NA	No	A
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	NA	NA	NA	NA	NA	NA

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 3-20A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
Volatile Organic Compounds		
1,1,1-Trichloroethane	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA
1,1,2-Trichloroethane	NA	NA
1,1-Dichloroethane	NA	NA
1,1-Dichloroethene	NA	NA
1,2-Dichloroethane (EDC)	NA	NA
1,2-Dichloroethene (total)	NA	NA
1,2-Dichloropropane	NA	NA
2-Butanone (MEK)	NA	NA
2-Hexanone	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA
Acetone	NA	NA
Benzene	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	NA
Bromomethane	NA	NA
Carbon disulfide	NA	NA
Carbon tetrachloride	NA	NA
Chlorobenzene	NA	NA
Chloroethane	NA	NA
Chloroform	NA	NA
Chloromethane	NA	NA
cis-1,2-Dichloroethene	NA	NA
cis-1,3-Dichloropropene	NA	NA
Dibromochloromethane	NA	NA
Ethylbenzene	NA	NA
Methylene chloride	NA	NA
N-Hexane	NA	NA
Styrene	NA	NA
Tetrachloroethylene (PCE)	NA	NA
Toluene	NA	NA
total Xylenes	NA	NA
trans-1,2-Dichloroethene	NA	NA
trans-1,3-Dichloropropene	NA	NA
Trichloroethylene (TCE)	NA	NA
Vinyl chloride	NA	NA
Semivolatile Organic Compounds		
1,2,4-Trichlorobenzene	Uncertainty	B
1,2-Dichlorobenzene	No	A
1,3-Dichlorobenzene	No	A

TABLE 3-20A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
1,4-Dichlorobenzene	Uncertainty	B
2,4,5-Trichlorophenol	No	A
2,4,6-Trichlorophenol	Uncertainty	B
2,4-Dichlorophenol	Uncertainty	B
2,4-Dimethylphenol	Uncertainty	B
2,4-Dinitrophenol	Uncertainty	B
2-Chloronaphthalene	No	A
2-Chlorophenol	Uncertainty	B
1-Methylnaphthalene	NA	NA
2-Methylnaphthalene	No	A
2-Methylphenol	No	A
2-Nitroaniline	No	A
2-Nitrophenol	No	A
3,3'-Dichlorobenzidine	Uncertainty	B
3-Nitroaniline	No	A
4,6-Dinitro-2-methylphenol	No	C
4-Bromophenyl phenyl ether	No	C
4-Chloro-3-methylphenol	No	A
4-Chloroaniline	Uncertainty	B
4-Chlorophenyl phenyl ether	No	C
4-Methylphenol	No	A
4-Nitroaniline	No	A
4-Nitrophenol	No	A
Acenaphthene	No	A
Acenaphthylene	No	A
Anthracene	No	A
Benzo(a)anthracene	Uncertainty	B
Benzo(a)pyrene	Uncertainty	B
Benzo(b)fluoranthene	Uncertainty	B
Benzo(g,h,i)perylene	No	A
Benzo(k)fluoranthene	No	A
bis(2-Chloroethoxy)methane	No	C
bis(2-Chloroethyl) ether	Uncertainty	B
bis(2-Chloroisopropyl) ether	No	A
bis(2-Ethylhexyl) phthalate	No	A
Butyl benzyl phthalate	No	A
Carbazole	Uncertainty	B
Chrysene	No	A
Di-n-butyl phthalate	No	A
Di-n-octyl phthalate	No	A
Dibenz(a,h)anthracene	Uncertainty	B

TABLE 3-20A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
Dibenzofuran	No	A
Diethyl phthalate	No	A
Dimethyl phthalate	No	A
Fluoranthene	No	A
Fluorene	No	A
Hexachlorobenzene	Uncertainty	B
Hexachlorobutadiene	Uncertainty	B
Hexachlorocyclopentadiene	No	A
Hexachloroethane	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	No	A
Isophorone	Uncertainty	B
N-Nitroso-di-n-propylamine	Uncertainty	B
N-Nitrosodiphenylamine	Uncertainty	B
Naphthalene	No	A
Pentachlorophenol	Uncertainty	B
Phenanthrene	No	A
Phenol	No	A
Pyrene	No	A
Metals and Inorganics		
Aluminum	No	F
Antimony	Yes	D
Arsenic	Yes	D
Barium	Yes	E
Beryllium	No	A
Boron	No	F
Cadmium	Uncertainty	B
Calcium	Uncertainty	G
Chromium	Yes	E
Cobalt	No	F
Copper	No	F
Cyanide, Total	NA	NA
Iron	No	F
Lead	No	F
Magnesium	Uncertainty	G
Manganese	No	F
Mercury	Uncertainty	B
Nickel	Yes	E
Potassium	Uncertainty	G
Selenium	Uncertainty	B
Silver	Yes	E
Sodium	No	C

TABLE 3-20A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
Thallium	No	F
Vanadium	No	F
Zinc	No	F
Explosives		
1,3,5-Trinitrobenzene	No	A
1,3-Dinitrobenzene	No	A
2,4,6-Trinitrotoluene (TNT)	No	A
2,4-Dinitrotoluene	Uncertainty	B
2,6-Dinitrotoluene	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	C
2-Nitrotoluene (ONT)	No	C
3-Nitrotoluene	No	A
4-Amino-2,6-Dinitrotoluene	No	C
4-Nitrotoluene (PNT)	No	A
HMX	No	A
Nitrobenzene	Uncertainty	B
Nitroglycerin	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA
Perchloric Acid	NA	NA
RDX	No	A
Tetryl	No	A
Other Parameters		
Perchlorate	No	A

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 3-21, AUS-0A2B
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	NA	NA	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	No	A
1,1,2-Trichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethene	NA	NA	NA	NA	No	A
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	No	A
1,2-Dichloroethene (total)	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	NA	NA	No	A
2-Butanone (MEK)	NA	NA	NA	NA	No	A
2-Hexanone	NA	NA	NA	NA	No	A
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	No	A
Acetone	NA	NA	NA	NA	No	F
Benzene	NA	NA	NA	NA	No	A
Bromodichloromethane	NA	NA	NA	NA	No	A
Bromoform	NA	NA	NA	NA	No	A
Bromomethane	NA	NA	NA	NA	No	A
Carbon disulfide	NA	NA	NA	NA	No	A
Carbon tetrachloride	NA	NA	NA	NA	No	A
Chlorobenzene	NA	NA	NA	NA	No	A
Chloroethane	NA	NA	NA	NA	No	C
Chloroform	NA	NA	NA	NA	No	A
Chloromethane	NA	NA	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	NA	NA	No	A
cis-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Dibromochloromethane	NA	NA	NA	NA	No	A
Ethylbenzene	NA	NA	NA	NA	No	A
Methylene chloride	NA	NA	NA	NA	No	A
N-Hexane	NA	NA	NA	NA	No	C
Styrene	NA	NA	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	NA	NA	No	F
Toluene	NA	NA	NA	NA	No	A
total Xylenes	NA	NA	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	NA	NA	No	F
Vinyl chloride	NA	NA	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	No	A	NA	NA	No	A
1,2-Dichlorobenzene	No	A	NA	NA	No	A
1,3-Dichlorobenzene	No	A	NA	NA	No	A
1,4-Dichlorobenzene	No	A	NA	NA	No	A
2,4,5-Trichlorophenol	No	A	NA	NA	No	A

TABLE 3-21, AUS-0A2B
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trichlorophenol	Uncertainty	B	NA	NA	No	A
2,4-Dichlorophenol	No	A	NA	NA	No	A
2,4-Dimethylphenol	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	Uncertainty	B	NA	NA	No	A
2-Chloronaphthalene	No	A	NA	NA	Uncertainty	B
2-Chlorophenol	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	No	A	NA	NA	Yes	E
2-Methylphenol	No	A	NA	NA	No	A
2-Nitroaniline	No	A	NA	NA	No	A
2-Nitrophenol	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	No	A	NA	NA	No	A
3-Nitroaniline	No	A	NA	NA	No	A
4,6-Dinitro-2-methylphenol	Uncertainty	B	NA	NA	No	C
4-Bromophenyl phenyl ether	Uncertainty	B	NA	NA	No	C
4-Chloro-3-methylphenol	Uncertainty	B	NA	NA	No	A
4-Chloroaniline	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	No	A	NA	NA	No	C
4-Methylphenol	No	A	NA	NA	No	A
4-Nitroaniline	No	A	NA	NA	No	A
4-Nitrophenol	No	A	NA	NA	No	A
Acenaphthene	No	A	NA	NA	No	A
Acenaphthylene	No	A	NA	NA	No	A
Anthracene	Uncertainty	B	NA	NA	Yes	E
Benzo(a)anthracene	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	Uncertainty	B	NA	NA	Yes	E
Benzo(b)fluoranthene	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	Uncertainty	B	NA	NA	Yes	E
Benzo(k)fluoranthene	Uncertainty	B	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	No	A	NA	NA	Uncertainty	B
bis(2-Chloroethyl) ether	No	A	NA	NA	No	A
bis(2-Chloroisopropyl) ether	No	C	NA	NA	No	C
bis(2-Ethylhexyl) phthalate	Uncertainty	B	NA	NA	Yes	E
Butyl benzyl phthalate	No	A	NA	NA	Yes	E
Carbazole	No	A	NA	NA	Yes	E
Chrysene	No	A	NA	NA	Yes	E
Di-n-butyl phthalate	Uncertainty	B	NA	NA	Yes	E
Di-n-octyl phthalate	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	Uncertainty	B	NA	NA	Yes	E
Dibenzofuran	Uncertainty	B	NA	NA	Yes	E
Diethyl phthalate	No	A	NA	NA	No	A
Dimethyl phthalate	No	A	NA	NA	No	A
Fluoranthene	Uncertainty	B	NA	NA	Yes	E

TABLE 3-21, AUS-0A2B
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Fluorene	Uncertainty	B	NA	NA	No	A
Hexachlorobenzene	Uncertainty	B	NA	NA	No	A
Hexachlorobutadiene	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	Uncertainty	B	NA	NA	No	A
Hexachloroethane	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	Uncertainty	B	NA	NA	Yes	E
Isophorone	No	A	NA	NA	No	A
N-Nitroso-di-n-propylamine	No	C	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	No	A	NA	NA	No	A
Naphthalene	No	A	NA	NA	No	F
Pentachlorophenol	Uncertainty	B	NA	NA	No	A
Phenanthrene	Uncertainty	B	NA	NA	Yes	E
Phenol	No	A	NA	NA	No	A
Pyrene	No	A	NA	NA	Yes	E
Metals and Inorganics						
Aluminum	Yes	E	NA	NA	Uncertainty	I
Antimony	No	A	NA	NA	Yes	E
Arsenic	No	F	NA	NA	Yes	E
Barium	No	F	NA	NA	Yes	E
Beryllium	Uncertainty	B	NA	NA	No	F
Boron	No	A	NA	NA	Yes	E
Cadmium	Uncertainty	B	NA	NA	No	F
Calcium	No	F,H	NA	NA	Uncertainty	G,H
Chromium	No	F	NA	NA	Yes	E
Cobalt	Uncertainty	B	NA	NA	Yes	E
Copper	Uncertainty	B	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	Yes	E
Iron	Yes	E	NA	NA	Yes	E
Lead	Yes	E	NA	NA	Yes	E
Magnesium	No	F,H	NA	NA	Uncertainty	G,H
Manganese	Yes	E	NA	NA	Yes	E
Mercury	No	A	NA	NA	Yes	E
Nickel	No	A	NA	NA	Yes	J
Potassium	No	F,H	NA	NA	Uncertainty	G,H
Selenium	No	A	NA	NA	Yes	E
Silver	Uncertainty	B	NA	NA	Yes	J
Sodium	No	F,H	NA	NA	Uncertainty	G,H
Thallium	Uncertainty	B	NA	NA	Yes	E
Vanadium	Uncertainty	B	NA	NA	Yes	E
Zinc	No	A	NA	NA	Yes	E
Explosives						
1,3,5-Trinitrobenzene	No	A	NA	NA	Uncertainty	B
1,3-Dinitrobenzene	No	A	NA	NA	No	A

TABLE 3-21, AUS-0A2B
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	A	NA	NA	No	A
2,6-Dinitrotoluene	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	A	NA	NA	No	A
2-Nitrotoluene (ONT)	No	A	NA	NA	No	C
3-Nitrotoluene	No	A	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	No	A	NA	NA	No	C
4-Nitrotoluene (PNT)	No	A	NA	NA	No	C
HMX	No	A	NA	NA	No	A
Nitrobenzene	No	A	NA	NA	No	A
Nitroglycerin	NA	NA	NA	NA	No	C
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	No	A	NA	NA	No	A
Tetryl	No	C	NA	NA	No	C

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.

J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 3-21A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
Volatile Organic Compounds		
1,1,1-Trichloroethane	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA
1,1,2-Trichloroethane	NA	NA
1,1-Dichloroethane	NA	NA
1,1-Dichloroethene	NA	NA
1,2-Dichloroethane (EDC)	NA	NA
1,2-Dichloroethene (total)	NA	NA
1,2-Dichloropropane	NA	NA
2-Butanone (MEK)	NA	NA
2-Hexanone	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA
Acetone	NA	NA
Benzene	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	NA
Bromomethane	NA	NA
Carbon disulfide	NA	NA
Carbon tetrachloride	NA	NA
Chlorobenzene	NA	NA
Chloroethane	NA	NA
Chloroform	NA	NA
Chloromethane	NA	NA
cis-1,2-Dichloroethene	NA	NA
cis-1,3-Dichloropropene	NA	NA
Dibromochloromethane	NA	NA
Ethylbenzene	NA	NA
Methylene chloride	NA	NA
N-Hexane	NA	NA
Styrene	NA	NA
Tetrachloroethylene (PCE)	NA	NA
Toluene	NA	NA
total Xylenes	NA	NA
trans-1,2-Dichloroethene	NA	NA
trans-1,3-Dichloropropene	NA	NA
Trichloroethylene (TCE)	NA	NA
Vinyl chloride	NA	NA
Semivolatile Organic Compounds		
1,2,4-Trichlorobenzene	No	A
1,2-Dichlorobenzene	No	A
1,3-Dichlorobenzene	No	A

TABLE 3-21A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
1,4-Dichlorobenzene	No	A
2,4,5-Trichlorophenol	No	A
2,4,6-Trichlorophenol	No	A
2,4-Dichlorophenol	No	A
2,4-Dimethylphenol	Uncertainty	B
2,4-Dinitrophenol	No	A
2-Chloronaphthalene	Uncertainty	B
2-Chlorophenol	Uncertainty	B
1-Methylnaphthalene	NA	NA
2-Methylnaphthalene	No	A
2-Methylphenol	No	A
2-Nitroaniline	No	A
2-Nitrophenol	No	A
3,3'-Dichlorobenzidine	No	A
3-Nitroaniline	No	A
4,6-Dinitro-2-methylphenol	No	C
4-Bromophenyl phenyl ether	No	C
4-Chloro-3-methylphenol	No	A
4-Chloroaniline	No	A
4-Chlorophenyl phenyl ether	No	C
4-Methylphenol	No	A
4-Nitroaniline	No	A
4-Nitrophenol	No	A
Acenaphthene	No	A
Acenaphthylene	No	A
Anthracene	No	A
Benzo(a)anthracene	No	A
Benzo(a)pyrene	No	A
Benzo(b)fluoranthene	No	A
Benzo(g,h,i)perylene	No	A
Benzo(k)fluoranthene	No	A
bis(2-Chloroethoxy)methane	Uncertainty	B
bis(2-Chloroethyl) ether	No	A
bis(2-Chloroisopropyl) ether	No	C
bis(2-Ethylhexyl) phthalate	No	A
Butyl benzyl phthalate	Uncertainty	B
Carbazole	No	C
Chrysene	No	A
Di-n-butyl phthalate	No	A
Di-n-octyl phthalate	No	A
Dibenz(a,h)anthracene	No	A

TABLE 3-21A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
Dibenzofuran	No	C
Diethyl phthalate	No	A
Dimethyl phthalate	No	A
Fluoranthene	No	A
Fluorene	No	A
Hexachlorobenzene	No	A
Hexachlorobutadiene	Uncertainty	B
Hexachlorocyclopentadiene	No	A
Hexachloroethane	No	A
Indeno(1,2,3-c,d)pyrene	No	A
Isophorone	No	A
N-Nitroso-di-n-propylamine	No	A
N-Nitrosodiphenylamine	No	A
Naphthalene	No	A
Pentachlorophenol	No	A
Phenanthrene	No	A
Phenol	No	A
Pyrene	No	A
Metals and Inorganics		
Aluminum	Uncertainty	G
Antimony	Yes	E
Arsenic	No	F
Barium	Yes	E
Beryllium	No	A
Boron	Yes	E
Cadmium	No	A
Calcium	Uncertainty	G
Chromium	Yes	E
Cobalt	No	F
Copper	Yes	E
Cyanide, Total	NA	NA
Iron	Yes	E
Lead	No	F
Magnesium	Uncertainty	G
Manganese	Yes	D
Mercury	No	A
Nickel	No	F
Potassium	Uncertainty	G
Selenium	No	A
Silver	Yes	E
Sodium	No	C

TABLE 3-21A, AUS-0A2B
(DRUM SAMPLES)
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Drum	
	COPC (yes/no)	Rationale
Thallium	No	F
Vanadium	No	F
Zinc	Yes	E
Explosives		
1,3,5-Trinitrobenzene	No	A
1,3-Dinitrobenzene	No	A
2,4,6-Trinitrotoluene (TNT)	No	A
2,4-Dinitrotoluene	No	A
2,6-Dinitrotoluene	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	A
2-Nitrotoluene (ONT)	No	C
3-Nitrotoluene	No	C
4-Amino-2,6-Dinitrotoluene	No	C
4-Nitrotoluene (PNT)	No	C
HMX	No	A
Nitrobenzene	No	A
Nitroglycerin	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA
Perchloric Acid	NA	NA
RDX	No	A
Tetryl	No	C
Other Parameters		
Perchlorate	No	C

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.

J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 3-22
AUS-0A2B - IOP BOOSTER LOADING LINE
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

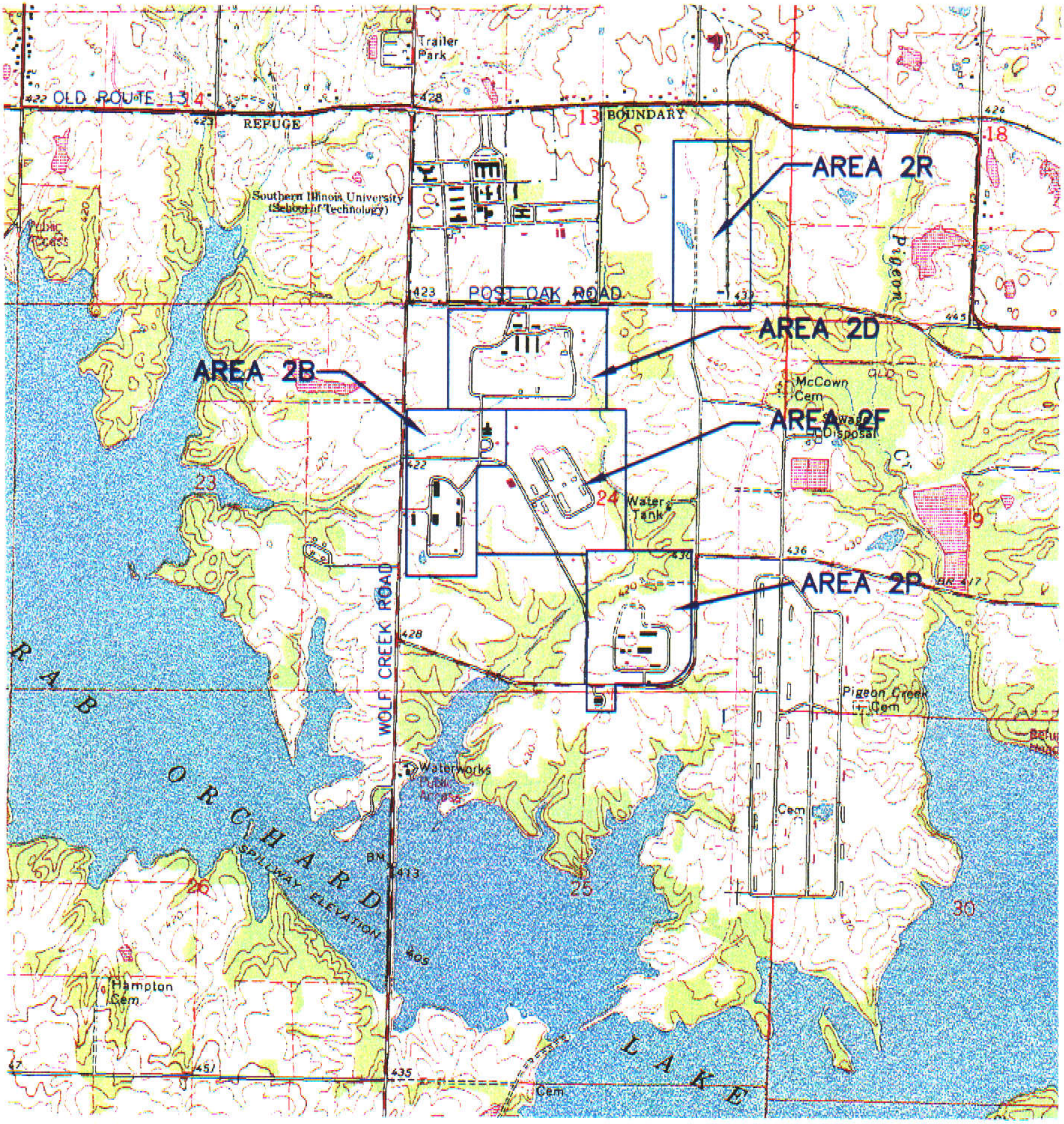
Chemical	Drum	Soil	Sediment	Ground Water	Surface Water
VOCs					
1,1-Dichloroethene	NA		NA	H	NA
cis-1,2-Dichloroethene	NA		NA	H	NA
Tetrachloroethylene (PCE)	NA	H	NA	H	NA
Trichloroethylene (TCE)	NA	H	NA	H	NA
SVOCs					
2-Methylnaphthalene		E	NA		
Anthracene		E	NA		
Benzo(a)anthracene		H,E	NA		
Benzo(a)pyrene		H,E	NA		
Benzo(b)fluoranthene		H,E	NA		
Benzo(g,h,i)perylene		E	NA		
Benzo(k)fluoranthene		E	NA		
bis(2-Ethylhexyl) phthalate		E	NA		
Butyl benzyl phthalate		E	NA		
Carbazole		H,E	NA		
Chrysene		E	NA		
Di-n-butyl phthalate		E	NA		
Dibenz(a,h)anthracene		H,E	NA		
Dibenzofuran		E	NA		
Fluoranthene		E	NA		
Indeno(1,2,3-c,d)pyrene		E	NA		
Phenanthrene		E	NA		
Pyrene		E	NA		
Metals					
Aluminum			NA		E
Antimony	E	H,E	NA		
Arsenic		H,E	NA		
Barium	H,E	H,E	NA		
Beryllium		H	NA		
Boron	E	E	NA		
Cadmium		H	NA		
Chromium	H,E	H,E	NA		
Cobalt		E	NA		
Copper	E	E	NA		
Cyanide, Total	NA	H,E	NA	NA	NA
Iron	E	E	NA		H,E
Lead		H,E	NA		E
Manganese		E	NA	H	H,E
Mercury		H,E	NA		
Nickel	H	H,E	NA		
Selenium		H,E	NA		
Silver	H,E	H,E	NA		
Thallium		E	NA		

TABLE 3-22
AUS-0A2B - IOP BOOSTER LOADING LINE
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND (WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum	Soil	Sediment	Ground Water	Surface Water
Vanadium		**E**	NA		
Zinc	**E**	**H,E**	NA		

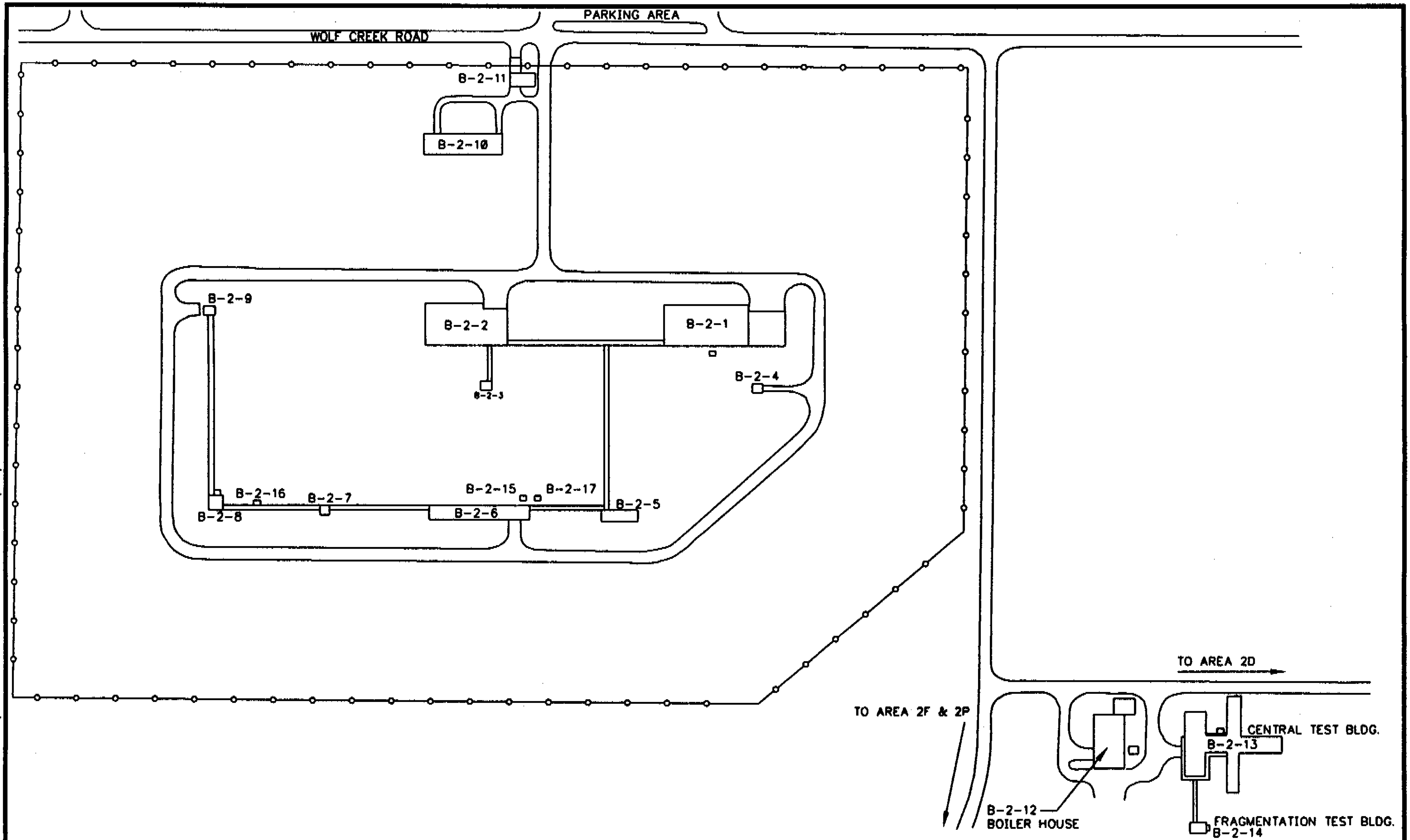
Key:
NA = not analyzed
H = human health screening criteria exceeded
E = ecological screening criteria exceeded



SOURCE: USGS DIGITAL RASTER GRAPHIC

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 6/29/00 DSGN. BY: mh CHKD. BY: cmw	Area 2 Site Location Map — FIG. NO. 3-1

File: E:\45FOM9602N\CRABFIG3-1.DWG Last edited: 07/16/01 @ 11:28 a.m. @ WCC-ST.LOUIS



SOURCE: U.S. ACE. 1944, WAR DEPARTMENT
FACILITIES INVENTORY OF THE ILLINOIS
ORDNANCE PLANT
PART I SECT. 5 PAGE 15
(PLAN NO. 6544-101.24)

NOT TO SCALE

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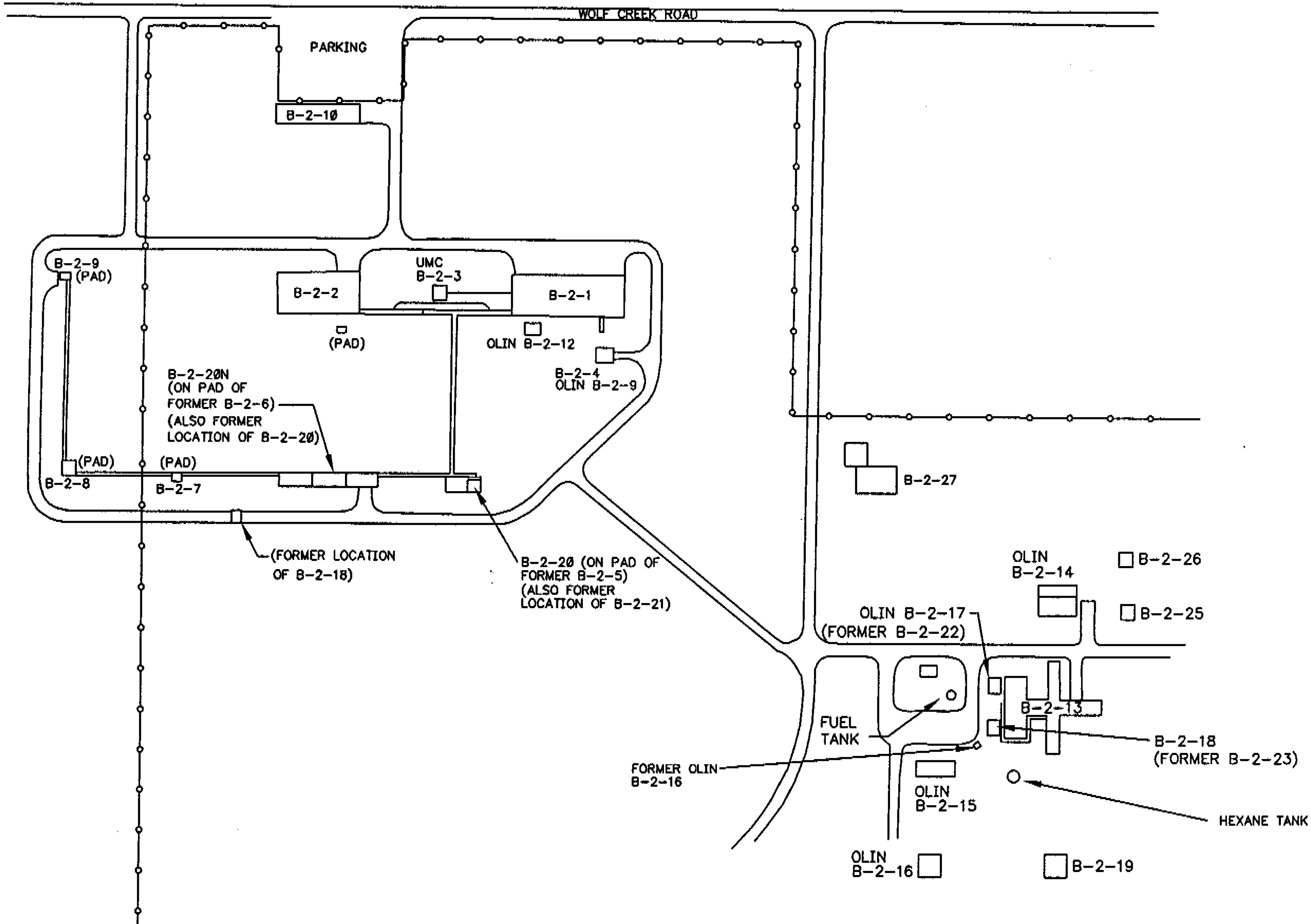
PA/SI REPORT – AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS Corporation

DRN. BY: djd 8/15/99 DSGN. BY: mh CHKD. BY: cmw	Original IOP Configuration for Area 2B	FIG. NO. 3–2

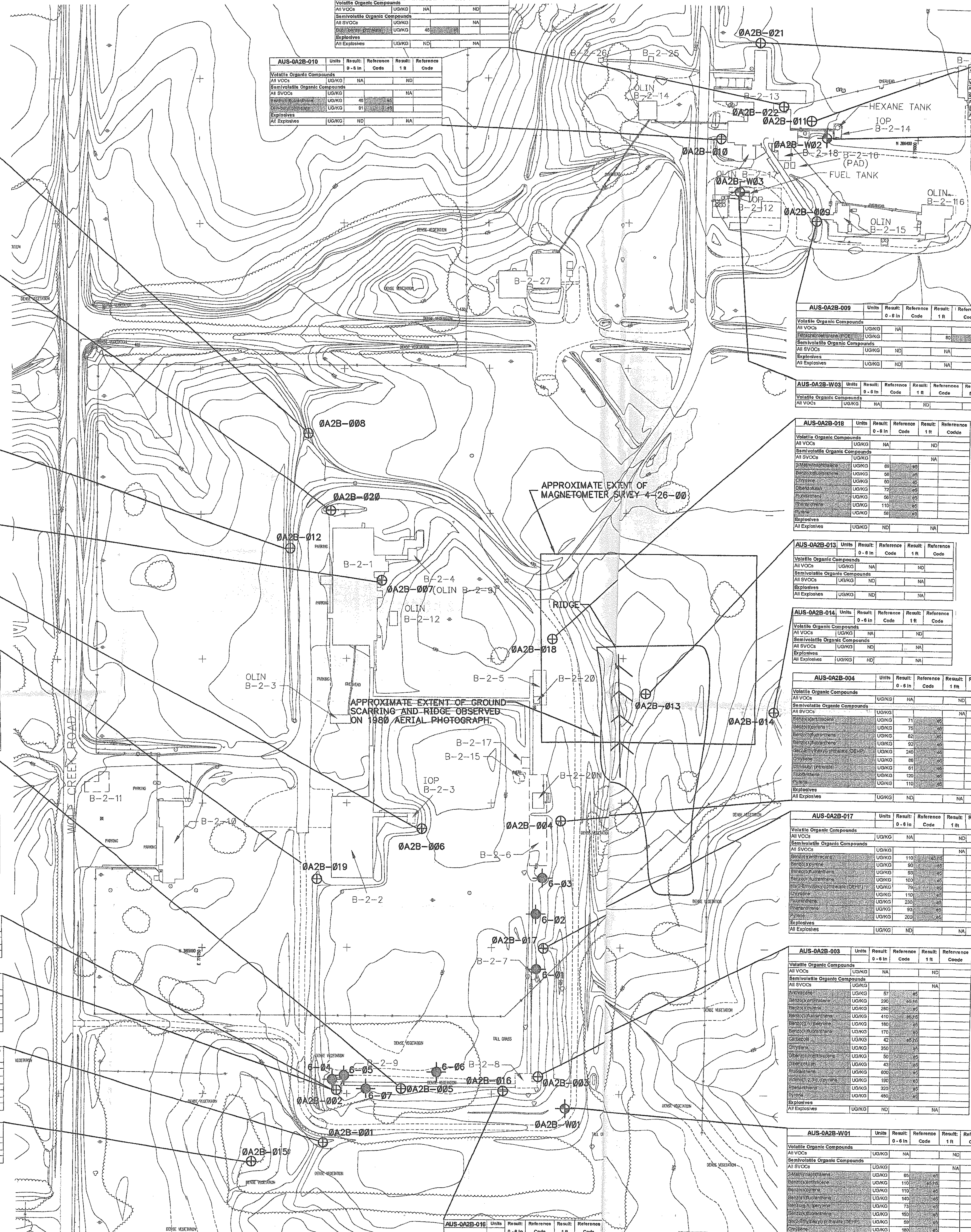


SOURCES: PRI Ø16805
PRI Ø16806
CO02156

NOT TO SCALE

PA/SI REPORT - AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 8/15/99 DSGN. BY: mh CHKD. BY: mch	Current Area 2B Configuration	FIG. NO. 3-3

File: E:\2320000026.00\PA-SI REPORT-AUS OU\CRABFIGS-3CS.DWG Last edited: 09/19/01 @ 10:18 a.m. WC-ST.LOUIS, MO



LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

AUS-0A2B-022	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Butyl benzyl phthalate	UG/KG	48	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-010	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Benzo(b)fluoranthene	UG/KG	46	e5		
Di-n-butyl phthalate	UG/KG	91	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-021	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Trichloroethylene (TCE)	UG/KG			150	h5,h9
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Di-n-butyl phthalate	UG/KG	78	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-011	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-W02	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 7.5 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Semivolatile Organic Compounds									
All SVOCs	UG/KG			NA		NA		NA	
2-Methylnaphthalene	UG/KG	55	e5						
Benzo(a)anthracene	UG/KG	120	e5,h5						
Benzo(a)pyrene	UG/KG	140	e5						
Benzo(b)fluoranthene	UG/KG	160	e5						
Benzo(g,h,i)perylene	UG/KG	97	e5						
Benzo(k)fluoranthene	UG/KG	170	e5						
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	49	e5						
Chrysene	UG/KG	180	e5						
Fluoranthene	UG/KG	140	e5						
Indeno(1,2,3-c,d)pyrene	UG/KG	88	e5						
Phenanthrene	UG/KG	67	e5						
Pyrene	UG/KG	130	e5						
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2B-008	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-020	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	66	e5		
Benzo(b)fluoranthene	UG/KG	76	e5		
Chrysene	UG/KG	59	e5		
Fluoranthene	UG/KG	50	e5		
Phenanthrene	UG/KG	85	e5		
Pyrene	UG/KG	76	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-012	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	250	e5		
Benzo(a)anthracene	UG/KG	170	e5,h5		
Benzo(a)pyrene	UG/KG	150	e5		
Benzo(b)fluoranthene	UG/KG	270	e5,h5		
Benzo(g,h,i)perylene	UG/KG	95	e5		
Benzo(k)fluoranthene	UG/KG	87	e5		
Chrysene	UG/KG	230	e5		
Dibenzofuran	UG/KG	120	e5		
Fluoranthene	UG/KG	240	e5		
Indeno(1,2,3-c,d)pyrene	UG/KG	100	e5		
Naphthalene	UG/KG	96			
Phenanthrene	UG/KG	300	e5		
Pyrene	UG/KG	300	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-007	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-006	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-019	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Benzo(b)fluoranthene	UG/KG	63	e5		
Chrysene	UG/KG	67	e5		
Fluoranthene	UG/KG	89	e5		
Phenanthrene	UG/KG	61	e5		
Pyrene	UG/KG	90	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-005	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Acetone	UG/KG			48	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Benzo(a)anthracene	UG/KG	48	e5		
Benzo(a)pyrene	UG/KG	46	e5		
Benzo(b)fluoranthene	UG/KG	120	e5		
Chrysene	UG/KG	71	e5		
Fluoranthene	UG/KG	72	e5		
Pyrene	UG/KG	60	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-002-DRUM	Units	Result	Screening Codes
Semivolatile Organic Compounds			
All SVOCs	UG/KG	ND	
Explosives			
All Explosives	UG/KG	ND	

AUS-0A2B-002	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-001	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Acetone	UG/KG			38	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-015	Units	Result: 0 - 6 in	Reference Code
Semivolatile Organic Compounds			
All SVOCs	UG/KG	ND	
Explosives			
All Explosives	UG/KG	ND	

AUS-0A2B-016	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Acetone	UG/KG			40	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-009	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Tetrachloroethylene (PCE)	UG/KG			80	h5,h9
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-W03	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Referencee Code	Result: 5 ft	Reference Code	Result: 10 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	

AUS-0A2B-018	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Refererence Codde
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	69	e5		
Benzo(b)fluoranthene	UG/KG	56	e5		
Chrysene	UG/KG	50	e5		
Dibenzofuran	UG/KG	72	e5		
Fluoranthene	UG/KG	56	e5		
Phenanthrene	UG/KG	110	e5		
Pyrene	UG/KG	56	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-013	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-014	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-004	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Benzo(a)anthracene	UG/KG	71	e5		
Benzo(a)pyrene	UG/KG	75	e5		
Benzo(b)fluoranthene	UG/KG	82	e5		
Benzo(k)fluoranthene	UG/KG	92	e5		
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	240	e5		
Chrysene	UG/KG	86	e5		
Di-n-butyl phthalate	UG/KG	61	e5		
Fluoranthene	UG/KG	120	e5		
Pyrene	UG/KG	110	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-017	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Benzo(a)anthracene	UG/KG	110	e5,h5		
Benzo(a)pyrene	UG/KG	90	e5		
Benzo(b)fluoranthene	UG/KG	93	e5		
Benzo(k)fluoranthene	UG/KG	100	e5		
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	79	e5		
Chrysene	UG/KG	110	e5		
Fluoranthene	UG/KG	230	e5		
Phenanthrene	UG/KG	93	e5		
Pyrene	UG/KG	200	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-003	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Referrence Coode
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Anthracene	UG/KG	57	e5		
Benzo(a)anthracene	UG/KG	290	e5,h5		
Benzo(a)pyrene	UG/KG	280	e5		
Benzo(b)fluoranthene	UG/KG	410	e5,h5		
Benzo(g,h,i)perylene	UG/KG	180	e5		
Benzo(k)fluoranthene	UG/KG	170	e5		
Carbazole	UG/KG	42	e5,h5		
Chrysene	UG/KG	350	e5		
Dibenz(a,h)anthracene	UG/KG	50	e5		
Dibenzofuran	UG/KG	43	e5		
Fluoranthene	UG/KG	600	e5		
Indeno(1,2,3-c,d)pyrene	UG/KG	190	e5		
Phenanthrene	UG/KG	320	e5		
Pyrene	UG/KG	480	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2B-W01	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 20 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Semivolatile Organic Compounds									
All SVOCs	UG/KG			NA		NA		NA	
2-Methylnaphthalene	UG/KG	65	e5						
Benzo(a)anthracene	UG/KG	110	e5,h5						
Benzo(a)pyrene	UG/KG	110	e5						
Benzo(b)fluoranthene	UG/KG	140	e5						
Benzo(g,h,i)perylene	UG/KG	73	e5						
Benzo(k)fluoranthene	UG/KG	160	e5						
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	59	e5						
Chrysene	UG/KG	180	e5						
Dibenzofuran	UG/KG	74	e5						
Fluoranthene	UG/KG	260	e5						
Indeno(1,2,3-c,d)pyrene	UG/KG	76	e5						
Phenanthrene	UG/KG	170	e5						
Pyrene	UG/KG	260	e5						
Explosives									
All Explosives	UG/KG	ND		N/A		NA		NA	

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SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2ØØØ. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES AND/OR ROADS.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.
4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

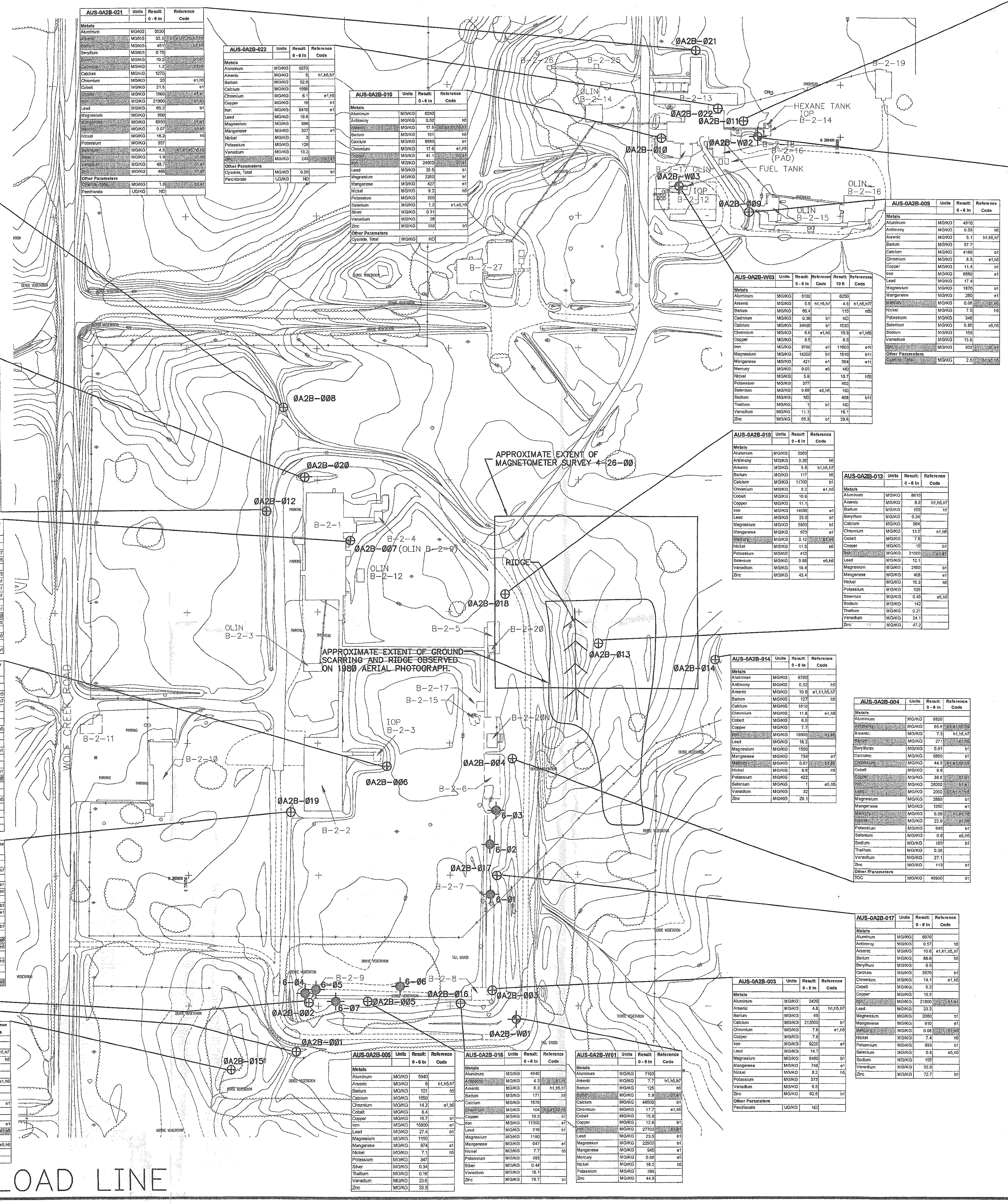
AUS-ØA2B
Sample Locations and Detections of Organic Compounds in Soils/Drums

Date: 11/14/ØØ	Project Number: 2320000026.ØØ	Figure Number: 3-4
Drawn by: DJD	Design by: MAM	Checked by: CMW

URS

AREA 2B-BOOSTER LOAD LINE

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-SAMPLE LOCATION 2\AUS-0A2B.DWG Last edited: SEP. 21, 01 @ 09:53 a.m. URS Corp.



AUS-0A2B-008	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6670	
Antimony	MG/KG	0.93	b1,h5
Arsenic	MG/KG	35.2	b1,e1,h1,h5,h7,h9
Barium	MG/KG	837	b1,e1,h5
Beryllium	MG/KG	1.3	b1,h7
Boron	MG/KG	7.1	b1,e1
Calcium	MG/KG	3360	b1
Chromium	MG/KG	14.2	e1,h5
Cobalt	MG/KG	25.6	b1,e1
Copper	MG/KG	11.3	
Iron	MG/KG	58800	b1,e1
Lead	MG/KG	62	b1
Magnesium	MG/KG	1480	
Mercury	MG/KG	0.07	b1,e5
Nickel	MG/KG	19	b1,h5
Potassium	MG/KG	383	
Selenium	MG/KG	4.1	b1,e1,e5,h5,h9
Silver	MG/KG	1.8	b1,h9
Vanadium	MG/KG	74.1	b1,e1
Zinc	MG/KG	59.3	b1
Other Parameters			
TOC	MG/KG	36100	b1

AUS-0A2B-021	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5520	
Arsenic	MG/KG	33.3	b1,e1,h1,h5,h7,h9
Barium	MG/KG	451	b1,h5
Beryllium	MG/KG	0.75	
Boron	MG/KG	10.2	b1,e1
Cadmium	MG/KG	1.2	b1,h5
Calcium	MG/KG	1270	
Chromium	MG/KG	20	e1,h5
Cobalt	MG/KG	21.6	e1
Copper	MG/KG	1560	b1,e1
Iron	MG/KG	21300	b1,e1
Lead	MG/KG	65.2	b1
Magnesium	MG/KG	800	
Manganese	MG/KG	6350	b1,e1
Mercury	MG/KG	0.07	b1,e5
Nickel	MG/KG	18.2	h5
Potassium	MG/KG	357	
Selenium	MG/KG	4.5	b1,e1,e5,h5,h9
Silver	MG/KG	1.9	b1,h9
Vanadium	MG/KG	48.7	b1,e1
Zinc	MG/KG	465	b1,e1
Other Parameters			
Cyanide, Total	MG/KG	1.6	b1,e1
Perchlorate	UG/KG	ND	

AUS-0A2B-022	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	3070	
Arsenic	MG/KG	5	h1,h5,h7
Barium	MG/KG	52.9	
Calcium	MG/KG	1590	
Chromium	MG/KG	6.1	e1,h5
Copper	MG/KG	19	b1
Iron	MG/KG	6410	e1
Lead	MG/KG	19.8	
Magnesium	MG/KG	686	
Manganese	MG/KG	327	e1
Nickel	MG/KG	3	
Potassium	MG/KG	129	
Vanadium	MG/KG	13.2	
Zinc	MG/KG	243	b1,e1
Other Parameters			
Cyanide, Total	MG/KG	0.59	b1
Perchlorate	UG/KG	ND	

AUS-0A2B-010	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6240	
Antimony	MG/KG	0.52	h5
Arsenic	MG/KG	17.5	b1,e1,h1,h5,h7
Barium	MG/KG	101	h5
Calcium	MG/KG	6880	b1
Chromium	MG/KG	17.6	e1,h5
Copper	MG/KG	41.1	b1,e1
Iron	MG/KG	24900	b1,e1
Lead	MG/KG	25.6	b1
Magnesium	MG/KG	2260	b1
Manganese	MG/KG	427	e1
Nickel	MG/KG	9.2	h5
Potassium	MG/KG	300	
Selenium	MG/KG	1.2	e1,e5,h5
Silver	MG/KG	0.31	
Vanadium	MG/KG	28	
Zinc	MG/KG	103	b1
Other Parameters			
Cyanide, Total	MG/KG	ND	

AUS-0A2B-020	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5780	
Antimony	MG/KG	0.31	h5
Arsenic	MG/KG	9.9	e1,h1,h5,h7
Barium	MG/KG	132	h5
Calcium	MG/KG	4340	b1
Chromium	MG/KG	7.8	e1,h5
Copper	MG/KG	9.5	
Iron	MG/KG	12200	e1
Lead	MG/KG	32	b1
Magnesium	MG/KG	2120	b1
Manganese	MG/KG	772	e1
Mercury	MG/KG	0.07	b1,e5
Nickel	MG/KG	6.6	
Potassium	MG/KG	344	
Selenium	MG/KG	0.78	e5,h5
Silver	MG/KG	0.3	
Vanadium	MG/KG	19.7	
Zinc	MG/KG	42.1	

AUS-0A2B-012	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5120	
Antimony	MG/KG	0.47	h5
Arsenic	MG/KG	8.3	h1,h5,h7
Barium	MG/KG	82.8	h5
Cadmium	MG/KG	0.41	b1,h5
Calcium	MG/KG	50000	b1
Chromium	MG/KG	7.6	e1,h5
Copper	MG/KG	26.4	b1
Iron	MG/KG	9970	e1
Lead	MG/KG	65.3	b1
Magnesium	MG/KG	6840	b1
Manganese	MG/KG	354	e1
Mercury	MG/KG	0.09	b1,e5
Nickel	MG/KG	9.6	h5
Potassium	MG/KG	348	
Selenium	MG/KG	1.1	e1,e5,h5
Vanadium	MG/KG	13.4	
Zinc	MG/KG	111	b1

AUS-0A2B-007	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5500	
Arsenic	MG/KG	8.5	h1,h5,h7
Barium	MG/KG	81.1	h5
Calcium	MG/KG	2000	
Chromium	MG/KG	7.5	e1,h5
Copper	MG/KG	21.3	b1
Iron	MG/KG	9980	e1
Lead	MG/KG	73.3	b1
Magnesium	MG/KG	944	
Manganese	MG/KG	311	e1
Mercury	MG/KG	0.18	b1,e5,h9
Nickel	MG/KG	7.3	h5
Potassium	MG/KG	261	
Selenium	MG/KG	0.3	e5
Vanadium	MG/KG	15.2	
Zinc	MG/KG	89.8	b1

AUS-0A2B-006	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7120	
Antimony	MG/KG	0.34	h5
Arsenic	MG/KG	5.5	h1,h5,h7
Barium	MG/KG	67.3	
Beryllium	MG/KG	0.05	
Calcium	MG/KG	466	
Chromium	MG/KG	8.5	e1,h5
Cobalt	MG/KG	1.1	
Copper	MG/KG	4.5	
Iron	MG/KG	10900	e1
Lead	MG/KG	9.2	
Magnesium	MG/KG	1180	
Manganese	MG/KG	170	e1
Mercury	MG/KG	0.19	b1,e5,h9
Nickel	MG/KG	4	
Potassium	MG/KG	265	
Selenium	MG/KG	0.55	e5,h5
Sodium	MG/KG	143	
Thallium	MG/KG	0.27	
Vanadium	MG/KG	19	
Zinc	MG/KG	19.5	

AUS-0A2B-019	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5680	
Arsenic	MG/KG	8.5	h1,h5,h7
Barium	MG/KG	74.8	
Calcium	MG/KG	13700	b1
Chromium	MG/KG	9.3	h5
Cobalt	MG/KG	3.6	
Copper	MG/KG	11.9	b1
Iron	MG/KG	14400	e1
Lead	MG/KG	20.6	
Magnesium	MG/KG	2590	b1
Manganese	MG/KG	360	
Mercury	MG/KG	0.11	b1,e5
Nickel	MG/KG	8.3	h5
Potassium	MG/KG	304	
Selenium	MG/KG	0.86	e5,h5
Silver	MG/KG	0.29	
Vanadium	MG/KG	15.7	
Zinc	MG/KG	256	b1,e1

AUS-0A2B-002-DRUM	Units	Result	Screening Codes
Metals			
Aluminum	MG/KG	8180	
Antimony	MG/KG	5.6	[illegible]
Arsenic	MG/KG	8.5	h1,h5,h7
Barium	MG/KG	1550	[illegible]
Beryllium	MG/KG	143	[illegible]
Cadmium	MG/KG	181	[illegible]
Calcium	MG/KG	3750	b1
Cobalt	MG/KG	11.6	
Copper	MG/KG	75.1	[illegible]
Iron	MG/KG	34300	[illegible]
Lead	MG/KG	281	b1
Magnesium	MG/KG	4440	b1
Manganese	MG/KG	495	e1
Mercury	MG/KG	23.7	[illegible]
Nickel	MG/KG	969	[illegible]
Potassium	MG/KG	[illegible]	b1
Silver	MG/KG	4	[illegible]
Thallium	MG/KG	0.17	
Vanadium	MG/KG	23.6	
Zinc	MG/KG	189	[illegible]
Other Parameters			
Perchlorate	UG/KG	ND	

AUS-0A2B-002	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7630	
Antimony	MG/KG	5.6	h5
Barium	MG/KG	1260	[illegible]
Boron	MG/KG	17.5	[illegible]
Cadmium	MG/KG	[illegible]	[illegible]
Chromium	MG/KG	43	[illegible]
Cobalt	MG/KG	8.8	
Copper	MG/KG	11.1	
Iron	MG/KG	16000	e1
Lead	MG/KG	[illegible]	b1
Magnesium	MG/KG	2930	b1
Manganese	MG/KG	540	e1
Nickel	MG/KG	18	h5
Potassium	MG/KG	996	b1
Silver	MG/KG	0.76	b1
Vanadium	MG/KG	25.8	
Zinc	MG/KG	35	
Other Parameters			
Cyanide, Total	MG/KG	ND	
Perchlorate	UG/KG	ND	

AUS-0A2B-001	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8580	
Arsenic	MG/KG	10.7	e1,h1,h5,h7
Barium	MG/KG	126	h5
Calcium	MG/KG	3750	b1
Chromium	MG/KG	15.4	e1,h5
Copper	MG/KG	10.9	
Iron	MG/KG	18300	e1
Lead	MG/KG	27.6	b1
Magnesium	MG/KG	2680	b1
Manganese	MG/KG	454	e1
Mercury	MG/KG	0.06	b1,e5
Nickel	MG/KG	13.5	h5
Potassium	MG/KG	672	b1
Vanadium	MG/KG	25.3	
Zinc	MG/KG	261	b1,e1

AUS-0A2B-015	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5620	
Arsenic	MG/KG	3.5	h1,h5,h7
Barium	MG/KG	112	h5
Beryllium	MG/KG	0.45	
Calcium	MG/KG	1030	
Chromium	MG/KG	8.4	e1,h5
Cobalt	MG/KG	5.8	
Copper	MG/KG	7.9	
Iron	MG/KG	6500	e1
Lead	MG/KG	18.5	
Magnesium	MG/KG	898	
Manganese	MG/KG	434	e1
Mercury	MG/KG	0.11	b1,e5
Nickel	MG/KG	6	
Selenium	MG/KG	0.79	e5,h5
Vanadium	MG/KG	17.9	
Zinc	MG/KG	35.1	

AUS-0A2B-005	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5940	
Arsenic	MG/KG	6	h1,h5,h7
Barium	MG/KG	101	h5
Calcium	MG/KG	1550	
Chromium	MG/KG	14.2	e1,h5
Cobalt	MG/KG	6.4	
Copper	MG/KG	15.7	b1
Iron	MG/KG	15800	e1
Lead	MG/KG	14.2	
Magnesium	MG/KG	1150	
Manganese	MG/KG	974	e1
Nickel	MG/KG	7.1	h5
Potassium	MG/KG	347	
Silver	MG/KG	0.34	
Thallium	MG/KG	0.16	
Vanadium	MG/KG	23.6	
Zinc	MG/KG	33.3	

AUS-0A2B-016	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4840	
Antimony	MG/KG	4.3	[illegible]
Arsenic	MG/KG	6.3	h1,h5,h7
Barium	MG/KG	171	h5
[illegible]	MG/KG	[illegible]	[illegible]
[illegible]	MG/KG	[illegible]	
Chromium	MG/KG	104	[illegible]
Cobalt	MG/KG	19.3	e1
Copper	MG/KG	[illegible]	[illegible]
Iron	MG/KG	11500	e1
Lead	MG/KG	316	b1
Magnesium	MG/KG	1160	
Manganese	MG/KG	647	e1
Nickel	MG/KG	7.7	h5
Potassium	MG/KG	303	
Silver	MG/KG	0.44	
Vanadium	MG/KG	16.1	
Zinc	MG/KG	79.7	b1

AUS-0A2B-W01	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7160	
Arsenic	MG/KG	7.7	h1,h5,h7
Barium	MG/KG	125	h5
[illegible]	MG/KG	5.9	[illegible]
Calcium	MG/KG	[illegible]	b1
Chromium	MG/KG	17.7	e1,h5
Cobalt	MG/KG	15.9	
Copper	MG/KG	12.8	b1
Iron	MG/KG	27700	[illegible]
Lead	MG/KG	23.5	b1
Magnesium	MG/KG	22800	b1
Manganese	MG/KG	945	e1
Mercury	MG/KG	0.08	e5
Nickel	MG/KG	18.2	h5
Potassium	MG/KG	384	b1
Zinc	MG/KG	44.8	

AUS-0A2B-011	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4100	
Arsenic	MG/KG	4.8	h1,h5,h7
Barium	MG/KG	34.6	
Calcium	MG/KG	971	
Chromium	MG/KG	5.8	e1,h5
Copper	MG/KG	4.1	
Iron	MG/KG	6500	e1
Lead (duplicate)	MG/KG	20.8	
Magnesium	MG/KG	644	
Manganese	MG/KG	235	e1
Nickel	MG/KG	3.2	
Potassium	MG/KG	201	
Selenium	MG/KG	0.43	e5,h5
Silver (duplicate)	MG/KG	0.44	
Vanadium	MG/KG	14.3	
Zinc	MG/KG	21.4	
Other Parameters			
Cyanide, Total	MG/KG	2.1	b1,e1,h5

AUS-0A2B-W02	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5390	
Arsenic	MG/KG	10.3	e1,h1,h5,h7
Barium	MG/KG	56.1	
Boron	MG/KG	2.9	e1
Calcium	MG/KG	50800	b1
Chromium	MG/KG	6.9	e1,h5
Copper	MG/KG	9.8	
Iron	MG/KG	10400	e1
Lead	MG/KG	14.4	
Magnesium	MG/KG	20100	b1
Manganese	MG/KG	254	e1
Nickel	MG/KG	6.6	
Potassium	MG/KG	491	
Selenium	MG/KG	0.54	e5,h5
Vanadium	MG/KG	14.9	
Zinc	MG/KG	39.2	
Other Parameters			
Cyanide, Total	MG/KG	ND	

AUS-0A2B-009	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4910	
Antimony	MG/KG	0.53	h5
Arsenic	MG/KG	5.1	h1,h5,h7
Barium	MG/KG	57.7	
Calcium	MG/KG	4180	b1
Chromium	MG/KG	8.5	e1,h5
Copper	MG/KG	11.4	b1
Iron	MG/KG	8880	e1
Lead	MG/KG	17.4	
Magnesium	MG/KG	1870	b1
Manganese	MG/KG	280	e1
Mercury	MG/KG	0.08	b1,e5
Nickel	MG/KG	7.5	h5
Potassium	MG/KG	346	
Selenium	MG/KG	0.85	e5,h5
Sodium	MG/KG	158	
Vanadium	MG/KG	13.8	
Zinc	MG/KG	302	b1,e1
Other Parameters			
Cyanide, Total	MG/KG	2.5	b1,e1,h5

AUS-0A2B-W03	Units	Result: 0 - 6 in	Reference Code	Result: 10 ft	Reference Code
Metals					
Aluminum	MG/KG	5130		6250	
Arsenic	MG/KG	5.9	h1,h5,h7	4.6	h1,h5,h7
Barium	MG/KG	66.4		115	h5
Cadmium	MG/KG	0.38	b1	ND	
Calcium	MG/KG	34400	b1	1530	
Chromium	MG/KG	6.6	e1,h5	10.5	e1,h5
Copper	MG/KG	8.5		8.5	
Iron	MG/KG	6790	e1	11600	e1
Magnesium	MG/KG	14200	b1	1810	b1
Manganese	MG/KG	421	e1	354	e1
Mercury	MG/KG	0.05	e5	ND	
Nickel	MG/KG	5.9		10.7	h5
Potassium	MG/KG	377		402	
Selenium	MG/KG	0.65	e5,h5	ND	
Sodium	MG/KG	ND		408	b1
Thallium	MG/KG	1	b1	ND	
Vanadium	MG/KG	11.1		18.1	
Zinc	MG/KG	56.3	b1	29.6	

AUS-0A2B-018	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5050	
Antimony	MG/KG	0.36	h5
Arsenic	MG/KG	5.8	h1,h5,h7
Barium	MG/KG	117	h5
Calcium	MG/KG	11700	b1
Chromium	MG/KG	9.2	e1,h5
Cobalt	MG/KG	10.6	
Copper	MG/KG	11.1	
Iron	MG/KG	14000	e1
Lead	MG/KG	25.9	b1
Magnesium	MG/KG	5850	b1
Manganese	MG/KG	973	e1
Mercury	MG/KG	0.12	b1,e5
Nickel	MG/KG	11.5	h5
Potassium	MG/KG	412	
Selenium	MG/KG	0.88	e5,h5
Vanadium	MG/KG	18.4	
Zinc	MG/KG	43.4	

AUS-0A2B-013	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8610	
Arsenic	MG/KG	8.9	h1,h5,h7
Barium	MG/KG	106	h5
Beryllium	MG/KG	0.34	
Calcium	MG/KG	964	
Chromium	MG/KG	13.2	e1,h5
Cobalt	MG/KG	7.5	
Copper	MG/KG	15	b1
Iron	MG/KG	21000	b1,e1
Lead	MG/KG	12.1	
Magnesium	MG/KG	2450	b1
Manganese	MG/KG	408	e1
Nickel	MG/KG	15.3	h5
Potassium	MG/KG	525	
Selenium	MG/KG	0.45	e5,h5
Sodium	MG/KG	142	
Thallium	MG/KG	0.21	
Vanadium	MG/KG	24.1	
Zinc	MG/KG	47.2	

AUS-0A2B-014	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6790	
Antimony	MG/KG	0.32	h5
Arsenic	MG/KG	10.9	e1,h1,h5,h7
Barium	MG/KG	127	h5
Calcium	MG/KG	1610	
Chromium	MG/KG	11.8	e1,h5
Cobalt	MG/KG	6.5	
Copper	MG/KG	7.7	
Iron	MG/KG	19800	b1,e1
Lead	MG/KG	18.2	
Magnesium	MG/KG	1550	
Manganese	MG/KG	736	e1
Mercury	MG/KG	0.07	b1,e5
Nickel	MG/KG	8.6	h5
Potassium	MG/KG	422	
Selenium	MG/KG	1	e5,h5
Vanadium	MG/KG	32	
Zinc	MG/KG	29.1	

AUS-0A2B-004	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6620	
Antimony	MG/KG	55.9	b1,e1,h5,h9
Arsenic	MG/KG	7.3	h1,h5,h7
Barium	MG/KG	271	b1,h5
Beryllium	MG/KG	0.91	b1
Calcium	MG/KG	6850	b1
Chromium	MG/KG	44.3	b1,e1,h5,h9
Cobalt	MG/KG	9.8	
Copper	MG/KG	36.6	b1,e1
Iron	MG/KG	28200	b1,e1
Lead	MG/KG	2000	b1,e1,h7,h8
Magnesium	MG/KG	2890	b1
Manganese	MG/KG	1290	e1
Mercury	MG/KG	0.99	b1,e5,h9
Nickel	MG/KG	22.9	b1,h5
Potassium	MG/KG	695	b1
Selenium	MG/KG	0.6	e5,h5
Sodium	MG/KG	185	b1
Thallium	MG/KG	0.38	
Vanadium	MG/KG	27.1	
Zinc	MG/KG	113	b1
Other Parameters			
TOC	MG/KG	46900	b1

AUS-0A2B-017	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6070	
Antimony	MG/KG	0.57	h5
Arsenic	MG/KG	10.6	e1,h1,h5,h7
Barium	MG/KG	89.6	h5
Beryllium	MG/KG	0.5	
Calcium	MG/KG	3570	b1
Chromium	MG/KG	14.1	e1,h5
Cobalt	MG/KG	5.2	
Copper	MG/KG	10.3	
Iron	MG/KG	21800	b1,e1
Lead	MG/KG	23.2	
Magnesium	MG/KG	2080	b1
Manganese	MG/KG	610	e1
Mercury	MG/KG	0.08	b1,e5
Nickel	MG/KG	7.4	h5
Potassium	MG/KG	693	b1
Selenium	MG/KG	0.8	e5,h5
Sodium	MG/KG	155	
Vanadium	MG/KG	32.9	
Zinc	MG/KG	72.7	b1

AUS-0A2B-003	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	2420	
Arsenic	MG/KG	4.8	h1,h5,h7
Barium	MG/KG	66	
Calcium	MG/KG	212000	b1
Chromium	MG/KG	7.8	e1,h5
Copper	MG/KG	7.6	
Iron	MG/KG	9220	e1
Lead	MG/KG	14.7	
Magnesium	MG/KG	8480	b1
Manganese	MG/KG	748	e1
Nickel	MG/KG	8.2	h5
Potassium	MG/KG	373	
Vanadium	MG/KG	6.5	
Zinc	MG/KG	62.8	b1
Other Parameters			
Perchlorate	UG/KG	ND	

LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

N

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SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES AND/OR ROADS.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS-0A2B
Sample Locations and Detections of Inorganic Compounds in Soils/Drums

Date: 11/14/00	Project Number: 23200000026.00	Figure Number: 3-5
Drawn by: DJD	Design by: MAM	Checked by: CMW

URS

AREA 2B-BOOSTER LOAD LINE

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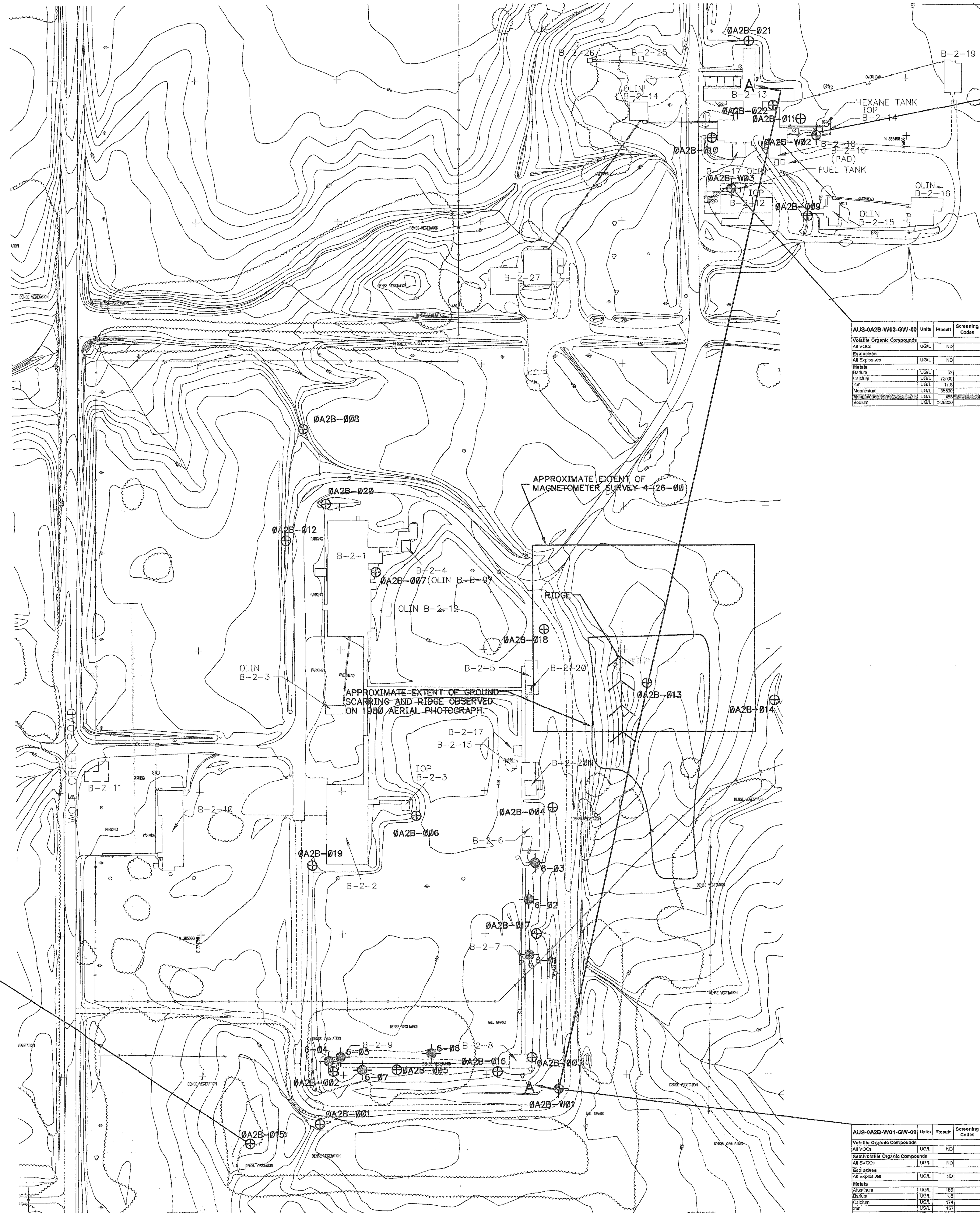

AUS-0A2B-W02-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
1,1-Dichloroethene	UG/L	0.7	h3
cis-1,2-Dichloroethene	UG/L	120	h4,h6
Tetrachloroethylene (PCE)	UG/L	15	h3,h6
trans-1,2-Dichloroethene	UG/L	24	
Trichloroethylene (TCE)	UG/L	47	h3,h4,h6
Explosives			
All Explosives	UG/L	ND	

AUS-0A2B-W03-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Barium	UG/L	52	
Calcium	UG/L	72500	
Iron	UG/L	17.8	
Magnesium	UG/L	35500	
Manganese	UG/L	458	h6
Sodium	UG/L	226000	

AUS-0A2B-015-SW-00	Units	Result	Screening Codes
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	28400	b3,e3
Arsenic	UG/L	5.8	
Barium	UG/L	247	b3
Calcium	UG/L	10900	b3
Chromium	UG/L	24.6	b3
Iron	UG/L	23300	b3,e3,e4,h10
Lead	UG/L	22.9	b3,e3,e4
Magnesium	UG/L	6170	b3
Manganese	UG/L	1450	b3,e3,e4,h10
Potassium	UG/L	3920	b3
Sodium	UG/L	3770	b3
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2B-W01-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	186	
Barium	UG/L	1.8	
Calcium	UG/L	174	
Iron	UG/L	157	
Magnesium	UG/L	28.9	
Manganese	UG/L	4.8	
Sodium	UG/L	90.6	
Zinc	UG/L	5.1	
Other Parameters			
Perchlorate	UG/L	ND	

AREA 2B—BOOSTER LOAD LINE

LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

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SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES AND/OR ROADS.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.
4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS-ØA2B
Sample Locations and Detections in Surface Water and Groundwater

Date: 11/14/ØØ	Project Number: 2320000026.ØØ	Figure Number: 3-6
Drawn by: DJD	Design by: MAM	Checked by: CMW

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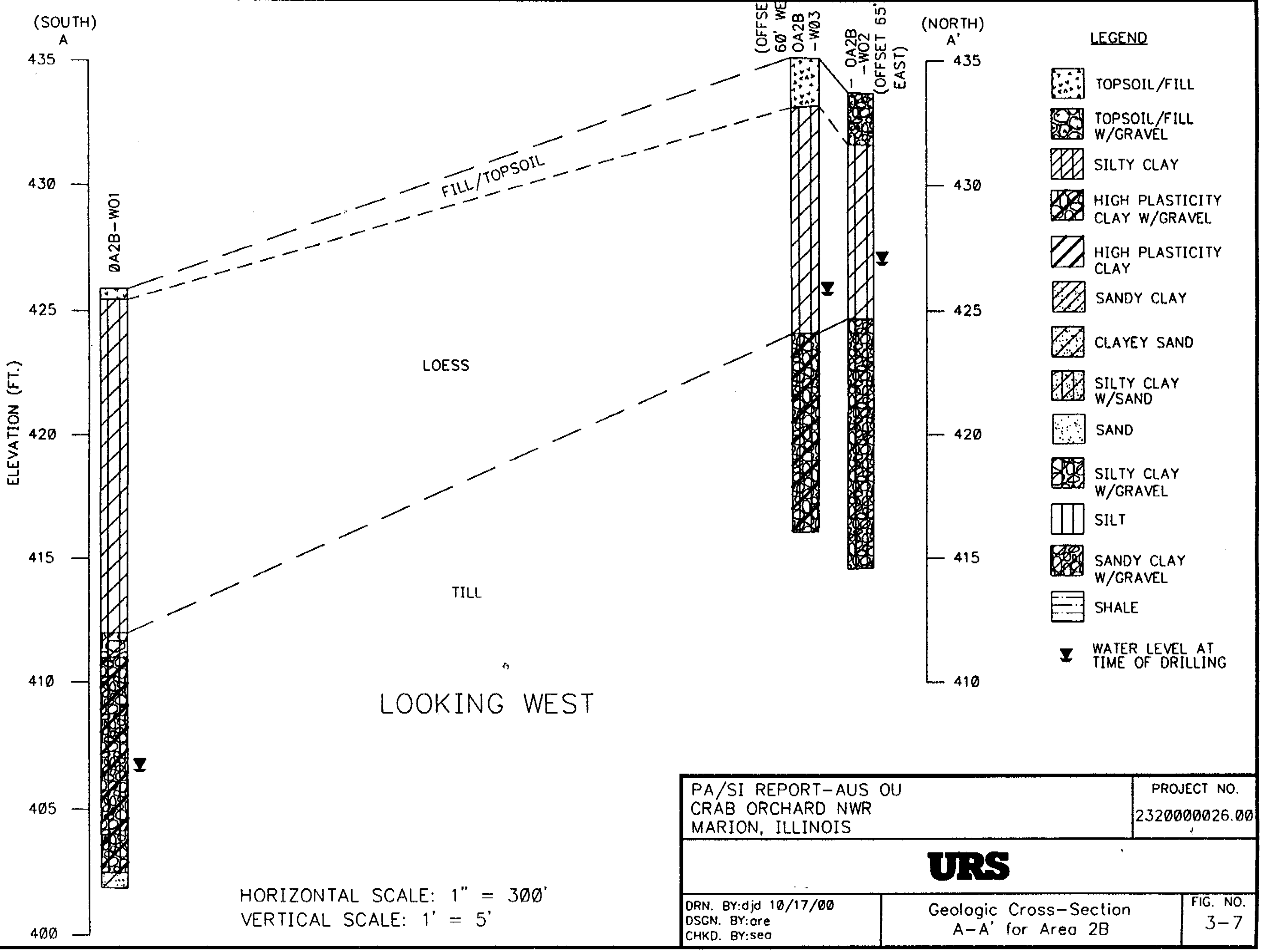
File: E:\2320000026.00\PA-SI REPORT-AUS OU\FIG3-7.DWG Last edited: JUN. 21, 01 @ 10:28 a.m. URS Corp.



PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO. 2320000026.00

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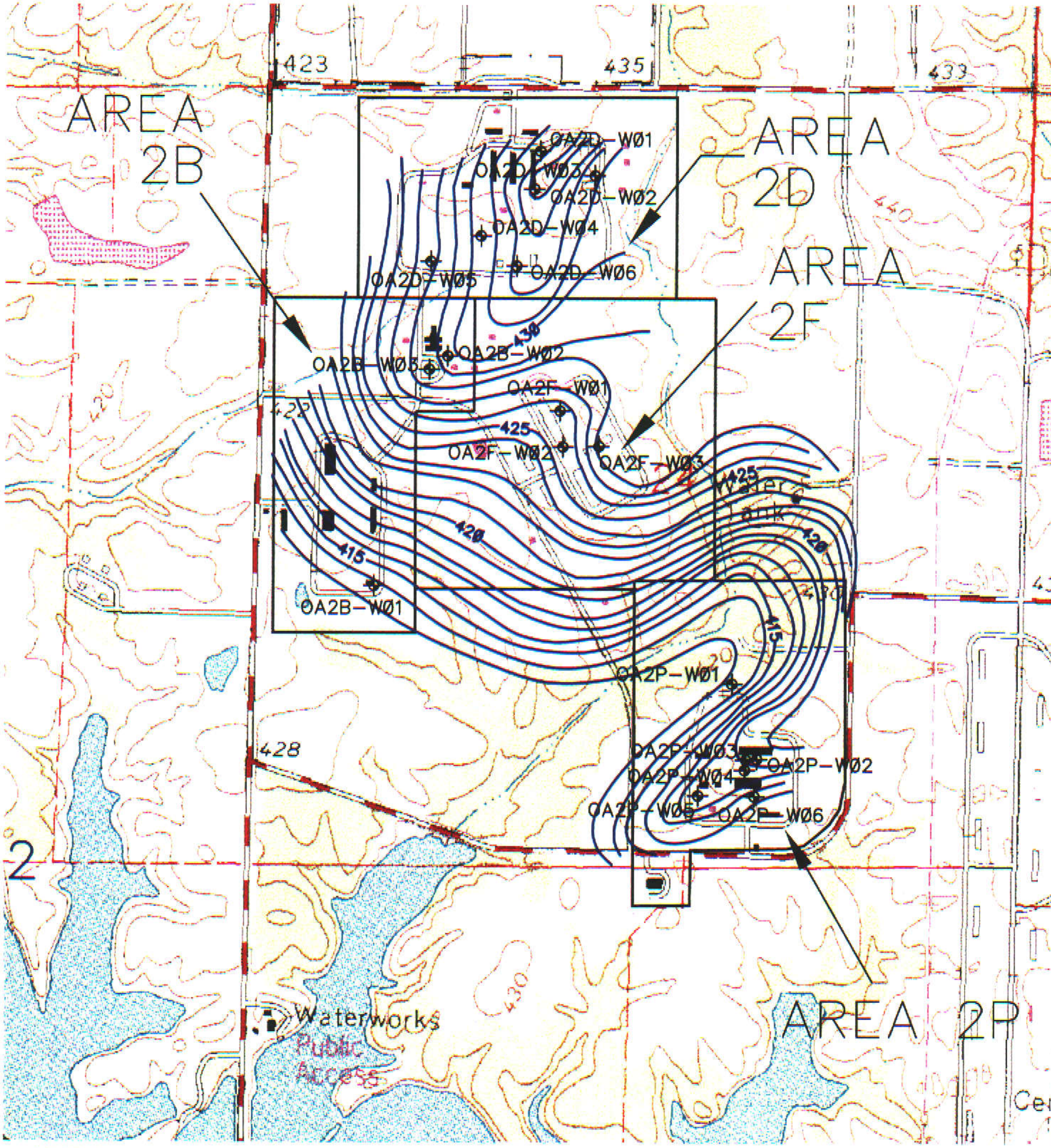
DRN. BY:djd 10/17/00
DSGN. BY:are
CHKD. BY:sea

Geologic Cross-Section A-A' for Area 2B

FIG. NO. 3-7



LEGEND

MONITORING WELL LOCATION

NOTE: 1-FOOT CONTOUR INTERVAL

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SCALE FEET

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
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DRN. BY: djd 11/20/00 DSGN. BY: mam CHKD. BY: mch/cmw	Groundwater Contours for Area 2 - October 2000 — FIG. NO. 3-8

File: E:\2320000026.00\PA-SI REPORT-AUS OU\CONTOURS 3-8.DWG Last edited: JUN. 21, 01 @ 2:09 p.m. URS Corp.

Area 2D was the Illinois Ordnance Plant (IOP) Detonator Loading Line, and has been used as an industrial facility since the 1950s. See the introduction to Section 3 for a general discussion of Area 2 and its location. Area 2 sites, including Area 2D (AUS-0A2D) are shown in Figure 3-1.

AUS Original Site Designations

Three of the original sites designated in 1997-1999 by the United States Fish & Wildlife Service (USFWS) as part of the Additional and Uncharacterized Sites Operable Unit (AUS OU) were located entirely or partly in Area 2D: AUS-0005, AUS-0007, and AUS-0008. These previous AUS sites in Area 2D (or portions located in Area 2D) have all been incorporated into the current Area 2D (AUS-0A2D) site.

4.1 HISTORIC SEARCH INFORMATION

4.1.1 Site Description

As noted in Section 3 (page 3-1), Area 2D is a current industrial facility, which along with Area 2B and part of Area 2F, is bounded by a 6-foot (ft) chain link fence with controlled entrances. Access is restricted by the industrial tenant, now General Dynamics Ordnance and Tactical Systems, inc. (GDO&TS). The area outside the buildings and parking lots is mostly grass-covered.

4.1.2 Operational History and Waste Characteristics

The Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department), operated the Detonator Load Line during World War II.[1] The area originally contained 41 buildings interconnected by covered and uncovered concrete and wooden walkways.[2] Figure 4-1 shows the original building configuration for Area 2D. Some of the original structures, which were slab on grade, wood frame buildings, have been removed with only the concrete pads and concrete walkways remaining. Many buildings have been added since the IOP days and building numbers now extend into the 90s.[3] Buildings in Area 2D, both past and present, and their general functions are identified in Table 4-1. Figure 4-2 shows the current configuration of buildings in Area 2D. Table 3-2 lists all of the known tenants for Area 2, some of whom may have been in Area 2D.

Two major industrial tenants have occupied Area 2D since the 1950s. From 1953 to 1963, Universal Match Corporation (UMC) (later Crane/Unidynamics-Phoenix, now Crane Co.)[4] leased buildings in Area 2D; and from 1964 to the present time, Olin and its successors have been the tenants in this area.

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[1] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13).
[2] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13).
[3] Changes to the general structure of Area 2D were observed during the Phase I Site Inspection on April 13, 1999.
[4] DOI 007946. Pursuant to Section 104(e) of CERCLA, Response to First Set of Information Requests for Unidynamics/Phoenix, dated September 14, 1989, Page 2.

UMC initially used the buildings in Area 2D for research and development of explosives, fuse trains, and pyrotechnic devices (see Table 3-3 for types and examples of UMC products).[5,6] After development of these products, UMC performed the full-scale production work.[7]

In September 1964, Olin (formerly Olin Mathieson Chemical Corporation), which was already operating in other areas of the Refuge (see Sections 15 through 20 for Areas 11 and 12 and Section 6 for Area 2P), expanded their manufacturing operations to include Area 2D,[8] which they leased until Olin's ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end of 1996. In January 2001, General Dynamics Corporation acquired Primex and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS).[9,10] GDO&TS is currently the sole tenant in Area 2D. Table 3-4 of this report presents types and examples of Olin/GDO&TS products manufactured at the Refuge.

4.1.2.1 Area 2D Products and Constituents

IOP Products and Constituents

Detonators use primary explosives to initiate an explosion train. Primary explosives are highly sensitive materials detonated easily by heat, spark, impact or friction.[11] Examples of the materials used in the production of detonators are lead azide, lead styphnate, mercury fulminate, and tetryl.[12] As discussed below, lead azide and tetryl were used at the IOP, and mercury fulminate was probably used. No documentation was found for the use of lead styphnate at the IOP.

The following materials were listed as having been consumed in the production of M1A1 and M1A2 detonators for mine fuzes, in an IOP cost statement for April, 1943: lead azide, antimony sulfide, carborundum, and potassium chlorate.[13] Lead azide was reported in the largest amount and was apparently the primary component.[14] Antimony sulfide sensitizes the priming mixture

[5] Deposition of Harvey Pitt, November 19, 1997. Pages 12, 13, and 41.
[6] DOI 008153 – DOI 008156. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 1 - 4.
[7] Deposition of Harvey Pitt, November 19, 1997, Pages 54-55.
[8] DOI 001461 -- DOI 001467. Eleventh Amendment of Lease Contract No. 14-19-0008-2675, by and between Olin Mathieson Chemical Corporation and the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service, dated September 1, 1964. *Note that Tract G is referring to Area 2D.*
[9] General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.
[10] Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.
[11] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 3-1.
[12] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), throughout Chapters 7 and 8 (specifically Pages 7-1, 7-5, 7-11, and 8-45).
[13] NAR-000227. Illinois Ordnance Plant, Carbondale, Illinois, Illinois Ordnance Plant, Historical Record, April 1st, 1943 to June 30th, 1943, Exhibit 9.
[14] NAR-000227. Illinois Ordnance Plant, Carbondale, Illinois, Illinois Ordnance Plant, Historical Record, April 1st, 1943 to June 30th, 1943, Exhibit 9.

to friction and percussion and also serves as a fuel. Potassium chlorate is an oxidizer[15] and carborundum is an inert substance and its purpose in the mixture is likely as a stabilizer.

Tetryl was used as a booster component in the detonators for the anti-tank mines produced at IOP. In the detonator explosion train, the priming mixture would cause an explosion in the tetryl component, which would in turn detonate the trinitrotoluene (TNT) in the mine.[16,17]

The evidence for mercury fulminate usage is more indirect. Buildings were constructed for the processing of mercury fulminate in Area 2D and a storage bunker was constructed in Area 14 (See Section 37.0 of this report for discussion of Area 14 Fulminate Storage Igloos [AUS-0060]). Based on a War Department memo from the Chief of Ordnance in Chicago to the Field Director in St. Louis, dated 20 July 1943, mercury fulminate was stored at the IOP. The memo suggested that the 2,888 pounds of mercury fulminate in storage at the IOP be shipped to some other plant unless it was needed in the near future.[18] That apparently was done. The Historical Record for the IOP for July through September 1943 stated that "mercury fulminate in storage but not needed at this plant was shipped to another facility using it."[19] A former SWDC/War Department employee reported that he saw mercury fulminate being used in Area 2B. He said it was used to sensitize the tetryl in the boosters produced in Area 2B.[20]

UMC Products and Constituents

UMC's activities in Area 2D reportedly began with research and development of primary and secondary explosives, and pyrotechnic devices.[21] A large number of UMC's clients were government agencies.[22,23,24] Originally UMC's production work at the Refuge consisted mainly of pyrotechnic devices and initiators (fuse trains).[25] Subsequently, in approximately 1959, they started receiving production contracts for the manufacture of large explosive devices for Sandia Corporation (a large national laboratory performing atomic bomb research).[26] In addition, UMC also produced solid propellant gas generators,[27,28] practice bombs, and solid mechanical devices

[15] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 7-18.
[16] Deposition of Harvey Pitt, November 19, 1997, Page 47.
[17] U.S. ACE, 1993, Ordnance and Explosive Waste Archives Search Report for Former Illinois Ordnance Plant Marion, IL, Appendix D-12G.
[18] NAR-000379. Illinois Ordnance Plant, Carbondale, Illinois, Illinois Ordnance Plant, Historical Record, July 1st, 1943 to September 30th, 1943, Reference No. 20 to the report.
[19] NAR-000293. Illinois Ordnance Plant, Carbondale, Illinois, Illinois Ordnance Plant, Historical Record, July 1st, 1943 to September 30th, 1943, Page 20.
[20] Thomas Throgmorton, personal interview, November 9, 1999.
[21] Deposition of Harvey Pitt, November 19, 1997. Pages 12, and 53-55.
[22] DOI 007951. Pursuant to Section 104(e) of CERCLA, Response to First Set of Information Requests for Unidynamics/Phoenix, dated September 14, 1989, Page 2.
[23] Deposition of Harvey Pitt, November 19, 1997, Page 52.
[24] Harvey Pitt, personal interview, April 18, 1991, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-20.
[25] Deposition of Harvey Pitt, November 19, 1997, Page 53.
[26] Deposition of Harvey Pitt, November 19, 1997, Pages 55 and 73.
[27] DOI 008156. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 4.
[28] Deposition of Harvey Pitt, November 19, 1997, Pages 71-72, 76 and 87.

such as actuators and switches.[29] A former employee, Vic Modglin, reported that UMC manufactured and tested pyrotechnic devices in Areas 2D, 2B, and 2F. The pyrotechnic devices included explosive switches; igniters, detonators, flares and atomic bomb burst simulators.[30] Modglin also reported that UMC tested the devices with lead styphnate and lead azide.[31] UMC's work also included a short contract for the assembly, welding and helium leak testing of nuclear reactor fuel rods.[32] Table 3-3 summarizes the available information on UMC products manufactured at the Refuge. According to a former employee, small amounts of isopropyl alcohol, toluene and trichloroethylene (TCE) were dumped by UMC in Areas 2B, 2D and 2F.[33] Thomas Throgmorton, a former UMC research engineer, reported that UMC used a lot of pentaerythritol tetranitrate (PETN) in Area 2D.[34]

Olin/Primex Products and Constituents

According to Mr. Robert Myers,[35] a former Olin truck driver, Olin's activities in Area 2D began when they moved their gas generator operations from Area 2P (see below) in 1963; however Olin did not begin leasing in Area 2D until September of 1964.[36] Gas generators included a product Olin called a jet starter or starter cartridge, which was used to start jet engines.[37] Other gas generator products produced since then include tank pressurizers, missile guidance control products (Minuteman, Lance and Trident missiles), and aircraft emergency evacuation slide inflation devices.[38,39,40] The manufacture of jet starters, gas generators, and rocket fuels is referred to as solid propellant operations (SPO) and the bulk of these operations took place in Area 2D.[41,42,43,44]

Solid propellants are manufactured by mixing the propellant components together in a mixer either dry or with a solvent.[45,46] The solvents facilitate the mixing process. The mixes are then

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29 DOI 008154 and DOI 008155. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 2 and 3.

30 Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-17.

31 Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-17.

32 DOI 008155. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 3.

33 Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.

34 Thomas Throgmorton, personal interview, November 9, 1999.

35 Deposition of Robert Myers, April 10, 1998, Pages 70, 80-81, and 105.

36 DOI 001461 – DOI 001467. Eleventh Amendment of Lease Contract No. 14-19-0008-2675, by and between Olin Mathieson Chemical Corporation and the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service, dated September 1, 1964. *Note that Tract G is referring to Area 2D.*

37 PRI-002573. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

38 PRI-002662 and PRI-002572. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

39 Rudy Okolski, personal interview, June 30, 1999.

40 Paul Moore, personal interview, July 14, 1999.

41 Deposition of Harvey Pitt, November 19, 1997, Pages 20 and 130.

42 Deposition of Charles Funk, April 9, 1998, Pages 10, 43, and 52.

43 Deposition of George Wisely, June 28, 1999, Page 20.

44 Deposition of Robert Myers, April 10, 1998, Page 44.

45 Harvey Pitt, personal interview, June 29, 1999.

either cured or molded (pressed into a mold shape), or poured into a casing (Olin used rubber sleeves as a heat insulator)[47] and heat cured in ovens depending on the application.[48] After pressing the propellant through a mold to obtain a particular shape ("grain"), the grain is then lathed in order to obtain the proper grain size for loading into the component.[49,50] Powdered lead stearate was reportedly used in the manufacture of gas generators in Area 2D,[51] as was TCE[52] and a chemical referred to as MOCA [4,4' methylene(bis)-2- chloroaniline].[53] Other chemicals used in Area 2D include degreasers.[54]

In addition to gas generators and other solid propellant systems, Olin/Primex has produced a wide range of products in Area 2D including the Light Antitank Weapon (LAW) rocket, 20 mm fuses, boosters, and ammunition ignition mixes. Table 3-4 summarizes products produced by Olin/Primex and their typical constituents.

4.1.2.2 Area 2D Processes and Operations

The Area 2D processes and operations are discussed below on a building-by-building basis.

Until the 1970s, industrial tenants at the Refuge were allowed to move existing buildings, construct new buildings, and raze old buildings in the areas they occupied; often the Refuge would not have complete records of this activity. Sometimes the new structures were assigned new building numbers; sometimes they were assigned a number that had been used previously for a different building. In this report, where the same building number was used more than once, a prefix has been added to the building number based on the tenant who it was assumed built the structure (e.g., IOP Building D-1-5, Olin Building D-1-5). Prefixes are not used when the building number is unique.

Building D-1-1

Building D-1-1 was the IOP Tetryl Service Magazine.[55] Tetryl was transported from off site and unloaded and stored in this building prior to pelletizing it in Building D-1-4 (Tetryl Pelleting Building).

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46 Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 9-4.
47 Deposition of Robert Myers, April 10, 1998, Page 44.
48 Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 9-4.
49 Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 9-5. A propellant's grain determines its shape and size. Ball powder, for instance, has a ball grain, which means it is small in size and round. Larger propellant systems can have grains that are cords, sheets, pellets, or perforated cords.
50 Paul Moore, personal interview, July 14, 1999.
51 ACO 002394. Pursuant to Section 104(e) of CERCLA, Responses of Olin Corporation to First Set of Information Requests, Crab Orchard National Wildlife Refuge, dated September 12, 1989, Page 21.
52 Deposition of George Wisely, July 15, 1999, Page 26.
53 Deposition of George Wisely, July 15, 1999, Page 55.
54 Deposition of John Miller, April 9, 1998, Page 57.
55 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.

Harvey Pitt, a former UMC employee and Olin manager, reported that the pad of Building D-1-1 had been used as a burn pad by UMC.[56] No corroborating evidence was found to support that use. There was no evidence of burning observed in the 1960 aerial photograph of Building D-1-1.[57] There were no available photographs from the time Harvey Pitt reported the pads were used for burning. Building D-1-1 was razed sometime before 1960.[58]

Building D-1-2

In the *War Department Facilities Inventory of the Illinois Ordnance Plant, Carbondale, Illinois,* Building D-1-2 is noted as both a Tool Room Building and a Tetryl Screen & Blend Building.[59] On 1941 and 1942 IOP drawings that show plumbing[60] and underground deluge piping[61] layouts, it is labeled as the Tetryl Screen & Blending Building. A December 1941 IOP light and power layout drawing shows it as both.[62]

UMC reportedly used Buildings D-1-2, D-1-3, and D-1-4 in the production of high explosives.[63]

Olin also used this building.[64] Primex leased Building D-1-2 from 1997 to 2001 for cold storage.[65] GDO&TS is the current tenant in this building.[66]

Building D-1-3

Building D-1-3 was the IOP Heater House.[67]

UMC used Buildings D-1-2, D-1-3, and D-1-4 in the production of high explosives.[68]

Olin was storing black powder in Building D-1-3 from at least 1970.[69] Primex leased Building D-1-3 from 1997 to 2001 for cold storage.[70] GDO&TS is the current tenant in this building.[71]

[56] Harvey Pitt interview on July 29, 1999. See interview notes in Appendix D of this report—there were a number of inconsistencies in Pitt's recollections of building numbers.
[57] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5. The Entech reports analyze historic aerial overflight photographs of industrial areas at the Refuge, from 1943 to 1993 (except in Area 2, which was analyzed from 1960-1993). The photos were obtained from the National Archives and Records Administration (NARA) and the U.S. Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS).
[58] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[59] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Sect. 5 Page 7 (Plan No. 6544-101.13), and Part II, Section 4, Sheet 4.
[60] Illinois Ordnance Plant, Carbondale, Illinois, Plan No. 6544-400.52, dated December 29, 1941.
[61] Illinois Ordnance Plant, Carbondale, Illinois, Plan No. 6544-440.18, dated February 23, 1942.
[62] Illinois Ordnance Plant, Carbondale, Illinois, Plan No. 6544-501.10, dated December 6, 1941.
[63] Harvey Pitt, personal interview, June 29, 1999.
[64] PRI-002064. Olin Corporation, Inspection Report, dated January 18, 1984, Page 2.
[65] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[66] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[67] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Par t I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4 Sheet 4.
[68] Harvey Pitt, personal interview, June 29, 1999.

Building D-1-4

Building D-1-4 was the IOP Tetryl Pelleting Building,[72] a long compartmentalized building with five pellet and press areas that were separated by 1-ft thick concrete walls[73] for explosion control. Tetryl pellets were made by compressing the blended tetryl into shape using press machines. Building D-1-4 contained 6 pelleting presses.[74]

UMC reportedly used Buildings D-1-2, D-1-3, and D-1-4 in the production of high explosives. Baratol (TNT and barium) were also used in Building D-1-4.[75] A former model shop and maintenance manager for UMC/Unidynamics Corporation[76] stated that the black powder used for the T-73 parachute flare was blended and pressed in Building D-1-4.[77]

In 1984, during Olin's tenure at the site, an inspection of this building revealed 4A/A booster pellets, waste containers and LUU 10/B-contaminated[78] hardware in this building.[79] In 1984 Olin planned to move research and development of glycidyl azide polymer (GAP) propellant to this building by the end of the year, and other propellants by March 1985; [80] it was not determined if this was done. By 1985 an operation involving plastic bonded explosive (PBX) was performed in Building D-1-4.[81] Slurry filtration (used in conjunction with PBX operations) resulted in a surface water discharge from the building; modifications were planned to eliminate the discharge.[82] By June 1987, the need for the PBXN5 slurry filtration was eliminated.[83]

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[69] PRI-004067. Olin inter office memo entitled "Safety Survey of Buildings D-1-4, 6, 7, and 8," dated January 30, 1970, Page 1.

[70] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[71] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[72] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.

[73] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 1 indicates Building D-1-4 is the similar in structure to B-2-6; and Part I, Section 8, Page 20 is a drawing/floor plan of Building B-2-6. Part I, Section 7, Page 13 (b/w photo of D-1-4).

[74] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 3.

[75] Harvey Pitt, personal interview, June 29, 1999.

[76] John R. Hempler Affidavit, dated September 13, 1989.

[77] DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.

[78] Based on information from the U.S. Air Force web site, LUU designates a series of flares. The 10/B may be a ground illuminating flare. What "LUU" stands for was not determined.

[79] PRI-002065 and PRI-002066. Olin Corporation, Inspection Report, dated January 18, 1984, Pages 4 and 5.

[80] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[81] PRI-016535. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated December 30, 1986.

[82] PRI-006599. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated November 11, 1985.

[83] PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.

In this building, explosives were blended with either No. 2 fuel oil or ethylene glycol in preparation for transportation off site.[84]

Primex leased Building D-1-4 from 1997 to 2001 for manufacturing purposes.[85] GDO&TS is the current tenant.[86]

IOP Building D-1-5

Building D-1-5 was the IOP Tetryl Pellet Magazine.[87] After the tetryl was pelleted in Building D-1-4 it was transported to Building D-1-5 for temporary storage prior to loading in Buildings D-1-6, D-1-7 and D-1-8.

Sometime between 1954 and 1957, UMC moved the blending and loading operations for the M-112 and M-123 photoflash shells from Building D-1-27 to D-1-5.[88]

Refuge documents indicate Building D-1-5 was destroyed [89] but the date was not documented. Aerial photographs indicate the building was razed sometime between 1951 and 1960.[90]

Olin Building D-1-5

Some time prior to May 1987, Olin probably began storing explosive waste in a portable buildings designated as D-1-5.[91,92] It is likely that Olin Building D-1-5 was, at times, located on the pad of the original IOP Building D-1-5. Primex leased Building D-1-5 from 1997 to 2001 for cold storage.[93] GDO&TS is the current tenant.[94]

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[84] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.
[85] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[86] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[87] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[88] DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.
[89] DPRA Document No. 00006467. CONWR, List of Buildings on the Refuge containing information such as FWS Building Numbers, Army Building Numbers, and Square Footage (date unknown).
[90] 1951 aerial photograph from the National Archives and Records Administration, College Park, Maryland; and, 1960 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[91] DOI 003204 and DOI 003211. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), March 1987, Pages 3 and 12
[92] DOI 003229. Olin Corporation, Attachment 1: Container Storage Area and Attachment 4: Site Plan – D, B, F Area, both submitted as attachments to Olin's
[93] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[94] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Buildings D-1-6, D-1-7 and D-1-8

Building D-1-6, D-1-7 and D-1-8 were the IOP Detonator Loading Buildings, the largest buildings in Area 2D.[95] Tetryl (from Building D-1-5, the Tetryl Pellet Magazine), along with priming mixture (including lead azide and inert components – from Building D-1-14, the Primer Mix and Azide Magazine) and mechanical detonator components were assembled in these buildings.

Thomas Throgmorton reported that Buildings D-1-6, D-1-7, and D-1-8 were used for the loading of photoflash shells which consisted of anodized aluminum, magnesium powder, barium nitrate, and an oxidizer, usually potassium perchlorate.[96,97]

During Olin's tenure at the site, curing and most of the assembly operations (pressing and loading) for all solid propellant systems took place in Building D-1-6, D-1-7 and D-1-8.[98,99,100] According to George Wisely, a former Olin chemist and manager, these three buildings were major areas for gas generator production.[101] It is likely that painting for the gas generator metal containers also occurred in these buildings.[102]

Buildings D-1-6

During the IOP era, Building D-1-6 contained 24 consolidating presses, 14 crimping presses, and 8 ejecting presses[103] on eight loading lines.[104]

UMC reportedly used Building D-1-6 for manufacturing the Hi-Burst signal (using 3 ounces of smokeless powder), and assembling the T-73 Parachute Flare, the M-112 and M-123 Photoflashes, and the Minuteman unit.[105]

In 1963, Olin had jet starter production operations in Building D-1-6. According to Rudy Okolski, a former Olin employee, Olin made starter cartridges in this building.[106]

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95 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
96 Thomas Throgmorton, personal interview, November 9, 1999.
97 DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.
98 Paul Moore, personal interview, July 14, 1999.
99 Rudy Okolski, personal interview, June 30, 1999.
100 PRI-016185. Olin inter office memo entitled *Special Survey – Sumps, Traps, and Vacuum Systems*, dated April 20, 1981, Page 1.
101 Deposition of George T. Wisely, February 15, 1999, Pages 67-68.
102 Deposition of George T. Wisely, February 15, 1999, Pages 67-68.
103 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Pages 3 and 4.
104 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 4.
105 DOI 008153, DOI 008154, and DOI 008155. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 1, 2, and 3.
106 Rudy Okolski, personal interview, June 30, 1999.

An area of dark-toned surface discoloration was observed in the 1965 aerial photograph (during Olin's tenure), along the east side of Building D-1-6.[107] This may have been the result of a liquid release or of precipitation.

In 1981, explosive 4A/A was reportedly in production in this building along with the Sidewinder, and there were three 4A/A presses and two Sidewinder presses in this building.[108] After February 1983, Olin reported the presence of asbestos fibers in Bay A of this building resulting from operations involving MXU 4A/A insulation sheeting.[109] After February 1983, propellant machining lathes were reported in both Bay C (used for MXU 4A/A propellant and igniter) and Bay H (used for N-28 propellant for Sidewinder).[110] During the 1984 inspection of this building, MXU 4A/A igniter material was being stored in the igniter bay and oil was being used in Bay C.[111] Beginning in April 1985, 4A/A was supposed to go into production in this building again.[112]

Primex leased Building D-1-6 from 1997 to 2001 for manufacturing purposes.[113] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days (Bays A, C, D, G, and H).[114]

GDO&TS is the current tenant.[115]

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[107] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Page 1 and Figure 2.
[108] PRI-016185. Olin inter office memo entitled *Special Survey – Sumps, Traps, and Vacuum Systems*, dated April 20, 1981, Page 1.
[109] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.
[110] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.
[111] PRI-002066. Olin Corporation, Inspection Report, dated January 18, 1984, Page 5.
[112] PRI-016712. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[113] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[114] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[115] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building D-1-7

UMC used Building D-1-7 for loading and pressing photo flash rounds, photo flash shells, smoke markers, and the Minuteman.[116,117,118,119] According to Harvey Pitt, this process also involved the use of toluene, methyl ethyl ketone and possibly acetone.[120]

In 1973, Olin referred to Building D-1-7 as the LAW Building and it was used for the loading of propellant for the LAW system. Propellants made with nitroglycerin were also loaded into containers in this building at this time.[121]

In 1974, this building contained M29A1 primer, IPM assembly, and 4A/A igniter assembly.[122] In 1975, Building D-1-7 contained a 20 mm fuse manufacturing operation that was run by Olin.[123] This building also contained floor drains.[124]

By 1979, Booster Sustainer Dome Flame-shield assembly was apparently being done in this building. The standard operating procedure (SOP) for Booster Sustainer Dome Flame-shield assembly [125] does not directly indicate the building where the assembly took place. It refers to the number of personnel in Building D-1-7 and makes no references to other buildings. The SOP equipment list includes "vapor degreaser w/trichloroethylene." An Olin interoffice memo (also dated 1979), indicated that the vapor degreaser emitted less than 15 pounds per day of trichloroethylene solvent vapors and therefore this vapor degreaser did not need a permit.[126] This memorandum stated that "A check of our large vapor degreaser indicated approximately 6 gallons per week solvent usage."[127]

After February 1983, Olin reported the presence of a grinding cabinet outside Bay F of this building.[128] This cabinet ground F-21D insulation inside and likely resulted in contamination

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[116] Deposition of Harvey Pitt, November 19, 1997, Page 31. In his deposition, Mr. Pitt referred to Building "D-1-17," but was confused at the time. Later, during his personal interview (June 29, 1999), he confirmed the building was D-1-7.

[117] Harvey Pitt, personal interview, June 29, 1999.

[118] DOI 008155. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 3.

[119] Thomas Throgmorton, personal interview, November 9, 1999.

[120] Harvey Pitt, personal interview, June 29, 1999.

[121] PRI-002078. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 4.

[122] PRI-013401. Olin, Standard Operating Procedure, S.O.P. No. 90,173, Scrap Collection for Incinerator – Bldg. D-1-7, Page 2.

[123] PRI 002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

[124] PRI-016698. Olin Corporation document, Recommendations for Correction and Prevention, Wastewater Discharges or Sources, Page 3.

[125] PRI-015817, PRI-015819, and PRI-015820. Olin, Manufacturing and Inspection, Standard Operating Procedure, Document No. 8039104, Booster Sustainer Dome Flame-shield Assembly 3046651, dated October 1, 1979, Pages 1, 3, and 4.

[126] PRI-00160/DPRA Document No. 00013793. Olin inter office memo, regarding EPA Operating Permits, dated November 12, 1979, from C. R. Moore/R. F. High to R. D. Altekruse.

[127] PRI-00160/DPRA Document No. 00013793. Olin inter office memo, regarding EPA Operating Permits, dated November 12, 1979, from C. R. Moore/R. F. High to R. D. Altekruse.

[128] PRI-00248. Document from the Olin files entitled "*B & D Area Dust Collectors,*" Page 1.

from metal particles and asbestos fibers.[129] As of March 1983, this building contained Paveway, Trident and Minuteman propellant in slug stage with no loose material; igniters were assembled biannually in this building.[130]

In this building, explosives were blended with either No. 2 fuel oil or ethylene glycol in preparation for transportation off site.[131]

Primex leased Building D-1-7 from 1997 to 2001 for cold storage.[132] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days (Bay F).[133]

GDO&TS is the current tenant.[134]

Building D-1-8

UMC used Building D-1-8 for the final assembly of the photo flash rounds, photo flash shells, smoke markers, and the milling of lead styphnate and lead azide[135,136] Also, according to a former UMC employee John Hempler, D-1-8 was also used for assembling the Navy Float Signal (containing red phosphorous, linseed oil, iron oxide, and manganese powder), and the Navy Practice Bomb (containing either red phosphorous powder or zinc oxide). Further, he stated the MC-935 Actuator, the MC 936 Switch, the MC-835, 875, and 1156 delay switches and columns were loaded and assembled in this building.[137]

Another propellant operation that took place in Area 2D during Olin's tenure in 1973,[138] involved nitroglycerin (N.G.) casting of Lance propellant grains. In Bay B of Building D-1-8, propellants for the Lance Missile System were sawed, trimmed, turned on lathes and cemented together.[139] Scrap grain was swept up and discarded in open containers or swept into the floor troughs and hosed down into the sump outside the building.[140] In 1982, Olin discovered

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[129] PRI-00248. Document from the Olin files entitled "*B & D Area Dust Collectors,*" Page 1.

[130] PRI-005087. Olin inter office memo entitled *D & P Areas Drain Survey*, dated March 10, 1983, Page 1.

[131] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.

[132] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[133] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.

[134] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[135] Harvey Pitt, personal interview, June 29, 1999.

[136] Thomas Throgmorton, personal interview, November 9, 1999.

[137] DOI 008154, DOI 008155, and DOI 0081565. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 2, 3, and 4.

[138] PRI-002075 and PRI-002077. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Pages 1 and 3.

[139] PRI-002077. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 3.

[140] PRI-002077. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 3.

nitroglycerin contamination in of the sumps located adjacent to this building.[141] Sump locations are shown on Figure 4-2.

In 1975, this building contained a machining bay, an inhibitor bay and a press area.[142] The machining and inhibitor bays both contained solvents.[143] IB-27 material was also stored in the machining bay.[144] The press area of this building contained at least one 100-ton press and one 300-ton press.[145] This suggests that both solvents and lubricants were used in this area.

As discussed above, the gluing of the propellant grains historically involved the use of a chemical referred to as MOCA, which was subsequently banned by Olin in 1985 because of its inherent dangers.[146,147] MOCA was also reported to have been used in Bay F of this building.[148] Acetone (used for cleaning), and likely other solvents, were used in this building, and they may have been stored in 55-gallon drums outside the building.[149]

The Minuteman Generator (which was also reportedly manufactured in this area) used MOCA in forming the binder.[150] Overflow of the material was necessary during loading, to ensure a complete seal.[151] A press was used to press the Minuteman ammonium nitrate propellant into grains.[152] Parts of the Minuteman Generator were reportedly manufactured in the Inhibiting Bay.[153] Olin did not specify which building that this bay was located in; however, it was likely in this building. Since MOCA was reportedly used in Building D-1-8, it is possible that the Minuteman Generator parts were manufactured in this building. MOCA was also reported to have been used in Building D-1-8 Annex;[154] however, the location of this building was not determined.

Sometime after February 1983, several different kinds of ammonium nitrate propellants were machined in this building: MM, N-28, Trident, Gap and Vickers.[155] At this time, there was a belt grinder outside Bay E of this building that ground F-21D insulation that was used as generator case insulation.[156] This grinder likely resulted in asbestos fibers contamination.[157] In 1984, N-

[141] PRI-016385. Olin inter office memo entitled *NG Contamination of Sump at D-1-8*, dated April 15, 1982.
[142] PRI-006685. Olin inter office memo entitled D and B Area Safety Inspection, dated July 18, 1977.
[143] PRI-006685. Olin inter office memo entitled D and B Area Safety Inspection, dated July 18, 1977.
[144] PRI-006685. Olin inter office memo entitled D and B Area Safety Inspection, dated July 18, 1977.
[145] PRI-006685. Olin inter office memo entitled D and B Area Safety Inspection, dated July 18, 1977.
[146] PRI-003620. Olin inter office memo entitled *MOCA*, dated September 16, 1985, Page 1.
[147] Richard Altekruse, personal interview, July 14, 1999.
[148] PRI-009427. Olin inter office memo entitled *MOCA and Asbestos*, dated August 6, 1974, Page 1.
[149] PRI-002078. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 4.
[150] PRI-002079. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 4.
[151] PRI-002079. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 5.
[152] PRI-016717. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[153] PRI-002079. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 5.
[154] PRI-013752. Olin Ordnance Products, *Safety Procedure No. 45, MOCA, 4,4' Methylene is (2-Chloroaniline)*, dated Revised May, 1983.
[155] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.
[156] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.

28 propellant for the Sidewinder and the Paveway gas generators was pressed into pellets and machined to specific requirements in this building.[158] An Olin-Marion Wastewater Discharges/Sources Status Report issued on January 16, 1986 reported that there was a 300-ton press located in Building D-1-8.[159] This press may have been used for pressing the propellant into pellets. Cutting oils (or lubricants) and degreasers are commonly used in association with presses. An April 1983 Olin document described an incident involving the dust collector located outside Bay E in Building D-1-8 discharging AN propellant onto the ground and surrounding area.[160]Olin has also maintained x-ray facilities in Area 2D. X-ray machines were located in Building D-1-8.[161,162,163] There were two x-ray process discharges that discharged wash water from this building.[164] The effluent from one of the x-ray operations in this building (in Bay J) was originally discharged onto the ground surface outside Building D-1-8.[165] This effluent was discharged to the sewer, as of June 1987.[166] The effluent from this operation was expected to contain heavy metals, acetic acid (potassium hydroxide solution), hydroquinone, unreacted aldehyde, sulfuric acid, aluminum sulfate, sodium dichromate, salt brine, zeolite and water.[167,168] A 1984 Olin report indicated that the effluent was discharged to a sewer, and that the process included the following chemicals: Kodak Industrex Developer Replenisher, Kodak Industrex Fixer and Replenisher, and Developer Systems Cleaner.[169] There was the potential for buildup of silver salts from the X-ray processes.[170] The effluent from the other x-ray operations discharged to the sewer,[171] and it is expected to contain the same contaminants as the other x-ray operations.

In this building, explosives were blended with either No. 2 fuel oil or ethylene glycol in preparation for transportation off site.[172]

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[157] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.

[158] PRI-016712. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[159] PRI-016549. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group A, Status Report, dated January 16, 1986.

[160] PRI-016656. Olin inter office memo entitled *Dust Collector, D-1-8*, dated April 18, 1983.

[161] PRI-016535. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated December 30, 1986.

[162] PRI-016696. Olin Corporation document, Recommendations for Correction and Prevention, Wastewater Discharges or Sources, Page 1.

[163] PRI-016185. Olin inter office memo entitled *Special Survey – Sumps, Traps, and Vacuum Systems*, dated April 20, 1981, Page 1.

[164] PRI-016711. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[165] PRI-016299. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 3.

[166] PRI-016550. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.

[167] PRI-016299. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 3.

[168] PRI-016732, PRI-016734, PRI-016736, PRI-016738, PRI-016739, and PRI-016741. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[169] PRI-016711. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[170] DOI 003199. Olin Corporation, Letter to Wayne Adams of Crab Orchard National Wildlife Refuge, regarding a revised request for Fish and Wildlife Approval, dated January 5, 1982.

[171] PRI-016711. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[172] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.

There were two sumps outside this building: one near the northeast corner and one on the south side (Figure 4-2). The northeast sump received double base [propellant] and saw and machine scrap in 1977.[173] The south sump received an N-28 dry blend prior to 1977.[174] Scrap from shaping, sizing, and gluing the propellant grains would be swept into the floor trough and hosed down into the sump.[175] Also, wash waters as well as process and cleaning solvents drained to the sumps.[176,177,178] The sumps were cleaned out by bailing the sump water onto the ground nearby and removing the solids for incineration, as discussed in further detail in Section 4.1.2.3 below.

At some time around 1987, Olin likely stored explosive waste in this building.[179] In a 1996 Primex document, Bay B of this building was listed as an area where hazardous wastes are accumulated on-site for less than 90 days.[180]

Primex leased Building D-1-8 from 1997 to 2001 for cold storage.[181] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days (Bay B).[182]

GDO&TS is the current tenant.[183]

IOP Building D-1-9

IOP Building D-1-9 was the IOP Detonator Line Office.[184] Refuge documents indicate this building was relocated to Area 7.[185] According to a USFWS map of Area 2D containing notes by Refuge personnel, when Building D-1-9 was moved to Area 7, it was positioned slightly

[173] PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[174] PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[175] PRI-002077. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 3.
[176] PRI-016499 to PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Pages 1 and 2.
[177] PRI-016594 to PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[178] Deposition of George Wisely, June 28, 1999, Pages 177, 180-181, and 196-198.
[179] DOI 003204. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), March 1987, Page 3.
[180] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 12.
[181] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[182] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[183] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[184] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[185] DPRA Document No. 00006467. CONWR, List of Buildings on the Refuge containing information such as FWS Building Numbers, Army Building Numbers, and Square Footage (date unknown), Pages 6 and 10. Building D-1-9 is also known as USFWS Building #130.

northwest of Building IN-2-5.[186] According to aerial photographs, this building appeared in Area 7 sometime prior to 1960.[187] Further, it is assumed that this move took place prior to 1956 when Grinnell Sash & Door Company (Grinnell) began occupying Building D-1-9.[188,189,190] Grinnell leased several other buildings in Area 7. Other Area 7 tenants also occupied this building in Area 7 including Central Fixture Manufacturing and Cubicon Corporation.[191,192]

Olin Building D-1-9

Olin Building D-1-9 was later built in the former location of IOP Building D-1-9. Olin was occupying this building by at least 1972.[193] MOCA was reportedly used in this building.[194]

Primex leased Building D-1-9 from 1997 to 2001 for cold storage.[195] GDO&TS is the current tenant.[196]

Building D-1-10

Building D-1-10 was the IOP Detonator Rest House.[197] The detonators may have been temporarily stored in this building after assembly in Buildings D-1-6, D-1-7 and D-1-8 (Loading Buildings) and prior to testing in Building D-1-11 (Detonator Rumbling Building).

According to John Hempler,[198] UMC used Buildings D-1-10 and D-1-12 to cure candles for the Navy Float Signal. The candles contained red phosphorous, linseed oil, iron oxide, and manganese powder.

Olin also used this building. In March 1983, Olin identified the following possible contaminants in this building: aluminum, graphite, Composition A4 and High Explosives Igniter (HEI)/Grease Mix from cleaning the presses.[199]

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186 Undated USFWS map of Area-IN with notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
187 1960 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photograph used by Entech, Inc.).
188 CRO 001254. Lease Contract No. 14-19-003-2646 by and between U.S. Fish and Wildlife Service and Grinnell Sash & Door Company, dated August 1956.
189 FWM 000968. Lease Contract No. 14-16-0003-4754 by and between U.S. Fish and Wildlife Service and Grinnell Sash & Door Company, dated August 28, 1961.
190 FWM 000973. Cancellation, Lease No. 14-16-0003-4757, dated October 31, 1967.
191 FWM 000886. Lease Contract No. 14-16-0003-13,980 by and between Cubicon Corporation, dated December 10, 1973.
192 CRO 000304. Lease Contract No. 14-16-0003-12645 by and between U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Central Fixtures Manufacturing Company, dated November 1967.
193 PRI-008163 – PRI-008164. Olin, Simulated OSHA Inspection, Marion, December 5 – 7, 1972, Standard 1910, Pages 7-8.
194 Deposition of George Wisely, July 15, 1999, Pages 55-56 and Exhibit 17.
195 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
196 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
197 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
198 DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.

Primex leased Building D-1-10 from 1997 to 2001 for cold storage.[200] GDO&TS is the current tenant.[201]

Building D-1-11

Building D-1-11 was the IOP Detonator Rumbling Building.[202] The assembled components were sent from Building D-1-10 to Building D-1-11 for testing. Building D-1-11 contained four motor rooms, four rumbling rooms, two detonator storage rooms, and four-detonator sawdust and mixing rooms. One-ft thick concrete walls, for explosion protection separated all of these rooms.[203]

UMC used Building D-1-11 for confidential work involving CIA contracts.[204] Some of the work involved the use of Royal Demolition Explosive (RDX) , Her Majesty's Explosive (HMX), High Blas Explosives (HBX), and cast TNT.[205] They also reportedly manufactured delay mixes and igniter mixes in this building,[206] including the mix for the candle used in the Navy Float Signal (containing red phosphorous, linseed oil, iron oxide, and manganese powder.[207]

During Olin's tenure Building D-1-11 housed the pelletizing of HEI mixes.[208] HEI/High Explosives (HE) mixes were also filtered in this building and the resulting products were pellets.[209] Aluminum and graphite were weighed out in Bay I of this building.[210] The sinks in this building previously discharged to the sewers.[211] In 1985, the sinks in this building were eliminated to control the discharge from this building.[212]

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[199] PRI-005087. Olin inter office memo entitled *D & P Areas Drain Survey*, dated March 10, 1983, Page 1.

[200] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[201] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[202] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13), Part I, Section 7, Page 13, and Part II, Section 4, Sheet 5.

[203] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 12.

[204] Deposition of Harvey Pitt, November 19, 1997, Pages 9, 12, and 19.

[205] Deposition of Harvey Pitt, November 19, 1997, Page 19.

[206] DOI 004798. Olin report entitled Final Report, Unidentified Flammable Material Outside D-1-11, Incident Date 4 August 1988, (DOI 004797 – DOI 004801), Page 2, introduced by an Olin inter office memo entitled *Unidentified Flammable Material Outside D-1-11*, dated August 25, 1988.

[207] DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.

[208] PRI-002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

[209] DOI 002500. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 3.

[210] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.

[211] PRI-016698. Olin Corporation document, Recommendations for Correction and Prevention, Wastewater Discharges or Sources, Page 3.

[212] PRI-006598. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group A, Status Report, 11 November 1985.

A 1987 Olin accident report [213] indicated Building D-1-11 contained at least two presses: a booster pellet press, and an explosive pellet press (R-4). On two separate occasions during November 1987, accidental detonations occurred in this building while Olin operators were pelletizing PBX-N5 on the R-4 press. Flammable solvents were being used to clean the press, including acetone and ethyl acetate. The accident report noted the accumulation of hazardous material in trash bags along the hallways and in all of the bays.

In this building, explosives were blended with either No. 2 fuel oil or ethylene glycol in preparation for transportation off site.[214]

In 1988 during excavation near Buildings D-1-11 and Olin Building D-1-15, the soil caught on fire. The fire apparently started as a result of a spark from the bucket of the excavator. Chemical analysis of the soil by Olin indicated the presence of metals but did not reveal the source of the material that burned. The following metals were detected: chromium, copper, iron, strontium, and molybdenum. [215]

Primex leased Building D-1-11 from 1997 to 2001 for manufacturing purposes.[216] GDO&TS is the current tenant.[217]

Building D-1-12

Building D-1-12 was the IOP Sawdust Storage Building.[218] Sawdust was used for operations in the Detonator Rumbling Building (Building D-1-11).[219]

According to John Hempler,[220] UMC used Buildings D-1-10 and D-1-12 to cure candles for the Navy Float Signal. The candles contained red phosphorous, linseed oil, iron oxide, and manganese powder.

In 1986, during Olin's tenure, a chemical leak occurred in Building D-1-12.[221] The leaking chemical (Dalco Solvent) was a solvent degreaser believed to contain HE/HEI mixes, and it was

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[213] PRI-008508, PRI-008510, PRI-008512-PRI-008514. Olin document Accident Investigation Report, D-1-11 HEDP Pellet Detonation, dated November 1987.

[214] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.

[215] DOI 004798. Olin report entitled Final Report, Unidentified Flammable Material Outside D-1-11, Incident Date 4 August 1988, (DOI 004797 – DOI 004801), Page 2, introduced by an Olin inter office memo entitled *Unidentified Flammable Material Outside D-1-11*, dated August 25, 1988.

[216] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[217] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[218] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.

[219] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 12.

[220] DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.

[221] DOI 004776 to DOI 004778. Two Olin inter office memos: one entitled *Building D-1-12*, dated February 18, 1986, and the second entitled *Building D-1-12 Status, Response to Correspondence dated 18 Febr. 86*, dated February 19, 1986 (memo contained MSDS sheets for the contaminant).

composed of both aliphatic hydrocarbons (60%) and chlorinated hydrocarbons (10-30%).[222] The solvent mixture was eventually contained but not before the spill impacted the grounds outside of the building.[223] No documentation of cleanup of this spill was found.

Primex leased Building D-1-12 from 1997 to 2001 for manufacturing purposes.[224] GDO&TS is the current tenant.[225]

Building D-1-13

Building D-1-13 was an IOP Inspection, Packing and Shipping Building.[226] After sensitivity testing in the rumbling building, detonators would be inspected, packed and shipped out of Building D-1-13.[227]

UMC used Building D-1-13 for the assembly, welding and helium leak testing of nuclear reactor fuel rods during the mid-1950s.[228] Thomas Throgmorton reported that Building D-1-13 was used for the Uranium Fuel Tube Rod Program for Westinghouse.[229] This involved the receipt of fabricated enriched uranium pellets from the manufacturer. UMC then cut the pellets to the proper length and inserted the pellets into a metal rod (reportedly aluminum). The rods were then evacuated of air and welded closed. After welding a leak check was performed to ensure the integrity of the vacuum.[230] This building was remediated by Olin in 1994 at the request of the Illinois Department of Nuclear Safety.

In 1965, Olin reportedly used this building for Propellant Storage. In 1998, Building D-1-13 was destroyed by a fire which also caused a small ammunition explosion within the building. Primex used Building D-1-13 for flash-out operations (this is the last step in large caliber ammunition demilitarization). 106-mm projectiles, containing the A-3 explosive composition, were being flashed out in this building when the fire occurred. Oxygen and propane tanks associated with

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[222] DOI 004777 to DOI 004779. Two Olin inter office memos: one entitled *Building D-1-12*, dated February 18, 1986, and the second entitled *Building D-1-12 Status, Response to Correspondence dated 18 Febr. 86*, dated February 19, 1986 (memo contained MSDS sheets for the contaminant).
[223] DOI 004778. Two Olin inter office memos: one entitled *Building D-1-12*, dated February 18, 1986, and the second entitled *Building D-1-12 Status, Response to Correspondence dated 18 Febr. 86*, dated February 19, 1986 (memo contained MSDS sheets for the contaminant).
[224] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[225] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[226] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13), Part I, Section 8, Page 1, and Part II, Section 4 Sheet 5.
[227] Description of the assembly, sensitivity testing, and shipping portions of the detonator manufacturing process determined from building names and layout on the architectural drawings for the Detonator Load Line.
[228] DOI 008155. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 3.
[229] Thomas Throgmorton, personal interview, November 9, 1999.
[230] DOI 008155. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 3.

the flash-out operation were located outside Building D-1-13.[231] Primex replaced the building on the original foundation.[232]

Primex leased Building D-1-13 from 1997 to 2001 for manufacturing purposes.[233] GDO&TS is the current tenant.[234]

IOP Building D-1-14 (Building D-1-75)

Building D-1-14, IOP Primer Mix and Azide Magazine,[235] was razed before 1975. Olin constructed Building D-1-75 in its place between 1975 and 1980.[236]

Primex leased Building D-1-75 from 1997 to 2001 for cold storage.[237] GDO&TS is the current tenant.[238]

Olin Building D-1-14

Sometime between 1971 and 1980, Olin constructed a building designated as Building D-1-14, but in a different location than the IOP Building D-1-14. Olin built a large earthen berm around the building.[239] In 1975, this building was used for explosives storage.[240]

Primex leased Building D-1-14 from 1997 to 2001 for cold storage.[241] GDO&TS is the current tenant.[242]

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[231] DPRA Document No. 00017580. Primex Technologies memorandum entitled *Incident Investigation Report – D-1-13 Fire*, dated February 17, 1998, Pages 1, 2, 3, 4, and 8.

[232] DPRA Document No. 00017584. Primex Technologies, letter to Fish and Wildlife Service regarding replacing Building D-1-13, dated March 12, 1998.

[233] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

[234] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[235] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.

[236] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.

[237] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[238] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[239] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.

[240] PRI 002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

[241] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[242] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

IOP Building D-1-15 (Building D-1-69)

Building D-1-15 was the IOP Azide Service Magazine.[243] It is presumed that the lead azide was brought into Area 2D and initially stored in Building D-1-15 until it was needed.

IOP Building D-1-15 was razed prior to 1960. Building D-1-69 was constructed in its place sometime between 1971 and 1980.[244] This building is apparently a portable building that is sometimes at this location, but may be located elsewhere. At some point, Olin likely stored explosive waste in this building.[245]

Primex leased Building D-1-69 from 1997 to 2001 for cold storage.[246] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[247]

GDO&TS is the current tenant.[248]

Olin Building D-1-15

Olin Building D-1-15 was constructed in a different location from the original IOP Building D-1-15, sometime between 1971 and 1980. A large earthen berm was built around the building.[249] In 1975, this building was used for HEI Blend.[250]

In this building, explosives were blended with either No. 2 fuel oil or ethylene glycol in preparation for transportation off site.[251] Primex leased Building D-1-15 from 1997 to 2001 for manufacturing purposes.[252] GDO&TS is the current tenant.[253]

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[243] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[244] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[245] DOI 003204. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), March 1987, Page 3.
[246] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 2-3.
[247] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[248] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[249] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[250] PRI 002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[251] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.
[252] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[253] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

IOP Building D-1-16

Building D-1-16 was the IOP Heater House,[254] and was probably used to heat Building D-1-17, the Azide Napkin Preparation Building.[255] It was razed before 1965.[256]

Olin Building D-1-16

This building was in a different location from the original IOP Building D-1-16. It was constructed approximately 93 ft west of Building D-1-12, sometime between 1971 and 1980.[257]

Olin stored iron powder, aluminum powder, stearic acid, soda ash, and aluminum stearate in this building in 1985.[258] Primex leased Building D-1-16 from 1997 to 2001 for cold storage.[259] GDO&TS is the current tenant.

IOP Building D-1-17

Building D-1-17 was the IOP Azide Napkin Preparation Building.[260] In the preparation of detonators for anti-tank mines and artillery shells, lead azide underwent several processes. Lead azide is a sensitive primary explosive. Because lead azide is more sensitive when dry, it was shipped in a water and alcohol solution.[261,262] Therefore, upon delivery to the detonator load line (to Building D-1-15), the lead azide needed to be dried. Drying involved removing the lead azide from the shipping container and decanting the liquid in the packaging using a filter cloth (called a napkin or diaper).[263] This was presumably done in the napkin house, Building D-1-17.[264] The azide was then dried in Buildings D-1-18, D-1-21 and D-1-23 (Azide Dry Houses). This building was razed sometime between 1965 and 1971.[265]

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[254] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[255] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[256] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 6.
[257] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
[258] PRI-003615. Attachment to an Olin inter office memo, attachment entitled "Chemicals/Assemblies Evaluation for I-1-1 Storage.
[259] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[260] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[261] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 7-1.
[262] Charlie Kersaw, Ralph Sloat, and Mark Vetter, personal (telephone) interview, August 24, 1999.
[263] Charlie Kersaw, Ralph Sloat, and Mark Vetter, personal (telephone) interview, August 24, 1999.
[264] Charlie Kersaw, Ralph Sloat, and Mark Vetter, personal (telephone) interview, August 24, 1999.
[265] 1965 and 1971 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

Olin Building D-1-17

This building was constructed between 1971 and 1980 in a different location than the original IOP Building D-1-17.[266] Olin Building D-1-17 had a boiler that was blown down daily onto the ground surface.[267] The blowdown is part of the boiler water that is occasionally released as part of the process. By 1987 the blowdown was connected to the sewer system.[268] Heavy metals contamination is possible in the area of the boiler blow down. Six chemicals periodically added to the water in the boilers: phosphate, alkaline solution, sulphite, ammonia, zeolite, and salt brine.[269]

Primex leased Building D-1-17 from 1997 to 2001 (this building is either a ramp, hallway, utility system, or boiler room, not used as part of manufacturing or cold storage).[270] GDO&TS is the current tenant.[271]

Building D-1-18 (Building D-1-44)

Building D-1-18 was the IOP Azide Dry House.[272] Lead azide was probably brought to this building from Building D-1-17 (Azide Napkin Preparation Building) for drying.[273] Once sufficiently dry, the lead azide was presumably transported to Building D-1-24 (Dry Azide Rest House) for temporary storage.

Building D-1-18 was razed before 1960.[274] Olin Building D-1-44 was constructed in this same location between 1965 and 1971.[275] An earthen berm was built around this building and there is also a sump located on the south side of this building, within the bermed area.

Olin remote control mixing operations occurred in Building D-1-44[276] (West Mix Building)[277] with the control room being situated in Building D-1-25.[278,279] Propellants, igniter, and booster

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[266] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[267] PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 2.
[268] PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.
[269] PRI-016299. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 3.
[270] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 2, and 10.
[271] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[272] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[273] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[274] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[275] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[276] PRI-016499. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 1.
[277] PRI-016186. Olin inter office memo entitled *Special Survey – Sumps, Traps, and Vacuum Systems*, dated April 20, 1981, Page 2.

mixes were mixed in this building.[280,281] In 1977, IB-43 was mixed here, and before 1977, both IB-43 and HEI were mixed in this building.[282] In addition to HEI and IB-43, Olin reported that IB-27, IB-50, IB-51 and IS-102 were historically mixed in this building.[283] George Wisely reported that methylene chloride was used in the mix houses to the east and west of D-1-25 (these would be Buildings D-1-43 and D-1-44).[284]

There is a sump along the south side of the building. Dust from explosives mixing operations was collected, filtered, and dumped into the sump.[285] Wash waters, as well as, process and cleaning solvents drained to this sump,[286,287,288] which had overflow problems.[289] The sump was cleaned out by bailing the sump water onto the ground nearby and removing the solids for incineration, as discussed in further detail in Section 4.1.2.3 below. By June 1987, the sump was connected to the sewer system.[290]

Primex leased Building D-1-44 from 1997 to 2001 for manufacturing purposes.[291] GDO&TS is the current tenant.[292]

Building D-1-19

Building D-1-19, an IOP Heater House,[293] was probably used to heat Building D-1-18 (Azide Dry House).[294] This building was razed before 1960.[295]

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[278] Rudy Okolski, personal interview, June 30, 1999.
[279] PRI-011667. Olin Corporation, Hazard Analysis of D-1-25 Complex, December 1978, Page 1.
[280] Rudy Okolski, personal interview, June 30, 1999.
[281] PRI-016499. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 1.
[282] PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[283] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[284] Deposition of George Wisely, July 15, 1999, Page 23.
[285] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.
[286] PRI-016499. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 1.
[287] PRI-016594 to PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[288] Deposition of George Wisely, June 28, 1999, Pages 177, 180-181, and 196-198, and Exhibit 16.
[289] PRI-016386. Olin Corporation, TSO Maintenance Request form originated by Olin employee Jean Schneiderman, dated January 28, 1983.
[290] PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.
[291] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[292] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[293] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[294] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[295] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.

Building D-1-20

Building D-1-20, another IOP Heater House,[296] probably heated Building D-1-21 (Azide Dry House).[297] This building was razed before 1960.[298]

Building D-1-21

Building D-1-21 was an IOP Azide Dry House, same as Building D-1-18.[299] This building was razed prior to 1960.[300]

Building D-1-22

Building D-1-22, an IOP Heater House,[301] probably heated Building D-1-23 (Azide Dry House).[302] This building was razed between 1960 and 1965.[303]

Building D-1-23

Building D-1-23 was an IOP Azide Dry House, same as Buildings D-1-18 and D-1-21.[304] This building was razed prior to 1960.[305]

Building D-1-24 (Building D-1-46)

IOP Building D-1-24 was a Dry Azide Rest House.[306] After drying in Buildings D-1-18, D-1-21 and D-1-23 (Azide Dry Houses), the lead azide was probably brought to this building for temporary storage, until being mixed with other priming compound constituents in the Building D-1-25 (Azide Preparation Building).[307]

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[296] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[297] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[298] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[299] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[300] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[301] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[302] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[303] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 6.
[304] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[305] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[306] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[307] Use of the azide preparation building determined from building location and the current use of the building as a mix house as well as a logical progression of work from individual constituents to mixes prior to assembly.

This building was razed before 1960 and another built in its place between 1960 and 1965.[308] The replacement building was referred to as Building D-1-46.

Olin Building D-1-46 contained an oven that was used for drying fluid ball powder, IB-43, IB-50 and IB-51.[309] This oven was to be used in the 4A/A process, beginning in March/April of 1985.[310]

There is a sump along the east side of the building which collected waters as well as process and cleaning solvents (Figure 4-2).[311,312,313] The sump historically was cleaned out by bailing the sump water onto the ground nearby and removing the solids for incineration, as discussed in further detail in Section 4.1.2.3 below.

Later, the cleaning procedure changed to comply with RCRA, as indicated in the following excerpt from a March 1987 Olin document, which described the filtering of explosives in D-1-46 and D-1-47:[314]

> The process involves the manufacturing operation of blending and screening explosives and pyrotechnics. Water is used in this operation for collection and removal of explosive dusts. The contaminated water passes through a filter into a sump. The filtrate and filter are periodically removed and packaged as explosive hazardous waste for thermal treatment.

By June 1987, the sump was supposed to have been connected to the sewer system;[315] however, a September 1987 Olin inter office memo indicates the connection never occurred, and the sump's use was discontinued at that time.[316]

In this building, explosives were blended with either No. 2 fuel oil or ethylene glycol in preparation for transportation off site.[317]

Primex leased Building D-1-46 from 1997 to 2001 for manufacturing purposes.[318] GDO&TS is the current tenant.[319]

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[308] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 6.
[309] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[310] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[311] PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 2.
[312] PRI-016596. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[313] Deposition of George Wisely, June 28, 1999, Pages 177, 180-181, and 196-198.
[314] DOI 002500. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 3.
[315] PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.
[316] PRI-016543. Olin inter office memo entitle *"D-1-46 Sump,"* dated September 15, 1987.
[317] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.
[318] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

Building D-1-25

Building D-1-25 was an IOP Azide Preparation Building.[320] Lead azide was probably brought from Building D-1-24 (Dry Azide Rest House) to Building D-1-25 for mixing with other priming compound constituents that were prepared in Building D-1-26 (Inert Primer Components Preparation House). This building contained two primer machines,[321] one was a mixing machine (in the mixing room) and one was a screening machine (in the screening room).[322] This priming mixture was probably transported to the Loading Buildings (Buildings D-1-6, D-1-7, and D-1-8) via Building D-1-14 (Primer Mix and Azide Magazine). The walls inside this building were 1-ft thick for explosion protection.[323]

Thomas Throgmorton reported that UMC used Building D-1-25 for mixing pyrotechnic mixes for photoflash shells.[324]

Olin used Building D-1-25 for pelleting operations. This building was also used as a Main Control Building for mixing operations in buildings D-1-43, D-1-44, and D-1-47.[325] In 1967, IB-36 was being used in this building.[326] In 1977, both IB-27 and IB-43 were mixed in this building, and prior to 1977, both IB-50 and HEI were mixed in this building.[327] In March 1983, Olin identified the following possible contaminants in this building: potassium nitrate, ammonium nitrate, ammonium perchlorate, ammonium chloride, potassium perchlorate, boron, aluminum, polyvinyl acetate, and fluid ball powder (comprised of 10% IB-52 Mix).[328] During a January 1984 inspection (during Olin's tenure), explosives-contaminated waste material was observed on tables and counters in this building. Ball powder was also reportedly washed in this building.[329]

In 1984 Building D-1-25 was reported to contain explosives-contaminated material.[330]

Hexane was used in this building.[331]

In 1988, Olin likely used Building D-1-25 for Igniter Manufacture.[332] There was a sump on the south side of this building and wash waters as well as process and cleaning solvents drained to

[319] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[320] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[321] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 4.
[322] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 1.
[323] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 14.
[324] Thomas Throgmorton, personal interview, November 9, 1999.
[325] PRI-011667. Olin Corporation, Hazard Analysis of D-1-25 Complex, December 1978, Page 1.
[326] PRI-005175. Olin Corporation, D-1-43 Mix House, 18 October 1973, Page 8.
[327] PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[328] PRI-005087. Olin inter office memo entitled *D & P Areas Drain Survey*, dated March 10, 1983, Page 1.
[329] PRI-016346. Olin Corporation, 1983 Point Source Discharge Inventory, Page 1.
[330] PRI-002063. Olin Corporation, Inspection Report, dated January 18, 1984, Page 1.
[331] PRI-006686. Olin inter office memo entitled "*D and B Area Safety Inspection*," dated July 18, 1977, Page 2.

this sump (Figure 4-2).[333,334] The sump was cleaned out by bailing the sump water onto the ground nearby and removing the solids for incineration, as discussed in further detail in Section 4.1.2.3 below.

Primex leased Building D-1-25 from 1997 to 2001 for manufacturing purposes.[335] GDO&TS is the current tenant.[336]

Building D-1-26

Building D-1-26 was the IOP Inert Primer Components Preparation House.[337]

According to former UMC employee John Hempler, from approximately 1954 through 1957, the M-112 and M-123 photoflash shell powder was blended in Building D-1-26.[338] This building was razed between 1960 and 1965, and another built in its place between 1965 and 1971.[339]

An Olin lease report indicates they occupied this building from at least 1973.[340] Primex leased Building D-1-26 from 1997 to 2001 for cold storage.[341] GDO&TS is the current tenant.[342]

Building D-1-27

Building D-1-27 was an IOP Fulminate Preparation Building.[343] The buildings designated for fulminate could possibly have also been used in the same capacity for lead azide. If so, this building may have been used for the same purpose as Building D-1-25, the Azide Preparation Building. As a result, both mercury fulminate and lead azide are potential concerns in the area surrounding this building.

UMC used Building D-1-27 to load the inner shell case of the M-122 and M-123 photoflash shells.[344]

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332 PRI-009229. Olin inter office memo entitled *Staff Safety Audit*, dated May 25, 1988.
333 PRI-016594 and PRI-016596. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
334 Deposition of George Wisely, June 28, 1999, Pages 177, 180-181, and 196-198.
335 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
336 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
337 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
338 DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.
339 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 6 and 7.
340 PRI-00533. Olin, Quarterly Report, Lease Contract No. 14-19-008-2675 and No. 14-16-0003-12613, dated June 30, 1980, Page 6.
341 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
342 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
343 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
344 DOI 008154. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Page 2.

During Olin's tenure, another propellant operation that took place in Area 2D involved nitroglycerin (N.G.) casting of Lance propellant grains. In this process, nitroglycerin is used as a gelatinizing agent for nitrocellulose, and is referred to as N.G. solvent (a mixture of nitroglycerin, dimethyl sebacate, and ethyl centralite).[345,346,347] N.G. casting took place in Building D-1-27.[348,349,350] Acetone was used to clean metals parts in this building, and the wastes from this building were burned in burn pits.[351] Nitroglycerin contaminated materials were found in this building during a January 1984 inspection.[352]

Primex leased Building D-1-27 from 1997 to 2001 for manufacturing purposes.[353] GDO&TS is the current tenant.[354]

Building D-1-28

Building D-1-28 was an IOP Fulminate Rest House.[355] The buildings designated for fulminate could possibly have been used in the same capacity for lead azide. If so, it would have been used the same way as Building D-1-24, the Dry Azide Rest House. As a result, both mercury fulminate and lead azide are potential concerns in the area surrounding this building.

This building was razed before 1960.[356]

IOP Building D-1-29

Building D-1-29 was an IOP Fulminate Dry House.[357] The buildings designated for fulminate could possibly have been used in the same capacity for lead azide. If so, it would have been used the same way as the Azide Dry Houses, Buildings D-1-18, D-1-21, and D-1-23. As a result, both mercury fulminate and lead azide are potential concerns in the area surrounding this building.

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[345] PRI-013460, PRI-013461, and PRI-013468. Olin Corporation, Standard Operating Procedure, N.G. Casting – Solid Propellant Grains, S.O.P. No 90,163, Pages 1, 2, and 10.
[346] Department of the Army, September 1984, Military Explosives Technical Manual, (NTIS # TM 9-1300-214), Page 8-9.
[347] PRI-0006033. Olin Corporation, Material Safety Data Sheet, dated July 10, 1980.
[348] PRI-002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[349] PRI-013460. Olin Corporation, Standard Operating Procedure, N.G. Casting – Solid Propellant Grains, S.O.P. No 90,163, Page 1.
[350] PRI-002075. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Page 1.
[351] PRI-002075 and PRI-002077. Olin inter office memo entitled *Employee Exposures to Nitroglycerin and MOCA {4,4'-Methylene(bis)-2-chloroaniline]*, dated July 31, 1973, Pages 1 and 3.
[352] PRI-002063. Olin Corporation, Inspection Report, dated January 18, 1984, Page 1.
[353] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[354] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[355] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[356] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[357] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.

This building was razed before 1960.[358]

Olin Building D-1-29

This building was built sometime between 1971 and 1980 at a different location than the IOP Building D-1-29. It is located approximately 41 ft west of Building D-1-25.[359] In 1987, Olin used this building for 4A/A booster assembly.[360]

Primex leased Building D-1-29 from 1997 to 2001 for cold storage.[361] GDO&TS is the current tenant.[362]

Building D-1-30 (Building D-1-73)

Building D-1-30 was an IOP Heater House.[363] It may have been used to heat Building D-1-29 (Fulminate Dry House).[364]

This original IOP building was razed before 1960. Another building was constructed in this location between 1971 and 1980,[365] and was labeled Building D-1-73. This building is no longer present on site.

Building D-1-31

Building D-1-31 was the IOP Inert Primer Components Preparation Building.[366] It was probably razed before 1960.[367]

Building D-1-32/Burn Pad

Building D-1-32 was an IOP Fulminate Service Magazine.[368] The buildings designated for fulminate could possibly have been used in the same capacity for lead azide. If so, then this

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[358] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[359] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[360] PRI-013879. Olin Ordnance, Safety Procedure No. 99, Revised: December, 1987, Hazardous Operations – Access Control, Page 2.
[361] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[362] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[363] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[364] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[365] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[366] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[367] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.

building may have been used as a lead azide service magazine, the same as Building D-1-15. As a result, both mercury fulminate and lead azide are potential concerns in the area surrounding this building. The building was razed sometime before 1960, based on aerial photography.

UMC, which occupied the buildings in the former Detonator Loading Line in Area 2, reportedly began burning its ignitable wastes soon after coming to the Refuge.[369] UMC's burning grounds in Area 2D were probably the concrete pads of IOP buildings that were razed after the end of World War II. The pad remaining from former IOP Building D-1-32 was probably used as a burn pad.[370,371] Waste burned at the pad(s) probably consisted mainly of components from UMC's fuse train and pyrotechnic production operations.[372] Waste containing lead azide, lead styphnate, red phosphorus, linseed oil, perchlorates and other chemicals may have been burned at the pads (see Table 3-4).

According to John Miller, a former Olin chemist and manager, UMC reportedly had a burn pad in the southeast part of Area 2D which Olin later used.[373] Robert High, a former Olin maintenance supervisor, described a pad as being in the southeast part of the D Area behind the buildings.[374] It is assumed that Miller and High were describing the burning pad at former Building D-1-32. Mr. Miller also stated that a "hill-like" protection was located on the end of the pad to protect surrounding buildings; and that on the south side of the pad liquids were poured into a small pit to burn.[375] He further stated that in burn pits you left the residue in place and simply covered it over.[376]

The 1960 aerial photograph (taken during UMC's tenure at the site) showed the foundation of this building as a darkened depression, which suggests it was used for burning.[377] The next available photograph, from 1965, (also during Olin's tenure at the site) also showed evidence of possible burning activities in this location.[378] By 1971, it appears that burning activities in this area had stopped, since the area appeared to be revegetating.[379] An Olin inventory of areas where they burned at the Refuge, identified a burn area in the southeast corner of Area 2D which appears to be the location of former Building D-1-32.[380] Another Olin document indicates they had an open burn site just south of Building D-1-32 where they burned explosive wastes from

[368] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[369] DOI 008156 to DOI 008158. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 4 -6.
[370] Deposition of John Miller, April 9, 1998, Pages 93- 94.
[371] DOI 008156 to DOI 008158. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 4 -6.
[372] DOI 008156 to DOI 008157. Exhibit 1 to the John R. Hempler Affidavit, dated August 29, 1989, Pages 4 -5.
[373] Deposition of John Miller, April 9, 1998, Pages 72-74, 93-94.
[374] Robert High, personal interview, September 29, 1997.
[375] Deposition of John Miller, April 9, 1998, Page 94.
[376] Deposition of John Miller, April 9, 1998, Page 96.
[377] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[378] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 6.
[379] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 6.
[380] DOI 004471. Olin Corporation, 1981, attachment to EPA Form, Notification of Hazardous Waste Site.

1965 to 1966.[381] Olin reported that an estimated 600-pounds of metal oxides remained at this location as a result of burning explosives, propellants, and pyrotechnics at this location.[382] Olin also reported that there was potential for lead contamination in the soils near this burning pad location.[383]

A lightly mottled area that appears to have been impacted by human activities was observed in the 1960 aerial photograph to the east of Building D-1-32 (across Service Road). In 1965, there was a crescent-shaped berm located in this same area.[384] This berm may have been related to the possible burning activities at former Building D-1-32. There was also a man-made lagoon or impoundment located along a creek that was observed to the northeast of this crescent-shaped berm in the 1965 aerial photograph.[385] This lagoon or impoundment was created sometime between 1960 and 1965, and it appears on the photograph as a light-toned area.[386]

Building D-1-33

Building D-1-33 was an IOP Heater House[387] and may have been used to heat Building D-1-34 (Fulminate Napkin Preparation Building).[388]

Sometime between 1965 and 1971, a large earthen berm was built around this building and Building D-1-34.[389] In 1975, Olin used this building for nitroglycerin storage.[390] An August 1990 Olin document indicates nitroglycerin contamination in Building D-1-33.[391]

Primex leased Building D-1-33 from 1997 to 2001 for cold storage.[392] GDO&TS is the current tenant.[393]

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[381] DOI 003205 and DOI 003211. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), Pages 4 and 10.
[382] DOI-004467. Olin Corporation, 1981, attachment to EPA Form, Notification of Hazardous Waste Site.
[383] DOI-004467.
[384] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[385] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 6.
[386] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[387] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.
[388] Description of the drying process for lead azide was determined from the building names and layout on the architectural drawings for the Detonator Load Line.
[389] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[390] PRI-002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[391] DPRA Document No. 0007415. Olin Ordnance, letter to Crab Orchard National Wildlife Refuge requesting permission to open burn Building D-1-33 due to nitroglycerin contamination, dated August 8, 1990.
[392] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.
[393] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building D-1-34

Building D-1-34 was an IOP Fulminate Napkin Preparation Building.[394] The buildings designated for fulminate could possibly have been used in the same capacity for lead azide. If so, then this building may have been used for lead azide, the same as Building D-1-17, the Azide Napkin Preparation Building. As a result, both mercury fulminate and lead azide are potential concerns in the area surrounding this building.

Sometime between 1965 and 1971, a large earthen berm was built around both this building and Building D-1-33.[395] This original IOP Building D-1-34 was removed prior to 1960 and replaced with another building between 1960 and 1965. From at least as early as 1973, Olin used this building for nitroglycerin storage.[396,397,398] In August 1990, the building was determined to be contaminated with nitroglycerin.[399]

Primex leased Building D-1-34 from 1997 to 2001 for cold storage.[400] GDO&TS is the current tenant.[401] This Building D-1-34 is assumed to be in the same location as the original Building D-1-34, but that has not been confirmed.

Building D-1-35

Building D-1-35 was an IOP Change House for Area 2D.[402] Workers changed clothes and showered in this building. Wash waters from this building may have contained explosives/organic solvent residues. It was not determined whether wash waters from this building drained into the sewer system or into drainage ditches that were located near the building.

During Olin's tenure at the site, metalworking (welding)[403] and solvent cleaning operations were also performed in Area 2D, as well as welding in Building D-1-35.[404,405] This building also

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[394] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 4.

[395] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.

[396] PRI-013469 – PRI-013470. Olin Corporation, Standard Operating Procedure, Unloading N.G. Barrels at D-1-34, S.O.P. No. 90162, dated December 13, 1973, Pages 1 and 2.

[397] PRI-013444 – PRI-013445. Olin Corporation, Standard Operating Procedure, N.G. Solvent Storage - D-1-34, S.O.P. No. 90166, dated 1974, Pages 1 and 2.

[398] PRI-002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

[399] DPRA Document No. 0007415. Olin Ordnance, letter to Crab Orchard National Wildlife Refuge requesting permission to open burn Building D-1-33 due to nitroglycerin contamination, dated August 8, 1990.

[400] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[401] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[402] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.

[403] PRI-016811. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86, Wastewater Discharge/Source Inventory 7/30/86.

[404] Deposition of John Miller, April 9, 1998, Page 57.

housed a degreaser using trichloroethylene[406] and "trichlorethane."[407] Olin has also maintained x-ray facilities in Area 2D. X-ray machines were located in Building D-1-35,[408,409] and there were three x-ray rooms and a dark room in this building[410]. The effluent from this operation was expected to contain heavy metals, acetic acid (potassium hydroxide solution), hydroquinone, unreacted aldehyde, sulfuric acid, aluminum sulfate, sodium dichromate, salt brine, zeolite and water.[411,412] The x-ray effluent was discharged to the sewer up until at least 1986.[413] A 1984 Olin report indicated that the effluent was discharged to a sewer, and that the process included the following chemicals: Kodak Industrex Developer Replenisher, Kodak Industrex Fixer and Replenisher, and Developer Systems Cleaner.[414]

Olin also used this building as an office and cafeteria.[415] Primex leased Building D-1-35 from 1997 to 2001 for cold storage.[416] GDO&TS is the current tenant.[417]

Building D-1-36

Building D-1-36 was an IOP Change House for Area 2D, the same as Building D-1-35. [418]

According to Harvey Pitt, the upper floor of Building D-1-36 was used by UMC as a research and development laboratory.[419] Thomas Throgmorton reported that he worked for UMC in Building D-1-36, where he did research and development for delay switches. This involved developing the chemical formulas for delays in initiating devices. The delays used normal lead

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405 PRI-016811. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86, Wastewater Discharge/Source Inventory 7/30/86.
406 PRI-002853 – PRI-002854. Olin, Supervisor's Investigation Report of Occupational Injury or Illness, dated September 28, 1979, Pages 1–2.
407 DPRA Document No. 00026949/PRI-006609. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00001.
408 PRI-016535. Olin Corporation, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated December 30, 1986.
409 PRI-016696. Olin Corporation document, Recommendations for Correction and Prevention, Wastewater Discharges or Sources, Page 1.
410 PRI-016811. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86, Wastewater Discharge/Source Inventory 7/30/86.
411 PRI-016299. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 3.
412 PRI-016732, PRI-016734, PRI-016736, PRI-016738, PRI-016739, and PRI-016741. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
413 PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.
414 PRI-016711. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
415 Original IOP Plan No.6544-101.13, last revision, June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
416 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
417 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
418 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
419 Deposition of Harvey Pitt, November 19, 1997, Page 31.

styphnate to initiate propellant charges (ball powder).[420] Pitt reported that on the lower floor of D-1-36, UMC performed pressing, consolidation, and compaction of the primary explosives, lead azide and lead styphnate, for the fuse train components.[421] Another former UMC employee, Vic Modglin, reported that Building "D-136" was used for non-destructive testing such as X-ray analysis.[422]

In 1975, Olin used this building for Maintenance and Engineering Offices.[423]

Primex leased Building D-1-36 from 1997 to 2001 for cold storage.[424] GDO&TS is the current tenant.[425]

Building D-1-37

Building D-1-37 was the IOP Timekeepers Building for Area 2D.[426]

Olin used this building for Offices, Loss Prevention and Medical in 1975.[427] It was used as a guard shack by Olin. Primex leased Building D-1-37 from 1997 to 2001.[428] GDO&TS is the current tenant.[429]

Building D-1-38

Building D-1-38 was the IOP Boiler House for Area 2D and was located approximately 417 ft northwest of Building D-1-13 in the uppermost northwest corner of Area 2D.[430] The original IOP plans do not identify any underground storage tanks (USTs) associated with this boiler house.[431] There were initially two coal-fired boilers located in this building and a blow-off basin was

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[420] Thomas Throgmorton, personal interview, November 9, 1999.
[421] Deposition of Harvey Pitt, November 19, 1997, Pages 53-54 and 76.
[422] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-17. Note that there is no Building D-136; Modglin presumably said "Building Dee-one-thirty-six" and it was recorded as D-136 rather than D-1-36.
[423] PRI-002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[424] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[425] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[426] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[427] PRI-002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[428] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[429] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[430] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[431] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 22.

located along the south side of the building.[432] A coal bin (45" by 20.6") was located on the north side of the building and a transformer enclosed with a chain-link fence was located on the east side of the building.[433] A stack was located just south of the building, but no other information was found regarding the stack.[434]

This building was razed before 1960.[435]

Building D-1-39

Building D-1-39 was the IOP Detonator Destruction Building,[436] which was used to destroy rejected detonators by heating until the detonators discharged. In March 18, 1943, an accidental explosion destroyed the building and killed one person.[437, 438]

Building D-1-39 is not shown in the plan drawings for the Detonator Loading Line. This building and other storage buildings were located in the Crab Orchard Cemetery (COC) Area, north of the COC Area Road and west of Wolf Creek Road.[439,440] A February 7, 1943 aerial photo confirms the locations of these buildings shown on the December 1942 Plant Protection Map.[441] This location is not shown in Figure 4-1. It appears to be included in the Explosives/Munitions Manufacturing Area Operable Unit (EMMA OU) Site, COC-3, and was therefore not included in the AUS OU.

An IOP burning ground was also located near (to the northwest of) the Detonator Destruction Building.[442] Kermit C. Troutman, a former SWDC employee stated in an interview with TechLaw, Inc. that he believed explosive wastes from sumps at IOP were burned at the burning

[432] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 22.

[433] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.

[434] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985.

[435] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.

[436] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.

[437] SW97-0280 – SW97-0281. Sherwin-Williams Defense Corporation, Proceedings of Board of Investigation, dated March 22, 1943, Pages 1 - 2.

[438] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part II, Section 4, Sheet 5.

[439] NAR 000147. Illinois Ordnance Plant, Carbondale, Illinois, Illinois Ordnance Plant, Historical Record, January 1st, 1943 to March 31st, 1943, Section III, Appendix G, Safety and Security, Document No. 5. *Note, the Bates number on this document reads "NAR 000;" however, it follows NAR 000146 and is therefore assumed to be NAR 000147.*

[440] CRO 002689 J. Sherwin-Williams Defense Corp, Illinois Ordnance Plant, Plant Protection (Posting of Guards and Firemen), Plan No. PL-280E, dated December 16, 1942.

[441] Entech, Inc., Letter from Steve Baker to Michael Hutcheson of URS Greiner Woodward Clyde regarding "*Request for Information on the Former IOP Burning Ground and Detonation Building*," dated July 29, 1999.

[442] CRO 002689 J. Sherwin-Williams Defense Corp, Illinois Ordnance Plant, Plant Protection (Posting of Guards and Firemen), Plan No. PL-280E, dated December 16, 1942.

grounds.[443] Analysis of the December 1942 SWDC/War Department Police and Fire Plant Protection Map for IOP shows the location of the burning grounds at the EMMA COC-3 Site.[444] It was therefore not included in the AUS OU.

Building D-1-40

Building D-1-40, the IOP Condensate Pump House,[445] was located next to Building D-1-4 (the Tetryl Pelleting Building). It was razed between 1971 and 1980.[446]

Building D-1-41 (Building D-1-62)

Building D-1-41, located between Buildings D-1-7 and D-1-8, was also designated as an IOP Condensate Pump House.[447]

Building D-1-41 was re-named Building D-1-62, likely by Olin since most of the new buildings in this area were added during Olin's tenure at the site. By the time UMC left the site, the building numbers did not go as high as "62."

Primex leased Building D-1-62 from 1997 to 2001 for cold storage.[448] GDO&TS is the current tenant.[449]

IOP Building D-1-42

Building D-1-42 was an IOP Condensate Pump House[450] and was located next to Building D-1-13. It was razed between 1971 and 1980.[451]

Olin Building D-1-42

This building was in a different location from the original IOP Building D-1-42. It is located to the southwest of Building D-1-25, south of the Service Road. It was built by Olin between 1971

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[443] Mr. Kermit Troutman, personal interview, TechLaw, Inc., 1997, Draft Investigation Report The Sherwin-Williams Company Illinois Ordnance Plant; Prepared for U.S. Army Corps of Engineers, Page B-3.
[444] CRO 002689 J. Sherwin-Williams Defense Corp, Illinois Ordnance Plant, Plant Protection (Posting of Guards and Firemen), Plan No. PL-280E, dated December 16, 1942.
[445] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[446] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[447] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[448] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[449] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[450] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13) and Part II, Section 4, Sheet 5.
[451] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.

and 1978 and was intended to be used as a Storage Building (it appears to be associated with Building D-1-84).[452,453]

Primex leased Building D-1-42 from 1997 to 2001 for cold storage.[454] GDO&TS is the current tenant.[455]

IOP Building D-1-43

Building D-1-43 was an IOP Control House.[456] The location of this building was not found.

Olin Building D-1-43

This building (East Mix Building) was in a different location from the original IOP Building D-1-43. Olin constructed this building between 1965 and 1971, and surrounded it with a large earthen berm.[457]

Olin remote control explosives mixing operations occurred in Building D-1-43 (East Mixer or Mix Building) with the control room in Building D-1-25.[458,459,460,461] In addition to propellants, igniter and booster mixes were mixed in this building.[462,463,464] Also during Olin's tenure, another propellant operation that took place in Area 2D involved nitroglycerin (N.G.) casting of Lance propellant grains. Nitroglycerin casting may have taken place in Building D-1-43.[465]

Olin reported that HEI, IB-43, IB-27, IB-50, IB-51 and IS-102 were historically mixed in this building,[466,467] as well as research and development of GAP Propellant.[468] An explosion occurred

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[452] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[453] DOI 001482. Amendment No. 16 to Lease Contract No. 14-19-0008-2675, Olin Corporation, dated December 1, 1978.
[454] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[455] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[456] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 7 (Plan No. 6544-101.13).
[457] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[458] PRI-002064. Olin Corporation, Inspection Report, dated January 18, 1984, Page 3.
[459] Rudy Okolski, personal interview, June 30, 1999.
[460] PRI-016499. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 1.
[461] PRI-016186. Olin inter office memo entitled *Special Survey – Sumps, Traps, and Vacuum Systems*, dated April 20, 1981, Page 2.
[462] Rudy Okolski, personal interview, June 30, 1999.
[463] PRI-016499. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 1.
[464] PRI-013797 – PRI-013801. Olin Corporation, Standard Operating Procedure, Cleaning Sumps D-1-43, D-1-44, and D-1-47, S.O.P. No 90228, Pages 1-5.
[465] Rudy Okolski, personal interview, June 30, 1999. Mr. Okolski stated that N.G. casting for lance propellants took place in building D-1-43. No supporting documentation for this could be found, however, IB-27 lance igniter propellant is mixed in D-1-43. Igniter propellant does not contain N.G. and is not cast.
[466] PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.

at Building D-1-43 in 1973. The vacuum line trap was removed from an igniter mixer and taken immediately outside of the building to a sidewalk for cleaning. The contaminated trap (compositions including IB-50, IB-51, and IB-27) exploded on the sidewalk.[469]

Building D-1-43 had a sump that was located along the south side of the building.[470] Dust resulting from explosives mixing operations was collected, filtered, and dumped into the sump.[471] Also, wash waters, as well as process and cleaning solvents would drain to this building's sump.[472,473,474,475,476] The sump was cleaned out by bailing the sump water onto the ground nearby and removing the solids for incineration, as discussed in further detail in Section 4.1.2.3 below. Methylene chloride was reportedly used as a part of the mixing activities in this building, and it was also reportedly discharged to the sump along with heavy metals, polyvinyl acetate, potassium nitrate, amorphous boron, graphite, aluminum powder, potassium perchlorate, ammonium perchlorate, and ammonium chloride.[477] George Wisely also reported that methylene chloride was used in the mix houses to the east and west of D-1-25 (these would be Buildings D-1-43 and D-1-44).[478] A 1983 sample taken by Olin from the sump at Building D-1-43 had a methylene chloride level of 1,421 micrograms per Liter (mg/L).[479] Heavy rains and excessive mixing could cause the sump to overflow onto the ground surface.[480,481] By June 1987, the sump was connected to the sewer system.[482]

Primex leased Building D-1-43 from 1997 to 2001 for manufacturing purposes.[483] GDO&TS is the current tenant.[484]

[467] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[468] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[469] PRI-005164-PRI-005165 and PRI-005168-PRI-005169. Olin Corporation, D-1-43 Mix House, 18 October 1973, Pages 1-2 and both cover sheets.
[470] PRI-016596. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[471] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.
[472] DOI 002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 2.
[473] PRI-016594, PRI-016599. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
[474] Deposition of George Wisely, June 28, 1999, Pages 177, 180, and 196-198.
[475] PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 2.
[476] PRI-016354. Olin inter office memo entitled *Point Source Discharges*, dated November 10, 1983.
[477] PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 2.
[478] Deposition of George Wisely, July 15, 1999, Page 23.
[479] PRI-016357. Olin inter office memo entitled *Point Source Discharges*, dated November 10, 1983.
[480] PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Page 2.
[481] PRI-016386. Olin Corporation, TSO Maintenance Request form originated by Olin employee Jean Schneiderman, dated January 28, 1983.
[482] PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.
[483] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[484] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building D-1-44

Building D-1-44 (West Mix Building) was not an original IOP building. It is at the former location of IOP Building D-1-18, and it is discussed above under "IOP Building D-1-18."

Building D-1-45

Building D-1-45 was built sometime between 1965 and 1971[485]. A 1986 Olin map of Area 2D indicates this building was located west of Building D-1-25;[486] however, no information was found regarding Olin's specific use of D-1-45. Primex leased Building D-1-45 from 1997 to 2001 for manufacturing purposes.[487] GDO&TS is the current tenant.[488] The current location of this building was not determined.

Building D-1-46

This building was constructed in the former location of IOP Building D-1-24, and it is discussed above under "IOP Building D-1-24."

Building D-1-47

Olin built this building sometime between 1965 and 1971[489] and surrounded it with a large earth berm.

Olin remote control mixing operations occurred in Building D-1-47 (Mix Building) with the control room in Building D-1-25.[490,491] In addition to mixing propellants, igniter and booster mixes were also mixed in this building.[492,493] Granulating was also reported to have been done in this building.[494] This building was inactive in September 1984.[495] It was reportedly used for mixing operations, depending on which programs were active at the time (i.e. IB-43, IB-50, IB-51 and IB-52).[496,497] Dust from these operations was drawn through a scrubber and wastewater

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[485] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[486] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.
[487] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[488] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[489] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[490] Rudy Okolski, personal interview, June 30, 1999.
[491] PRI-011667. Olin Corporation, Hazard Analysis of D-1-25 Complex, December 1978, Page 1.
[492] Rudy Okolski, personal interview, June 30, 1999.
[493] PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 2.
[494] PRI-016186. Olin inter office memo entitled *Special Survey – Sumps, Traps, and Vacuum Systems*, dated April 20, 1981, Page 2.
[495] PRI-016706 and PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[496] PRI-016715. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

from the scrubber was discharged into the sump discussed below.[498] In 1985, screening of IB-50 and IB-51 for the 4A/A program was planned.[499]

There was a sump on the north side of the building (Figure 4-2)[500] which received wash waters as well as process and cleaning solvents.[501,502,503504] The sump had overflow problems.[505] The sump was cleaned out by bailing the sump water onto the ground nearby and removing the solids for incineration, as discussed in further detail in Section 4.1.2.3 below. By June 1987, the sump was connected to the sewer system.[506]

Primex leased Building D-1-47 from 1997 to 2001 for manufacturing purposes.[507] GDO&TS is the current tenant.[508]

Building D-1-48

This building was built sometime between 1965 and 1971. [509] In 1975, Olin used it as an Igniter Control Preparation Building.[510]

Primex leased Building D-1-48 from 1997 to 2001 for cold storage.[511] GDO&TS is the current tenant.[512]

Building D-1-49

Building D-1-49 was built sometime between 1971 and 1978 to be used as an Igniter Storage Building.[513,514] Olin documents indicate that in 1988, solvent was stored in this building.[515]

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497 PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 2.
498 PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 2.
499 PRI-016716. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
500 PRI-016596. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
501 PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Page 2.
502 PRI-016594. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977.
503 DOI 002500. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987, Page 3.
504 Deposition of George Wisely, June 28, 1999, Pages 177, 180, and 196-198.
505 PRI-016386. Olin Corporation, TSO Maintenance Request form originated by Olin employee Jean Schneiderman, dated January 28, 1983.
506 PRI-016550. Olin Corporation. Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated June 1, 1987.
507 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
508 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
509 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
510 PRI 002646. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
511 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
512 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Primex leased Building D-1-49 from 1997 to 2001 for manufacturing purposes.[516] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[517]

GDO&TS is the current tenant in this building.[518]

Building D-1-50

Building D-1-50 was built sometime between 1971 and 1980.[519] Primex leased Building D-1-50 from 1997 to 2001 for cold storage.[520] GDO&TS is the current tenant.[521]

Building D-1-51

Building D-1-51 was built sometime after 1960, and Olin began occupying it in 1965.[522,523]

Primex leased Building D-1-51 from 1997 to 2001 (this building is either a ramp, hallway, utility system, or boiler room, not used as part of manufacturing or cold storage).[524] GDO&TS is the current tenant.[525]

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513 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.

514 DOI 001482. Amendment No. 16 to Lease Contract No. 14-19-0008-2675, Olin Corporation, dated December 1, 1978.

515 PRI-009233. Olin inter office memo entitled "*Safety Audit – High Hazards Area,*" dated July 27, 1988, Page 1.

516 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

517 DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.

518 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

519 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.

520 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1-2.

521 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

522 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.

523 PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

524 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 3, and 10.

525 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building D-1-52

Building D-1-52 was built sometime between 1960 and 1965.[526] Olin began occupying this building in 1965,[527] and it appeared to be either attached to or an annex of Building D-1-25 (on the north side).[528]

Primex leased Building D-1-52 from 1997 to 2001 for manufacturing purposes.[529] GDO&TS is the current tenant.[530]

Building D-1-53

Building D-1-53 was built sometime after 1971, and Olin began occupying it in 1972.[531,532] Primex leased it from 1997 to 2001 for cold storage.[533] GDO&TS is the current tenant.[534]

Building D-1-54

Building D-1-54 was not an original IOP building. The only information found regarding this building was Primex's lease indicating occupancy from 1997 to 2001.[535] GDO&TS is the current tenant.[536]

Building D-1-55

Building D-1-55 was not an original IOP building and in 1986, it was located adjacent to Building D-1-8, south of Building D-1-92.[537]. Olin began occupying this building in 1965.[538]

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[526] 1960 and 1965 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[527] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.
[528] DPRA Document No. 00017544, Primex Technologies, Proposed Water Main Extension for New Sprinkler System, October 2, 1997, Page 2.
[529] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[530] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[531] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 7.
[532] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.
[533] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[534] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[535] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[536] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Primex leased Building D-1-55 from 1997 to 2001. This building is either a ramp, hallway, utility system, or boiler room, and is not used as part of manufacturing or cold storage.[539] GDO&TS is the current tenant.[540]

Building D-1-56

Building D-1-56 was built sometime between 1971 and 1980, and it was surrounded by a large earthen berm.[541] Primex leased Building D-1-56 from 1997 to 2001 for cold storage.[542] GDO&TS is the current tenant.[543]

Building D-1-57

Olin built Building D-1-57 in 1979[544] and surrounded it with a large earthen berm.[545] Mixing operations for smoke candles (LUU-10B (red dye-methyl amino anthroquinone, sodium picrate, ball powder, and triethylene glycol dinitrate)) were done in this building.[546,547] Both lead and di-n-octylphthalate may be chemicals of concern in this building.

During construction of this building in 1979, a fuel oil standpipe, from the former aboveground storage tanks (ASTs) that were located in the same place as Building D-1-58, was broken and approximately 2,500 gallons of fuel oil spilled and drained into this area (bunker area) and into a nearby ditch.[548] This ditch drains from Area 2D to the south and then turns to the southwest. Olin made an effort to contain the spill by pumping the standing fuel oil into 55-gallon drums and attempting to soak up the rest using straw.[549] The top layer of soil in the ditch and the fuel-

[537] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.
[538] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.
[539] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 3, and 10.
[540] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[541] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[542] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[543] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[544] PRI-002738. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 1.
[545] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[546] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.
[547] PRI-002531. Olin inter office memo entitle "Industrial Hygiene Survey, Marion, IL," dated June 19, 1981, Page 1.
[548] PRI-002738. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 1.
[549] PRI-002738. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 1.

soaked straw were taken to a landfill for disposal.[550] It is possible that some of this fuel oil contaminated the area near Building D-1-57.

Primex leased Building D-1-57 from 1997 to 2001 for manufacturing purposes.[551] GDO&TS is the current tenant.[552]

Building D-1-58/Bermed AST Area

Olin built Building D-1-58 in 1979[553] and surrounded it with a large earthen berm.[554] Screening operations for smoke candles (LUU-10B[555]) were done in this building.[556,557] Both lead and di-n-octylphthalate may be chemicals of concern in this building. Screening of sodium picrate was also done in this building.[558,559]

Prior to this building being built, two probable ASTs surrounded by a berm were observed in this same location, in the 1960, 1965 and 1971 aerial photographs.[560] The 1965 and 1971 aerial photographs showed surface discoloration and probable standing liquid inside the southern portion of this bermed area.[561] By 1980, this area of surficial discoloration and standing liquid was covered with the large earthen berm that surrounds the newly constructed Olin Building D-1-58.[562] During construction of this building in 1979, a fuel oil standpipe, probably from these former ASTs, was broken and a spill occurred as described under Building D-1-57, above. It is possible that oil contamination remained around the "east bunker"[563] (possibly Building D-1-58).

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[550] PRI-002739. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 2.
[551] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[552] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[553] PRI-002738. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 1.
[554] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[555] PRI-002738. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 1.
[556] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.
[557] PRI-002531. Olin inter office memo entitle "Industrial Hygiene Survey, Marion, IL," dated June 19, 1981, Page 1.
[558] PRI-00248. Olin Corporation document entitled "*B & D Area Dust Collectors,*" Page 1.
[559] PRI-002531. Olin inter office memo entitle "Industrial Hygiene Survey, Marion, IL," dated June 19, 1981, Page 1.
[560] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 5, 6 and 7.
[561] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 6 and 7.
[562] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[563] PRI-002738. Olin inter office memo entitled *Oil Spill 7-12-79*, dated July 19, 1979, Page 1.

Primex leased Building D-1-58 from 1997 to 2001 for manufacturing purposes.[564] GDO&TS is the current tenant.[565]

Building D-1-59

Building D-1-59 was an Olin portable building (56 square ft) that went into disuse in 1980.[566] An Olin building usage document indicates this building was removed from site, but it does not include a date for this removal.[567]

Building D-1-60

Building D-1-60 was built sometime between 1971 and 1980.[568] Primex leased Building D-1-60 from 1997 to 2001 for cold storage.[569] GDO&TS is the current tenant.[570]

Building D-1-61

Building D-1-61 is a 47-square-ft, portable building installed by Olin sometime between 1971 and 1980.[571,572] Primex used this building for cold storage of inert materials and surplus equipment.[573] This building was removed sometime between 1980 and 1993.[574]

Building D-1-62

Building D-1-62 appears to be former IOP Building D-1-41 that was renamed by Olin. It is discussed above under "IOP Building D-1-41."

[564] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[565] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[566] PRI-00440. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 3.
[567] PRI-00440. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 3.
[568] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
[569] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[570] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[571] DPRA Document No. 00017640, Amendment No. 9 to Building and Igloo Lease Contract No. 14-16-0003-96-579, "*Environmental Site Closure Assessment.*"
[572] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
[573] DPRA Document No. 00017640, Amendment No. 9 to Building and Igloo Lease Contract No. 14-16-0003-96-579, "*Environmental Site Closure Assessment.*"
[574] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

Building D-1-63

Building D-1-63 was built sometime after 1960,[575] and Olin began occupying it in 1979.[576] From at least 1985 to 1988, Olin used this building for storing flammable materials.[577] Primex leased Building D-1-63 from 1997 to 2001 for cold storage.[578] GDO&TS is the current tenant.[579]

Building D-1-64

Building D-1-64 was built sometime between 1960 and 1965.[580] Primex leased it from 1997 to 2001 (this building is a ramp, hallway, utility system, or boiler room, not used as part of manufacturing or cold storage).[581] GDO&TS is the current tenant.[582]

Building D-1-65

Building D-1-65 was not an original IOP building. It was referenced in a 1984 Olin document,[583] which also indicated that the building had been razed prior to 1984. However, a 1987 Olin document indicates Building D-1-65 was located north of Olin Building D-1-14; and a 1986 Olin map of Area 2D indicates it was located next to D-1-6, north of Building D-1-10.[584] This building is noted on these maps with a "P," indicating it was probably a portable building. Therefore, it is likely that at various times it was located in both of these locations and probably others as well. Olin stored explosives (hazardous waste) in this building.[585,586]

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[575] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[576] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.
[577] PRI-006610. Olin Corporation, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00002; and PRI017406. Olin Corporation, Air Source Inventory/OP/Marion/RC, dated November 25, 1988, Page 00006.
[578] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[579] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[580] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 5 and 6.
[581] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 3, and 10.
[582] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[583] PRI-016722. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.
[584] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.
[585] DOI 003204 and DOI 003211. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), Pages 3 and 10.
[586] PRI-003292. Olin Corporation, RCRA Update pertaining to Training, Inspections, and Shipment Limits containing Hazardous Waste Explosive Lists, dated February 10, 1987.

Primex leased Building D-1-65 from 1997 to 2001 for cold storage.[587] GDO&TS is the current tenant.[588]

Building D-1-66

A 1984 Olin document indicates this portable building was located east of Building D-1-14.[589] Building D-1-66 was located just east of Olin Building D-1-14. Primex used this building for cold storage of inert materials and surplus equipment.[590]

Building D-1-67

There was no evidence of this building in historical aerial photographs; however, Primex lease documents indicate they occupied this portable building since 1997 and used it for cold storage of inert materials and surplus equipment.[591]

Building D-1-68

This building was built sometime after 1980.[592] An Olin document identifies its location north of D-1-44.[593] Primex leased Building D-1-63 from 1997 to 2001 for manufacturing purposes.[594] GDO&TS is the current tenant.[595]

Building D-1-69

This building was constructed in the former location of IOP Building D-1-15 and is discussed above under "IOP Building D-1-15".

Building D-1-70

Building D-1-70 was a portable building installed sometime after 1971.[596] Olin began occupying it in 1979.[597] In 1997, Primex took over the lease and used the building for cold storage of surplus equipment and inert materials.[598]

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[587] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[588] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[589] PRI-016722. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[590] DPRA Document No. 00017640, Amendment No. 9 to Building and Igloo Lease Contract No. 14-16-0003-96-579, "*Environmental Site Closure Assessment.*"

[591] DPRA Document No. 00017640, Amendment No. 9 to Building and Igloo Lease Contract No. 14-16-0003-96-579, "*Environmental Site Closure Assessment.*"

[592] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure8.

[593] PRI-016722. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[594] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[595] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building D-1-71

Building D-1-71 was built sometime between 1971 and 1980.[599] Primex leased it from 1997 to 2001 for cold storage.[600] GDO&TS is the current tenant.[601]

Building D-1-72

Building D-1-72 was built sometime between 1971 and 1980.[602] In 1982, it was used for storage of waste debris from open burning areas.[603,604] A 1990 Olin document indicates this building was contaminated with nitroglycerin.[605] Primex leased Building D-1-72 from 1997 to 2001 for manufacturing purposes.[606] GDO&TS is the current tenant.[607]

Building D-1-73

Building D-1-73 was constructed sometime between 1971 and 1980 in the former location of IOP Building D-1-30. It is discussed above under "IOP Building D-1-30."

Building D-1-74

Building D-1-74 was not an original IOP building. According to a 1986 Olin map of Area 2D, this building was noted as D-1-74G and was located east of Building D-1-37, at the northern entrance to Area 2D.[608] Primex leased Building D-1-74 from 1997 to 2001 for cold storage.[609] GDO&TS is the current tenant.[610]

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[596] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
[597] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.
[598] DPRA Document No. 00017640, Amendment No. 9 to Building and Igloo Lease Contract No. 14-16-0003-96-579, "*Environmental Site Closure Assessment.*"
[599] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
[600] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[601] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[602] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
[603] PRI-016277. Olin, Open Burning Debris Record, dated June 24, 1982.
[604] PRI-016274. Olin, Open Burning Debris Record, dated approximately August 3, 1982.
[605] DPRA Document No. 0007415. Olin Ordnance, letter to Crab Orchard National Wildlife Refuge requesting permission to open burn buildings with nitroglycerin contamination, dated August 8, 1990.
[606] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.
[607] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[608] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.

Building D-1-75

This building is discussed above under "IOP Building D-1-14."

Building D-1-76

Building D-1-76 was not an original IOP building. It is located nearly adjacent to Building D-1-6 to the east.[611] Olin began occupying this building in 1974.[612] Primex leased Building D-1-76 from 1997 to 2001 for cold storage.[613] GDO&TS is the current tenant.[614]

Building D-1-77

Building D-1-77 was built sometime between 1971 and 1980,[615] and Olin used it for explosive (hazardous) waste storage.[616,617] Primex documents indicate this was a portable building.[618] It is no longer on site.

Building D-1-78

Building D-1-78 was built sometime between 1971 and 1980. Olin began occupancy of this (portable) building in 1979[619] and used it as the electrical load center for Building D-1-13.[620] A 1998 explosion in D-1-13 damaged Building D-1-78. It was never replaced.[621]

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[609] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[610] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[611] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.

[612] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

[613] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

[614] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[615] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.

[616] DOI 003204 and DOI 003211. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), Pages 3 and 10.

[617] PRI-003292. Olin Corporation, RCRA Update pertaining to Training, Inspections, and Shipment Limits containing Hazardous Waste Explosive Lists, dated February 10, 1987.

[618] DPRA Document No. 00017640, Amendment No. 9 to Building and Igloo Lease Contract No. 14-16-0003-96-579, "*Environmental Site Closure Assessment.*"

[619] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

[620] DPRA Document No. 00017584. Primex Technologies, Letter to the United Sates Department of the Interior regarding replacing Building D-1-13 (and not restoring D-01-78), dated March 12, 1998.

[621] DPRA Document No. 00017584. Primex Technologies, Letter to the United Sates Department of the Interior regarding replacing Building D-1-13 (and not restoring D-01-78), dated March 12, 1998.

Building D-1-79

Building D-1-79 was not an original IOP building and was in place some time after 1965,[622] located adjacent to Building D-1-8 to the east. Olin began occupying it in 1970.[623] In 1984, MOCA was used in this building.[624]

Building D-1-80

Building D-1-80 was not an original IOP building. In 1986, it was located between Buildings D-1-8 and D-1-79.[625] Olin began occupying Building D-1-80 in 1965.[626] Aerial photographs were not clear enough to determine when this building appeared on site, and when it was removed.

Building D-1-81

A location for this building was not determined. Olin lease documents indicate this was a portable building that went into disuse in 1980.[627] An Olin building usage document indicates this building was removed from site, but it does not include a date for this removal.[628]

Building D-1-82

Building D-1-82 was not an original IOP building. It is located south of Building D-1-7.[629] Olin began occupying this building in 1978.[630] Primex leased Building D-1-82 from 1997 to 2001. This building is a ramp, hallway, utility system, or boiler room, and was not used as part of manufacturing or cold storage.[631] GDO&TS is the current tenant.[632]

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[622] 1965 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[623] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

[624] PRI-016765. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984.

[625] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.

[626] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

[627] PRI-00440. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 3.

[628] PRI-00440. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 3.

[629] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.

[630] PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

[631] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 3, and 10.

[632] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building D-1-83

Building D-1-83 was built sometime after August 1980.[633] Olin began occupying Building D-1-83 in 1980.[634] Primex leased Building D-1-83 from 1997 to 2001 for cold storage.[635] GDO&TS is the current tenant.[636]

Building D-1-84

Building D-1-84 was built sometime between 1971 and 1980.[637] It was constructed to the south of Building D-1-43, south of the Service Road. Primex leased Building D-1-84 from 1997 to 2001 for cold storage.[638] GDO&TS is the current tenant.[639]

Building D-1-85

An Olin lease document indicates this was a portable building that went into disuse in 1980;[640] however, other Olin documents indicate this building was in use in 1987 for storage of explosive (hazardous) waste.[641,642,643] An Olin building usage document indicates this building was removed from site, but it does not include a date for this removal.[644]

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633 Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8

634 PRI-00439. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 2.

635 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

636 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

637 Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.

638 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 3.

639 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

640 PRI-00440. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 3.

641 DOI 003204 and DOI 003211. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), Pages 3 and 10.

642 PRI-003292. Olin Corporation, RCRA Update pertaining to Training, Inspections, and Shipment Limits containing Hazardous Waste Explosive Lists, dated February 10, 1987.

643 PRI-016553. Olin inter office memo entitle "*Request for Assistance, 1.) B-2-13 Scrap, 2.) D Area Sumps,*" dated May 1, 1987, Page 1.

644 PRI-00440. Olin document entitled "*Additions to Updated Rental Adjustment Thru 31 August 1980 for Lease Contracts No. 14-19-008-2675 and No. 14-16-12613,*" dated September 5, 1980, Page 3.

Building D-1-86

Olin began using this portable building in 1980.[645] In 1982, it was used for storage of waste debris from open burning areas.[646,647] By 1983, Building D-1-86 was moved to Olin's Test Range.[648]

Building D-1-87

Olin began occupying this portable building in December 1980.[649] The location of this building probably varied over time. In 1986, it was located slightly northwest of Building D-1-56.[650] Its current location is unknown. Primex leased Building D-1-87 from 1997 to 2001 for cold storage.[651] GDO&TS is the current tenant.[652]

Building D-1-88

Olin began occupying this portable building in 1980.[653] Primex leased Building D-1-88 from 1997 to 2001 for cold storage.[654] The location of this building probably varied over time. In 1986, it was located northwest of Building D-1-57.[655] Its current location is unknown.,

Building D-1-89

This building was built sometime after 1980. Olin began occupying it in 1981.[656] Primex leased Building D-1-89 from 1997 to 2001 for cold storage.[657] The location of this building probably varied over time, and no information was found regarding its current location or if it was removed from the site.

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645 DOI 001765. Olin, Building Usage November 1980, Lease #14-16-008-2675, dated December 5, 1980.
646 PRI-016277. Olin, Open Burning Debris Record, dated June 24, 1982.
647 PRI-016274. Olin, Open Burning Debris Record, dated approximately August 3, 1982.
648 DOI 001745. Olin, Building Usage Report for the quarter January – March 1983, dated April 14, 1983.
649 DOI 001763. Olin, Building Usage December 1980, Lease #14-16-008-2675, dated January 7, 1981.
650 DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.
651 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
652 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
653 DOI 001763. Olin, Building Usage December 1980, Lease #14-16-008-2675, dated January 7, 1981.
654 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
655 DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.
656 DOI 001761. Olin, Building Usage 1st Quarter 1981, Lease #14-16-008-2675, dated April 9, 1981.
657 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.

Building D-1-90

Building D-1-90 was built sometime after 1980.[658] Olin took occupancy of this building in 1981.[659] During 1988, Building D-1-90 contained both High Explosive Detonation Product (HEDP)[660] projectiles and trichloroethane, and it was also used as a flammable storage building.[661]

Primex leased Building D-1-90 from 1997 to 2001 for manufacturing purposes.[662] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[663]

GDO&TS is the current tenant.[664]

Building D-1-90A

Building D-1-90A was not an original IOP Building. The location of this building was not determined. Primex leased Building D-1-90A from 1997 to 2001 for manufacturing purposes.[665] GDO&TS is the current tenant.[666]

Building D-1-91

Building D-1-91 was built sometime after 1980,[667] and was located approximately 150 ft east of D-1-13.[668,669,670] Olin described this as the "old oven building." Olin used it to "heat treat HEI

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[658] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[659] DOI 001757. Olin, Building Usage 3rd Quarter 1981, Lease #14-16-008-2675, dated October 9, 1981.
[660] This acronym occurs in many Olin documents and likely means "High Explosive Detonation Product."
[661] PRI-017407. Olin Corporation, Air Source Inventory/OP/Marion/RC, dated November 25, 1988, Page 00007
[662] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[663] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[664] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[665] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[666] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[667] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 8.
[668] DPRA Document NO. 00017580. Primex Technologies memorandum entitled "Incident Investigation Report – D-1-13 Fire," dated February 17, 1998, Page 4.
[669] PRI-017415. Olin Corporation, Air Source Inventory/OP/Marion/RC, dated November 25, 1988.
[670] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.

pellets."[671,672] A 1998 fire in Building D-1-13 ignited the earthen barricade around building D-1-91.[673]

Primex leased Building D-1-91 from 1997 to 2001 for manufacturing purposes.[674] GDO&TS is the current tenant.[675]

Building D-1-92

Building D-1-92 was built sometime between 1971 and 1980.[676] Olin did not begin occupying this building (Humidity Control Building) until 1983.[677]

Primex leased Building D-1-92 from 1997 to 2001. This building is a ramp, hallway, utility system, or boiler room, and was not used as part of manufacturing or cold storage.[678] GDO&TS is the current tenant.[679]

Building D-1-93

Building D-1-93 was built sometime between 1965 and 1971.[680] Olin lease documents indicate they did not begin occupying this building (Humidity Control Building) until 1983.[681]

Primex leased Building D-1-93 from 1997 to 2001. This building is a ramp, hallway, utility system, or boiler room, not used as part of manufacturing or cold storage.[682] GDO&TS is the current tenant.[683]

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671 PRI-008966. Olin summary report of a safety inspection from April 1987.
672 PRI-017408. Olin Corporation, Air Source Inventory/OP/Marion/RC, dated November 25, 1988, Page 00008
673 DPRA Document NO. 00017580. Primex Technologies memorandum entitled "Incident Investigation Report – D-1-13 Fire," dated February 17, 1998, Page 4.
674 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
675 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
676 Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 7 and 8.
677 DOI 001743. Olin, Building Usage Lease #14-16-008-2675, April-June 1983.
678 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 4, and 10.
679 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
680 Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 6 and 7.
681 DOI 001743. Olin, Building Usage Lease #14-16-008-2675, April-June 1983.
682 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 4, and 10.
683 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building Not Identified with a Number

Both the 1943 and 1951 aerial photographs[684] show a building located due east of Building D-1-37 (Figure 4-1). No other information was found regarding this building. By 1960, the building is no longer on site.[685]

4.1.2.3 Miscellaneous Area 2D Information

IOP Decontamination

After the IOP operations ended at CONWR, the IOP was to be decontaminated in accordance with a manual developed by the Ordnance Field Director of Ammunition Plants (OFDAP), called "*Shut-Down and Decontamination Procedures for F.D.A.P Facilities*."[686] This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.[687] According to this document, there were several cleaning compounds used for desensitizing various explosives (for a list of and brief discussion of the compounds, see section 3.1.2.3.).

Post-World War II military records are inadequate to determine if this area was decontaminated and, if so, whether it was adequately decontaminated, and if decontamination instructions were followed.

Possible Chemical Dumping Area

There is a three-acre lawn located to the northwest of Building D-1-35, where barrels of chemicals were reportedly dumped.[688] This information is essentially hearsay; the 1988 O'Brien & Gere report does not give the source.

Two scarred areas were noted in this general area in the 1960 aerial photograph (during UMC's tenure at the site).[689] These two areas may have been areas where the chemicals were previously dumped. A drainage ditch was also observed in the 1960 aerial photograph, which contained light-toned sediments that appears to have received drainage from the southernmost scarred area.[690] This drainage ditch runs along the north side of the Service Road, to the north of Buildings D-1-1, D-1-2 and D-1-3.[691]

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[684] 1943 and 1951 aerial photographs from the National Archives and Records Administration, College Park, Maryland (same photographs used by Entech, Inc.).
[685] 1960 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photograph used by Entech, Inc.).
[686] ACO-5047 through ACO-5109 – Office of Field Director of Ammunition Plants, "Shut-Down and Decontamination Procedures for F.D.A.P. Facilities."
[687] ACO-4979 through ACO-4980 – CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.
[688] O'Brien & Gere. 1988. Remedial Investigation Report – Crab Orchard National Wildlife Refuge. Page 13-1.
[689] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[690] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.
[691] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 5.

Historic Releases

In many cases in the early days of industrial activity at the Refuge, solvent wastes were probably disposed of by dumping. Statements by former employees of both UMC and Olin indicate that dumping of organic chemicals (solvents) onto the grounds surrounding process buildings was common.[692,693] This type of activity was probably also common during the IOP era. Solvents reportedly used and/or dumped by industrial tenants include methylene chloride, methyl ethyl ketone, acetone, trichloroethylene, and hexane.[694,695,696] Mr. Rudy Okolski reported that TCE was the universal cleaning agent and that it was dropped off everywhere in 55-gallon drums. This was during the 1964 through 1980 time period.[697]

In addition, in at least some cases during regular cleaning activities in buildings not containing sumps, water was used to hose down the building interior. The wash water was then allowed to drain out the door onto the surrounding grounds and ditches.[698,699] Wash waters as well as process and cleaning solvents drained to the sumps in the buildings with sumps (Buildings D-1-8, D-1-25, D-1-43, D-1-44, D-1-46, and D-1-47).[700,701,702,703]

In 1977, Olin standard operating procedures for the cleaning of process residues (ignitable materials) from sump basins called for the pumping of the sump waters outside a dike to the ground and then scooping the residue out of the sump for incineration.[704,705] Paul Moore, a former employee of Olin, described the cleaning of a sump, which contained N.G. and ball powder, around 1961. At that time Olin bailed out the water from the sump and dumped the water onto the ground just outside the door. They then packaged up the material in the bottom of the sump, presumably for incineration.[706]

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[692] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[693] Paul Moore, personal interview, July 14, 1999.
[694] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[695] Rudy Okolski, personal interview, June 30, 1999.
[696] Deposition of George Wisely, June 28, 1999, Page 178.
[697] Rudy Okolski, personal interview, June 30, 1999.
[698] Paul Moore, personal interview, July 14, 1999.
[699] NAR-0766. Letter report of sanitary survey from the IOP from April 10, 1943 visit, dated April 12, 1943.
[700] PRI-016499 to PRI-016500. Olin inter office memo entitled *"D" Area Sumps – For The Record*, dated August 22, 1985, Pages 1 and 2.
[701] PRI-016594. Olin inter office memo entitled *Explosive Sumps*, dated June 3, 1977, Page 1.
[702] Deposition of George Wisely, June 28, 1999, Pages 177, 180-181, and 196-198.
[703] PRI-016297 and PRI-016298. Olin inter office memo entitled *Water Discharges*, dated February 12, 1982, Pages 1 and 2.
[704] The dike was a raised soil wall providing physical protection of nearby buildings from the process or mix building surrounded by the dike. The dikes were required so an explosion in the building would not destroy nearby process areas.
[705] PRI-013797 – PRI-013799. Olin Corporation, Standard Operating Procedure, Cleaning Sumps D-1-43, D-1-44, and D-1-47, S.O.P. No 90228, Pages 1-3.
[706] Paul Moore, personal interview, July 14, 1999.

Also, John Miller stated that upon his arrival at the refuge in 1957, burning was the principal means of disposal of solid and hazardous waste.[707] Liquid waste was poured into saw dust and then burned.[708]

Explosive Scrap Pickup

There were six explosive scrap pickup points identified by Olin in 1975, in Area 2D. They were as follows:[709]

- D-1-6 – Propellant
- D-1-7 – Fuses
- D-1-8 – Propellant
- D-1-11 – Explosives
- D-1-25 – Igniter
- D-1-27 – Case Propellant.

The explosive scrap was collected from these six points and transported to the burning grounds for disposal.

Polychlorinated Biphenyls (PCBs)

Electrical transformers have been located in Area 2D from at least as far back as the IOP days. In 1946, IOP documented five pole-mounted transformers and a substation consisting of six ground-elevation transformers in Area 2D:[710,711]

- one three-phase transformer bank of two (2) 75-KVA pole-mounted transformers located north of Building D-1-35;
- one three-phase transformer bank of three (3) 7.5-KVA pole-mounted transformers located south of Building D-1-8; and,
- one ground-elevation substation consisting of three (3) 250-KVA transformers and three (3) 15-KVA transformers located northeast of Building D-1-36.

By 1979, Olin began to inventory their "PCB transformers" at the Refuge, listing 19 transformers in Area 2D.[712] Following is a summary of the history of these transformers and their replacements.

[707] Deposition of John Miller, April 9, 1998, Page 76.
[708] Deposition of John Miller, April 9, 1998, Page 76.
[709] PRI-002629. Olin document entitled 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[710] DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Page 16.
[711] DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Plan No. 6544-502.75, Plate No. 10, Page 102.
[712] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
South of **D-1-6**	25567	Ground	37.5	5 ppm[a]	• Documented as early as 1979[713] • 1985 – transformer removed; stored in F-2-2; replaced with S/N 85VA051082[714]
South of **D-1-6**	85VA051082	Ground	37.5	5 ppm[a]	• 1985 – replaced S/N 25567[715] • 1986 – noted in service[716]
South of **D-1-6**	25697	Ground	37.5	57 ppm Analytical certification by Cepheus Industries, Inc., August 9, 1982	• Documented as early as 1979[717] • 1982 – transformer removed; stored in F-2-2 for service; replaced with S/N 25572[718] • 1982 – transformer content analytical results indicated 57 ppm Arochlor 1260[719,720] • 1983 – transformer stored in F-2-4[721] • 1983 – transformer received by CECOS for disposal[722]
South of **D-1-6**	25572	Ground	50	5 ppm[a]	• 1979 – being stored in F-2-3[723] (Note, origin of this transformer is unknown) • 1982 – removed from storage; replaced S/N 25697[724] • 1985 – transformer removed; stored in F-2-2; replaced with S/N 85VA051009[725]
South of **D-1-6**	85VA051009	Ground	37.5	5 ppm[a]	• 1985 – replaced S/N 25572[726] • 1986 – noted in service[727]

[713] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[714] DOI 004413 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00002 and 00003.
[715] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[716] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[717] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[718] DOI 004338 and DOI 004348. Olin, 1982 PCB Annual Document for "PCB Transformers in Storage."
[719] PRI-002090. Olin inter office memo entitled "*PCB Transformer S/N 25697*," dated August 12, 1982.
[720] PRI-002092. Cephis Industries Report #643, dated August 9, 1982.
[721] DOI 004358. Olin, 1983 PCB Annual Document "PCBs and PCB Items in Service or Projected for Disposal."
[722] DOI 004365. Special Waste Hauling Manifest No. 080981, dated November 22, 1983.
[723] PRI-00610. Olin, 1980 PCB Annual Document, dated June 21, 1982.
[724] DOI 004338. Olin, 1982 PCB Annual Document for "PCB Transformers in Storage."
[725] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[726] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
South of **D-1-6**	25698	Ground	37.5	54 ppm [a]	• Documented as early as 1979[728] • 1985 – transformer removed; stored in F-2-4; replaced with S/N 85NB403088[729] • 1985 – received by CECOS for disposal[730]
South of **D-1-6**	85NB403088	Ground	37.5	5 ppm[a]	• 1985 – replaced S/N 25698[731] • 1986 – noted in service[732]
South of **D-1-7**	26049	Ground	150	5 ppm[a]	• Documented as early as 1979[733] • 1986 – noted in service[734]
South of **D-1-7**	26050	Ground	150	5 ppm[a]	• Documented as early as 1979[735] • 1985 – transformer "burned out;" stored in F-2-2; replaced with S/N7512490[736]
South of **D-1-7**	7512490	Ground	167	5 ppm[a]	• 1985 – replaced S/N 26050[737] • 1986 – noted in service[738]
South of **D-1-7**	26051	Ground	150	5 ppm[a]	• Documented as early as 1979[739] • 1986 – noted in service[740]

[727] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[728] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[729] DOI 004413 and DOI 004415. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00002 and 00004.
[730] DOI 004398. Uniform Hazardous Waste Manifest No. IL1311047, dated November 1985.
[731] DOI 004413 and DOI 004415. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00002 and 00004.
[732] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[733] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[734] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[735] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[736] DOI 004413 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00002 and 00003.
[737] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[738] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[739] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[740] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
South of **D-1-8**	25706	Ground	75	< 1 mg/l Analytical certification by Envirodyne Engineers October 30, 1979	• 1979 – transformer removed; stored in F-2-3; replaced with S/N 25705[741,742] • 1979 – transformer content analytical results indicated < 50 ppm PCBs;[743,744] Olin indicated transformer "non-PCB" thus exempting it from 40CFR 761 – Olin sends transformer to a landfill[745]
South of **D-1-8**	25705	Ground	75	5 ppm[a]	• 1979 – replaced S/N 25706[746] • 1981 – transformer removed; stored in F-2-3; replaced with new transformer S/N 18D4535-5[747] • 1981 –transformer stored in F-2-2[748] • 1983 – transformer stored in F-2-4[749] • 1986 – transformer stored in F-2-2[750]
South of **D-1-8**	18D4535-5	Ground	100	Unknown	• 1981 – new transformer replacing S/N 25705[751] • 1982 – transformer removed; stored in F-2-2; replaced with new transformer "containing no PCB" S/N N326649YGTA[752]
South of **D-1-8**	N326649YGTA	Ground	100	5 ppm[a]	• 1982 – new transformer replacing S/N 18D4535-5[753] • 1986 – noted in service[754]

[741] DOI 004323. Olin, 1979 PCB Annual Document, dated June 1982.
[742] PRI-00634-PRI-00635. Olin inter office memo entitled "Scrap Transformers," dated November 6, 1979.
[743] PRI-00634-PRI-00635. Olin inter office memo entitled "Scrap Transformers," dated November 6, 1979.
[744] PRI-00635. Envirodyne Engineers, Report of Analysis, dated October 10, 1979
[745] DOI 004323. Olin, 1979 PCB Annual Document, dated June 1982.
[746] DOI 004323. Olin, 1979 PCB Annual Document, dated June 1982.
[747] DOI 004324. Olin, 1981 PCB Annual Document, dated June 22, 1982.
[748] DOI 004335. Olin, 1981 PCB Inventory, F-Area Storage.
[749] DOI 004358. Olin, 1983 PCB Annual Document "PCBs and PCB Items in Service or Projected for Disposal," Table I – F-2-4 Olin-Marion Storage for Olin-Marion Transformers.
[750] DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[751] DOI 004324. Olin, 1981 PCB Annual Document, dated June 22, 1982.
[752] ACO 002493. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[753] ACO 002493. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[754] DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
South of **D-1-8**	6874876403	Ground	100	5 ppm[a]	• Documented as early as 1979.[755] • 1986 – noted in service[756]
South of **D-1-8**	7407-6317	Ground	100	5 ppm[a]	• Documented as early as 1979.[757] • 1986 – noted in service[758]
South of **D-1-11**	275516	Pole	25	5 ppm[a]	• 1965 – transformer located in FAM warehouse area; proposed for use in "D" area[759] • 1979 - documentation indicates location near D-1-7, however, all other documentation indicates the location south of D-1-11 [760] • 1983 – last known documentation found indicating transformer still in use south of D-1-11[761] • 1985 – transformer stored in F-2-4; noted as "empty;" comments indicate transformer sent to landfill 4/85, however, no documentation was found to substantiate this[762]
North of **D-1-35**	1753605	Ground	167	18 ppm[a]	• Documented as early as 1979.[763] • 1986 – noted in service[764]
North of **D-1-35**	1753606	Ground	167	18 ppm[a]	• Documented as early as 1979.[765] • 1986 – noted in service[766]
North of **D-1-35**	1753607	Ground	167	18 ppm[a]	• Documented as early as 1979.[767] • 1986 – noted in service[768]

755 PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
756 DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
757 PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
758 DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
759 PRI-00511. Olin, Letter to Fish &Wildlife Service regarding installing transformer in "D" Area, dated April 8, 1965.
760 PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
761 DOI 004435. Olin, 1983 PCB Annual Document "PCBs and PCB Items in Service or Projected for Disposal."
762 DOI 004415. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00004.
763 PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
764 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
765 PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
766 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
767 PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
768 DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
North of **D-1-35**	1757383	Ground	50	5 ppm[a]	• Documented as early as 1979.[769] • 1986 – noted in service[770]
North of **D-1-35**	I-357379	Ground	50	5 ppm[a]	• Documented as early as 1979.[771] • 1986 – noted in service[772]
North of **D-1-35**	I-357369	Ground	50	5 ppm[a]	• Documented as early as 1979.[773] • 1986 – noted in service[774]
North of **D-1-36**	25703	Pole	75	5 ppm[a]	• Documented as early as 1979.[775] • 1985 – transformer removed; stored in F-2-2; replaced with S/N 742J030001[776]
North of **D-1-36**	742J030001	Pole	37.5	0 ppm[a]	• 1985 – replaced S/N 25703[777] • 1986 – noted in service[778]
North of **D-1-36**	25704	Pole	75	Unknown	• Documented as early as 1979.[779] • 1985 – transformer removed; stored in F-2-2; replaced with S/N 84ZJ030002[780] (Document shows "25701" but this is probably a typographical error.)
North of **D-1-36**	84ZJ030002	Pole	37.5	0 ppm[a]	• 1985 – replaced S/N 25704[781] • 1986 – noted in service[782]

[769] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[770] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[771] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[772] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[773] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[774] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[775] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[776] DOI 004412 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00001 and 00003.
[777] DOI 004412 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00001 and 00003.
[778] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[779] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[780] DOI 004412 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00001 and 00003.
[781] DOI 004412 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Pages 00001 and 00003.
[782] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
North of **D-1-36**	1722245	Pole	37.5	20 ppm[a]	• Documented as early as 1979.[783] • 1986 – noted in service (note text reads 1922245 – this is probably a typographical error)[784]
D-1-2	81D2121301	Ground	45	0 ppm[a]	• 1986 – first documentation for this transformer; indicates in service[785]
D-1-9	4626444482	Ground	50	50 ppm[a]	• 1986 – first documentation for this transformer; indicates in service[786]
D-1-9	4626445282	Ground	50	50 ppm[a]	• 1986 – first documentation for this transformer; indicates in service[787]
D-1-9	4626445482	Ground	50	50 ppm[a]	• 1986 – first documentation for this transformer; indicates in service[788]

[a] PCB content values and other information described above was found in an Olin transformer inventory document.[789] The letters "LT" followed some of the PCB values. However, it is unclear what this means. This document contained a column for entries regarding PCB certification by either "Letter" or "Analysis," but the document did not indicate the origin of the letter or who performed the analysis. No other documentation was found to substantiate these PCB values.

Note, the only transformers in Area 2D with documentation of their shipment dates to appropriate landfills were S/N numbers 25697 and 25698. No other information was found to indicate if the rest remain in storage or were disposed. Nothing was found to indicate that any transformers, including 25697 and 25698, were received by landfills.

A 1986 Olin map indicated 4 substations in Area 2D.[790] These substations are still present today with one located north of Building D-1-35 and the other three south of Buildings D-1-6, D-1-7, and D-1-8 (Exhibit 4-5).

The previously mentioned Olin transformer inventory document also noted that Central Illinois Public Service (CIPS) had two pole-mounted transformers in Area 2D south of D-1-15.[791] No other information was found regarding these transformers.

[783] PRI-00623. Olin, "Oct. 1979 PCB Transformer Inventory, (D-Area)."
[784] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[785] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[786] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[787] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[788] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[789] DOI 004412 – DOI 004425. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986.
[790] DPRA Document No. CO02157. Olin Ordnance Products, HEDP Quantity/Distance D-Area Site Plan, Drawing No. 6010188, dated June 1986.
[791] DOI 004420 . Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986.

Other Olin Chemicals of Concern

The following chemicals, among others, were listed on an obsolete Olin MSDS list.[792]

- Trichloroethylene
- Toluene
- Xylene
- Boron
- Barium nitrate
- Chromic acid, solid
- Mercury
- Copper sulfate
- Zinc oxide
- Acetone
- Methyl isobutyl ketone
- Methyl ethyl ketone
- Trichlorotrifluoroethane
- Methylene chloride
- Chloroform
- Benzene
- 4,4-methylene bis(2-chloroanaline)
- Pyridine
- Triethylamine
- Aniline
- Cresol
- Carbon tetrachloride
- Carbon disulfide
- Diethyl ether
- Dimethyl ether
- 4-di-isocyanate
- Ethylene diamine
- Perchloroethylene
- Di-(2ethylhexyl)phthalate
- Dimethyl phthalate
- Dibutyl phthalate
- Cobalt (6%) naphthenate solution

The following wastes, among others, were identified in a 1981 letter from J.E. Redden, Vice President of Olin's Technical Systems Operations to Refuge Manager Wayne Adams.[793] Redden indicates that the information was requested by Mr. Adams, and listed wastes "which it may be necessary to store in Refuge buildings pending arrangements for disposal.":

- RCRA Code F002, Spent hologinated (sic) solvent, maximum 1,000 lbs

[792] DOI-001780 through DOI-001782. This is an obsolete MSDS list from Olin's file. It contains an index of chemicals on file prior to the OSHA hazard communication law.
[793] FWM 000098 - FWM 000099. Olin Corporation, Letter to Crab Orchard National Wildlife Refuge regarding special Wastes and the possibility of storing them in refuge buildings, dated May 8, 1981.

- RCRA Code U102, Dimethyl phthalate, maximum 50 lbs.
- RCRA Code U107, Di-n-octyl phthalate, maximum 50 lbs
- RCRA Code U160, Methyl ethyl ketone peroxide, maximum 50 lbs
- RCRA Code U196, Pyridine, maximum 50 lbs
- RCRA Code U223, Toluene di-isocyanate, maximum 50 lbs
- RCRA Code U002, Acetone, maximum 200 lbs
- RCRA Code U226, 1-1-1 Trichloroethane, maximum 150 lbs
- RCRA Code U228, Trichloroethane, maximum 150 lbs
- RCRA Code P015, Beryllium dust, maximum 50 lbs
- RCRA Code D005, Barium salts, maximum 500 lbs
- RCRA Code D006, Cadmium salts, maximum 50 lbs
- RCRA Code D007, Chromium salts, maximum 50 lbs
- RCRA Code D008, Lead salts, maximum 100 lbs
- RCRA Code D009, Mercury salts, maximum 50 lbs
- RCRA Code D010, Selenium salts, maximum 5 lbs
- RCRA Code D011, Silver salts, maximum 50 lbs.

In a 1983 Generator Annual Hazardous Waste Report to the State of Illinois, Olin listed the following wastes, among others:[794]

- RCRA Code F005, Spent pyridine, solidified (Karl Fisher), 55 gallons
- RCRA Code D006, Cadmium and lead/debris from fired generator/Ajax ash, 55 gallons
- RCRA Code D001, Ignitable and spent toluene and spent methyl isobutyl ketone (spent thinner and adhesive mixture, solidified), 55 gallons
- RCRA Code U158, 4,4'-methylene bis (2-chloroaniline), 110 gallons
- RCRA Code D009, Mercury/lab pack/mercury contaminated material, 55 gallons.

The following constituents of waste explosive compounds and compositions, among others, were listed in another Olin document:[795]

- Ammonium dichromate
- Barium nitrate
- 2-nitrodiphenylamine (described as a constituent of Fluid Ball Powder Type A and Type B)

4.1.3 Area 2D Previous Sampling Results

O'Brien & Gere, 1988

The following sites in Area 2D were included in the original 1988 remedial investigation (RI) for the Refuge:

- Site 7--D Area Southeast Drainage Channel
- Site 7A--D Area North Lawn
- Site 8--D Area Southwest Drainage Channel

[794] DOI 002359. Olin Corporation, Illinois Environmental Protection Agency, Generator Annual Hazardous Waste Report, dated February 23, 1984, Page 002.
[795] DOI 002616. Olin Corporation, Hazardous Waste Facility Closure Plan, Ordill Industrial Area, S.O.P. 90.356, REV. K 9/88, dated October 4, 1988, Page 39.

The site locations are shown in Figure 4-3 and 4-3a. Results are summarized below.

Site 7--D Area Southeast Drainage Channel

This channel is located to the east of Area 2D and discharges into Crab Orchard Lake. One composite surface water sample and one composite sediment sample were collected from this channel, which is upstream of Sites 9 and 10. One sediment sample was reanalyzed in Phase II.[796] Some results reported by O'Brien and Gere are not included here because they were determined to be not useable. Results reported here are estimated.[797] In the surface water sample, aluminum (0.5 mg/L) and iron (3.2 mg/L) exceeded United States Environmental Protection Agency (USEPA) Region IV screening criteria. Also in the surface water sample, barium (0.072 mg/L) and manganese (1.5 mg/L) exceeded USEPA ECOTOX.

Site 7A--D Area North Lawn

This site is a three-acre lawn located to the northwest of Building D-1-35, where barrels of chemicals were reportedly dumped.[798] The source for the reported dumping was not referenced in the O'Brien & Gere RI. Several composite soil samples were collected from this area. Soil results reported in dry weight. Some results reported by O'Brien and Gere are not included here because they were determined to be not useable. Results reported here are estimated.[799] Acetone (0.644 mg/kg) and methylene chloride (0.039 mg/kg) exceeded USEPA Soil Screening Levels (SSLs). Phenanthrene (0.021 mg/kg) and pyrene (0.039 mg/kg) were detected above either USEPA SSLs and/or Canadian Soil Quality Guidelines (CSOQGs). Antimony (8.7 mg/kg) and barium (460 mg/kg) were detected above USEPA SSLs and Refuge background levels.[800]

Site 8--D Area Southwest Drainage Channel

This drainage channel is located near the southwest corner of Area 2D.[801] One composite surface water sample (0-1 ft) and a composite sediment sample (0-1 ft) were collected.[802] Some results reported by O'Brien and Gere are not included here because they were determined to be

[796] O'Brien & Gere. 1988. Remedial Investigation Report – Crab Orchard National Wildlife Refuge. Figure 12-1.
[797] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987. The letter reports that the data for the following constituents are not useable: 2-butanone, vinyl acetate, 4-methyl-2-pentanone, aniline, bis(2-chloro-isopropyl)ether, 4-chloroaniline, 2-nitrosodiphenylamine, benzidine, di-n-octyl-phthalate, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, cyanide, Ag, As, Be, Cd, Cu, Ni, Pb, Se, Zn, and Hg.
[798] O'Brien & Gere. 1988. Remedial Investigation Report – Crab Orchard National Wildlife Refuge. Page 13-1.
[799] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987. The letter reports that the data for the following constituents are not useable: 2-butanone, vinyl acetate, 4-methyl-2-pentanone, aniline, bis(2-chloro-isopropyl)ether, 4-chloroaniline, 2-nitrosodiphenylamine, benzidine, di-n-octyl-phthalate, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, cyanide, Ag, As, Be, Cd, Cu, Ni, Pb, Se, Zn, and Hg.
[800] See Table 1-11 of this report for Refuge background soil values used for the PA.
[801] O'Brien & Gere, 1988. Remedial Investigation Report – Crab Orchard National Wildlife Refuge. Figure 12-1.
[802] O'Brien & Gere, 1988. Remedial Investigation Report – Crab Orchard National Wildlife Refuge. Page 14-1.

not useable. Results reported here are estimated.[803] In the surface water sample, barium (0.09 mg/L) exceeded USEPA ECOTOX.

Woodward Clyde Consultants, 1996

In the Federal Facilities Agreement (FFA) for the Refuge Sites 7, 7A, and 8 were included as part of the Miscellaneous Areas Operable Unit (MISCA OU). An RI for the MISCA OU was completed in 1996.[804] The results from the 1996 RI are summarized below.

Site 7--D Area Southeast Drainage Channel

One composite/discrete soil sample pair was collected from the same drainageway sampled during the 1988 RI. The discrete sample was collected from a depth of 1.9 ft below ground surface (bgs) and analyzed for the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) Target Compound List (TCL) volatile organic compounds (VOCs). The composite sample was taken over the depth interval from 1.7 to 1.8 ft bgs and analyzed for the CERCLA Target Analyte List (TAL) inorganics and TCL organics (except VOCs), and explosives. No organic compounds were detected, and all inorganic detections were with the background range for the Refuge. The 1996 RI concluded that no further investigations were necessary at this site.[805]

Site 7A--D Area North Lawn

Magnetometer and electromagnetic surveys did not detect anomalies suggestive of buried metallic objects.

Four composite/discrete soil sample pairs were collected during the 1988 RI. The discrete samples were analyzed for the CERCLA TCL VOCs. The composite samples were analyzed for the CERCLA TAL inorganics and TCL organics (except VOCs), and explosives. No organic compounds were detected, and all inorganic detections were with the background range for the Refuge. The 1996 RI concluded that no further investigations were necessary at this site.[806]

Site 8--D Area Southwest Drainage Channel

Samples collected during the 1996 RI were analyzed for explosives and for the CERCLA TAL inorganics and TCL organics. No preliminary levels of concern (PLCs) were exceeded for any constituents. Acetone (70 ug/kg and 200 mg/kg) was the only organic compound detected, and

[803] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987. The letter reports that the data for the following constituents are not useable: 2-butanone, vinyl acetate, 4-methyl-2-pentanone, aniline, bis(2-chloro-isopropyl)ether, 4-chloroaniline, 2-nitro-sodiphenylamine, benzidine, di-n-octyl-phthalate, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, cyanide, Ag, As, Be, Cd, Cu, Ni, Pb, Se, Zn, and Hg.
[804] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[805] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, pages 5-5, 5-6 and page ES-ii.
[806] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, pages 5-6 and page ES-ii.

all metals detected were within Refuge background levels. The 1996 RI concluded that no further investigations were necessary at this site.[807]

USEPA Sampling, 1998

USEPA sample locations in Area 2D are shown in Figures 4-4, 4-5, and 4-6. The results for all detected constituents are listed in Table 4-1A.

USEPA collected two samples from the original site AUS-0005 (Area 2D—Detonator Load Line), AUS 5-01 and 5-02. The following SVOC compounds were detected at the site above either USEPA SSLs and/or CSOQGs: indeno[1,2,3-cd]pyrene (1.3 mg/kg), dibenz[a,h]anthracene (1.0 mg/kg), benzo[k]fluoranthene (1.5 mg/kg), benzo[a]anthracene (0.15 mg/kg), benzo[b]fluoranthene (1.5 mg/kg), and benzo[a]pyrene (0.5 mg/kg). Barium (170 mg/kg) and mercury (0.11 mg/kg) were detected above USEPA SSLs and Refuge background levels.[808] Zinc (170 mg/kg) was above New Dutchlist Soil Optimum Level (DSOL) and Refuge background level.

USEPA collected five samples (AUS 7-01 through AUS 7-05) from AUS-0007 (Tested Pyrotechnic Devices in Areas 2D, 2B and 2F). The following SVOC compounds were detected at the site above either USEPA SSLs and/or CSOQGs: benzo[b]fluoranthene (85 mg/kg), benzo[a]anthracene (58 mg/kg), benzo[a]pyrene (50 mg/kg), naphthalene (1.1 mg/kg), phenanthrene (110 mg/kg), carbazole (17 mg/kg), pyrene (120 mg/kg), chrysene (68 mg/kg), benzo[k]fluoranthene (32 mg/kg), indeno[1,2,3-cd]pyrene (24 mg/kg), and dibenz[a,h]anthracene (6.4 mg/kg). Total polynuclear aromatic hydrocarbons (PAHs) also exceeded DSOLs. Arsenic (110 mg/kg), barium (20,000 mg/kg), beryllium (2.2 mg/kg), nickel (31 mg/kg), mercury (0.10 mg/kg), and cadmium (6.7 mg/kg) exceeded USEPA SSLs and Refuge background levels.[809] Lead (2400 mg/kg), copper (1900mg/kg), cobalt (55 mg/kg), and zinc (440 mg/kg) exceeded DSOLs and Refuge background levels. Chromium (94 mg/kg) exceeded CSOQGs and Refuge background levels.

4.1.4 Observations During Site Visit

Several drainage ditches were observed throughout the area during the site reconnaissance. In general, most of the northern and southern portions and the entire western portion of Area 2D drain off site to the northwest and southwest via drainage ditches. The eastern portions of Area 2D generally drain off site to the east via drainage ditches.

Earthen berms surround several of the buildings in this area. It assumed that they are used to protect the rest of the area from possible explosions.

[807] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, pages 5-6 and page ES-ii.
[808] See Table 2-6 of this report for Refuge background soil values used for the PA.
[809] See Table 2-6 of this report for Refuge background soil values used for the PA.

4.1.5 Recommendations Based on Preliminary Assessment

Based on the historic search, all potential releases from Area 2D have not been previously addressed. The only previous CERCLA-related investigation at Area 2D was the sampling done by USEPA in 1998. Based on the lack of previous investigation and the exceedances of Preliminary Assessment (PA) screening levels in the USEPA 1998 results, Area 2D (AUS-0A2D) was included in the SI.

4.2 SITE INVESTIGATION INFORMATION

URS conducted a Site Investigation at AUS-0A2D from March 22 through May 17, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)[810] for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 4.1) has been updated to include that information. The sampling locations discussed below are based on the information that was available at the time the FSP was developed, and may not address all areas of potential releases.

AUS OU SI sample locations are shown on Figures 4-4, 4-5, and 4-6. Survey coordinates for all sample locations in Area 2D are listed in Table 4-2. Table 4-4 lists the sample locations and the matrix sampled at that location. All samples are soil samples unless otherwise noted. Groundwater samples were taken from all monitoring wells installed.

4.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. The field investigation is summarized in this section, following the same order of description of site features as Section 4.1.2.2 of this report.

Building D-1-1

Sample 0A2D-002 was located next to the foundation of former IOP Building D-1-1. During the IOP era, tetryl was unloaded at this building for storage. One former UMC employee reported that the building pad was used for burning. There is the possibility of explosives, metals, perchlorates and solvent contamination at this location. Solvents and/or oils may have been used to transport the explosives and aid in the burning process.

Sample 0A2D-016 is located in a drainage ditch to the west of this building, which is likely to receive drainage from the area surrounding Building D-1-1.

All samples were collected in accordance with the tables in the Field Sampling Plan with the following exception:

- AUS-0A2D-016-SD-0X Dioxins were not analyzed for at this location as planned.

[810] U.S. Fish & Wildlife Service, Department of the Interior, March 2000, Draft Final Field Sampling Plan Site Inspection, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County), prepared by URS Corporation.

Building D-1-4

Samples 0A2D-003 and 0A2D-004 were located on the south and north sides of Building D-1-4, respectively. During the IOP, this building was used as a Tetryl Pelleting Building. This building may also have been used by UMC in the production of high explosives, along with Buildings D-1-2 and D-1-3. Baratol (TNT and barium) was reportedly used in Building D-1-4. Olin used this building for some explosive storage and for an operation involving PBX. Plasticizers and solvents may have also been used in this building.

Building D-1-6

Samples 0A2D-005 and 0A2D-006 were located on either side (west and east sides, respectively) of Building D-1-6, which was an IOP Loading Building. Both tetryl and a lead azide mix were loaded in this building. UMC used this building for the blending and loading of spotter rounds and smoke markers, which may have used toluene, methyl ethyl ketone, and acetone. An area of dark-toned surface discoloration was observed in the 1965 aerial photograph, along the eastern side of Building D-1-6. This area may have been the result of a liquid release or of precipitation. Sample 0A2D-006 was placed in the location of the former surficially discolored area. Olin had curing, pressing and loading operations for explosives, solid propellants and pyrotechnics in this building. They also cast Lance propellant grains in this building which involved the use of nitroglycerin. Other potential chemicals of concern in this building are explosives, metals, perchlorates, solvents, and binders (possibly MOCA).

Building D-1-7

Samples 0A2D-007 and 0A2D-008 were located on either side (west and east sides, respectively) of Building D-1-7. During the IOP, Building D-1-7 was used as a Loading Building. Both tetryl and a lead azide mix were loaded in this building. UMC used this building for the loading and pressing of photo flash rounds and smoke markers, which may have used toluene, methyl ethyl ketone, and acetone. Olin had curing, pressing and loading operations for explosives, solid propellants and pyrotechnics in this building. They also loaded propellant for the LAW system in this building and cast Lance propellant grains in this building, which involved the use of nitroglycerin. Other potential chemicals of concern in this building are explosives, metals, perchlorates, solvents, and binders (possibly MOCA). Also during Olin's tenure at the site, Building D-1-7 contained a 20 mm fuse manufacturing operation.

Building D-1-8

Samples 0A2D-009 and 0A2D-010 were located on either side (west and east sides, respectively) of Building D-1-8. During the IOP, Building D-1-8 was used as a Loading Building. Both tetryl and a lead azide mix were loaded in this building. UMC used this building for the final assembly of the photo flash rounds and smoke markers. Olin had curing, pressing and loading operations for explosives, solid propellants and pyrotechnics in this building. Propellants for the Lance Missile System were also reportedly cast and cured, and then shaped, sized, and loaded in Building D-1-8 by Olin. This work included the use of presses, band saws, lathes, and glues for the sizing, shaping, and gluing of the Lance propellant grains. Potential chemicals of concern in this building are explosives, metals, perchlorates, solvents, and binders (possibly MOCA).

Acetone and other solvents were used in this building, and they were stored in 55-gallon drums outside the building. Olin has also maintained x-ray facilities in this building.

Finally, there were two sumps located outside this building which may have resulted in contamination of the area surrounding the sumps (Figure 4-2). Monitoring Wells 0A2D-W01 and 0A2D-W02 were each located next to one of the two sumps (northernmost and southernmost sumps, respectively), to evaluate the possibility of groundwater contamination in this area, resulting from either overflow or cleaning of the sump.

Building D-1-11

Samples 0A2D-011 and 0A2D-012 were collected from next to Building D-1-11 (northwest and southeast of building, respectively). UMC used this building and some of their work involved the use of RDX, HMX, HBX, and cast TNT. During Olin's tenure at the site, Building D-1-11 housed the pelletizing of high explosive igniter (HEI) mixes. In 1988, soil from near this building ignited during excavation, suggesting the potential for white phosphorus contamination. Potential chemicals of concern in this area are metals, binders, solvents, perchlorates, and explosives. Sample 0A2D-013 was collected from a drainage ditch that appears to have received drainage from the area surrounding this building, as well as Buildings D-1-12 and D-1-13.

Monitoring well 0A2D-W03 was installed near the northeast corner of Building D-1-11, near an entrance to the building.

Building D-1-12

Sample 0A2D-045 was collected from the northeast side of Building D-1-12. A chemical leak of a solvent mixture, occurred in Building D-1-12 in 1986. The leaking chemical was a solvent degreaser believed to contain HE/HEI mixes. The solvent mixture was eventually contained but not before the spill impacted the grounds outside of the building.

IOP Building D-1-17

Sample 0A2D-017 was located right outside the entrance to IOP Building D-1-17. During the IOP, Building D-1-17 was used as an Azide Napkin Preparation Building. There is the possibility of lead contamination outside this building from spillage of the liquids that the lead azide was packed in for shipping. This building was razed prior to 1960, and another was built in its place sometime between 1971 and 1980.

Samples 0A2D-038 and 0A2D-039 were located in drainage ditches nearby IOP Building D-1-17 that would likely have received drainage from the area surrounding this building.

IOP Building D-1-18 (Olin Building D-1-44)

Sample 0A2D-023 was collected from near the entrance to Olin Building D-1-44 (IOP Building D-1-18). During the IOP, this building was used as an Azide Dry House. This building was razed sometime prior to 1960, and Olin constructed a Mix Building in this location sometime between 1965 and 1971. Propellants, igniter, and booster mixes were mixed in this building.

There is a sump along the south side of the building, which collected waters, as well as, process and cleaning solvents (Figure 4-2). Monitoring well 0A2D-W05 was located next to this sump to detect contamination in the groundwater resulting from overflow or cleaning of the sump.

IOP Building D-1-24 (Olin Building D-1-46)

IOP Building D-1-24, a Dry Azide Rest House, was razed prior to 1960. Between 1960 and 1965 Olin built Building D-1-46 at the same location and used this building for curing and for nitroglycerin casting of Lance propellant grains.

There was a sump along the east side of the building that collected wash waters, as well as, process and cleaning solvents (Figure 4-2). Monitoring well 0A2D-W04 was located next to this sump to evaluate contamination in the groundwater resulting from overflow or cleaning of the sump.

Building D-1-25

Samples 0A2D-024 and 0A2D-025 were located next to Building D-1-25, an Azide Preparation Building, on the north and south ends of the building, respectively. Both samples were located near entrances to the building. It is presumed that the lead azide was mixed with other priming compound constituents in this building. There was a sump on the south side of this building that collected wash waters, as well as, process and cleaning solvents (Figure 4-2). Sample 0A2D-025 was also located next to the sump.

Building D-1-27

Samples 0A2D-026 and 0A2D-027 were located next to Building D-1-27, on the north and south ends of the building, respectively. Both samples were located next to entrances to the building. During Olin's tenure, N.G. casting of Lance propellant grains took place in Building D-1-27. Acetone was used to clean metals parts in this building, and the wastes from this building were burned in burn pits.

Building D-1-32/Burn Pad

Samples 0A2D-028 (in drainageway) and 0A2D-035 were located next to former Building D-1-32, on the north and south sides respectively. This building was formerly used to store lead azide, prior to drying. Later, after the building was razed, the foundation of the former building was used as a burn pad. Waste burned at these pads consisted mainly of components from UMC's fuse train and pyrotechnic production operations. Some of the chemicals involved included lead azide, lead styphnate, red phosphorus, linseed oil, perchlorates, and other chemicals (see Table 3-3).

To the east of former Building D-1-32, a lightly mottled area, which appears to have been impacted by human activities, was observed in historical aerial photographs. A crescent-shaped berm was later also observed in this same area. Sample 0A2D-036 was located in this area.

There was also a man-made lagoon or impoundment located along a creek that was observed to the northeast of this crescent-shaped berm in historical aerial photographs. Sample locations

0A2D-014 and 0A2D-044 were both in this creek, in the area of the possible former man-made lagoon or impoundment. Sample 0A2D-044 includes a soil and a surface water sample. This lagoon or impoundment is no longer present on site. Its previous location is currently marked by a drainageway and the samples were collected from this drainageway.

Building D-1-35

Sample 0A2D-001 was collected from next to Building D-1-35 that was originally an IOP Change House for Area 2D. During Olin's tenure at the site, both welding and x-ray facilities were located in this building.

Olin Building D-1-43

Olin Building D-1-43 was used for nitroglycerin casting, to mix propellants, and to mix igniter and booster mixes. This building had a sump that was located along the south side of the building. Monitoring well 0A2D-W06 was placed next to this sump to determine if sump overflowing or sump cleaning activities has impacted the groundwater. Sample location 0A2D-034 was located in an area just southwest of the sump, which may have received overflow from the sump and may have received drainage from the area surrounding Olin Building D-1-43.

Building D-1-47

Building D-1-47 was used to mix propellants, igniter, and booster mixes. This building had a sump that was located along the north side of the building. Sample 0A2D-022 was placed next to this sump to determine if sump overflowing or sump cleaning activities have impacted the soils near this sump. Sample 0A2D-033 was located in an area just south of the building, that may have received overflow from the sump and may have received drainage from the area surrounding Building D-1-47.

Building D-1-56

The use of this building was not identified in Olin-supplied information. Based on its proximity to Buildings D-1-57 and D-1-58, it is assumed that this building was also used in the LUU-10B smoke candles operations. Sample 0A2D-018 was located near the entrance to this building.

All samples were collected in accordance to the tables in the Field Sampling Plan with the following exception:

- AUS-0A2D-018-SS-0X The FSP did not plan for the analysis of dioxins for this sample, however, they were added in the field.

Building D-1-57

Building D-1-57 was used for screening and mixing operations for smoke candles (LUU-10B). Sample 0A2D-019 was located near the entrance to this building.

Building D-1-58/Bermed AST Area

Building D-1-58 was used for screening and mixing operations for smoke candles (LUU-10B). Sample 0A2D-020 was located near the entrance to this building. The soil in this area may have also been impacted by the 1979 oil spill that occurred in this area. This oil spill apparently drained to a nearby ditch, where there was standing oil in the ditch that was either pumped out or soaked up with straw. This ditch is located to the south of this building and sample 0A2D-021 was collected from this ditch.

Building D-1-60

Sample 0A2D-004 is located immediately east of Building D-1-60.

Building D-1-72

An Olin document indicates this building was likely contaminated with nitroglycerin. Sample 0A2D-026 was located to the north of Building D-1-72.

Building D-1-86

Sample location 0A2D-027 was located to the northwest of former Building D-1-86.

Building D-1-90

Olin built Building D-1-90 sometime after 1980. Sample 0A2D-016 was located in a drainage ditch north of this building. This ditch likely receives drainage from the area surrounding this building and from the area of a possible former burn pad (former Building D-1-1). During 1988, Building D-1-90 contained both High Explosive Detonation Product (HEDP) projectiles and trichloroethane, and it was also used as a flammable storage building. In 1993, this building was used as a 90-day hazardous waste accumulation area. Sample 0A2D-015 is northeast of Building D-1-90 in a drainage ditch that flows to the northwest and appears to receive drainage from the northwesternmost portion of Area 2D.

Possible Chemical Dumping Area

A three-acre lawn where barrels of chemicals were rumored to have been dumped is located to the northwest of Building D-1-35. This area was previously investigated in the 1988 RI and the 1996 MISCA OU RI and was recommended for no further action (see discussions above). It would not have been sampled except for two scarred areas identified in this area in the 1960 aerial photographs. Also observed in the 1960 photograph was a drainage ditch, which contained light-toned sediments, that appears to have received drainage from the southernmost scarred area. One sample (0A2D-037) was collected from this drainage ditch.

Magnetometer Survey Area

A magnetometer survey was done in the open area to the east of Building D-1-75. This area was rumored to have received surplus waste during World War II. No previous investigation has been done in this area to either confirm or deny this information. Sample 0A2D-031 was placed in this area in the location of a slightly depressed area (potential for buried material in this location).

Miscellaneous Area 2D Drainage

Six samples were located in drainage ditches that receive drainage from the southwesternmost portion of Area 2D. These samples are: 0A2D-029, 0A2D-030, 0A2D-032, 0A2D-040, 0A2D-041, 0A2D-042 and 0A2D-043. Sample 0A2D-043 is located in a west-flowing drainage ditch on south side of the Service Road, just south of Building D-1-43. Sample 0A2D-030 is in a south-flowing drainage ditch on the east side of the Service Road, southeast of Building D-1-48. Samples 0A2D-041 and 0A2D-042 were located in two separate south-flowing drainage ditches on the south side of the Service Road, to the south of Building D-1-44. Sample 0A2D-029 is located in a west flowing drainage ditch, which appears to receive drainage from all of the above mentioned drainage ditches, on the south side of the Service Road. Finally, sample 0A2D-032 appears to receive drainage from the area surrounding former IOP Buildings D-1-15, D-1-16 and D-1-17.

Sample 0A2D-040 was collected from a west-flowing drainage ditch that appears to originate to the southwest of Building D-1-56 and to the east of former Building D-1-17. This ditch may have received drainage from the area surrounding these two buildings.

4.2.2 Field Results

4.2.2.1 Site Conditions

4.2.2.1.1 Geologic Conditions

There were six monitoring wells installed at this site, as shown in Figure 4-6. Geologic cross-sections are shown in Figures 4-7 and 4-8. The wells extended to depths ranging from 19 to 20 ft bgs. Copies of the boring logs and monitoring well construction diagrams are included in Appendices A and B, respectively.

As shown in Figures 4-7 and 4-8, a two-inch to 1-ft thick layer of topsoil overlies most of the site. In Well 0A2D-W04 the six-inch fill material layer contains gravel as does the first 5.5 inches of the loess layer. Beneath the fill is a 9 to 13.5 ft layer of low plastic silty clay loess, which overlies glacial till. In all wells except 0A2D-W05 and 0A2D-W03 the glacial till consists of 3.5 to 6 ft of silty clay with gravel. In Well 0A2D-W03, till was described as sandy clay with gravel, and in Well 0A2D-W01 the till is high plasticity clay with gravel. In Well 0A2D-W05 there is four-inch sandy clay layer within the till. In Wells 0A2D-W01 and 0A2D-W04 the glacial till overlies shale, and in Wells0A2D-W02, 0A2D-W03, and 0A2D-W06, the glacial till overlies high plastic clay. This high plastic clay may be residual material derived from the shale.

4.2.2.1.2 Hydrogeologic Conditions

At AUS-0A2D groundwater was encountered in all six soil borings during drilling at depths ranging from 7-ft bgs at Well 0A2D-W01, to 14.5 ft bgs, at Well 0A2D-W04. Depths at which groundwater was encountered during drilling are shown in Figures 4-7 and 4-8.

Figure 3-8 is a groundwater contour map of Area 2 based on data from the eighteen monitoring wells installed at Area 2, obtained during October 2000. Table 3-7 presents the groundwater elevations measured in the Area 2 wells in May, July, September, and October 2000. As shown in the groundwater contour map, the overall flow direction of the groundwater appears to be toward Crab Orchard Lake (to the south-southwest). Slug tests were performed on each of the six wells that were installed within Area 2D during the AUS OU investigation, resulting in hydraulic conductivity values that ranged from 2.51E-07 to 2.09E-05 centimeters per second (cm/sec). Slug test results are presented in Table 4-3. Slug tests are included in Appendix C.

Hydraulic conductivity values from slug tests are less than the trigger values for State of Illinois Class I Groundwater (Title 35 of the Illinois Administrative Code (35 IAC) 620.210(a)(4)(B)(ii)). Based on the borings at the site, the aquifer does not appear to meet any of the other criteria for Class I Groundwater (35 IAC 620), although one of the trigger criterion has not been measured. That criterion is "sustained groundwater yield, from up to a 12 inch borehole, of 150 gallons per day or more from a thickness of 15 ft or less" (35 IAC 620.210(a)(4)(A)). Based on the slow recovery of wells at this site, yields that would indicate Class I groundwater by that criterion would definitely not be expected. In accordance with 35 IAC 620.220, groundwater that does not meet the criteria for Class I, III, or IV is classified as Class II. Based on the available data, the groundwater at this site appears to be Class II as defined by the State of Illinois. This classification could change based on additional data.

4.2.2.1.3 Hydrologic Conditions

Area 2D is on a gently sloping ridge near Crab Orchard Lake (Figure 3-1). The area was leveled as part of the IOP construction and drainage ditches were built along roadways. These ditches flow to natural drainageways located to the east, northwest and southwest (Figure 3-1). There are no permanent water bodies on the site.

4.2.2.2 Chemical Results

The sample analytical results are summarized in the following tables:

- Table 4-5 – soil samples results,
- Table 4-6 – groundwater results, and
- Table 4-7 – surface water samples results.

These tables list all the chemicals detected in Area 2D during this investigation, along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report.

Sample results are presented on the following figures:

- Figure 4-4 – organic results for soil samples,
- Figure 4-5 – inorganic results for soil samples, and
- Figure 4-6 – all results for surface water and groundwater samples at this site.

4.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 4-8 through 4-12 as follows:

- Table 4-8—human health risk screening for soils,
- Table 4-9—human health risk screening for groundwater,
- Table 4-10—human health risk screening for surface water,
- Table 4-11—ecological risk screening for soils, and
- Table 4-12—ecological risk screening for surface water.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A2D. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

Chemicals that are shaded in the tables are those that exceeded the screening criteria, and are identified as chemicals of potential concern (COPCs) for human health risk, and chemicals of potential ecological concern (COPECs) for ecological risk. The only COPCs/COPECs not shaded in the table are those inorganic constituents that exceeded the screening criteria but were detected at levels below Refuge background.

In cases where the chemical was analyzed but not detected, the HQ is the ratio between the maximum reporting limit and the screening concentration. Chemicals not detected are identified with a "U" qualifier in the qualifier column. When these HQ values exceed one, they are not shaded. These constituents are not identified as COPCs/COPECs, but rather as uncertainties.

In Figures 4-4 through 4-6, the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tetrachlorodibenzo-p-Dioxin (TCDD) equivalent results for Area 2D are not shown in the screening tables. They are instead included in Table 4-13, and are discussed in the following human health and ecological risk sections.

Tables 4-14 (human health risk) and 4-15 (ecological risk) list all the analytes and corresponding media sampled and indicate whether each is a COPC (or COPEC), not a COPC (or COPEC), or an uncertainty. The codes in the tables indicate the rationale for each classification. All COPCs (Table 4-14) and COPECs (Table 4-15) are shaded in the tables.

4.3.1 Human Health Risk

4.3.1.1 Soil

Human health screening results for soil samples are presented in Table 4-8. For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil PRGs as screening values. Calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values derived the cancer risk. These ratios were then multiplied by 1 x 10^{-6}. In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (DAF=1), the Illinois TACO Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

Dioxin/furan congener concentrations were converted to 2,3,7,8-TCDD equivalents, for comparison against a 2,3,7,8-TCDD screening value. A toxic equivalency (TEQ) was calculated for each dioxin/furan congener by multiplying a congener-specific toxic equivalency factor (TEF) value by the congener's observed concentration. The TEQs for all congeners in a sample were summed. The summed TEQ values were then compared to the 2,3,7,8-TCDD screening value of 1 ppb. Refer to Table 4-13.

There were six soil samples analyzed for dioxin/furan congeners with detections noted in all six. However, none of the TEQ values calculated for the congeners exceeded the 2,3,7,8-TCDD screening level of one ug/kg. Therefore, none of the dioxin/furan congeners detected within Area 2D are judged to pose potential risk to human health.

4.3.1.2 Groundwater

Human health screening results for groundwater are presented in Table 4-9. The maximum groundwater concentrations from Area 2D were screened against MCLs and Illinois Class I groundwater standards. This may be conservative, since the groundwater at this site may be Illinois Class II.

4.3.1.3 Surface Water

Human health risk screening results for chemicals in surface water at Area 2D are presented in Table 4-10. The maximum concentrations from Area 2D were screened against the Illinois EPA General Use Surface Water Quality Criteria – Human Health.

4.3.2 Ecological Risk

4.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 4-11. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[811]
- Environment Canada (1995)[812]
- Talmage *et al.* (1999)[813]

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[811] USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.

[812] Environment Canada. 1995. Toxicity Testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Guidelines Division, Evaluation and interpretation Branch, Environmental Conservation Directorate, Environment Canada. Hull, Quebec.

- Efroymson *et al.* (1997a, 1997b)[814]
- CCME (1999)[815]
- MHSPE (1994)[816]
- Other Sources

A detailed discussion of the screening concentration selection is presented in Appendix G.

The screening approach for ingestion pathway exposures was based on the potential for a chemical to bioaccumulate. The potential for a chemical to bioaccumulate was based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. The document *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991)[817] used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

Direct exposure screening concentrations in soils were available for 2,3,7,8-TCDD, but not for other dioxin/furan congeners. Therefore, the potential for direct exposure effects were only screened in conjunction with 2,3,7,8-TCDD (Table 4-11). Based on the screening results in Table 4-11, 2,3,7,8-TCDD is not a concern relative to direct exposures, but is a potential bioaccumulative concern. Other congeners, if detected, were retained as potentially bioaccumulative COPECs. Results of the dioxin/furan analyses are presented in Table 4-13. Congeners detected are summarized below:

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813 Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E Welsh, F. M. Cretella, P.H. Reno, and F. B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev Environ. Contam. Toxicol 161:1-156.

814 Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-126/R2.

815 Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

816 Ministry of Housing, Spatial Planning, and the Environment (MHSPE). 1994. *Intervention Values and Target Values – Soil Quality Standards.* Directorate General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

817 USEPA 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

Dioxins/Furans Detected in Soils (AUS-0A2D)	
2,3,7,8-TCDD	2,3,7,8-TCDF
1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDF
1,2,3,4,7,8-HxCDD	2,3,4,7,8-PeCDF
1,2,3,6,7,8-HxCDD	1,2,3,4,7,8-HxCDF
1,2,3,7,8,9-HxCDD	1,2,3,6,7,8-HxCDF
1,2,3,4,6,7,8-HpCDD	2,3,4,6,7,8-HxCDF
OCDD	1,2,3,7,8,9-HxCDF
	1,2,3,4,6,7,8-HpCDF
	1,2,3,4,7,8,9-HpCDF
	OCDF

Each of these congeners is retained as a COPEC (note the individual congeners are not included in the COPEC summary of Table 4-15).

4.3.2.2 Surface Water

Ecological screening results for surface water samples are presented in Table 4-12. TRVs for direct exposure by aquatic organisms in surface water were obtained from:

- Illinois water quality standards
- National Recommended Ambient Water Quality Criteria (USEPA 1999a)[818]
- EcoTox (USEPA 1996)[819]
- USEPA Region IV Freshwater Screening Values (1999b)[820]
- Maximum Acceptable Toxicant Concentrations (MATCs) or lowest observed effect concentrations (LOECs) obtained from the USEPA Assessment Tools for the Evaluation of Risk database (ASTER 2000)[821]
- Other sources

The Illinois water quality standards are believed to be the most relevant, followed by national recommended ambient water quality criteria. EcoTox reports values based on ambient water quality criteria, and Tier II water quality criteria have been developed in the absence of sufficient information to support a national recommended water quality criterion using guidelines outlined in the Great Lakes Water Quality Initiative. Remaining sources were prioritized based on relevance to the area and professional judgment. The detailed discussion of the approach for

[818] USEPA. 1999a. National Recommended Water Quality Criteria--Correction. Office of Water. EPA 822-Z-99-001. April.
[819] USEPA. 1996. ECO Update: Ecotox Thresholds. EPA-540/F-95/038. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. 12pp.
[820] USEPA. 1999b. Region IV Ecological Risk Assessment Bulletins – Supplement to RAGS. Available at http://www.epa.gov/region4/waste/oftecser/ecolbul.htm.
[821] ASTER. 2000. Assessment Tools for Evaluation of Risk Database. United States Environmental Protection Agency, Office of Research and Development.

selecting a single ecological screening value (ESV) from among the multiple sources is presented in Appendix G.

The screening approach for ingestion pathway exposures was the same as for soils as presented in Section 4.3.2.1.

4.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A2D, based on exceedances of the SI screening criteria.

This report recommends that inorganic constituents that exceeded project screening criteria but were within Refuge background levels not be retained as COPCs/COPECs for further evaluation. These are the constituents coded with "D" on the COPC list, Table 4-14; and on the COPEC list, Table 4-15. The only COPC in this category is selenium in soil. COPECs coded with a "D" in Table 4-15 include selenium in surface water, and manganese, selenium and vanadium in soil. All other COPCs/COPECs listed on these tables should be investigated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 4-16.

Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. These issues will be addressed in the work plan for the RI. The discussion of past usage included in this section should be carefully reviewed during work plan development.

TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Building D-1-1	1942-1945	SWDC/War Dep't	Tetryl Service Magazine
	1953-1962	UMC	Possible use as burn pad
Building D-1-2	1942-1945	SWDC/War Dep't	Tool Room Building/Tetryl Screen & Blend Building
	1953-1962	UMC	High explosives production
	?-Current	Olin/Primex/GDO&TS	Unknown (unspecified storage for Primex)
Building D-1-3	1942-1945	SWDC/War Dep't	Heater House
	1953-1962	UMC	High explosives production
	?-Current	Olin/Primex/GDO&TS	Unknown, Olin - black powder (1970), unspecified storage for Primex
Building D-1-4	1942-1945	SWDC/War Dep't	Tetryl Pelleting Building
	1953-1962	UMC	High explosives production and baratol manufacturing; black powder blended and pressed
	?-1997	Olin	Storage (1975); plastic bonded explosive mixing or use research and development of propellants (1985)
	1997-2001	Primex/GDO&TS	Unknown, unspecified manufacturing for Primex
IOP Building D-1-5	1942-1945	SWDC/War Dep't	Tetryl Pellet Magazine
	1953-?	UMC	Photoflash blending and loading (1950s)
Olin Building D-1-5	?-1997	Olin	Explosive waste storage (1987)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-6	1942-1945	SWDC/War Dep't	Detonator loading
	1953-1962	UMC	Blending and loading of spotter rounds and smoke markers; blending and assembly of photoflash shells; manufacturing of hiburst-signal; assembly of parachute flares; manufacturing of photoflash and minuteman
	?-1997	Olin	Gas generator production; jet starter production; propellant curing, pressing, and loading operations; MXU 4A/A and sidewinder production
	1997-2001	Primex	Unspecified manufacturing/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building D-1-7	1942-1945	SWDC/War Dep't	Detonator Loading
	1953-1962	UMC	Loading and pressing of smoke markers and photo flash rounds, loading of photo flash round, pressing and loading photo flash shells
	?-1997	Olin	Gas generator production; propellant curing, pressing and loading; LAW manufacture; M29AI primer; IPM assembly; 4A/A igniter assembly; 20mm fuse manufacture; boosters; paveway, trident and minuteman propellant; building contained a trichloroethylene degreaser
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	?

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TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Building D-1-8	1942-1945	SWDC/War Dep't	Detonator Loading
	1953-1962	UMC	Final assembly of smoke markers and photo flash rounds; assembly of photoflash shells, lead styphnate and lead azide milling; navy float signal and navy practice bomb assembly; MC-935 actuator, MC936 switch, and delay switch loading and assembly
	?-1997	Olin	Gas generator production; explosive waste storage; propellant curing, pressing and loading; lance propellant lathing, sawing, and binding; manufacture of minuteman generator; 90-day hazardous waste accumulation point; machining of ammonium nitrate propellants; pressing and machining of N-28 propellant for sidewinder and paveway gas generators; X-ray operations
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
IOP Building D-1-9	1942-1945	SWDC/War Dep't	Office
Olin Building D-1-9	?-1997	Olin	Reported use of MOCA in this building
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	?
Building D-1-10	1942-1945	SWDC/War Dep't	Detonator Rest House
	1953-1962	UMC	Candle curing for the navy float signal (1950s)
	?-1997	Olin	Pressing activities: Comp A-4, HEI, aluminum, graphite (1980)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-11	1942-1945	SWDC/War Dep't	Detonator Rumbling Building
	1953-1962	UMC	Explosive production using RDX, HMX, HBX, and cast TNT; manufacture of delay mixes and igniter mixes
	?-1997	Olin	Propellant storage; HEI pelletizing
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-12	1942-1945	SWDC/War Dep't	Sawdust Storage Building
	1953-1962	UMC	Candle curing for the navy float signal (1950s)
	?-1997	Olin	Degreaser spill in this building
	1997-2001	Primex	Unspecified manufacturing;
	2001	GDO&TS	Unknown
Building D-1-13	1942-1945	SWDC/War Dep't	Inspection, Packing, and Shipping Building
	1953-1962	UMC	Uranium fuel rod assembly (1954)
	?-1997	Olin	Propellant storage (1965)
	1997-2001	Primex	Unspecified manufacturing; flash-out operations (1965)
	2001	GDO&TS	Unknown
IOP Building D-1-14 (Building D-1-75)	1942-1945	SWDC/War Dep't	Primer Mix & Azide Magazine
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown

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TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Olin Building D-1-14	?-1997	Olin	Explosives storage (1975)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
IOP Building D-1-15 (Building D-1-69)	1942-1945	SWDC/War Dep't	Azide Service Magazine
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Olin Building D-1-15	?-1997	Olin	HEI blending (1975)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
IOP Building D-1-16	1942-1945	SWDC/War Dep't	Heater House
Olin Building D-1-16	?-1997	Olin	Storage of iron powder, aluminum powder, stearate acid, soda ash, and aluminum stearate (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
IOP Building D-1-17	1942-1945	SWDC/War Dep't	Azide Napkin Preparation Bldg.
Olin Building D-1-17	?-1997	Olin	Building contained a boiler
	1997-2001	Primex	Structure was either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building D-1-18 (Building D-1-44)	1942-1945	SWDC/War Dep't	Azide Dry House
	?-1997	Olin	Mixing of propellants, igniter mixes and booster mixes; explosives (such as igniters) mix building (1984)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-19	1942-1945	SWDC/War Dep't	Heater House
Building D-1-20	1942-1945	SWDC/War Dep't	Heater House
Building D-1-21	1942-1945	SWDC/War Dep't	Azide Dry House
Building D-1-22	1942-1945	SWDC/War Dep't	Heater House
Building D-1-23	1942-1945	SWDC/War Dep't	Azide Dry House
Building D-1-24 (Building D-1-46)	1942-1945	SWDC/War Dep't	Dry Azide Storage
	?-1997	Olin	Drying (curing) fluid ball powder; oven used in MXU 4A/A process; mixing of Explosives and Pyrotechnics
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-25	1942-1945	SWDC/War Dep't	Azide Preparation Building
	?-1997	Olin	Mix house control room; IB36 storage; igniter waste pickup; mixing of igniters and washing of ball powder; pelleting operations; igniter manufacture
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-26	1942-1945	SWDC/War Dep't	Inert Primer Component Preparation House
	1953-1962	UMC	M-112 and M-123 photoflash powder blending
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown

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TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Building D-1-27	1942-1945	SWDC/War Dep't	Fulminate Preparation Building
	1953-1962	UMC	Loading of the inner shell case of the M-122 and M-123 photoflash shells (1950s)
	?-1997	Olin	Nitroglycerin casting of lance propellant grains (1975)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-28	1942-1945	SWDC/War Dep't	Fulminate Rest House
IOP Building D-1-29	1942-1945	SWDC/War Dep't	Fulminate Dry House
Olin Building D-1-29	1987	Olin	4A/A booster assembly
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-30 (Building D-1-73)	1942-1945	SWDC/War Dep't	Heater House
Building D-1-31	1942-1945	SWDC/War Dep't	Inert Primer Components Preparation House
Building D-1-32	1942-1945	SWDC/War Dep't	Fulminate Service Magazine
	1953-1962	UMC	Burn pad (1953)
	1964	Olin	Burn pad
Building D-1-33	1942-1945	SWDC/War Dep't	Heater House
	?-1997	Olin	Nitroglycerin storage (1975)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-34	1942-1945	SWDC/War Dep't	Fulminate Napkin Preparation Building
	?-1997	Olin	N.G. solvent storage (1975)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-35	1942-1945	SWDC/War Dept	Change House
	?-1997	Olin	Office and cafeteria; metal cleaning, welding, and X-ray operations; building housed trichlorethane and trichloroethylene degreasers
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-36	1942-1945	SWDC/War Dep't	Change House
	1952	UMC	Explosives milling; research and development; consolidation and pressing of lead azide and lead styphnate
	?-1997	Olin	Maintenance and engineering (1975)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-37	1942-1945	SWDC/War Dep't	Timekeepers Building
	?-1997	Olin	Offices, loss prevention and medical services; guard shack
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-38	1942-1945	SWDC/War Dep't	Boiler House
Building D-1-39 (in the COC Area)	1942-1945	SWDC/War Dep't	Detonator Destruction Building
Building D-1-40	1942-1945	SWDC/War Dep't	Condensate Pump House

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TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Building D-1-41 (Building D-1-62)	1942-1945	SWDC/War Dept	Condensate Pump House
	?-1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
IOP Building D-1-42	1942-1945	SWDC/War Dep't	Condensate Pump House
Olin Building D-1-42	?-2001	Olin/Primex	Unspecified storage
	2001	GDO&TS	Unknown
IOP Building D-1-43	1942-1945	SWDC/War Dep't	Control House
Olin Building D-1-43	?-1997	Olin	Propellant, boosters and igniter mix house; nitroglycerin casting of lance propellant grains; igniter mix house, research and development of GAP propellant
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-45	?-1997	Olin	Unspecified storage
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-47	?-1997	Olin	Propellant, booster and igniter mix house (1975); screening of igniter mixes for MXU 4A/A program (1985)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-48	1975	Olin	Igniter control preparation building
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-49	?-1997	Olin	Igniter storage building; solvent storage
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building D-1-50	?-1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-51	1965-1997	Olin	Unknown
	1997-2001	Primex	Structure is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building D-1-52	1965-1997	Olin	Unknown
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-53	1972-1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-54	?	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown

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TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Building D-1-55	1965-1997	Olin	Unknown
	1997-2001	Primex	Structure is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building D-1-56	?-1997	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building D-1-57	?-1997	Olin	Screening and mixing operations for smoke candle mixes (1979)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-58	?-1997	Olin	Screening and mixing operations for smoke candle mixes (1979)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-59	1980	Olin	Unknown
Building D-1-60	?-1997	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building D-1-61	?-1997	Olin	Unknown
	1997-2001	Primex	Storage of inert materials and surplus equipment
	2001	GDO&TS	Unknown
Building D-1-63	1979-1997	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building D-1-64	?-1997	Olin	Unknown
	1997-2001	Primex	Structure is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	?
Building D-1-65	?-1997	Olin	Explosive waste storage (1987)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-66	?-1997	Olin	Unknown
	1997 -	Primex	Storage of inert materials and surplus equipment
Building D-1-67	?-1997	Olin	Unknown
	1997 -	Primex	Storage of inert materials and surplus equipment
Building D-1-68	?-1997	Olin	Unknown
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-70	?-1997	Olin	Unknown
	1997	Primex	Storage of inert materials and surplus equipment
Building D-1-71	?1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-72	?-1997	Olin	Building had NG contamination
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown

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TABLE 4-1
AREA 2D OPERATORS/LESSEES AND BUILDING USES

Building Number	Year	Operator/Lessee	Product Line or Use
Building D-1-74	?-1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-76	1984-1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-77	?-1997	Olin	Storage of explosive waste
	1997-	Primex	Unspecified storage
Building D-1-78	1979-1998	Olin/Primex	Electrical load center for Building D-1-13
Building D-1-79	1970-?	Olin	MOCA was used in this Building
Building D-1-80	?	Olin	Unknown
Building D-1-81	?-1980	Olin	Unknown
Building D-1-82	1978-1997	Olin	Unknown
	1997-2001	Primex	Structure is either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building D-1-83	1980-1997	Olin	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building D-1-84	?-1997	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building D-1-85	?	Olin	Explosive waste storage (1987)
Building D-1-86	1980-?	Olin	Unknown
	?	Olin	Hazardous waste storage (1982)
Building D-1-87	1980-1997	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building D-1-88	1980-	Olin	Unknown
Building D-1-89	1981-1997	Olin	Unknown
	1997-?	Primex	Unknown
Building D-1-90	?-1997	Olin	Contained HEDP projectiles and trichloroethane, also used as flammable storage building (1988)
	1997-2001	Primex	Unspecified Manufacturing/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building D-1-90A	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-91	?-1997	Olin	Heat and treat HEI pellets
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building D-1-92	1983-1997	Olin	Humidity control building
	1997-2001	Primex	Likely humidity control building
	2001	GDO&TS	Likely humidity control building
Building D-1-93	1983-1997	Olin	Humidity control building
	1997-2001	Primex	Likely humidity control building
	2001	GDO&TS	Likely humidity control building

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References for this table can be found in the Section 4.1.2.2 of this report.

TABLE 4-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
5-1	Anthracene	0.8J
	Benzo[a]anthracene	0.15J
	Benzo[a]pyrene	0.14J, 0.5J
	Benzo[b]fluoranthene	0.25J, 1.5J
	Benzo[k]fluoranthene	1.5J
	Bis(2-Ethylhexyl)phthalate	0.12J
	Chrysene	0.17J
	Dibenz[a,h]anthracene	1.0J
	Fluoranthene	0.34J, 0.8J
	Indeno[1,2,3-c,d]pyrene	1.3J
	Phenanthrene	0.21J, 0.7J
	Pyrene	0.27J, 0.7J
	Aluminum	6,600
	Barium	76
	Calcium	160,000
	Chromium	14
	Cobalt	4.7
	Copper	23
	Iron	11,000
	Lead	47
	Magnesium	15,000
	Manganese	380
	Mercury	0.11
	Nickel	15
	Potassium	800
	Sodium	220
	Vanadium	14
	Zinc	170
5-2	Aluminum	11,000
	Barium	170
	Beryllium	0.9
	Calcium	12,000
	Chromium	15
	Cobalt	8.9
	Copper	20
	Iron	20,000
	Lead	20
	Magnesium	5,000
	Manganese	490
	Mercury	0.04
	Nickel	18
	Potassium	1,600
	Vanadium	29
	Zinc	160
7-1	Benzo[a]pyrene	0.5J
	Benzo[b]fluoranthene	0.64J, 1.7J
	Benzo[k]fluoranthene	1.7J
	Chrysene	0.47J

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TABLE 4-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
7-1	Fluoranthene	0.88J
	Pyrene	0.67J
	Aluminum	8,800
	Arsenic	110
	Barium	140
	Beryllium	0.5
	Calcium	10,000
	Chromium	13
	Cobalt	5.3
	Copper	33
	Iron	12,000
	Lead	47
	Magnesium	2,600
	Manganese	990
	Nickel	8.6
	Potassium	650
	Vanadium	24
	Zinc	90
7-2	Benzo[a]anthracene	0.31J
	Benzo[a]pyrene	0.35J
	Benzo[b]fluoranthene	0.56
	Benzo[g,h,i]perylene	0.25J
	Benzo[k]fluoranthene	0.20J
	Bis(2-Ethylhexyl)phthalate	1.30
	Chrysene	0.44
	Fluoranthene	0.72
	Indeno[1,2,3-c,d]pyrene	0.29J
	Phenanthrene	0.36J
	Pyrene	0.46J
	Aluminum	9,500
	Arsenic	75
	Barium	390
	Beryllium	0.5
	Calcium	50,000
	Chromium	13
	Cobalt	8.3
	Copper	24
	Iron	13,000
	Lead	88
	Magnesium	3100
	Manganese	2300
	Nickel	10
	Potassium	700
	Vanadium	27
	Zinc	110
7-3	Anthracene	1.0J
	Benzo[a]anthracene	0.59, 0.8J
	Benzo[a]pyrene	0.62, 1.0J

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TABLE 4-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
7-3	Benzo[b]fluoranthene	1.00, 2.7J
	Benzo[g,h,i]perylene	0.33J, 0.5J
	Benzo[k]fluoranthene	0.31J, 2.7J
	Bis(2-Ethylhexyl)phthalate	1.70
	Chrysene	0.76, 0.8J
	Dibenz[a,h]anthracene	0.8J
	Diethylphthalate	1.1
	Fluoranthene	1.30, 2.3J
	Indeno[1,2,3-c,d]pyrene	0.41J, 1.8J
	Phenanthrene	0.60, 1.5J
	Pyrene	0.83J, 1.7J
	Aluminum	11,000
	Arsenic	25
	Barium	180
	Beryllium	0.5
	Calcium	11,000
	Chromium	33
	Cobalt	6.4
	Copper	190
	Iron	14,000
	Lead	1,300
	Magnesium	5,600
	Manganese	940
	Nickel	16
	Potassium	590
	Vanadium	22
	Zinc	310
7-4	Aluminum	10,000
	Barium	84
	Beryllium	0.4
	Calcium	24,000
	Chromium	73
	Cobalt	4.3
	Copper	16
	Iron	13,000
	Lead	230
	Magnesium	6,700
	Manganese	350
	Mercury	0.10
	Nickel	10
	Potassium	870
	Vanadium	22
	Zinc	54
7-5	Acenaphthene	6.10, 1.2J
	Anthracene	17.0, 4.2J
	Benzo[a]anthracene	58[1,2], 14J
	Benzo[a]pyrene	50[1,2], 14J
	Benzo[b]fluoranthene	85[1,2], 32J

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TABLE 4-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
7-5	Benzo[g,h,i]perylene	18[1,2], 12J
	Benzo[k]fluoranthene	19.0J, 32J
	Carbazole	17.0
	Chrysene	68[1,2], 16J
	Dibenz[a,h]anthracene	6.4J, 4.7J
	Dibenzofuran	3.20
	Fluoranthene	140[1], 34J
	Fluorene	7.30, 1.4J
	Indeno[1,2,3-c,d]pyrene	24[1,2], 12.0J
	Naphthalene	1.10J
	Phenanthrene	110[1], 21.0J
	Pyrene	120[1], 26J
	Aluminum	19,000
	Arsenic	54
	Barium	20,000
	Beryllium	2.2
	Cadmium	6.7
	Calcium	23,000
	Chromium	94
	Cobalt	55
	Copper	1,900
	Iron	18,000
	Lead	2,400
	Magnesium	5,500
	Manganese	670
	Mercury	0.07
	Nickel	31
	Potassium	1,100
	Vanadium	20
	Zinc	440

Sheet 4 of 4

[1] This sample was noted with a qualifier of "E" replaced manually with a "D" qualifier. No information was found defining "D" or "E" qualifiers.
[2] The original laboratory result was manually replaced with the number shown in this table. Refer to USEPA laboratory analysis data sheets for original result.
Notes:
When two results are shown for one constituent, the first result is the semivolatile organics analysis data, and the second result is the polyaromatic hydrocarbons analysis data.
mg/kg = milligrams per kilogram
J = Estimated

TABLE 4-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A2D

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A2D-001	387897.5	776088.7	435.04	NA	
0A2D-002	387577.3	775682.5	434.12	NA	
0A2D-003	387519.0	775933.1	432.86	NA	
0A2D-004	387576.2	775946.3	434.25	NA	
0A2D-005	387602.9	776044.3	434.47	NA	
0A2D-006	387640.8	776138.6	433.92	NA	
0A2D-007	387659.6	776191.7	434.10	NA	
0A2D-008	387690.9	776297.6	433.79	NA	
0A2D-009	387605.7	776337.0	434.49	NA	
0A2D-010	387583.7	776461.0	433.32	NA	
0A2D-011	387595.0	776730.4	433.02	NA	
0A2D-012	387517.0	776834.8	432.32	NA	
0A2D-013	387352.4	776888.5	431.21	NA	
0A2D-014	387293.1	776985.3	426.38	NA	
0A2D-015	387671.2	775525.7	428.50	NA	
0A2D-016	387618.5	775578.6	431.30	NA	
0A2D-017	387246.9	775542.6	434.00	NA	
0A2D-018	387348.8	775766.3	434.00	NA	
0A2D-019	387316.3	775918.0	434.42	NA	
0A2D-020	387315.8	776059.4	435.60	NA	
0A2D-021	387182.3	776143.5	431.64	NA	
0A2D-022	387200.5	776252.0	434.10	NA	
0A2D-023	387044.4	775776.7	437.12	NA	
0A2D-024	387060.4	776195.9	434.33	NA	
0A2D-025	386977.5	776195.3	434.35	NA	
0A2D-026	387074.5	776429.7	434.12	NA	
0A2D-027	386991.7	776447.2	434.61	NA	
0A2D-028	387038.0	776871.6	434.84	NA	
0A2D-029	386767.2	775710.9	425.04	NA	
0A2D-030	386970.3	775972.1	426.76	NA	
0A2D-031	387399.1	776585.7	436.68	NA	
0A2D-032	386902.3	775489.2	428.78	NA	
0A2D-033	387137.4	776200.9	434.26	NA	
0A2D-034	386946.7	776219.7	431.68	NA	
0A2D-035	387003.2	776880.9	433.98	NA	
0A2D-036	387084.5	776978.8	429.62	NA	
0A2D-037	387709.9	775856.0	430.88	NA	
0A2D-038	387264.2	775458.3	431.22	NA	
0A2D-039	387350.0	775500.4	431.77	NA	
0A2D-040	387293.6	775696.0	431.69	NA	
0A2D-041	386894.8	775731.6	427.15	NA	
0A2D-042	386870.2	775882.2	425.30	NA	

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TABLE 4-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A2D

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A2D-043	386866.8	776329.8	430.70	NA	
0A2D-044	387185.4	777080.2	421.39	NA	
0A2D-045	387698.3	776814.6	434.49	NA	
0A2D-W01	387722.0	776433.0	436.43	439.07	New monitoring well
0A2D-W02	387549.4	776358.6	435.85	438.35	New monitoring well
0A2D-W03	387604.8	776828.3	435.92	438.56	New monitoring well
0A2D-W04	387172.3	776075.9	434.65	437.26	New monitoring well
0A2D-W05	386988.8	775693.3	432.37	434.93	New monitoring well
0A2D-W06	386938.7	776320.3	435.54	438.08	New monitoring well

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NA = Not Applicable

TABLE 4-3
SLUG TEST RESULTS

Well ID Number	Hydraulic Conductivity (cm/sec)
0A2D-W01	2.51E-07
0A2D-W02	2.09E-05
0A2D-W03	1.74E-05
0A2D-W04	6.89E-07
0A2D-W05	2.26E-06
0A2D-W06	3.52E-07

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cm/sec = centimeters per second

TABLE 4-4
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A2D

Soil		Groundwater	Surface Water
AUS-0A2D-001	AUS-0A2D-027	AUS-0A2D-W01	AUS-0A2D-044
AUS-0A2D-002	AUS-0A2D-028	AUS-0A2D-W02	
AUS-0A2D-003	AUS-0A2D-029*	AUS-0A2D-W03	
AUS-0A2D-004	AUS-0A2D-030*	AUS-0A2D-W04	
AUS-0A2D-005	AUS-0A2D-031	AUS-0A2D-W05	
AUS-0A2D-006	AUS-0A2D-032*	AUS-0A2D-W06	
AUS-0A2D-007	AUS-0A2D-033		
AUS-0A2D-008	AUS-0A2D-034		
AUS-0A2D-009	AUS-0A2D-035		
AUS-0A2D-010	AUS-0A2D-036		
AUS-0A2D-011	AUS-0A2D-037*		
AUS-0A2D-012	AUS-0A2D-038*		
AUS-0A2D-013*	AUS-0A2D-039*		
AUS-0A2D-014*	AUS-0A2D-040*		
AUS-0A2D-015*	AUS-0A2D-041*		
AUS-0A2D-016*	AUS-0A2D-042*		
AUS-0A2D-017	AUS-0A2D-043*		
AUS-0A2D-018	AUS-0A2D-044*		
AUS-0A2D-019	AUS-0A2D-045		
AUS-0A2D-020	AUS-0A2D-W01		
AUS-0A2D-021*	AUS-0A2D-W02		
AUS-0A2D-022	AUS-0A2D-W03		
AUS-0A2D-023	AUS-0A2D-W04		
AUS-0A2D-024	AUS-0A2D-W05		
AUS-0A2D-025	AUS-0A2D-W06		
AUS-0A2D-026			

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* Note that the samples at this location were originally designated as sediment, but are actually soil samples.

TABLE 4-5
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
Acetone	1/61	34 ug/kg
cis-1,2-Dichloroethene	4/52	19 ug/kg to 220 ug/kg
Methyl ethyl ketone (2-butanone)	1/61	1,200 ug/kg
n-Hexane	1/61	16 ug/kg
Tetrachloroethylene(PCE)	3/61	3 ug/kg to 810 ug/kg
Toluene	1/61	2 ug/kg
total 1,2-Dichloroethene	4/61	20 ug/kg to 230 ug/kg
Trichloroethylene (TCE)	7/61	3 ug/kg to 920 ug/kg
Semivolatile Organic Compounds		
2-Methylnaphthalene	7/42	50 ug/kg to 7,100 ug/kg
Acenaphthene	3/42	79 ug/kg to 520 ug/kg
Anthracene	7/42	46 ug/kg to 1,200 ug/kg
Benzo(a)anthracene	21/42	47 ug/kg to 4,800 ug/kg
Benzo(a)pyrene	23/42	42 ug/kg to 4,800 ug/kg
Benzo(b)fluoranthene	23/42	47 ug/kg to 5,200 ug/kg
Benzo(g,h,i)perylene	18/42	62 ug/kg to 2,300 ug/kg
Benzo(k)fluoranthene	21/42	50 ug/kg to 4,400 ug/kg
Benzyl butyl phthalate	14/42	49 ug/kg to 5,900 ug/kg
Bis(2-ethylhexyl) phthalate	23/42	45 ug/kg to 11,000 ug/kg
Carbazole	4/42	62 ug/kg to 620 ug/kg
Chrysene	24/42	42 ug/kg to 5,500 ug/kg
Dibenz(a,h)anthracene	5/42	43 ug/kg to 1,200 ug/kg
Dibenzofuran	8/42	45 ug/kg to 2,700 ug/kg
Dimethyl phthalate	1/42	2,500 ug/kg
Di-n-butyl phthalate	4/42	67 ug/kg to 220 ug/kg
Fluoranthene	23/42	57 ug/kg to 7,100 ug/kg
Fluorene	2/42	340 ug/kg to 430 ug/kg
Indeno(1,2,3-c,d)pyrene	17/42	61 ug/kg to 2,100 ug/kg
Naphthalene	3/42	50 ug/kg to 2,800 ug/kg
Pentachlorophenol	1/42	92 ug/kg
Phenanthrene	19/42	52 ug/kg to 6,500 ug/kg
Phenol	1/42	100 ug/kg
Pyrene	24/42	54 ug/kg to 6,800 ug/kg
Explosives		
HMX	1/47	6,000 ug/kg
Nitroglycerin	1/30	5,300 ug/kg
RDX	1/47	76,000 ug/kg
Dioxins		
2,3,7,8-TCDD	3/6	0.0000511 ug/kg to 0.0005950 ug/kg

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TABLE 4-5
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Aluminum	51/51	537 mg/kg to 19,100 mg/kg
Antimony	13/51	0.31 mg/kg to 5.3 mg/kg
Arsenic	50/51	3.2 mg/kg to 120 mg/kg
Barium	51/51	17.8 mg/kg to 302 mg/kg
Beryllium	25/51	0.26 mg/kg to 1.1 mg/kg
Boron	25/51	1.7 mg/kg to 2,460 mg/kg
Cadmium	23/51	0.14 mg/kg to 2.3 mg/kg
Calcium	51/51	727 mg/kg to 133,000 mg/kg
Chromium, Total	51/51	5.9 mg/kg to 96.8 mg/kg
Cobalt	24/51	3.9 mg/kg to 15 mg/kg
Copper	51/51	3.6 mg/kg to 937 mg/kg
Cyanide	1/17	0.88 mg/kg
Iron	51/51	6,250 mg/kg to 22,600 mg/kg
Lead	43/51	9.1 mg/kg to 372 mg/kg
Magnesium	51/51	636 mg/kg to 40,800 mg/kg
Manganese	51/51	127 mg/kg to 2,370 mg/kg
Mercury	16/51	0.06 mg/kg to 0.19 mg/kg
Nickel	51/51	3.8 mg/kg to 24.3 mg/kg
Potassium	49/51	111 mg/kg to 2,240 mg/kg
Selenium	41/51	0.26 mg/kg to 2.2 mg/kg
Silver	24/51	0.23 mg/kg to 40.3 mg/kg
Sodium	8/51	134 mg/kg to 656 mg/kg
Thallium	11/51	0.15 mg/kg to 0.26 mg/kg
Vanadium	51/51	5.5 mg/kg to 43.7 mg/kg
Zinc	51/51	18 mg/kg to 1,060 mg/kg
Other Inorganics		
Phosphorus, Total (as P)	4/5	227 mg/kg to 891 mg/kg
Total Organic Carbon	2/2	27,400 mg/kg to 87,000 mg/kg

Sheet 2 of 2

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 05/18/01

TABLE 4-6
GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
1,1,2-Trichloroethane	1/6	28 ug/L
1,1-Dichloroethane	1/6	2 ug/L
1,1-Dichlorethene	2/6	2 ug/L to 9 ug/L
Chloroform	1/6	0.5 ug/L
cis-1,2-Dichloroethylene	4/6	1 ug/L to 9,700 ug/L
Tetrachloroethylene(PCE)	2/6	2 ug/L to 2,800 ug/L
Trans-1,2-dichloroethene	2/6	2 ug/L to 180 ug/L
Trichloroethylene (TCE)	3/6	0.6 ug/L to 54,000 ug/L
Vinyl chloride	2/6	11 ug/L to 53 ug/L
Semivolatile Organic Compounds		
Bis(2-ethylhexyl) phthalate	3/6	1.1 ug/L to 9.4 ug/L
Metals		
Aluminum	6/6	100 ug/L to 9,130 ug/L
Antimony	1/6	2.3 ug/L
Barium	6/6	28.1 ug/L to 117 ug/L
Boron	2/6	13.2 ug/L to 14.1 ug/L
Calcium	6/6	39,500 ug/L to 269,000 ug/L
Chromium, Total	3/6	2.9 ug/L to 12.8 ug/L
Copper	5/6	1.4 ug/L to 5.8 ug/L
Iron	6/6	118 ug/L to 10,700 ug/L
Lead	1/6	3.4 ug/L
Magnesium	6/6	13,000 ug/L to 107,000 ug/L
Manganese	6/6	66.4 ug/L to 948 ug/L
Mercury	1/6	0.13 ug/L
Nickel	5/6	1.6 ug/L to 10.9 ug/L
Potassium	4/6	1,860 ug/L to 2,960 ug/L
Sodium	6/6	129,000 ug/L to 286,000 ug/L
Thallium	1/6	3.4 ug/L
Vanadium	3/6	5.1 ug/L to 14.8 ug/L
Zinc	2/6	8.5 ug/L to 36.6 ug/L
Other Inorganic Compounds		
Alkalinity, Total (as CACO3)	2/2	395 mg/L to 670 mg/L
Nitrogen, Ammonia (as N)	1/3	0.13 mg/L
Nitrogen, Nitrate+Nitrite	2/3	0.21 mg/L to 0.34 mg/L
Phosphorus, Total (as P)	2/3	0.13 mg/L to 0.14 mg/L

Sheet 1 of 2

TABLE 4-6
GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Suspended Solids (Residue, Non-Filterable)	2/2	5 mg/L to 84.5 mg/L
Total Dissolved Solids (Residue, Filterable)	2/2	513 mg/L to 2,080 mg/L

Sheet 2 of 2

mg/L = milligrams per Liter
ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 05/18/01

TABLE 4-7
SURFACE WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Explosives		
RDX	1/1	1.8 ug/L
Metals		
Aluminum	1/1	2,720 ug/L
Arsenic	1/1	3 ug/L
Barium	1/1	65.9 ug/L
Calcium	1/1	33,100 ug/L
Chromium, Total	1/1	2.4 ug/L
Iron	1/1	2,290 ug/L
Magnesium	1/1	10,700 ug/L
Potassium	1/1	1,870 ug/L
Selenium	1/1	2.5 ug/L
Sodium	1/1	20,900 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 05/18/01

TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Volatile Organic Compounds								
71-55-6	1,1,1-Trichloroethane	10	U	UG/KG			3.00E-06	1.00E-01
79-34-5	1,1,2,2-Tetrachloroethane	10	U	UG/KG		1.11E-08	2.56E-06	5.00E+01
79-00-5	1,1,2-Trichloroethane	10	U	UG/KG		5.26E-09	6.57E-05	1.11E+01
75-34-3	1,1-Dichloroethane	10	U	UG/KG			4.85E-06	1.00E-02
75-35-4	1,1-Dichloroethene	10	U	UG/KG		8.42E-08	1.48E-04	3.33E+00
107-06-2	1,2-Dichloroethane (EDC)	10	U	UG/KG		1.31E-08	2.84E-04	1.00E+01
540-59-0	1,2-Dichloroethene (total)	230		UG/KG			1.56E-03	1.15E+01
78-87-5	1,2-Dichloropropane	10	U	UG/KG		1.30E-08	4.69E-04	1.00E+01
78-93-3	2-Butanone (MEK)	1200	J	UG/KG			4.33E-05	
591-78-6	2-Hexanone	19	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	19	U	UG/KG			6.58E-06	
67-64-1	Acetone	34	J	UG/KG			5.47E-06	4.25E-02
71-43-2	Benzene	10	U	UG/KG		6.83E-09	4.13E-04	5.00E+00
75-27-4	Bromodichloromethane	10	U	UG/KG		4.24E-09	9.58E-06	3.33E-01
75-25-2	Bromoform	10	U	UG/KG		3.20E-11	5.68E-07	2.50E-01
74-83-9	Bromomethane	10	U	UG/KG			7.61E-04	1.00E+00
75-15-0	Carbon disulfide	10	U	UG/KG			8.27E-06	5.00E-03
56-23-5	Carbon tetrachloride	10	U	UG/KG		1.89E-08	1.43E-03	3.33E+00
108-90-7	Chlorobenzene	10	U	UG/KG			1.84E-05	1.43E-01
75-00-3	Chloroethane	10	U	UG/KG		1.54E-09	5.30E-07	
67-66-3	Chloroform	10	U	UG/KG		1.92E-08	7.76E-03	3.33E-01
74-87-3	Chloromethane	10	U	UG/KG		3.76E-09		
156-59-2	cis-1,2-Dichloroethene	220		UG/KG			1.49E-03	1.10E+01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
10061-01-5	cis-1,3-Dichloropropene	10	U	UG/KG		5.62E-08	2.27E-04	
124-48-1	Dibromochloromethane	10	U	UG/KG		3.77E-09	6.28E-06	5.00E-01
100-41-4	Ethylbenzene	10	U	UG/KG			1.67E-06	1.43E-02
75-09-2	Methylene chloride	11	U	UG/KG		5.36E-10	1.13E-06	1.10E+01
110-54-3	N-Hexane	16		UG/KG			3.96E-05	
100-42-5	Styrene	10	U	UG/KG			4.89E-07	5.00E-02
127-18-4	Tetrachloroethylene (PCE)	810	J	UG/KG		4.34E-08	4.76E-04	2.70E+02
108-88-3	Toluene	2	J	UG/KG			1.01E-06	3.33E-03
1330-20-7	total Xylenes	10	U	UG/KG			2.25E-06	1.00E-03
156-60-5	trans-1,2-Dichloroethene	10	U	UG/KG			4.67E-05	3.33E-01
10061-02-6	trans-1,3-Dichloropropene	10	U	UG/KG		5.62E-08	2.27E-04	
79-01-6	Trichloroethylene (TCE)	920	J	UG/KG		1.50E-07	1.16E-02	3.07E+02
75-01-4	Vinyl chloride	10	U	UG/KG		2.05E-07		1.43E+01
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	710	U	UG/KG			9.32E-05	2.37E+00
95-50-1	1,2-Dichlorobenzene	710	U	UG/KG			2.14E-04	7.89E-01
541-73-1	1,3-Dichlorobenzene	710	U	UG/KG			1.37E-02	
106-46-7	1,4-Dichlorobenzene	710	U	UG/KG		8.73E-08	3.70E-04	7.10E+00
95-95-4	2,4,5-Trichlorophenol	3500	U	UG/KG			3.97E-05	3.50E-01
88-06-2	2,4,6-Trichlorophenol	710	U	UG/KG		3.17E-09		8.88E+01
120-83-2	2,4-Dichlorophenol	710	U	UG/KG			2.69E-04	1.42E+01
105-67-9	2,4-Dimethylphenol	710	U	UG/KG			4.03E-05	1.78E+00
51-28-5	2,4-Dinitrophenol	3500	UJ	UG/KG			1.99E-03	3.50E+02
91-58-7	2-Chloronaphthalene	710	U	UG/KG			2.60E-05	

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J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
95-57-8	2-Chlorophenol	710	U	UG/KG			2.94E-03	3.55E+00
91-57-6	2-Methylnaphthalene	7100		UG/KG			1.31E-04	3.55E-02
95-48-7	2-Methylphenol	710	U	UG/KG			1.61E-05	8.88E-01
88-74-4	2-Nitroaniline	3500	U	UG/KG			6.95E-02	
88-75-5	2-Nitrophenol	710	U	UG/KG			1.01E-04	
91-94-1	3,3'-Dichlorobenzidine	1000	U	UG/KG		1.82E-07		3.33E+03
99-09-2	3-Nitroaniline	3500	U	UG/KG			6.95E-02	
101-14-4	4,4'-Methylene bis(2-chloroaniline)	620	U	UG/KG		3.27E-08	1.01E-03	
534-52-1	4,6-Dinitro-2-methylphenol	3500	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	710	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	710	U	UG/KG			1.61E-05	
106-47-8	4-Chloroaniline	1400	U	UG/KG			3.97E-04	4.67E+01
7005-72-3	4-Chlorophenyl phenyl ether	710	U	UG/KG				
106-44-5	4-Methylphenol	710	U	UG/KG			1.61E-04	
100-01-6	4-Nitroaniline	3500	U	UG/KG			6.95E-02	
100-02-7	4-Nitrophenol	3500	U	UG/KG			4.97E-04	
83-32-9	Acenaphthene	520		UG/KG			1.36E-05	1.73E-02
208-96-8	Acenaphthylene	710	U	UG/KG			1.31E-05	3.55E-03
120-12-7	Anthracene	1200		UG/KG			3.08E-06	2.00E-03
56-55-3	Benzo(a)anthracene	4800		UG/KG		1.66E-06		6.00E+01
50-32-8	Benzo(a)pyrene	4800		UG/KG		1.66E-05		1.20E+01
205-99-2	Benzo(b)fluoranthene	5200		UG/KG		1.80E-06		2.60E+01
191-24-2	Benzo(g,h,i)perylene	2300		UG/KG			4.24E-05	1.15E-02
207-08-9	Benzo(k)fluoranthene	4400		UG/KG		1.52E-07		2.20E+00

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
111-91-1	bis(2-Chloroethoxy)methane	710	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	710	U	UG/KG		1.15E-06		3.55E+04
108-60-1	bis(2-Chloroisopropyl) ether	710	U	UG/KG		8.79E-08	1.67E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	11000		UG/KG		6.24E-08	6.24E-04	
85-68-7	Butyl benzyl phthalate	5900	J	UG/KG			3.35E-05	7.38E-03
86-74-8	Carbazole	620		UG/KG		5.03E-09		2.07E+01
218-01-9	Chrysene	5500		UG/KG		1.91E-08		6.88E-01
84-74-2	Di-n-butyl phthalate	220	J	UG/KG			2.50E-06	7.33E-04
117-84-0	Di-n-octyl phthalate	710	U	UG/KG			4.03E-05	7.10E-05
53-70-3	Dibenz(a,h)anthracene	1200		UG/KG		4.16E-06		1.50E+01
132-64-9	Dibenzofuran	2700		UG/KG			5.33E-04	
84-66-2	Diethyl phthalate	710	U	UG/KG			1.01E-06	
131-11-3	Dimethyl phthalate	2500		UG/KG			2.84E-07	
206-44-0	Fluoranthene	7100		UG/KG			2.36E-04	3.55E-02
86-73-7	Fluorene	430	J	UG/KG			1.30E-05	1.43E-02
118-74-1	Hexachlorobenzene	710	U	UG/KG		4.61E-07	1.01E-03	7.10E+00
87-68-3	Hexachlorobutadiene	710	U	UG/KG		2.25E-08	4.03E-03	7.10E+00
77-47-4	Hexachlorocyclopentadiene	710	UJ	UG/KG			1.20E-04	3.55E-02
67-72-1	Hexachloroethane	710	U	UG/KG		4.03E-09	8.06E-04	3.55E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	2100		UG/KG		7.28E-07		3.00E+00
78-59-1	Isophorone	710	U	UG/KG		2.73E-10	4.03E-06	2.37E+01
621-64-7	N-Nitroso-di-n-propylamine	710	U	UG/KG		2.01E-06		3.55E+05
86-30-6	N-Nitrosodiphenylamine	710	U	UG/KG		1.41E-09		1.18E+01
91-20-3	Naphthalene	2800		UG/KG			1.48E-02	7.00E-01

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
87-86-5	Pentachlorophenol	92	J	UG/KG		8.30E-09	6.45E-06	9.20E+01
85-01-8	Phenanthrene	6500		UG/KG			1.20E-04	3.25E-02
108-95-2	Phenol	100	J	UG/KG			1.89E-07	2.00E-02
129-00-0	Pyrene	6800		UG/KG			1.25E-04	3.40E-02
Explosives								
99-35-4	1,3,5-Trinitrobenzene	530	U	UG/KG			2.01E-05	
99-65-0	1,3-Dinitrobenzene	530	U	UG/KG			6.02E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	1100	U	UG/KG		1.34E-08	2.50E-03	
121-14-2	2,4-Dinitrotoluene	530	U	UG/KG			3.01E-04	1.33E+04
606-20-2	2,6-Dinitrotoluene	750	U	UG/KG			8.51E-04	2.50E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	1100	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	1100	U	UG/KG				
99-08-1	3-Nitrotoluene	1100	U	UG/KG			5.41E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	1100	U	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	1100	U	UG/KG			5.41E-04	
2691-41-0	HMX	6000	J	UG/KG			1.36E-04	
98-95-3	Nitrobenzene	530	U	UG/KG			4.63E-03	
55-63-0	Nitroglycerin	5300		UG/KG		3.01E-08		
78-11-5	Pentaerythritol tetranitrate (PETN)	3700	UJ	UG/KG				
121-82-4	RDX	76000		UG/KG		3.39E-06	2.88E-02	
479-45-8	Tetryl	1600	U	UG/KG			1.82E-04	

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Metals								
7429-90-5	Aluminum	19100	J	MG/KG	6.63E-01		1.14E-02	
7440-36-0	Antimony	5.3		MG/KG	6.39E+00		6.48E-03	1.77E+01
7440-38-2	Arsenic	120		MG/KG	8.89E+00	4.40E-05	2.73E-01	1.20E+02
7440-39-3	Barium	302		MG/KG	1.55E+00		2.43E-03	3.78E+00
7440-41-7	Beryllium	1.1		MG/KG	1.45E+00	4.91E-10	2.98E-04	3.67E-01
7440-42-8	Boron	2460		MG/KG	4.64E+02		3.11E-02	
7440-43-9	Cadmium	2.3		MG/KG	1.21E+01	7.70E-10	2.84E-03	5.75E+00
7440-70-2	Calcium	133000		MG/KG	5.33E+01			
7440-47-3	Chromium	96.8		MG/KG	3.84E+00	2.16E-07		4.84E+01
7440-48-4	Cobalt	15		MG/KG	6.91E-01		1.22E-04	
7440-50-8	Copper	937		MG/KG	8.29E+01		1.23E-02	
57-12-5	Cyanide, Total	0.88		MG/KG	2.15E+00		4.99E-05	4.40E-01
7439-89-6	Iron	22600		MG/KG	1.17E+00		3.69E-02	
7439-92-1	Lead	372		MG/KG	1.59E+01			
7439-95-4	Magnesium	40800		MG/KG	2.63E+01			
7439-96-5	Manganese	2370		MG/KG	6.51E-01		7.35E-02	
7439-97-6	Mercury	0.19	J	MG/KG	3.17E+00			
7440-02-0	Nickel	24.3		MG/KG	1.29E+00		5.94E-04	3.47E+00
2023695	Potassium	2240		MG/KG	3.58E+00			
7782-49-2	Selenium	2.2		MG/KG	9.40E-01		2.15E-04	7.33E+00
7440-22-4	Silver	40.3		MG/KG	6.95E+01		3.94E-03	2.02E+01
7440-23-5	Sodium	656		MG/KG	3.86E+00			
7440-28-0	Thallium	0.26	J	MG/KG	6.34E-01		1.82E-06	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-62-2	Vanadium	46.3		MG/KG	9.81E-01		3.24E-03	1.54E-01
7440-66-6	Zinc	1060		MG/KG	2.06E+01		1.73E-03	1.77E+00
Dioxins								
1746-01-6	2,3,7,8-TCDD	0.000595	XJ	UG/KG				
Other Parameters								
7601-90-3	Perchlorate	9300	U	UG/KG			9.10E-03	
7723-14-0	Phosphorus, Total (as P)	891		MG/KG			2.18E+01	
TOC	TOC	87000		MG/KG	2.77E+00			

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TABLE 4-8
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ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	10	U	UG/KG			5.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	10	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	10	U	UG/KG	1.22E-06	1.22E-06	5.00E-01
75-34-3	1,1-Dichloroethane	10	U	UG/KG	5.00E-08	5.00E-08	4.35E-04
75-35-4	1,1-Dichloroethene	10	U	UG/KG	5.56E-07	5.56E-06	1.67E-01
107-06-2	1,2-Dichloroethane (EDC)	10	U	UG/KG	1.59E-04	7.14E-06	5.00E-01
540-59-0	1,2-Dichloroethene (total)	230		UG/KG	1.15E-05	1.15E-05	5.75E-01
78-87-5	1,2-Dichloropropane	10	U	UG/KG	1.19E-04	5.56E-06	3.33E-01
78-93-3	2-Butanone (MEK)	1200	J	UG/KG			
591-78-6	2-Hexanone	19	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	19	U	UG/KG			
67-64-1	Acetone	34	J	UG/KG	1.70E-07	1.70E-07	2.13E-03
71-43-2	Benzene	10	U	UG/KG	5.00E-05	2.33E-06	3.33E-01
75-27-4	Bromodichloromethane	10	U	UG/KG	1.09E-04	5.00E-06	1.67E-02
75-25-2	Bromoform	10	U	UG/KG	1.39E-05	6.25E-07	1.25E-02
74-83-9	Bromomethane	10	U	UG/KG	3.45E-06	1.00E-05	5.00E-02
75-15-0	Carbon disulfide	10	U	UG/KG	5.00E-08	5.00E-07	3.13E-04
56-23-5	Carbon tetrachloride	10	U	UG/KG	2.27E-04	2.44E-05	1.43E-01
108-90-7	Chlorobenzene	10	U	UG/KG	2.44E-07	2.44E-06	1.00E-02
75-00-3	Chloroethane	10	U	UG/KG			
67-66-3	Chloroform	10	U	UG/KG	1.06E-05	5.00E-06	1.67E-02
74-87-3	Chloromethane	10	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	220		UG/KG	1.10E-05	1.10E-05	5.50E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
10061-01-5	cis-1,3-Dichloropropene	10	U	UG/KG			
124-48-1	Dibromochloromethane	10	U	UG/KG	2.44E-07	2.44E-07	2.50E-02
100-41-4	Ethylbenzene	10	U	UG/KG	5.00E-08	5.00E-07	7.69E-04
75-09-2	Methylene chloride	11	U	UG/KG	1.45E-05	9.17E-07	5.50E-01
110-54-3	N-Hexane	16		UG/KG			
100-42-5	Styrene	10	U	UG/KG	2.44E-08	2.44E-07	2.50E-03
127-18-4	Tetrachloroethylene (PCE)	810	J	UG/KG	7.36E-03	3.38E-04	1.35E+01
108-88-3	Toluene	2	J	UG/KG	4.88E-09	4.88E-09	1.67E-04
1330-20-7	total Xylenes	10	U	UG/KG	1.00E-08	2.44E-08	6.67E-05
156-60-5	trans-1,2-Dichloroethene	10	U	UG/KG	2.44E-07	2.44E-07	1.43E-02
10061-02-6	trans-1,3-Dichloropropene	10	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	920	J	UG/KG	1.77E-03	7.67E-04	1.53E+01
75-01-4	Vinyl chloride	10	U	UG/KG	3.33E-03	1.54E-04	1.00E+00
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	710	U	UG/KG	3.55E-05	3.55E-04	1.42E-01
95-50-1	1,2-Dichlorobenzene	710	U	UG/KG	3.94E-06	3.94E-05	4.18E-02
541-73-1	1,3-Dichlorobenzene	710	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	710	U	UG/KG			3.55E-01
95-95-4	2,4,5-Trichlorophenol	3500	U	UG/KG	1.75E-05	1.75E-05	1.30E-02
88-06-2	2,4,6-Trichlorophenol	710	U	UG/KG	1.37E-03	6.45E-05	3.55E+00
120-83-2	2,4-Dichlorophenol	710	U	UG/KG	1.16E-04	1.16E-03	7.10E-01
105-67-9	2,4-Dimethylphenol	710	U	UG/KG	1.73E-05	1.73E-05	7.89E-02
51-28-5	2,4-Dinitrophenol	3500	UJ	UG/KG	8.54E-04	8.54E-03	1.75E+01
91-58-7	2-Chloronaphthalene	710	U	UG/KG			

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	710	U	UG/KG	7.10E-05	7.10E-05	1.78E-01
91-57-6	2-Methylnaphthalene	7100		UG/KG	1.16E-04	1.16E-04	1.69E-03
95-48-7	2-Methylphenol	710	U	UG/KG	7.10E-06	7.10E-06	4.73E-02
88-74-4	2-Nitroaniline	3500	U	UG/KG			
88-75-5	2-Nitrophenol	710	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	1000	U	UG/KG	7.69E-02	3.57E-03	1.43E+02
99-09-2	3-Nitroaniline	3500	U	UG/KG			
101-14-4	4,4'-Methylene bis(2-chloroaniline)	620	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	3500	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	710	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	710	U	UG/KG			
106-47-8	4-Chloroaniline	1400	U	UG/KG	1.71E-04	1.71E-03	2.00E+00
7005-72-3	4-Chlorophenyl phenyl ether	710	U	UG/KG			
106-44-5	4-Methylphenol	710	U	UG/KG			
100-01-6	4-Nitroaniline	3500	U	UG/KG			
100-02-7	4-Nitrophenol	3500	U	UG/KG			
83-32-9	Acenaphthene	520		UG/KG	4.33E-06	4.33E-06	9.12E-04
208-96-8	Acenaphthylene	710	U	UG/KG	1.16E-05	1.16E-05	1.69E-04
120-12-7	Anthracene	1200		UG/KG	1.97E-06	1.97E-06	1.00E-04
56-55-3	Benzo(a)anthracene	4800		UG/KG	6.00E-01	2.82E-02	2.40E+00
50-32-8	Benzo(a)pyrene	4800		UG/KG	6.00E+00	2.82E-01	6.00E-01
205-99-2	Benzo(b)fluoranthene	5200		UG/KG	6.50E-01	3.06E-02	1.04E+00
191-24-2	Benzo(g,h,i)perylene	2300		UG/KG	3.77E-05	3.77E-05	5.48E-04
207-08-9	Benzo(k)fluoranthene	4400		UG/KG	5.64E-02	2.59E-03	8.98E-02

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-91-1	bis(2-Chloroethoxy)methane	710	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	710	U	UG/KG	1.42E-01	9.47E-03	1.78E+03
108-60-1	bis(2-Chloroisopropyl) ether	710	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	11000		UG/KG	2.68E-02	2.68E-03	3.06E-03
85-68-7	Butyl benzyl phthalate	5900	J	UG/KG	1.44E-05	1.44E-05	6.34E-03
86-74-8	Carbazole	620		UG/KG	2.14E-03	1.00E-04	1.03E+00
218-01-9	Chrysene	5500		UG/KG	7.05E-03	3.24E-04	3.44E-02
84-74-2	Di-n-butyl phthalate	220	J	UG/KG	1.10E-06	1.10E-06	9.57E-05
117-84-0	Di-n-octyl phthalate	710	U	UG/KG	1.73E-05	1.73E-04	7.10E-05
53-70-3	Dibenz(a,h)anthracene	1200		UG/KG	1.50E+00	7.06E-02	6.00E-01
132-64-9	Dibenzofuran	2700		UG/KG			
84-66-2	Diethyl phthalate	710	U	UG/KG	7.10E-07	7.10E-07	1.51E-03
131-11-3	Dimethyl phthalate	2500		UG/KG			
206-44-0	Fluoranthene	7100		UG/KG	8.66E-05	8.66E-05	1.65E-03
86-73-7	Fluorene	430	J	UG/KG	5.24E-06	5.24E-06	7.68E-04
118-74-1	Hexachlorobenzene	710	U	UG/KG	1.78E-01	9.10E-03	3.55E-01
87-68-3	Hexachlorobutadiene	710	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	710	UJ	UG/KG	5.07E-05	5.07E-05	1.78E-03
67-72-1	Hexachloroethane	710	U	UG/KG	3.55E-04	3.55E-04	1.42E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	2100		UG/KG	2.63E-01	1.24E-02	1.50E-01
78-59-1	Isophorone	710	U	UG/KG	1.73E-06	1.73E-06	8.88E-02
621-64-7	N-Nitroso-di-n-propylamine	710	U	UG/KG	8.88E-01	3.94E-02	1.42E+04
86-30-6	N-Nitrosodiphenylamine	710	U	UG/KG	5.92E-04	2.84E-05	7.10E-01
91-20-3	Naphthalene	2800		UG/KG	3.41E-05	3.41E-04	3.33E-02

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
87-86-5	Pentachlorophenol	92	J	UG/KG	3.83E-03	1.77E-04	3.07E+00
85-01-8	Phenanthrene	6500		UG/KG	1.07E-04	1.07E-04	1.55E-03
108-95-2	Phenol	100	J	UG/KG	1.00E-07	8.33E-07	1.00E-03
129-00-0	Pyrene	6800		UG/KG	1.11E-04	1.11E-04	1.62E-03
Explosives							
99-35-4	1,3,5-Trinitrobenzene	530	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	530	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	1100	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	530	U	UG/KG	6.31E-02	2.94E-03	6.63E+02
606-20-2	2,6-Dinitrotoluene	750	U	UG/KG	8.93E-02	4.17E-03	1.07E+03
35572-78-2	2-Amino-4,6-Dinitrotoluene	1100	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	1100	U	UG/KG			
99-08-1	3-Nitrotoluene	1100	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	1100	U	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	1100	U	UG/KG			
2691-41-0	HMX	6000	J	UG/KG			
98-95-3	Nitrobenzene	530	U	UG/KG	5.30E-04	5.30E-04	5.30E+00
55-63-0	Nitroglycerin	5300		UG/KG			
78-11-5	Pentaerythritol tetranitrate (PETN)	3700	UJ	UG/KG			
121-82-4	RDX	76000		UG/KG			
479-45-8	Tetryl	1600	U	UG/KG			

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TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Metals							
7429-90-5	Aluminum	19100	J	MG/KG			
7440-36-0	Antimony	5.3		MG/KG	6.46E-03	6.46E-02	1.06E+00
7440-38-2	Arsenic	120		MG/KG	4.00E+01	1.97E+00	4.29E+00
7440-39-3	Barium	302		MG/KG	2.16E-03	2.16E-02	2.52E-01
7440-41-7	Beryllium	1.1		MG/KG	1.10E+00	3.79E-02	1.67E-01
7440-42-8	Boron	2460		MG/KG	1.37E-02	1.37E-01	
7440-43-9	Cadmium	2.3		MG/KG	1.15E-03	1.15E-02	6.22E-01
7440-70-2	Calcium	133000		MG/KG			
7440-47-3	Chromium	96.8		MG/KG	9.68E-03	2.36E-02	3.46E+00
7440-48-4	Cobalt	15		MG/KG	1.25E-04	1.25E-03	
7440-50-8	Copper	937		MG/KG	1.14E-02	1.14E-01	8.52E-02
57-12-5	Cyanide, Total	0.88		MG/KG	2.15E-05	2.15E-04	2.20E-02
7439-89-6	Iron	22600		MG/KG			
7439-92-1	Lead	372		MG/KG	9.30E-01	9.30E-01	
7439-95-4	Magnesium	40800		MG/KG			
7439-96-5	Manganese	2370		MG/KG	2.47E-02	2.47E-01	
7439-97-6	Mercury	0.19	J	MG/KG	3.11E-04	3.11E-03	1.27E+00
7440-02-0	Nickel	24.3		MG/KG	5.93E-04	5.93E-03	3.20E-01
2023695	Potassium	2240		MG/KG			
7782-49-2	Selenium	2.2		MG/KG	2.20E-04	2.20E-03	9.17E-01
7440-22-4	Silver	40.3		MG/KG	4.03E-03	4.03E-02	2.69E+01
7440-23-5	Sodium	656		MG/KG			
7440-28-0	Thallium	0.26	J	MG/KG	1.63E-03	1.63E-03	1.08E-01

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J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-62-2	Vanadium	46.3		MG/KG	3.31E-03	3.31E-02	4.72E-02
7440-66-6	Zinc	1060		MG/KG	1.74E-03	1.74E-02	2.94E-01
Dioxins							
1746-01-6	2,3,7,8-TCDD	0.000595	XJ	UG/KG			
Other Parameters							
7601-90-3	Perchlorate	9300	U	UG/KG			
7723-14-0	Phosphorus, Total (as P)	891		MG/KG			
TOC	TOC	87000		MG/KG			

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TABLE 4-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	2500	U	UG/L		3.16E+00	1.25E+01
79-34-5	1,1,2,2-Tetrachloroethane	2500	U	UG/L	4.52E-02	6.85E+00	
79-00-5	1,1,2-Trichloroethane	28	J	UG/L	1.40E-04	1.15E+00	5.60E+00
75-34-3	1,1-Dichloroethane	2	J	UG/L		2.47E-03	
75-35-4	1,1-Dichloroethene	9	J	UG/L	1.97E-04	1.64E-01	1.29E+00
107-06-2	1,2-Dichloroethane (EDC)	2500	U	UG/L	2.03E-02	2.47E+02	5.00E+02
78-87-5	1,2-Dichloropropane	2500	U	UG/L	1.52E-02	3.62E+02	5.00E+02
78-93-3	2-Butanone (MEK)	12000	U	UG/L		6.30E+00	
591-78-6	2-Hexanone	12000	U	UG/L			
108-10-1	4-Methyl-2-pentanone (MIBK)	12000	U	UG/L		7.60E+01	
67-64-1	Acetone	12000	U	UG/L		1.97E+01	
71-43-2	Benzene	2500	U	UG/L	6.10E-03	2.23E+02	5.00E+02
75-27-4	Bromodichloromethane	2500	U	UG/L	1.38E-02	2.05E+01	
75-25-2	Bromoform	2500	U	UG/L	2.94E-04	3.42E+00	
74-83-9	Bromomethane	2500	U	UG/L		2.89E+02	
75-15-0	Carbon disulfide	2500	U	UG/L		2.40E+00	
56-23-5	Carbon tetrachloride	2500	U	UG/L	1.46E-02	5.87E+02	5.00E+02
108-90-7	Chlorobenzene	2500	U	UG/L		2.36E+01	2.50E+01
75-00-3	Chloroethane	2500	U	UG/L	5.39E-04	2.91E-01	
67-66-3	Chloroform	0.5	J	UG/L	3.04E-06	7.98E-01	
74-87-3	Chloromethane	2500	U	UG/L	1.65E-03		
156-59-2	cis-1,2-Dichloroethene	9700		UG/L		1.59E+02	1.39E+02
10061-01-5	cis-1,3-Dichloropropene	2500	U	UG/L	3.09E-02	2.88E+02	
124-48-1	Dibromochloromethane	2500	U	UG/L	1.87E-02	2.05E+01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-9

HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
100-41-4	Ethylbenzene	2500	U	UG/L		1.87E+00	3.57E+00
75-09-2	Methylene chloride	2500	U	UG/L	5.85E-04	1.54E+00	5.00E+02
110-54-3	N-Hexane	2500	U	UG/L		7.13E+00	
100-42-5	Styrene	2500	U	UG/L		1.52E+00	2.50E+01
127-18-4	Tetrachloroethylene (PCE)	2800		UG/L	2.59E-03	1.10E+01	5.60E+02
108-88-3	Toluene	2500	U	UG/L		3.46E+00	2.50E+00
1330-20-7	total Xylenes	2500	U	UG/L		1.75E+00	2.50E-01
156-60-5	trans-1,2-Dichloroethene	180	EJ	UG/L		1.48E+00	1.80E+00
10061-02-6	trans-1,3-Dichloropropene	2500	U	UG/L	3.09E-02	2.88E+02	
79-01-6	Trichloroethylene (TCE)	54000		UG/L	3.29E-02	1.48E+03	1.08E+04
75-01-4	Vinyl chloride	53	EJ	UG/L	2.68E-03		2.65E+01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		5.14E-02	1.43E-01
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		2.70E-02	1.67E-02
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		1.83E+00	
106-46-7	1,4-Dichlorobenzene	10	U	UG/L	1.99E-05	5.48E-02	1.33E-01
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		1.37E-02	
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L	1.64E-06		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		9.13E-02	
105-67-9	2,4-Dimethylphenol	10	U	UG/L		1.37E-02	
51-28-5	2,4-Dinitrophenol	50	U	UG/L		6.85E-01	
91-58-7	2-Chloronaphthalene	10	U	UG/L		2.05E-02	
95-57-8	2-Chlorophenol	10	U	UG/L		3.29E-01	
91-57-6	2-Methylnaphthalene	10	U	UG/L		5.48E-02	
95-48-7	2-Methylphenol	10	U	UG/L		5.48E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect

J = Estimated U = Nondetect

TABLE 4-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
88-74-4	2-Nitroaniline	50	U	UG/L		2.40E+01	
88-75-5	2-Nitrophenol	10	U	UG/L		3.42E-02	
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L	1.34E-04		
99-09-2	3-Nitroaniline	50	U	UG/L		2.40E+01	
101-14-4	4,4'-Methylene bis(2-chloroaniline)	10	U	UG/L	1.93E-05	3.91E-01	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L			
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L			
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		5.48E-03	
106-47-8	4-Chloroaniline	20	U	UG/L		1.37E-01	
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L			
106-44-5	4-Methylphenol	10	U	UG/L		5.48E-02	
100-01-6	4-Nitroaniline	50	U	UG/L		2.40E+01	
100-02-7	4-Nitrophenol	50	U	UG/L		1.71E-01	
83-32-9	Acenaphthene	10	U	UG/L		2.74E-02	
208-96-8	Acenaphthylene	10	U	UG/L		5.48E-02	
120-12-7	Anthracene	10	U	UG/L		5.48E-03	
56-55-3	Benzo(a)anthracene	10	U	UG/L	1.09E-04		
50-32-8	Benzo(a)pyrene	10	U	UG/L	1.09E-03		5.00E+01
205-99-2	Benzo(b)fluoranthene	10	U	UG/L	1.09E-04		
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		5.48E-02	
207-08-9	Benzo(k)fluoranthene	10	U	UG/L	1.09E-05		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L			
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L	1.02E-03		
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L	3.64E-05	4.11E-02	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	9.4	J	UG/L	1.96E-06	1.29E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
85-68-7	Butyl benzyl phthalate	10	U	UG/L		1.37E-03	
86-74-8	Carbazole	10	U	UG/L	2.97E-06		
218-01-9	Chrysene	10	U	UG/L	1.09E-06		
84-74-2	Di-n-butyl phthalate	10	U	UG/L		2.74E-03	
117-84-0	Di-n-octyl phthalate	10	U	UG/L		1.37E-02	
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L	1.09E-03		
132-64-9	Dibenzofuran	10	U	UG/L		4.11E-01	
84-66-2	Diethyl phthalate	10	U	UG/L		3.42E-04	
131-11-3	Dimethyl phthalate	10	U	UG/L		2.74E-05	
206-44-0	Fluoranthene	10	U	UG/L		6.85E-03	
86-73-7	Fluorene	10	U	UG/L		4.11E-02	
118-74-1	Hexachlorobenzene	10	U	UG/L	2.38E-04	3.42E-01	1.00E+01
87-68-3	Hexachlorobutadiene	10	U	UG/L	1.16E-05	1.37E+00	
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		3.91E-02	2.00E-01
67-72-1	Hexachloroethane	10	U	UG/L	2.08E-06	2.74E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L	1.09E-04		
78-59-1	Isophorone	10	U	UG/L	1.41E-07	1.37E-03	
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L	1.04E-03		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L	7.29E-07		
91-20-3	Naphthalene	10	U	UG/L		1.61E+00	
87-86-5	Pentachlorophenol	50	U	UG/L	8.92E-05	4.57E-02	5.00E+01
85-01-8	Phenanthrene	10	U	UG/L		5.48E-02	
108-95-2	Phenol	10	U	UG/L		4.57E-04	1.00E-01
129-00-0	Pyrene	10	U	UG/L		5.48E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Explosives							
99-35-4	1,3,5-Trinitrobenzene	0.25	U	UG/L		2.28E-04	
99-65-0	1,3-Dinitrobenzene	0.25	U	UG/L		6.85E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L	2.23E-07	2.74E-02	
121-14-2	2,4-Dinitrotoluene	0.25	U	UG/L		3.42E-03	
606-20-2	2,6-Dinitrotoluene	0.5	U	UG/L		1.37E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L			
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L			
99-08-1	3-Nitrotoluene	0.5	U	UG/L		8.22E-03	
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L			
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		8.22E-03	
2691-41-0	HMX	0.5	U	UG/L		2.74E-04	
98-95-3	Nitrobenzene	0.25	U	UG/L		7.36E-02	
55-63-0	Nitroglycerin	1	U	UG/L	2.08E-07		
78-11-5	Pentaerythritol tetranitrate (PETN)	2	U	UG/L			
121-82-4	RDX	0.5	U	UG/L	8.18E-07	4.57E-03	
479-45-8	Tetryl	0.75	U	UG/L		2.05E-03	
Metals							
7429-90-5	Aluminum	9130		UG/L		2.50E-01	
7440-36-0	Antimony	2.3	J	UG/L		1.58E-01	3.83E-01
7440-38-2	Arsenic	10	U	UG/L	2.23E-04	9.13E-01	2.00E-01
7440-39-3	Barium	117	J	UG/L		4.58E-02	5.85E-02
7440-41-7	Beryllium	5	U	UG/L		6.85E-02	1.25E+00
7440-42-8	Boron	14.1	J	UG/L		4.29E-03	7.05E-03
7440-43-9	Cadmium	5	U	UG/L		2.74E-01	1.00E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
7440-70-2	Calcium	269000		UG/L			
7440-47-3	Chromium	12.8		UG/L			1.28E-01
7440-48-4	Cobalt	50	U	UG/L		2.28E-02	5.00E-02
7440-50-8	Copper	5.8	J	UG/L		4.28E-03	8.92E-03
7439-89-6	Iron	10700		UG/L		9.77E-01	2.14E+00
7439-92-1	Lead	3.4		UG/L			4.53E-01
7439-95-4	Magnesium	107000		UG/L			
7439-96-5	Manganese	948		UG/L		1.08E+00	6.32E+00
7439-97-6	Mercury	0.13	J	UG/L			6.50E-02
7440-02-0	Nickel	10.9		UG/L		1.49E-02	1.09E-01
2023695	Potassium	2960		UG/L			
7782-49-2	Selenium	5	U	UG/L		2.74E-02	1.00E-01
7440-22-4	Silver	10	U	UG/L		5.48E-02	2.00E-01
7440-23-5	Sodium	286000		UG/L			
7440-28-0	Thallium	3.4	J	UG/L		1.33E+00	1.70E+00
7440-62-2	Vanadium	14.8	J	UG/L		5.79E-02	
7440-66-6	Zinc	36.6		UG/L		3.34E-03	7.32E-03
Other Parameters							
ALK	Alkalinity, Total (as CaCO3)	670	J	MG/L			
7664-41-7	Nitrogen, Ammonia (as N)	0.13		MG/L			
Nitrate+Nitrite	Nitrogen, Nitrate-Nitrite	0.34	J	MG/L		3.40E-01	3.40E-01
7601-90-3	Perchlorate	500	U	UG/L		2.74E+01	
7723-14-0	Phosphorus, Total (as P)	0.14		MG/L		1.92E+02	
TDS	TDS	2080		MG/L			1.73E+00
TSS	TSS	84.5		MG/L			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 4-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
Semivolatile Organic Compounds						
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		
106-46-7	1,4-Dichlorobenzene	10	U	UG/L		
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		
105-67-9	2,4-Dimethylphenol	10	U	UG/L		
51-28-5	2,4-Dinitrophenol	50	U	UG/L		
91-58-7	2-Chloronaphthalene	10	U	UG/L		
95-57-8	2-Chlorophenol	10	U	UG/L		
91-57-6	2-Methylnaphthalene	10	U	UG/L		2.86E-03
95-48-7	2-Methylphenol	10	U	UG/L		
88-74-4	2-Nitroaniline	50	U	UG/L		
88-75-5	2-Nitrophenol	10	U	UG/L		
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L		
99-09-2	3-Nitroaniline	50	U	UG/L		
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L		
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L		
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		
106-47-8	4-Chloroaniline	20	U	UG/L		
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L		
106-44-5	4-Methylphenol	10	U	UG/L		
100-01-6	4-Nitroaniline	50	U	UG/L		
100-02-7	4-Nitrophenol	50	U	UG/L		
83-32-9	Acenaphthene	10	U	UG/L		
208-96-8	Acenaphthylene	10	U	UG/L		2.86E-03
120-12-7	Anthracene	10	U	UG/L		2.86E-04
56-55-3	Benzo(a)anthracene	10	U	UG/L		1.00E+02
50-32-8	Benzo(a)pyrene	10	U	UG/L		1.00E+03
205-99-2	Benzo(b)fluoranthene	10	U	UG/L		1.00E+02
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		2.86E-03
207-08-9	Benzo(k)fluoranthene	10	U	UG/L		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L		
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L		
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L		
85-68-7	Butyl benzyl phthalate	10	U	UG/L		
86-74-8	Carbazole	10	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
218-01-9	Chrysene	10	U	UG/L		1.00E+00
84-74-2	Di-n-butyl phthalate	10	U	UG/L		
117-84-0	Di-n-octyl phthalate	10	U	UG/L		
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L		
132-64-9	Dibenzofuran	10	U	UG/L		
84-66-2	Diethyl phthalate	10	U	UG/L		
131-11-3	Dimethyl phthalate	10	U	UG/L		
206-44-0	Fluoranthene	10	U	UG/L		8.33E-02
86-73-7	Fluorene	10	U	UG/L		2.22E-03
118-74-1	Hexachlorobenzene	10	U	UG/L		
87-68-3	Hexachlorobutadiene	10	U	UG/L		
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		
67-72-1	Hexachloroethane	10	U	UG/L		
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L		1.00E+02
78-59-1	Isophorone	10	U	UG/L		
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L		
91-20-3	Naphthalene	10	U	UG/L		
87-86-5	Pentachlorophenol	50	U	UG/L		
85-01-8	Phenanthrene	10	U	UG/L		2.86E-03
108-95-2	Phenol	10	U	UG/L	1.00E+00	1.00E-01
129-00-0	Pyrene	10	U	UG/L		2.86E-03
Explosives						
99-35-4	1,3,5-Trinitrobenzene	0.25	UJ	UG/L		
99-65-0	1,3-Dinitrobenzene	0.25	UJ	UG/L		
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	UJ	UG/L		
121-14-2	2,4-Dinitrotoluene	0.25	UJ	UG/L		
606-20-2	2,6-Dinitrotoluene	0.5	UJ	UG/L		
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	UJ	UG/L		
88-72-2	2-Nitrotoluene (ONT)	0.5	UJ	UG/L		
99-08-1	3-Nitrotoluene	0.5	UJ	UG/L		
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	UJ	UG/L		
99-99-0	4-Nitrotoluene (PNT)	0.5	UJ	UG/L		
2691-41-0	HMX	0.5	UJ	UG/L		
98-95-3	Nitrobenzene	0.25	UJ	UG/L		
121-82-4	RDX	1.8	J	UG/L		
479-45-8	Tetryl	0.75	UJ	UG/L		
Metals						
7429-90-5	Aluminum	2720	J	UG/L	1.36E+01	
7440-36-0	Antimony	6	U	UG/L	1.00E+00	

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J = Estimated U = Nondetect

TABLE 4-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
7440-38-2	Arsenic	3	J	UG/L	3.00E-01	
7440-39-3	Barium	65.9	J	UG/L	2.90E+00	1.32E-02
7440-41-7	Beryllium	5	U	UG/L	1.00E+00	
7440-42-8	Boron	100	U	UG/L		1.00E-01
7440-43-9	Cadmium	5	U	UG/L	1.00E+00	
7440-70-2	Calcium	33100		UG/L	4.60E+00	
7440-47-3	Chromium	2.4	J	UG/L	2.40E-01	
7440-48-4	Cobalt	50	U	UG/L	1.00E+00	
7440-50-8	Copper	10	U	UG/L	1.00E+00	
7439-89-6	Iron	2290	J	UG/L	2.29E+01	2.29E+00
7439-92-1	Lead	3	U	UG/L	1.50E+00	
7439-95-4	Magnesium	10700		UG/L	4.22E+00	
7439-96-5	Manganese	42	U	UG/L	7.22E-02	4.20E-02
7439-97-6	Mercury	0.2	U	UG/L	1.00E+00	1.67E+01
7440-02-0	Nickel	10	U	UG/L	1.00E+00	1.00E-02
2023695	Potassium	1870		UG/L	1.16E+00	
7782-49-2	Selenium	2.5	J	UG/L	9.26E-01	2.50E-03
7440-22-4	Silver	10	U	UG/L	1.00E+00	2.00E+00
7440-23-5	Sodium	20900		UG/L	6.60E+00	
7440-28-0	Thallium	10	U	UG/L	1.00E+00	
7440-62-2	Vanadium	50	U	UG/L	1.00E+00	
7440-66-6	Zinc	20	U	UG/L	1.00E+00	2.00E-02
Other Parameters						
7601-90-3	Perchlorate	500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		10	U	UG/KG	3.36E-04	
79-34-5	1,1,2,2-Tetrachloroethane		10	U	UG/KG	7.86E-02	
79-00-5	1,1,2-Trichloroethane		10	U	UG/KG	3.50E-04	
75-34-3	1,1-Dichloroethane		10	U	UG/KG	4.98E-04	
75-35-4	1,1-Dichloroethene		10	U	UG/KG	1.21E-03	
107-06-2	1,2-Dichloroethane (EDC)		10	U	UG/KG	4.72E-04	
540-59-0	1,2-Dichloroethene (total)		230		UG/KG	2.92E-01	
78-87-5	1,2-Dichloropropane		10	U	UG/KG	1.43E-05	
78-93-3	2-Butanone (MEK)		1200	J	UG/KG	1.34E-02	
591-78-6	2-Hexanone		19	U	UG/KG	1.51E-03	
108-10-1	4-Methyl-2-pentanone (MIBK)		19	U	UG/KG	4.29E-05	
67-64-1	Acetone		34	J	UG/KG	1.36E-02	
71-43-2	Benzene		10	U	UG/KG	6.25E-04	
75-27-4	Bromodichloromethane		10	U	UG/KG	1.85E-02	
75-25-2	Bromoform		10	U	UG/KG	6.29E-04	
74-83-9	Bromomethane		10	U	UG/KG	4.25E-02	
75-15-0	Carbon disulfide		10	U	UG/KG	1.06E-01	
56-23-5	Carbon tetrachloride		10	U	UG/KG	1.00E-05	
108-90-7	Chlorobenzene		10	U	UG/KG	2.50E-04	
75-00-3	Chloroethane		10	U	UG/KG		
67-66-3	Chloroform		10	U	UG/KG	8.40E-03	
74-87-3	Chloromethane		10	U	UG/KG	9.62E-04	
156-59-2	cis-1,2-Dichloroethene		220		UG/KG	2.79E-01	
10061-01-5	cis-1,3-Dichloropropene		10	U	UG/KG	2.51E-02	
124-48-1	Dibromochloromethane		10	U	UG/KG	4.88E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
100-41-4	Ethylbenzene		10	U	UG/KG	2.00E-03	
75-09-2	Methylene chloride		11	U	UG/KG	2.72E-03	
110-54-3	N-Hexane		16		UG/KG		
100-42-5	Styrene		10	U	UG/KG	3.33E-05	
127-18-4	Tetrachloroethylene (PCE)		810	J	UG/KG	6.23E-02	
108-88-3	Toluene		2	J	UG/KG	6.67E-04	
1330-20-7	total Xylenes		10	U	UG/KG	1.67E-02	
156-60-5	trans-1,2-Dichloroethene		10	U	UG/KG	1.27E-02	
10061-02-6	trans-1,3-Dichloropropene		10	U	UG/KG	2.51E-02	
79-01-6	Trichloroethylene (TCE)		920	J	UG/KG	1.02E-01	
75-01-4	Vinyl chloride		10	U	UG/KG	1.55E-02	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		710	U	UG/KG	3.55E-02	
95-50-1	1,2-Dichlorobenzene		710	U	UG/KG	2.40E-01	
541-73-1	1,3-Dichlorobenzene		710	U	UG/KG	1.88E-02	
106-46-7	1,4-Dichlorobenzene		710	U	UG/KG	3.55E-02	
95-95-4	2,4,5-Trichlorophenol		3500	U	UG/KG	8.75E-01	
88-06-2	2,4,6-Trichlorophenol		710	U	UG/KG	7.10E-02	
120-83-2	2,4-Dichlorophenol		710	U	UG/KG	8.11E-03	
105-67-9	2,4-Dimethylphenol		710	U	UG/KG	7.10E+01	
51-28-5	2,4-Dinitrophenol		3500	UJ	UG/KG	1.75E-01	
91-58-7	2-Chloronaphthalene		710	U	UG/KG	5.83E+01	
95-57-8	2-Chlorophenol		710	U	UG/KG	2.93E+00	
91-57-6	2-Methylnaphthalene		7100		UG/KG	2.19E+00	YES
95-48-7	2-Methylphenol		710	U	UG/KG	1.76E-02	
88-74-4	2-Nitroaniline		3500	U	UG/KG	4.72E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
88-75-5	2-Nitrophenol		710	U	UG/KG	4.44E-01	
91-94-1	3,3'-Dichlorobenzidine		1000	U	UG/KG	1.55E+00	
99-09-2	3-Nitroaniline		3500	U	UG/KG	1.11E+00	
101-14-4	4,4'-Methylene bis(2-chloroaniline)		620	U	UG/KG		
534-52-1	4,6-Dinitro-2-methylphenol		3500	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		710	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		710	U	UG/KG	8.93E-02	
106-47-8	4-Chloroaniline		1400	U	UG/KG	1.27E+00	
7005-72-3	4-Chlorophenyl phenyl ether		710	U	UG/KG		
106-44-5	4-Methylphenol		710	U	UG/KG	4.36E-03	
100-01-6	4-Nitroaniline		3500	U	UG/KG	1.60E-01	
100-02-7	4-Nitrophenol		3500	U	UG/KG	5.00E-01	
83-32-9	Acenaphthene		520		UG/KG	7.62E-04	YES
208-96-8	Acenaphthylene		710	U	UG/KG	1.04E-03	
120-12-7	Anthracene		1200		UG/KG	8.11E-04	YES
56-55-3	Benzo(a)anthracene		4800		UG/KG	9.21E-01	YES
50-32-8	Benzo(a)pyrene		4800		UG/KG	1.09E-03	YES
205-99-2	Benzo(b)fluoranthene		5200		UG/KG	8.70E-02	YES
191-24-2	Benzo(g,h,i)perylene		2300		UG/KG	1.93E-02	YES
207-08-9	Benzo(k)fluoranthene		4400		UG/KG	7.36E-02	YES
111-91-1	bis(2-Chloroethoxy)methane		710	U	UG/KG	2.34E+00	
111-44-4	bis(2-Chloroethyl) ether		710	U	UG/KG	3.00E-02	
108-60-1	bis(2-Chloroisopropyl) ether		710	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		11000		UG/KG	1.19E+01	YES
85-68-7	Butyl benzyl phthalate		5900	J	UG/KG	2.47E+01	YES
86-74-8	Carbazole		620		UG/KG		YES

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
218-01-9	Chrysene		5500		UG/KG	1.16E+00	YES
84-74-2	Di-n-butyl phthalate		220	J	UG/KG	1.10E-03	YES
117-84-0	Di-n-octyl phthalate		710	U	UG/KG	1.00E-03	
53-70-3	Dibenz(a,h)anthracene		1200		UG/KG	6.52E-02	YES
132-64-9	Dibenzofuran		2700		UG/KG		YES
84-66-2	Diethyl phthalate		710	U	UG/KG	7.10E-03	
131-11-3	Dimethyl phthalate		2500		UG/KG	1.25E-02	
206-44-0	Fluoranthene		7100		UG/KG	5.82E-02	YES
86-73-7	Fluorene		430	J	UG/KG	1.43E-02	YES
118-74-1	Hexachlorobenzene		710	U	UG/KG	7.10E-04	
87-68-3	Hexachlorobutadiene		710	U	UG/KG	1.79E+01	
77-47-4	Hexachlorocyclopentadiene		710	UJ	UG/KG	7.10E-02	
67-72-1	Hexachloroethane		710	U	UG/KG	1.19E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		2100		UG/KG	1.93E-02	YES
78-59-1	Isophorone		710	U	UG/KG	5.11E-03	
621-64-7	N-Nitroso-di-n-propylamine		710	U	UG/KG	1.31E+00	
86-30-6	N-Nitrosodiphenylamine		710	U	UG/KG	3.55E-02	
91-20-3	Naphthalene		2800		UG/KG	1.12E-02	
87-86-5	Pentachlorophenol		92	J	UG/KG	1.53E-02	YES
85-01-8	Phenanthrene		6500		UG/KG	1.42E-01	YES
108-95-2	Phenol		100	J	UG/KG	2.50E-03	
129-00-0	Pyrene		6800		UG/KG	8.66E-02	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		530	U	UG/KG	1.41E+00	
99-65-0	1,3-Dinitrobenzene		530	U	UG/KG	8.10E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		1100	U	UG/KG	3.67E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
121-14-2	2,4-Dinitrotoluene		530	U	UG/KG	4.14E-01	
606-20-2	2,6-Dinitrotoluene		750	U	UG/KG	2.28E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		1100	U	UG/KG	1.38E-02	
88-72-2	2-Nitrotoluene (ONT)		1100	U	UG/KG		
99-08-1	3-Nitrotoluene		1100	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		1100	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		1100	U	UG/KG		
2691-41-0	HMX		6000	J	UG/KG	2.40E-01	
98-95-3	Nitrobenzene		530	U	UG/KG	1.33E-02	
55-63-0	Nitroglycerin		5300		UG/KG		
78-11-5	Pentaerythritol tetranitrate (PETN)		3700	UJ	UG/KG		
121-82-4	RDX		76000		UG/KG	7.60E-01	
479-45-8	Tetryl		1600	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	19100	J	MG/KG		
7440-36-0	Antimony	0.83	5.3		MG/KG	1.06E+00	
7440-38-2	Arsenic	13.5	120		MG/KG	1.33E+01	
7440-39-3	Barium	195	302		MG/KG	6.04E-01	
7440-41-7	Beryllium	0.76	1.1		MG/KG	1.10E-01	
7440-42-8	Boron	5.3	2460		MG/KG	4.92E+03	
7440-43-9	Cadmium	0.19	2.3		MG/KG	7.93E-02	
7440-70-2	Calcium	2497	133000		MG/KG		
7440-47-3	Chromium	25.2	96.8		MG/KG	1.94E+01	
7440-48-4	Cobalt	21.7	15		MG/KG	7.50E-01	
7440-50-8	Copper	11.3	937		MG/KG	3.02E+01	
57-12-5	Cyanide, Total	0.41	0.88		MG/KG	9.78E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 4-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7439-89-6	Iron	19306	22600		MG/KG	1.13E+02	
7439-92-1	Lead	23.4	372		MG/KG	8.59E-01	
7439-95-4	Magnesium	1552	40800		MG/KG		
7439-96-5	Manganese	3640	2370		MG/KG	2.37E+01	
7439-97-6	Mercury	0.06	0.19	J	MG/KG	2.71E-02	YES
7440-02-0	Nickel	18.9	24.3		MG/KG	8.10E-01	
2023695	Potassium	625	2240		MG/KG		
7782-49-2	Selenium	2.34	2.2		MG/KG	2.20E+00	YES
7440-22-4	Silver	0.58	40.3		MG/KG	2.02E+01	
7440-23-5	Sodium	170	656		MG/KG		
7440-28-0	Thallium	0.41	0.26	J	MG/KG	2.60E-01	
7440-62-2	Vanadium	47.2	46.3		MG/KG	1.01E+00	
7440-66-6	Zinc	51.4	1060		MG/KG	8.83E+00	
Dioxins							
1746-01-6	2,3,7,8-TCDD		0.000595	XJ	UG/KG	1.19E-07	YES
Other Parameters							
7601-90-3	Perchlorate		9300	U	UG/KG		
7723-14-0	Phosphorus, Total (as P)		891		MG/KG		
TOC	TOC	31393	87000		MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect X = Estimated Maximum Possible Concentration

TABLE 4-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		10	U	UG/L	2.23E-01	
95-50-1	1,2-Dichlorobenzene		10	U	UG/L	7.14E-01	
541-73-1	1,3-Dichlorobenzene		10	U	UG/L	1.99E-01	
106-46-7	1,4-Dichlorobenzene		10	U	UG/L	8.93E-01	
95-95-4	2,4,5-Trichlorophenol		50	U	UG/L	7.94E-01	
88-06-2	2,4,6-Trichlorophenol		10	U	UG/L	3.13E+00	
120-83-2	2,4-Dichlorophenol		10	U	UG/L	2.74E-01	
105-67-9	2,4-Dimethylphenol		10	U	UG/L	4.72E-01	
51-28-5	2,4-Dinitrophenol		50	U	UG/L	8.06E+00	
91-58-7	2-Chloronaphthalene		10	U	UG/L	3.23E-02	
95-57-8	2-Chlorophenol		10	U	UG/L	2.28E-01	
91-57-6	2-Methylnaphthalene		10	U	UG/L	2.40E-02	
95-48-7	2-Methylphenol		10	U	UG/L	7.69E-01	
88-74-4	2-Nitroaniline		50	U	UG/L	2.16E-03	
88-75-5	2-Nitrophenol		10	U	UG/L	2.90E-03	
91-94-1	3,3'-Dichlorobenzidine		20	U	UG/L	1.90E-01	
99-09-2	3-Nitroaniline		50	U	UG/L	7.32E-04	
534-52-1	4,6-Dinitro-2-methylphenol		50	U	UG/L	2.17E+01	
101-55-3	4-Bromophenyl phenyl ether		10	U	UG/L	6.67E+00	
59-50-7	4-Chloro-3-methylphenol		10	U	UG/L	3.33E+01	
106-47-8	4-Chloroaniline		20	U	UG/L	8.89E-03	
7005-72-3	4-Chlorophenyl phenyl ether		10	U	UG/L	2.17E-01	
106-44-5	4-Methylphenol		10	U	UG/L	4.44E-03	
100-01-6	4-Nitroaniline		50	U	UG/L	1.08E-03	
100-02-7	4-Nitrophenol		50	U	UG/L	6.04E-01	
83-32-9	Acenaphthene		10	U	UG/L	5.88E-01	
208-96-8	Acenaphthylene		10	U	UG/L	1.50E-02	
120-12-7	Anthracene		10	U	UG/L	1.67E+00	
56-55-3	Benzo(a)anthracene		10	U	UG/L	3.70E+02	
50-32-8	Benzo(a)pyrene		10	U	UG/L	7.14E+02	
205-99-2	Benzo(b)fluoranthene		10	U	UG/L	1.79E+03	
191-24-2	Benzo(g,h,i)perylene		10	U	UG/L	1.31E+00	
207-08-9	Benzo(k)fluoranthene		10	U	UG/L	1.79E+03	
111-91-1	bis(2-Chloroethoxy)methane		10	U	UG/L	1.56E-03	
111-44-4	bis(2-Chloroethyl) ether		10	U	UG/L	4.20E-03	
108-60-1	bis(2-Chloroisopropyl) ether		10	U	UG/L		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		10	U	UG/L	3.33E+00	
85-68-7	Butyl benzyl phthalate		10	U	UG/L	5.26E-01	
86-74-8	Carbazole		10	U	UG/L	1.12E-02	
218-01-9	Chrysene		10	U	UG/L	6.25E-01	
84-74-2	Di-n-butyl phthalate		10	U	UG/L	1.06E+00	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
117-84-0	Di-n-octyl phthalate		10	U	UG/L	1.41E-02	
53-70-3	Dibenz(a,h)anthracene		10	U	UG/L	6.25E+03	
132-64-9	Dibenzofuran		10	U	UG/L	2.70E+00	
84-66-2	Diethyl phthalate		10	U	UG/L	4.76E-02	
131-11-3	Dimethyl phthalate		10	U	UG/L	3.03E-02	
206-44-0	Fluoranthene		10	U	UG/L	1.23E+00	
86-73-7	Fluorene		10	U	UG/L	2.56E+00	
118-74-1	Hexachlorobenzene		10	U	UG/L	2.72E+00	
87-68-3	Hexachlorobutadiene		10	U	UG/L	1.08E+01	
77-47-4	Hexachlorocyclopentadiene		10	U	UG/L	1.43E+02	
67-72-1	Hexachloroethane		10	U	UG/L	1.02E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		10	U	UG/L	2.32E+00	
78-59-1	Isophorone		10	U	UG/L	8.55E-03	
621-64-7	N-Nitroso-di-n-propylamine		10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine		10	U	UG/L	1.71E-01	
91-20-3	Naphthalene		10	U	UG/L	8.33E-01	
87-86-5	Pentachlorophenol		50	U	UG/L	3.33E+00	
85-01-8	Phenanthrene		10	U	UG/L	1.59E+00	
108-95-2	Phenol	10	10	U	UG/L	1.00E-01	
129-00-0	Pyrene		10	U	UG/L	1.64E-01	
Explosives							
99-35-4	1,3,5-Trinitrobenzene		0.25	UJ	UG/L	8.33E-03	
99-65-0	1,3-Dinitrobenzene		0.25	UJ	UG/L	1.25E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)		0.5	UJ	UG/L	1.25E-02	
121-14-2	2,4-Dinitrotoluene		0.25	UJ	UG/L	1.09E-03	
606-20-2	2,6-Dinitrotoluene		0.5	UJ	UG/L	1.19E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene		0.5	UJ	UG/L	2.50E-02	
88-72-2	2-Nitrotoluene (ONT)		0.5	UJ	UG/L	6.85E-05	
99-08-1	3-Nitrotoluene		0.5	UJ	UG/L	6.02E-05	
19406-51-0	4-Amino-2,6-Dinitrotoluene		0.5	UJ	UG/L	9.26E-04	
99-99-0	4-Nitrotoluene (PNT)		0.5	UJ	UG/L	7.14E-05	
2691-41-0	HMX		0.5	UJ	UG/L	1.52E-03	
98-95-3	Nitrobenzene		0.25	UJ	UG/L	9.26E-04	
121-82-4	RDX		1.8	J	UG/L	9.47E-03	
479-45-8	Tetryl		0.75	UJ	UG/L		
Metals							
7429-90-5	Aluminum	200	2720	J	UG/L	3.13E+01	
7440-36-0	Antimony	6	6	U	UG/L	2.00E-01	
7440-38-2	Arsenic	10	3	J	UG/L	1.58E-02	
7440-39-3	Barium	22.7	65.9	J	UG/L	1.32E-02	
7440-41-7	Beryllium	5	5	U	UG/L	9.43E+00	
7440-42-8	Boron		100	U	UG/L	1.00E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
7440-43-9	Cadmium	5	5	U	UG/L	4.55E+00	
7440-70-2	Calcium	7197	33100		UG/L	2.85E-01	
7440-47-3	Chromium	10	2.4	J	UG/L	1.16E-02	
7440-48-4	Cobalt	50	50	U	UG/L	2.17E+01	
7440-50-8	Copper	10	10	U	UG/L	8.47E-01	
7439-89-6	Iron	100	2290	J	UG/L	2.29E+00	
7439-92-1	Lead	2	3	U	UG/L	1.49E-01	
7439-95-4	Magnesium	2534	10700		UG/L	1.30E-01	
7439-96-5	Manganese	582	42	U	UG/L	4.20E-02	
7439-97-6	Mercury	0.2	0.2	U	UG/L	1.54E-01	
7440-02-0	Nickel	10	10	U	UG/L	1.00E-02	
2023695	Potassium	1613	1870		UG/L	3.53E-02	
7782-49-2	Selenium	2.7	2.5	J	UG/L	2.50E-03	YES
7440-22-4	Silver	10	10	U	UG/L	2.00E+00	
7440-23-5	Sodium	3169	20900		UG/L	3.07E-02	
7440-28-0	Thallium	10	10	U	UG/L	2.50E+00	
7440-62-2	Vanadium	50	50	U	UG/L	2.63E+00	
7440-66-6	Zinc	20	20	U	UG/L	2.00E-02	
Other Parameters							
7601-90-3	Perchlorate		500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 4-13

DIOXIN/FURAN TOXICITY EQUIVALENTS
FOR SOIL SAMPLES FROM AREA 2D (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU

FIELD ID	TEF	AUS-0A2D-002-SS-0X			AUS-0A2D-017-SS-0X			AUS-0A2D-018-SS-0X			AUS-0A2D-028-SS-0X			AUS-0A2D-035-SS-0X			AUS-0A2D-036-SS-0X		
		Result	Qual	*TEQ*	Result	Qual	*TEQ*	Result	Qual	*TEQ*	Result	Qual	*TEQ*	Result	Qual	*TEQ*	Result	Qual	*TEQ*
DIOXINS / FURANS (ng/kg)																			
2,3,7,8-TCDD	**1.000**	<	U		0.0511	J	*0.0511*	<	U		0.595	XJ	*0.5950*	0.189	J	*0.1890*	<	U	
1,2,3,7,8-PeCDD	**1.000**	0.409	XJ	*0.4090*	0.176	XJ	*0.1760*	0.411	J	*0.4110*	2.61	X	*2.6100*	0.527	J	*0.5270*	0.11	XJ	*0.1100*
1,2,3,4,7,8-HxCDD	**0.100**	0.555	J	*0.0555*	0.214	XJ	*0.0214*	0.728	J	*0.0728*	1.88	J	*0.1880*	0.714	J	*0.0714*	0.143	XJ	*0.0143*
1,2,3,6,7,8-HxCDD	**0.100**	1.65	J	*0.1650*	0.873	J	*0.0873*	1.09	J	*0.1090*	3.22		*0.3220*	1.21	J	*0.1210*	0.333	XJ	*0.0333*
1,2,3,7,8,9-HxCDD	**0.100**	1.59	J	*0.1590*	0.505	J	*0.0505*	1.2	J	*0.1200*	2.53		*0.2530*	1.15	J	*0.1150*	0.208	XJ	*0.0208*
1,2,3,4,6,7,8-HpCDD	**0.010**	43.6		*0.4360*	8.8		*0.0880*	50.6		*0.5060*	21.1		*0.2110*	31.7		*0.3170*	9.08		*0.0908*
OCDD	**0.0001**	1360		*0.1360*	549		*0.0549*	4410		*0.4410*	457		*0.0457*	1700		*0.1700*	534		*0.0534*
2,3,7,8--TCDF	**0.100**	<	U		0.182	J	*0.0182*	<	U		10.3		*1.0300*	0.372	J	*0.0372*	<	U	
1,2,3,7,8-PeCDF	**0.050**	0.195	XJ	*0.0098*	<	U		0.0958	J	*0.0048*	16.1		*0.8050*	0.429	J	*0.0215*	<	U	
2,3,4,7,8-PeCDF	**0.500**	<	U		<	U		0.109	J	*0.0545*	25.9		*12.9500*	0.642	J	*0.3210*	<	U	
1,2,3,4,7,8-HxCDF	**0.100**	1.19	J	*0.1190*	0.103	XJ	*0.0103*	0.0937	XJ	*0.0094*	25		*2.5000*	0.535	J	*0.0535*	0.0985	XJ	*0.0099*
1,2,3,6,7,8-HxCDF	**0.100**	0.461	J	*0.0461*	0.0691	XJ	*0.0069*	0.083	J	*0.0083*	23.3		*2.3300*	0.492	J	*0.0492*	0.0716	J	*0.0072*
2,3,4,6,7,8-HxCDF	**0.100**	0.344	J	*0.0344*	0.0942	J	*0.0094*	0.0894	J	*0.0089*	24.4		*2.4400*	0.535	J	*0.0535*	<	U	
1,2,3,7,8,9-HxCDF	**0.100**	0.177	J	*0.0177*	<	U		<	U		7.83		*0.7830*	0.183	J	*0.0183*	<	U	
1,2,3,4,6,7,8-HpCDF	**0.010**	8.63		*0.0863*	1.04	J	*0.0104*	0.73	J	*0.0073*	72.3		*0.7230*	2.61		*0.0261*	0.64	J	*0.0064*
1,2,3,4,7,8,9-HpCDF	**0.010**	0.43	J	*0.0043*	<	U		<	U		11.9		*0.1190*	0.287	J	*0.0029*	<	U	
OCDF	**0.0001**	23.6		*0.0024*	0.597	J	*0.0001*	1.88	J	*0.0002*	48.9		*0.0049*	5.53		*0.0006*	1.54	J	*0.0002*
Total TCDDs		<	U		0.244	J		0.564	J		31			0.834	J		<	U	
Total PeCDDs		0.889	J		0.682	J		2.18	J		34.1			2.37	J		0.302	J	
Total HxCDDs		12.3			7.4	J		12.7			37.2			7.99			2.07	J	
Total HpCDDs		86.2			19.2			114			41.3			68.6			20.4		
Total TCDFs		<	U		1.31			<	U		296			4.96			0.0783	J	
Total PeCDFs		0.764	J		1.01	J		0.641	J		269			4.68	J		0.201	J	
Total HxCDFs		6.96	J		1.26	J		0.792	J		216			5.75	J		0.528	J	
Total HpCDFs		17.7			1.72	J		1.74	J		122			6.79			1.58	J	
TOTAL TEQ				***1.6804***			***0.58449***			***1.75319***			***27.9096***			***2.09407***			***0.34616***

Diluted sample results were used, if available.
E = Value exceeds linear range
EDL = Estimated Detection Limit
J = Estimated
ND = Not Detected
Qual = Qualifier
TEF = Toxic Equivalency Factor
TEQ = Toxicity Equivalent
U = Nondetect
UJ = Estimated Nondetect
X = Estimated Maximum Possible Concentration (EMPC)

TABLE 4-14, AUS-0A2D
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Volatile Organic Compounds								
1,1,1-Trichloroethane	NA	NA	Uncertainty	B	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1,2-Trichloroethane	NA	NA	Yes	E	NA	NA	Uncertainty	B
1,1-Dichloroethane	NA	NA	No	F	NA	NA	No	A
1,1-Dichloroethene	NA	NA	Yes	E	NA	NA	Uncertainty	B
1,2-Dichloroethane (EDC)	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	Yes	E
1,2-Dichloropropane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2-Butanone (MEK)	NA	NA	Uncertainty	B	NA	NA	No	F
2-Hexanone	NA	NA	No	C	NA	NA	No	C
4-Methyl-2-pentanone (MIBK)	NA	NA	Uncertainty	B	NA	NA	No	A
Acetone	NA	NA	Uncertainty	B	NA	NA	No	F
Benzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Bromodichloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Bromoform	NA	NA	Uncertainty	B	NA	NA	No	A
Bromomethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Carbon disulfide	NA	NA	Uncertainty	B	NA	NA	No	A
Carbon tetrachloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Chlorobenzene	NA	NA	Uncertainty	B	NA	NA	No	A
Chloroethane	NA	NA	Uncertainty	B	NA	NA	No	A
Chloroform	NA	NA	Yes	E	NA	NA	No	A
Chloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	Yes	E	NA	NA	Yes	E
cis-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Dibromochloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Ethylbenzene	NA	NA	Uncertainty	B	NA	NA	No	A
Methylene chloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
N-Hexane	NA	NA	Uncertainty	B	NA	NA	No	F
Styrene	NA	NA	Uncertainty	B	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	Yes	E	NA	NA	Yes	E
Toluene	NA	NA	Uncertainty	B	NA	NA	No	F
total Xylenes	NA	NA	Uncertainty	B	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	Yes	E	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	Yes	E	NA	NA	Yes	E
Vinyl chloride	NA	NA	Yes	E	NA	NA	Uncertainty	B
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	No	C	No	A	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	No	C	No	A	NA	NA	No	A
1,3-Dichlorobenzene	No	C	Uncertainty	B	NA	NA	No	A
1,4-Dichlorobenzene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	No	C	No	A	NA	NA	No	A

TABLE 4-14, AUS-0A2D
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trichlorophenol	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2,4-Dichlorophenol	No	C	No	A	NA	NA	Uncertainty	B
2,4-Dimethylphenol	No	C	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	No	C	No	A	NA	NA	Uncertainty	B
2-Chloronaphthalene	No	C	No	A	NA	NA	No	A
2-Chlorophenol	No	C	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	No	A	No	A	NA	NA	No	F
2-Methylphenol	No	C	No	A	NA	NA	No	A
2-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
2-Nitrophenol	No	C	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	No	C	Uncertainty	B	NA	NA	Uncertainty	B
3-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
4,6-Dinitro-2-methylphenol	No	C	No	C	NA	NA	No	C
4-Bromophenyl phenyl ether	No	C	No	C	NA	NA	No	C
4-Chloro-3-methylphenol	No	C	No	A	NA	NA	No	A
4-Chloroaniline	No	C	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	No	C	No	C	NA	NA	No	C
4-Methylphenol	No	C	No	A	NA	NA	No	A
4-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
4-Nitrophenol	No	C	No	A	NA	NA	No	A
Acenaphthene	No	C	No	A	NA	NA	No	F
Acenaphthylene	No	A	No	A	NA	NA	No	A
Anthracene	No	A	No	A	NA	NA	No	F
Benzo(a)anthracene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(b)fluoranthene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	No	A	No	A	NA	NA	No	F
Benzo(k)fluoranthene	No	C	Uncertainty	B	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	No	C	No	C	NA	NA	No	C
bis(2-Chloroethyl) ether	No	C	Uncertainty	B	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	No	C	Uncertainty	B	NA	NA	No	A
bis(2-Ethylhexyl) phthalate	No	C	Yes	E	NA	NA	No	F
Butyl benzyl phthalate	No	C	No	A	NA	NA	No	F
Carbazole	No	C	Uncertainty	B	NA	NA	Yes	E
Chrysene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	J
Di-n-butyl phthalate	No	C	No	A	NA	NA	No	F
Di-n-octyl phthalate	No	C	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	No	C	Uncertainty	B	NA	NA	Yes	E
Dibenzofuran	No	C	No	A	NA	NA	No	F
Diethyl phthalate	No	C	No	A	NA	NA	No	A
Dimethyl phthalate	No	C	No	A	NA	NA	No	F
Fluoranthene	No	A	No	A	NA	NA	No	F

TABLE 4-14, AUS-0A2D
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Fluorene	No	A	No	A	NA	NA	No	F
Hexachlorobenzene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorobutadiene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	No	C	No	A	NA	NA	No	A
Hexachloroethane	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Isophorone	No	C	No	A	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	No	C	Uncertainty	B	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	No	C	No	A	NA	NA	Uncertainty	B
Naphthalene	No	C	Uncertainty	B	NA	NA	No	F
Pentachlorophenol	No	C	Uncertainty	B	NA	NA	Yes	E
Phenanthrene	No	A	No	A	NA	NA	No	F
Phenol	No	A	No	A	NA	NA	No	F
Pyrene	No	A	No	A	NA	NA	No	F
Metals and Inorganics								
Aluminum	Uncertainty	G	No	F	NA	NA	No	F
Antimony	No	C	No	F	NA	NA	Yes	E
Arsenic	Uncertainty	G	Uncertainty	B	NA	NA	Yes	E
Barium	No	F	No	F	NA	NA	Yes	E
Beryllium	No	C	Uncertainty	B	NA	NA	Yes	E
Boron	No	A	No	F	NA	NA	No	F
Cadmium	No	C	Uncertainty	B	NA	NA	Yes	E
Calcium	No	H	No	H	NA	NA	No	H
Chromium	Uncertainty	G	No	F	NA	NA	Yes	E
Cobalt	No	C	No	A	NA	NA	No	F
Copper	No	C	No	F	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	No	F
Iron	Yes	E	Yes	E	NA	NA	No	F
Lead	No	C	No	F	NA	NA	Yes	J
Magnesium	No	H	No	H	NA	NA	No	H
Manganese	No	A	Yes	E	NA	NA	No	F
Mercury	Uncertainty	B	No	F	NA	NA	Yes	E
Nickel	No	A	No	F	NA	NA	Yes	E
Potassium	No	H	No	H	NA	NA	No	H
Selenium	No	F	No	A	NA	NA	Yes	D
Silver	Uncertainty	B	No	A	NA	NA	Yes	E
Sodium	No	H	No	H	NA	NA	No	H
Thallium	No	C	Yes	E	NA	NA	No	F
Vanadium	No	C	No	F	NA	NA	No	F
Zinc	No	A	No	F	NA	NA	Yes	E
Explosives								
1,3,5-Trinitrobenzene	No	C	No	A	NA	NA	No	A
1,3-Dinitrobenzene	No	C	No	A	NA	NA	No	A

TABLE 4-14, AUS-0A2D
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	C	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
2-Nitrotoluene (ONT)	No	C	No	C	NA	NA	No	C
3-Nitrotoluene	No	C	No	A	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
4-Nitrotoluene (PNT)	No	C	No	A	NA	NA	No	A
HMX	No	C	No	A	NA	NA	No	F
Nitrobenzene	No	C	No	A	NA	NA	Uncertainty	B
Nitroglycerin	NA	NA	No	A	NA	NA	No	F
Pentaerythritol tetranitrate (PETN)	NA	NA	No	C	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	Uncertainty	G	No	A	NA	NA	Yes	E
Tetryl	No	C	No	A	NA	NA	No	A
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	No	F	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	Yes	E	NA	NA	Yes	E
Dioxins								
2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA	Uncertainty	G

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceceded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 4-15, AUS-0A2D
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	NA	NA	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	No	A
1,1,2-Trichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethene	NA	NA	NA	NA	No	A
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	No	A
1,2-Dichloroethene (total)	NA	NA	NA	NA	No	F
1,2-Dichloropropane	NA	NA	NA	NA	No	A
2-Butanone (MEK)	NA	NA	NA	NA	No	F
2-Hexanone	NA	NA	NA	NA	No	A
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	No	A
Acetone	NA	NA	NA	NA	No	F
Benzene	NA	NA	NA	NA	No	A
Bromodichloromethane	NA	NA	NA	NA	No	A
Bromoform	NA	NA	NA	NA	No	A
Bromomethane	NA	NA	NA	NA	No	A
Carbon disulfide	NA	NA	NA	NA	No	A
Carbon tetrachloride	NA	NA	NA	NA	No	A
Chlorobenzene	NA	NA	NA	NA	No	A
Chloroethane	NA	NA	NA	NA	No	C
Chloroform	NA	NA	NA	NA	No	A
Chloromethane	NA	NA	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	NA	NA	No	F
cis-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Dibromochloromethane	NA	NA	NA	NA	No	A
Ethylbenzene	NA	NA	NA	NA	No	A
Methylene chloride	NA	NA	NA	NA	No	A
N-Hexane	NA	NA	NA	NA	Uncertainty	G
Styrene	NA	NA	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	NA	NA	No	F
Toluene	NA	NA	NA	NA	No	F
total Xylenes	NA	NA	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	NA	NA	No	F
Vinyl chloride	NA	NA	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	No	A	NA	NA	No	A
1,2-Dichlorobenzene	No	A	NA	NA	No	A
1,3-Dichlorobenzene	No	A	NA	NA	No	A
1,4-Dichlorobenzene	No	A	NA	NA	No	A
2,4,5-Trichlorophenol	No	A	NA	NA	No	A

TABLE 4-15, AUS-0A2D
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trichlorophenol	Uncertainty	B	NA	NA	No	A
2,4-Dichlorophenol	No	A	NA	NA	No	A
2,4-Dimethylphenol	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	Uncertainty	B	NA	NA	No	A
2-Chloronaphthalene	No	A	NA	NA	Uncertainty	B
2-Chlorophenol	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	No	A	NA	NA	Yes	E
2-Methylphenol	No	A	NA	NA	No	A
2-Nitroaniline	No	A	NA	NA	No	A
2-Nitrophenol	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	No	A	NA	NA	Uncertainty	B
3-Nitroaniline	No	A	NA	NA	Uncertainty	B
4,6-Dinitro-2-methylphenol	Uncertainty	B	NA	NA	No	C
4-Bromophenyl phenyl ether	Uncertainty	B	NA	NA	No	C
4-Chloro-3-methylphenol	Uncertainty	B	NA	NA	No	A
4-Chloroaniline	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	No	A	NA	NA	No	C
4-Methylphenol	No	A	NA	NA	No	A
4-Nitroaniline	No	A	NA	NA	No	A
4-Nitrophenol	No	A	NA	NA	No	A
Acenaphthene	No	A	NA	NA	Yes	E
Acenaphthylene	No	A	NA	NA	No	A
Anthracene	Uncertainty	B	NA	NA	Yes	E
Benzo(a)anthracene	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	Uncertainty	B	NA	NA	Yes	E
Benzo(b)fluoranthene	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	Uncertainty	B	NA	NA	Yes	E
Benzo(k)fluoranthene	Uncertainty	B	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	No	A	NA	NA	Uncertainty	B
bis(2-Chloroethyl) ether	No	A	NA	NA	No	A
bis(2-Chloroisopropyl) ether	No	C	NA	NA	No	C
bis(2-Ethylhexyl) phthalate	Uncertainty	B	NA	NA	Yes	E
Butyl benzyl phthalate	No	A	NA	NA	Yes	E
Carbazole	No	A	NA	NA	Yes	E
Chrysene	No	A	NA	NA	Yes	E
Di-n-butyl phthalate	Uncertainty	B	NA	NA	Yes	E
Di-n-octyl phthalate	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	Uncertainty	B	NA	NA	Yes	E
Dibenzofuran	Uncertainty	B	NA	NA	Yes	E
Diethyl phthalate	No	A	NA	NA	No	A
Dimethyl phthalate	No	A	NA	NA	No	F
Fluoranthene	Uncertainty	B	NA	NA	Yes	E

TABLE 4-15, AUS-0A2D
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Fluorene	Uncertainty	B	NA	NA	Yes	E
Hexachlorobenzene	Uncertainty	B	NA	NA	No	A
Hexachlorobutadiene	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	Uncertainty	B	NA	NA	No	A
Hexachloroethane	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	Uncertainty	B	NA	NA	Yes	E
Isophorone	No	A	NA	NA	No	A
N-Nitroso-di-n-propylamine	No	C	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	No	A	NA	NA	No	A
Naphthalene	No	A	NA	NA	No	F
Pentachlorophenol	Uncertainty	B	NA	NA	Yes	E
Phenanthrene	Uncertainty	B	NA	NA	Yes	E
Phenol	No	A	NA	NA	No	F
Pyrene	No	A	NA	NA	Yes	E
Metals and Inorganics						
Aluminum	Yes	E	NA	NA	Uncertainty	I
Antimony	No	A	NA	NA	Yes	E
Arsenic	No	F	NA	NA	Yes	E
Barium	No	F	NA	NA	Yes	J
Beryllium	Uncertainty	B	NA	NA	No	F
Boron	No	A	NA	NA	Yes	E
Cadmium	Uncertainty	B	NA	NA	No	F
Calcium	No	F,H	NA	NA	Uncertainty	G,H
Chromium	No	F	NA	NA	Yes	E
Cobalt	Uncertainty	B	NA	NA	Yes	J
Copper	No	A	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	No	F
Iron	Yes	E	NA	NA	Yes	E
Lead	No	A	NA	NA	Yes	J
Magnesium	No	F,H	NA	NA	Uncertainty	G,H
Manganese	No	A	NA	NA	Yes	D
Mercury	No	A	NA	NA	Yes	E
Nickel	No	A	NA	NA	Yes	J
Potassium	No	F,H	NA	NA	Uncertainty	G,H
Selenium	Yes	D	NA	NA	Yes	D
Silver	Uncertainty	B	NA	NA	Yes	E
Sodium	No	F,H	NA	NA	Uncertainty	G,H
Thallium	Uncertainty	B	NA	NA	No	F
Vanadium	Uncertainty	B	NA	NA	Yes	D
Zinc	No	A	NA	NA	Yes	E
Explosives						
1,3,5-Trinitrobenzene	No	A	NA	NA	Uncertainty	B
1,3-Dinitrobenzene	No	A	NA	NA	No	A

TABLE 4-15, AUS-0A2D
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	A	NA	NA	No	A
2,6-Dinitrotoluene	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	A	NA	NA	No	A
2-Nitrotoluene (ONT)	No	A	NA	NA	No	C
3-Nitrotoluene	No	A	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	No	A	NA	NA	No	C
4-Nitrotoluene (PNT)	No	A	NA	NA	No	C
HMX	No	A	NA	NA	No	F
Nitrobenzene	No	A	NA	NA	No	A
Nitroglycerin	NA	NA	NA	NA	Uncertainty	G
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	No	F	NA	NA	No	F
Tetryl	No	C	NA	NA	No	C
Dioxins						
2,3,7,8-TCDD	NA	NA	NA	NA	Yes	E

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.

J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 4-16
AUS-0A2D - IOP DETONATOR LOADING LINE
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

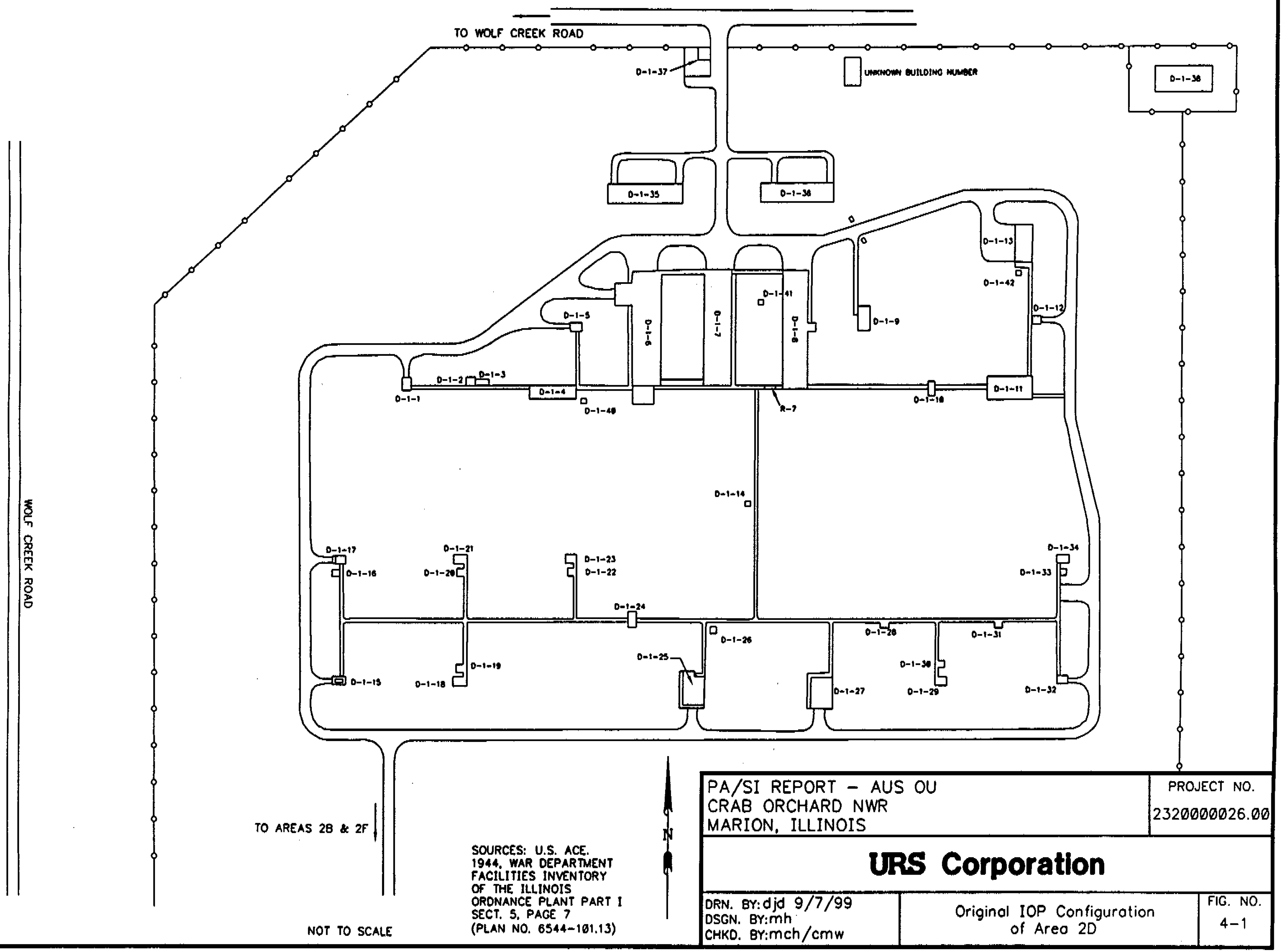
Chemical	Drum[1]	Soil	Sediment	Ground Water	Surface Water
VOCs					
1,1,2-Trichloroethane			NA	H	NA
1,1-Dichloroethene			NA	H	NA
1,2-Dichloroethene (total)		H	NA	NA	NA
Chloroform			NA	H	NA
cis-1,2-Dichloroethene		H	NA	H	NA
Tetrachloroethylene (PCE)		H	NA	H	NA
trans-1,2-Dichloroethene			NA	H	NA
Trichloroethylene (TCE)		H	NA	H	NA
Vinyl chloride			NA	H	NA
SVOCs					
2-Methylnaphthalene		E	NA		
Acenaphthene		E	NA		
Anthracene		E	NA		
Benzo(a)anthracene		H,E	NA		
Benzo(a)pyrene		H,E	NA		
Benzo(b)fluoranthene		H,E	NA		
Benzo(g,h,i)perylene		E	NA		
Benzo(k)fluoranthene		H,E	NA		
bis(2-Ethylhexyl)phthalate		E	NA	H	
Butyl benzyl phthalate		E	NA		
Carbazole		H,E	NA		
Chrysene		H,E	NA		
Di-n-butyl phthalate		E	NA		
Dibenz(a,h)anthracene		H,E	NA		
Dibenzofuran		E	NA		
Fluoranthene		E	NA		
Fluorene		E	NA		
Indeno(1,2,3-c,d)pyrene		H,E	NA		
Pentachlorophenol		H,E	NA		
Phenanthrene		E	NA		
Pyrene		E	NA		
Metals					
Aluminum			NA		E
Antimony		H,E	NA		
Arsenic		H,E	NA		
Barium		H,E	NA		
Beryllium		H	NA		
Boron		E	NA		
Cadmium		H	NA		
Chromium		H,E	NA		
Cobalt		E	NA		
Copper		E	NA		

TABLE 4-16
AUS-0A2D - IOP DETONATOR LOADING LINE
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum[1]	Soil	Sediment	Ground Water	Surface Water
Iron		**E**	NA	**H**	**H,E**
Lead		**H,E**	NA		
Manganese			NA	**H**	
Mercury		**H,E**	NA		
Nickel		**H,E**	NA		
Silver		**H,E**	NA		
Thallium			NA	**H**	
Zinc		**H,E**	NA		
Explosives					
RDX		**H**	NA		
Dioxins					
2,3,7,8-TCDD		**E**	NA	NA	NA
Other Parameters					
Phosphorus, Total (as P)		**H**	NA	**H**	NA

Key:
[1] Drums were not present at this site.
NA = not analyzed
H = human health screening criteria exceeded
E = ecological screening criteria exceeded

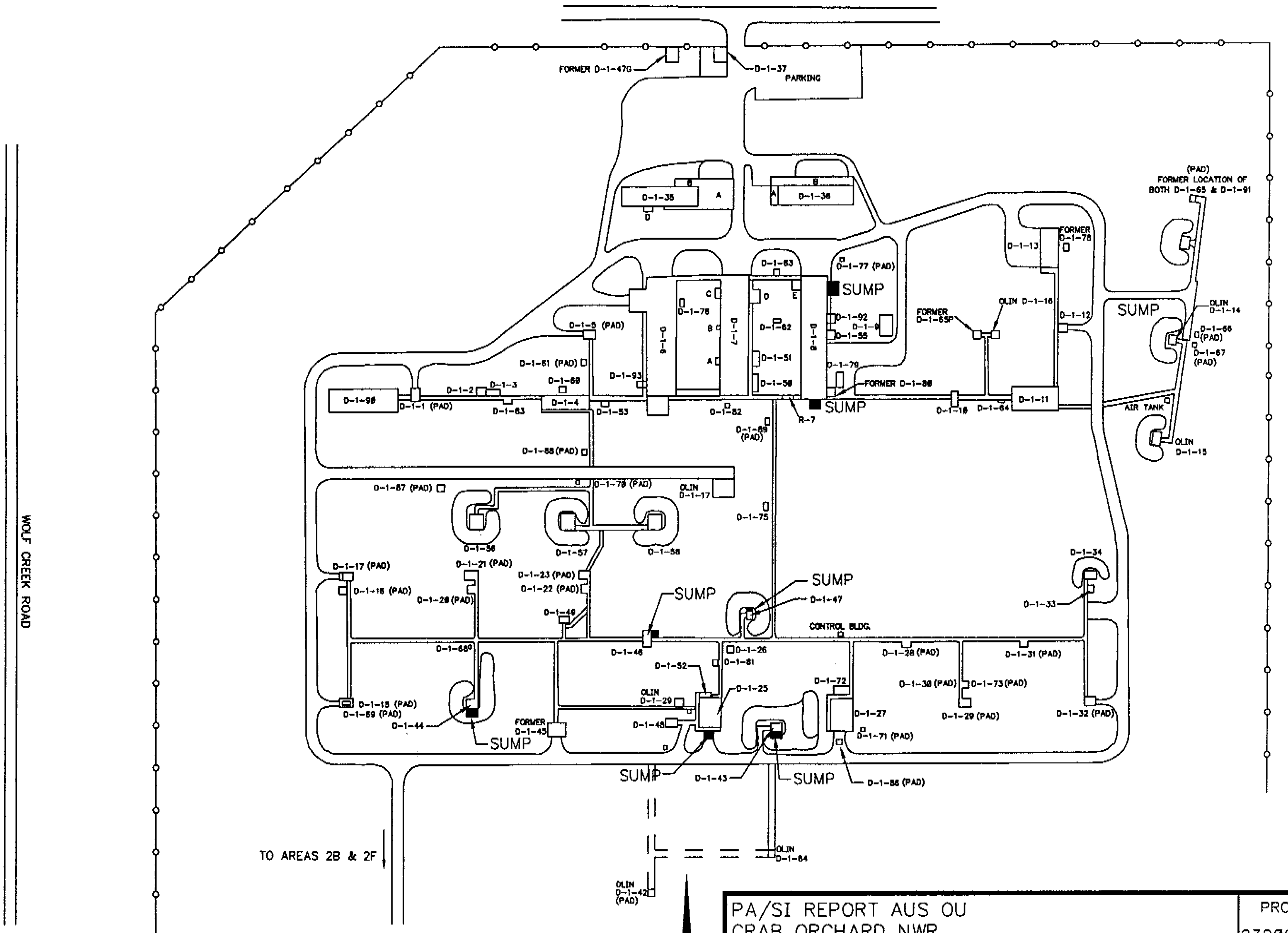


PA/SI REPORT - AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS Corporation

DRN. BY: djd 9/7/99 DSGN. BY: mh CHKD. BY: mch/cmw	Original IOP Configuration of Area 2D	FIG. NO. 4-1

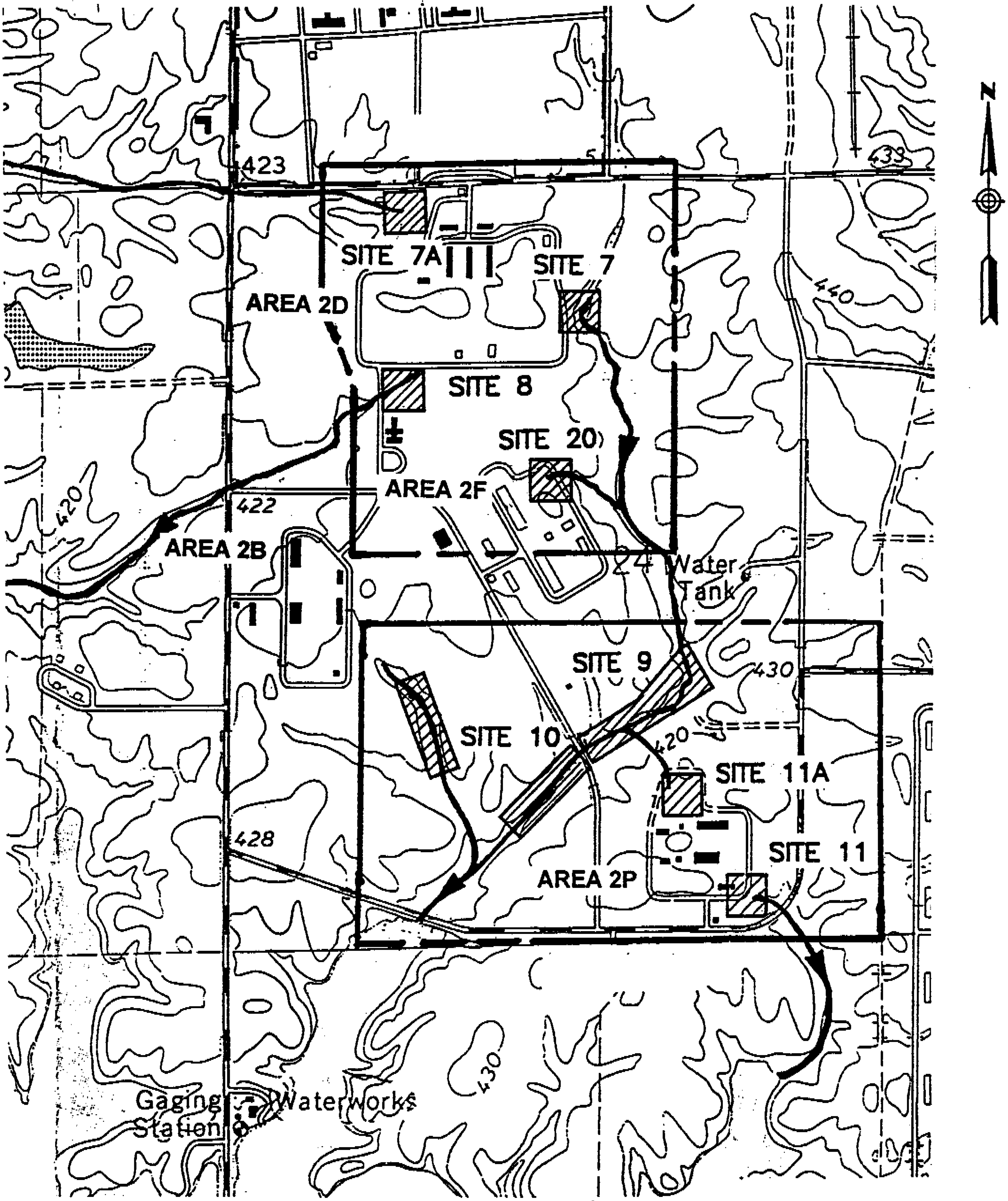
File: E:\2320000026.00\PA-SI REPORT-AUS OU\CRABFIG4-1LS.DWG Last edited: 08/09/01 @ 10:59 a.m. WC-ST.LOUIS, MO



LEGEND

SOURCES: PRI – 016812
PRI – 016722
CO02157

PA/SI REPORT AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 9/7/99 DSGN. BY: mh CHKD. BY: mch/cmw	Area 2D Current Configuration — FIG. NO. 4-2



SOURCE:
USGS QUADRANGLE MAP
CRAB ORCHARD LAKE, ILL.,
1966 (PHOTOREVISED 1978)

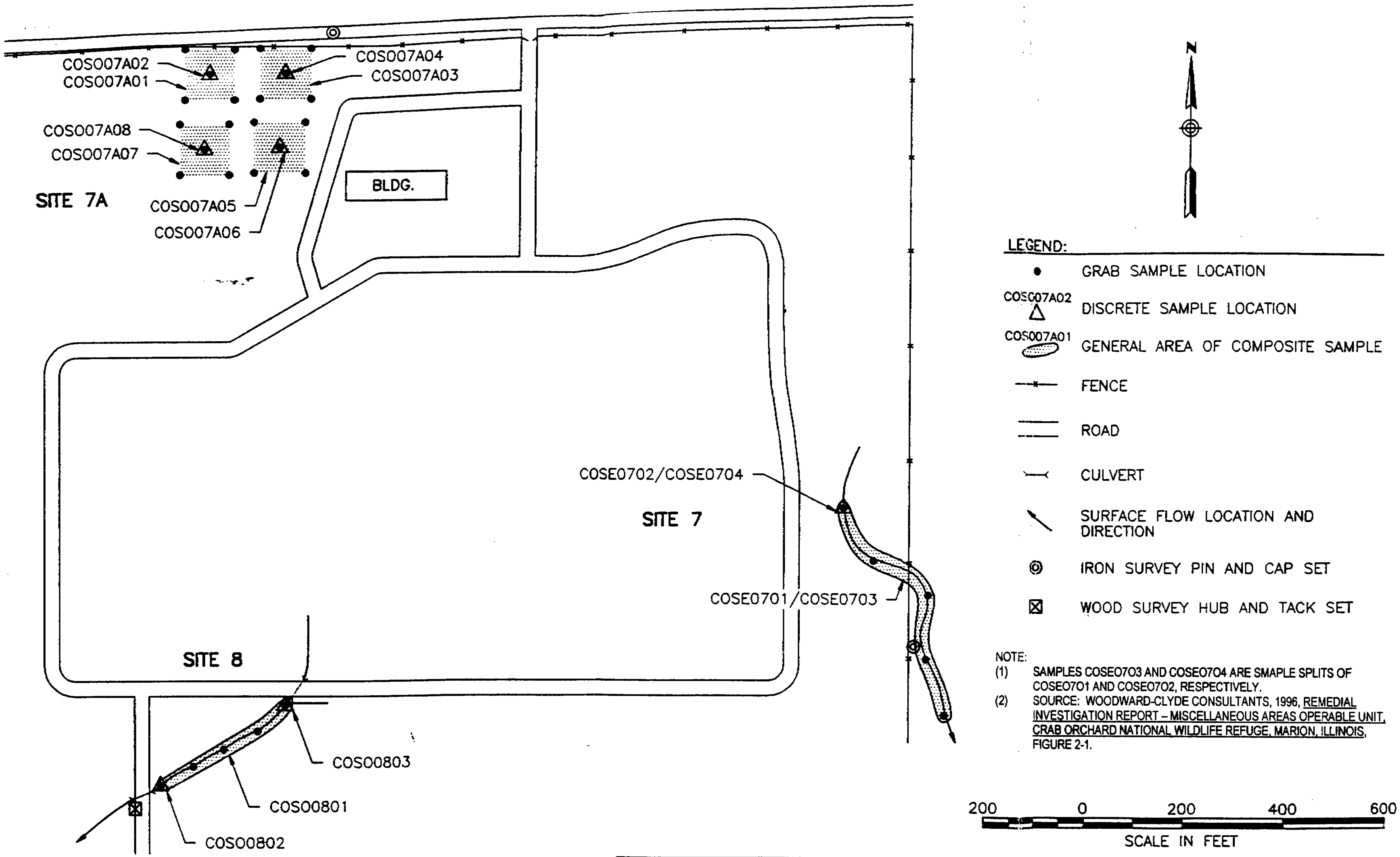
1000 0 1000 2000 3000

SCALE IN FEET

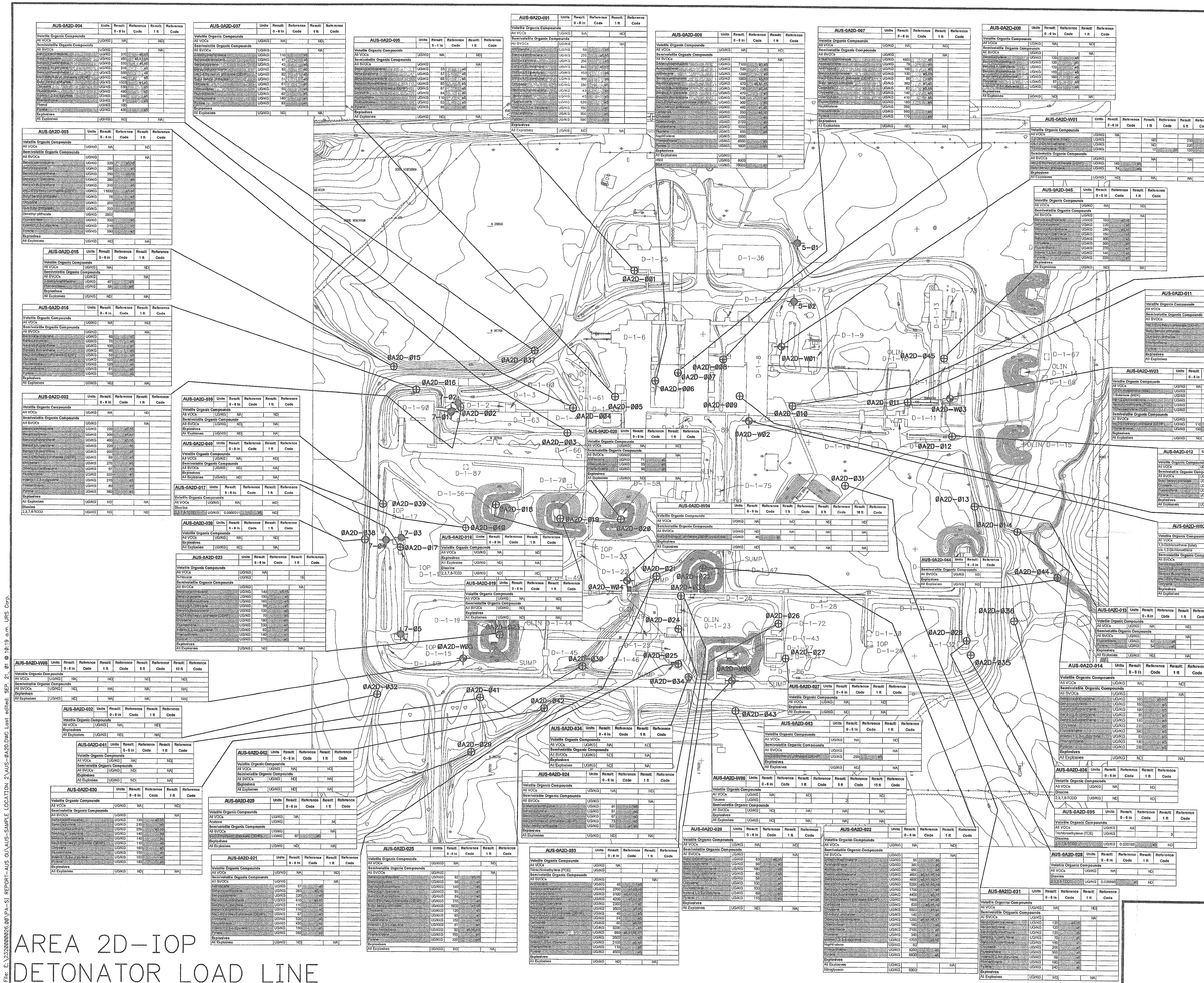
LEGEND:

SURFACE DRAINAGE FROM SITE AREAS

Figure 4-3
MISCA OU Sites in Area 2



CLIENT/PROJECT	TITLE		
W–C/CRAB ORCHARD RI/IL	SITES 7, 7A AND 8 PHASE–I SAMPLE LOCATIONS		
	DRAWN MRM	DATE 2-24-95	JOB NO. 933-8168
	CHECKED 1/6/B	SCALE AS SHOWN	DWG. NO.
	REVIEWED 1/6/B	FILE NAME 8168149	FIGURE NO. 4-3a



LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.

2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES.

3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.

4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

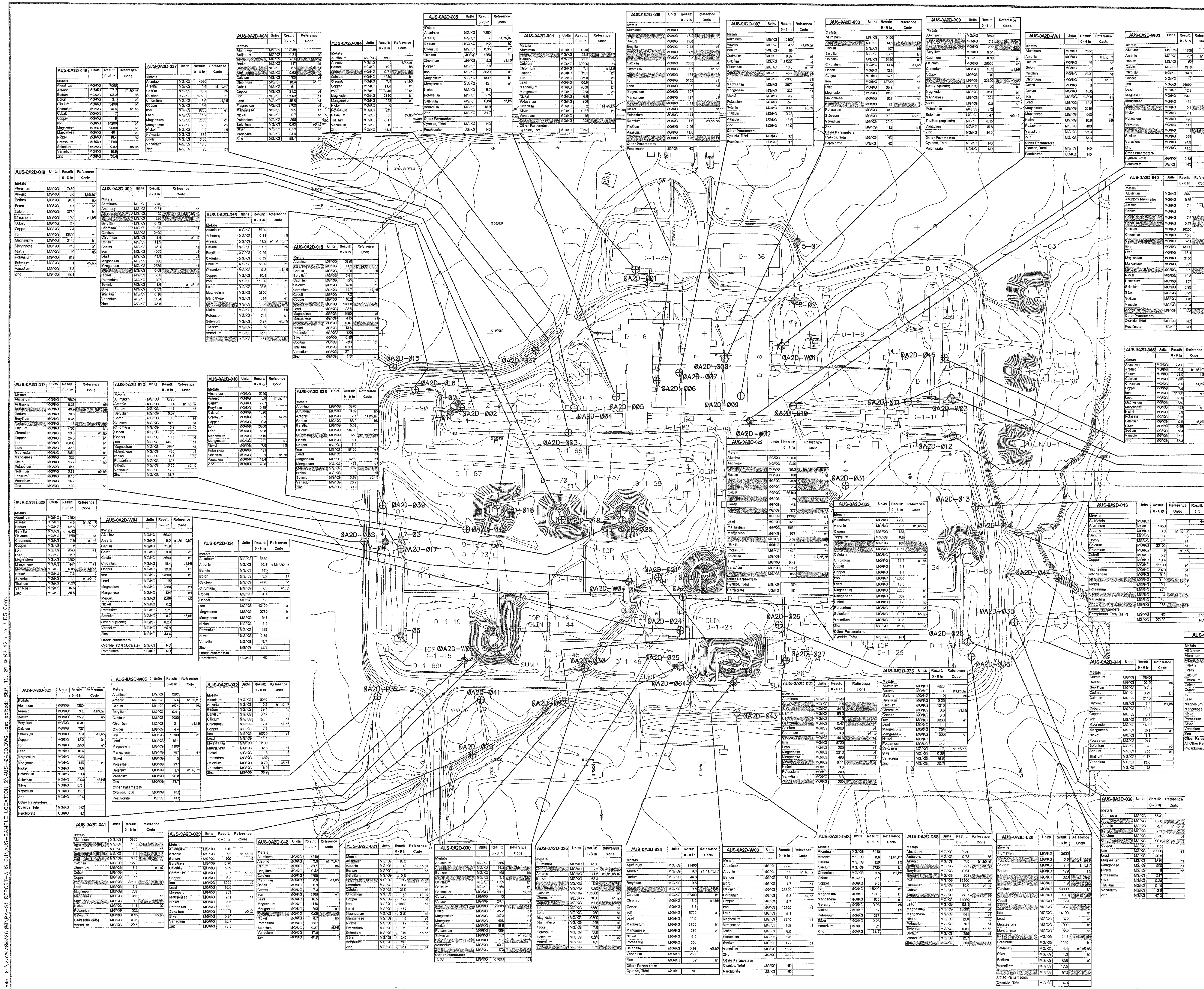
REVISIONS

PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–ØA2D
Sample Locations and Detections of Organic Compounds in Soils

Date: 6/28/ØØ	Project Number: 232ØØØØØ26.ØØ	Figure Number: 4–4
Drawn by: DJD	Design by: MM	Checked by: CMW

URS



LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

100 0 100

SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.

2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES.

3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.

PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–0A2D
Sample Locations and Detections of Inorganic Compounds in Soils

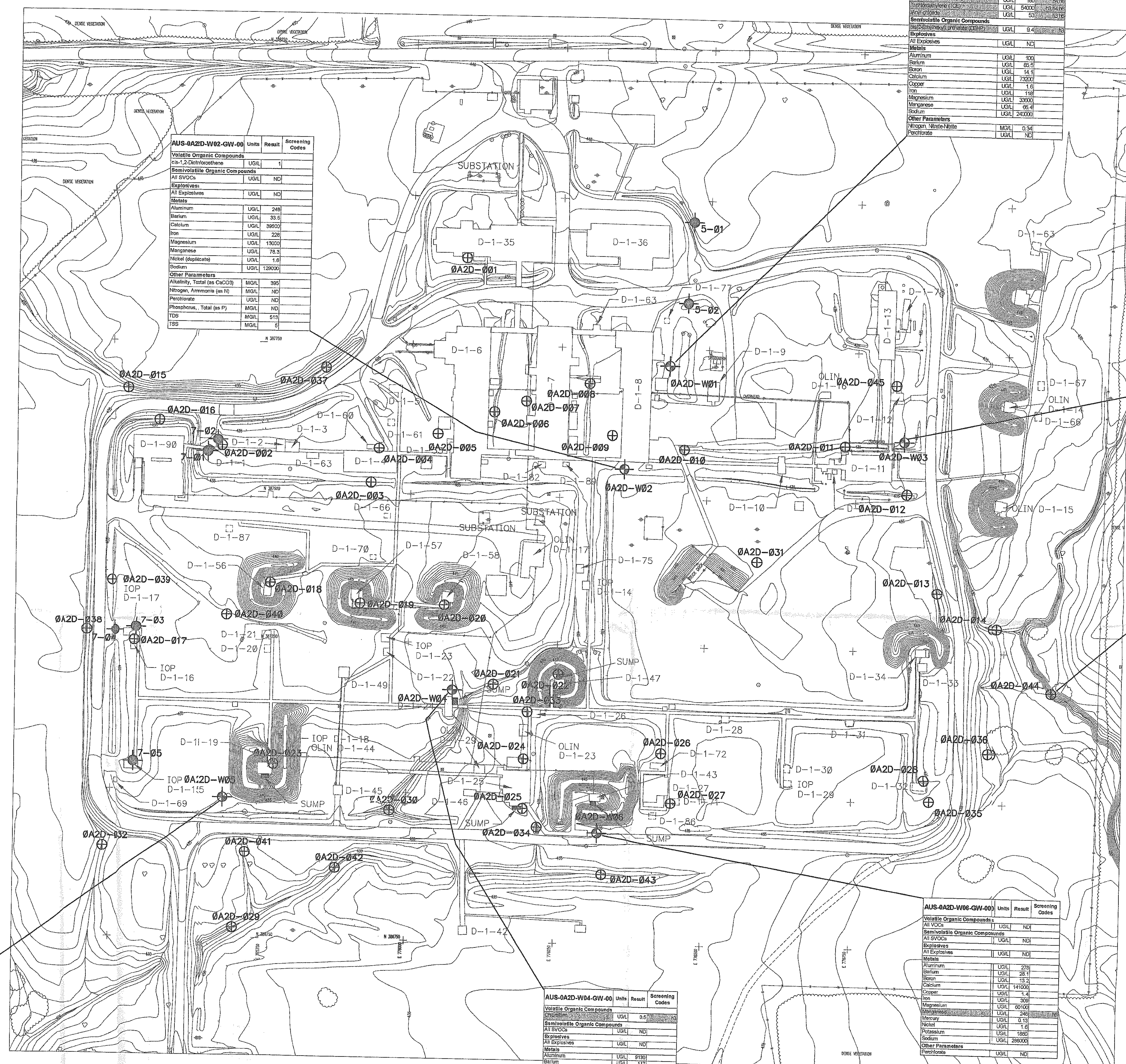
Date: 6/28/00	Project Number: 23200000026.00	Figure Number: 4–5
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATION



AUS-0A2D-W01-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
1,1,2-Trichloroethane	UG/L	28	h3,h4,h6
1,1-Dichloroethane	UG/L	2	
1,1-Dichloroethene	UG/L	9	h3,h6
cis-1,2-Dichloroethene	UG/L	9700	h4,h6
Tetrachloroethylene (PCE)	UG/L	2	h3
trans-1,2-Dichloroethene	UG/L	180	h4,h6
Trichloroethylene (TCE)	UG/L	54000	h3,h4,h6
Vinyl chloride	UG/L	53	h3,h6
Semivolatile Organic Compounds			
bis(2-Ethylhexyl) phthalate (DEHP)	UG/L	9.4	h3
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	100	
Barium	UG/L	85.5	
Boron	UG/L	14.1	
Calcium	UG/L	73200	
Copper	UG/L	1.6	
Iron	UG/L	118	
Magnesium	UG/L	33600	
Manganese	UG/L	66.4	
Sodium	UG/L	240000	
Other Parameters			
Nitrogen, Nitrate-Nitrite	MG/L	0.34	
Perchlorate	UG/L	ND	

AUS-0A2D-W02-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
cis-1,2-Dichloroethene	UG/L	1	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	248	
Barium	UG/L	33.5	
Calcium	UG/L	38500	
Iron	UG/L	228	
Magnesium	UG/L	13000	
Manganese	UG/L	78.3	
Nickel (duplicate)	UG/L	1.6	
Sodium	UG/L	129000	
Other Parameters			
Alkalinity, Total (as CaCO3)	MG/L	395	
Nitrogen, Ammonia (as N)	MG/L	ND	
Perchlorate	UG/L	ND	
Phosphorus, , Total (as P)	MG/L	ND	
TDS	MG/L	513	
TSS	MG/L	5	

AUS-0A2D-W03-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
1,1-Dichloroethene	UG/L	2	h3
cis-1,2-Dichloroethene	UG/L	400	h4,h6
Tetrachloroethylene (PCE)	UG/L	2800	h3,h4,h6
trans-1,2-Dichloroethene	UG/L	2	
Trichloroethylene (TCE)	UG/L	4200	h3,h4,h6
Vinyl chloride	UG/L	11	h3,h6
Semivolatile Organic Compounds			
bis(2-Ethylhexyl) phthalate (DEHP)	UG/L	1.1	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	4520	
Barium	UG/L	73.2	
Calcium	UG/L	56300	
Chromium	UG/L	7.5	
Copper	UG/L	4.4	
Iron	UG/L	4110	
Magnesium	UG/L	21100	
Manganese	UG/L	164	h6
Nickel	UG/L	3.9	
Potassium	UG/L	2050	
Sodium	UG/L	134000	
Vanadium	UG/L	10.8	
Other Parameters			
Nitrogen, Ammonia (as N)	MG/L	0.13	
Nitrogen, Nitrate-Nitrite	MG/L	ND	
Perchlorate	UG/L	ND	
Phosphorus, Total (as P)	MG/L	0.14	h4

AUS-0A2D-044-SW-00	Units	Result	Screening Codes
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
RDX	UG/L	1.8	
Metals			
Aluminum	UG/L	2720	b3,e3
Arsenic	UG/L	3	
Barium	UG/L	65.9	b3
Calcium	UG/L	33100	b3
Chromium	UG/L	2.4	
Iron	UG/L	2290	b3,e3,e4,h10
Magnesium	UG/L	10700	b3
Potassium	UG/L	1870	b3
Selenium	UG/L	2.5	e5
Sodium	UG/L	20900	b3
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2D-W05-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
cis-1,2-Dichloroethene	UG/L	4	
Trichloroethylene (TCE)	UG/L	0.6	
Semivolatile Organic Compounds			
bis(2-Ethylhexyl) phthalate (DEHP)	UG/L	1.4	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	4300	
Antimony	UG/L	2.3	
Barium	UG/L	100	
Calcium	UG/L	269000	
Chromium	UG/L	2.9	
Copper	UG/L	1.7	
Iron	UG/L	2520	
Magnesium	UG/L	107000	
Manganese	UG/L	258	h6
Nickel	UG/L	4.6	
Potassium	UG/L	2920	
Sodium	UG/L	224000	
Vanadium	UG/L	5.1	
Zinc	UG/L	8.5	
Other Parameters			
Alkalinity, Total (as CaCO3)	MG/L	670	
Nitrogen, Ammonia (as N)	MG/L	ND	
Nitrogen, Nitrate-Nitrite	MG/L	0.21	
Perchlorate	UG/L	ND	
Phosphorus, Total (as P)	MG/L	0.13	h4
TDS	MG/L	2080	h6
TSS	MG/L	84.5	

AUS-0A2D-W04-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
Chloroform	UG/L	0.5	h3
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	9130	
Barium	UG/L	117	
Calcium	UG/L	155000	
Chromium	UG/L	12.8	
Copper	UG/L	5.8	
Iron	UG/L	10700	h6
Lead	UG/L	3.4	
Magnesium	UG/L	76500	
Manganese	UG/L	948	h4,h6
Nickel	UG/L	10.9	
Potassium	UG/L	2960	
Sodium	UG/L	240000	
Thallium	UG/L	3.4	h4,h6
Vanadium	UG/L	14.8	
Zinc	UG/L	36.6	
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2D-W06-GW-000	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	278	
Barium	UG/L	28.1	
Boron	UG/L	13.2	
Calcium	UG/L	141000	
Copper	UG/L	1.4	
Iron	UG/L	309	
Magnesium	UG/L	60100	
Manganese	UG/L	246	h6
Mercury	UG/L	0.13	
Nickel	UG/L	1.6	
Potassium	UG/L	1860	
Sodium	UG/L	286000	
Other Parameters			
Perchlorate	UG/L	ND	

N

100 0 100

SCALE FEET

Revision No.	Description	Date	By	App.

REVISIONS

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.
4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS-ØA2D
Sample Locations and Detections
in Surface Water and Groundwater

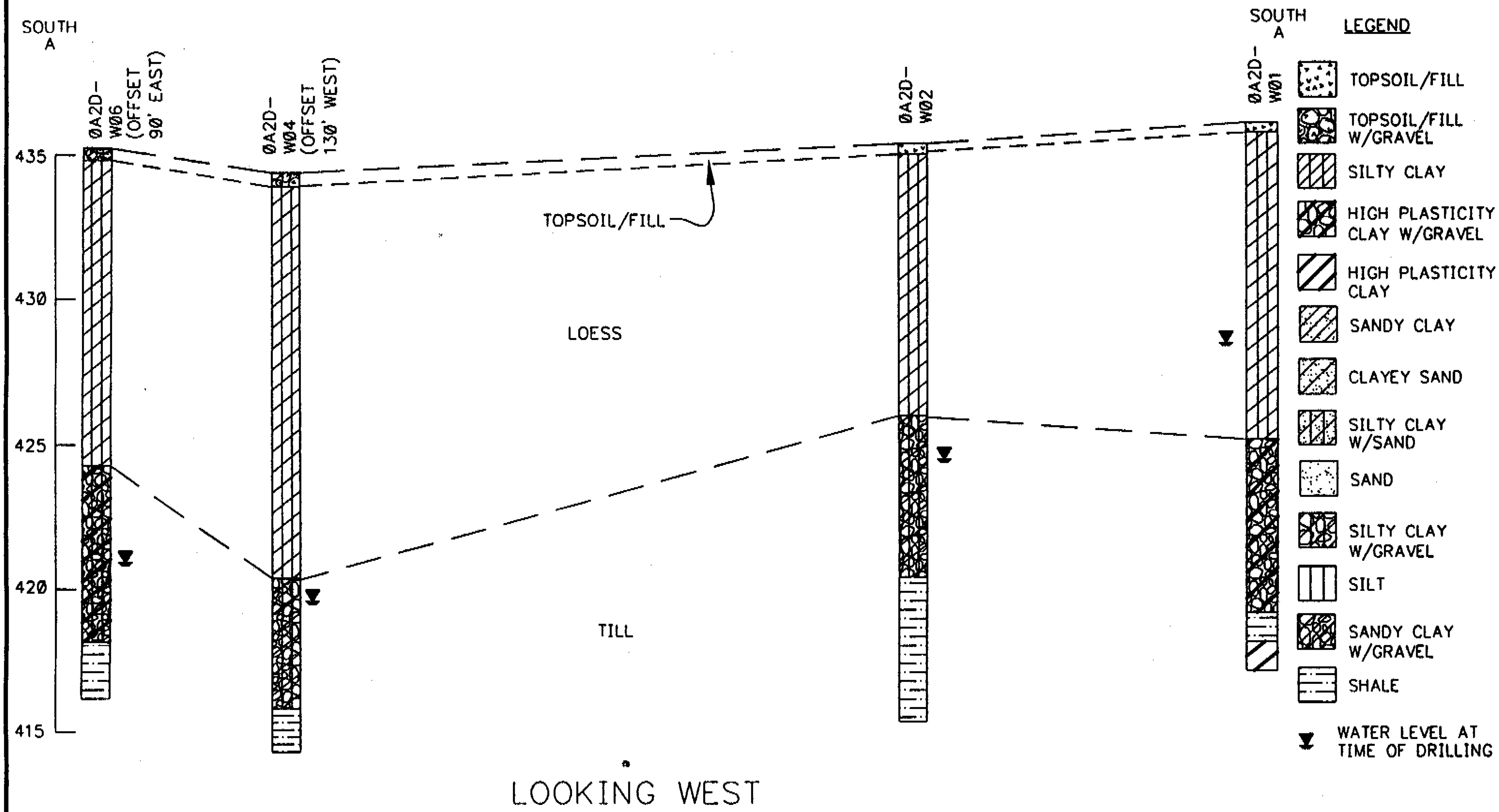
Date: 6/28/ØØ	Project Number: 2320000026.ØØ	Figure Number: 4-6
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

AREA 2D-IOP DETONATOR LOAD LINE

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-SAMPLE LOCATION 2\AUS-0A2D.DWG Last edited: SEP. 21, 01 @ 10:09 a.m. URS Corp.

File: E:\2320000026.00\PA-SI REPORT-AUS OU\FIG4-7A.DWG Last edited: JUN. 21, 01 @ 10:45 a.m. URS Corp.

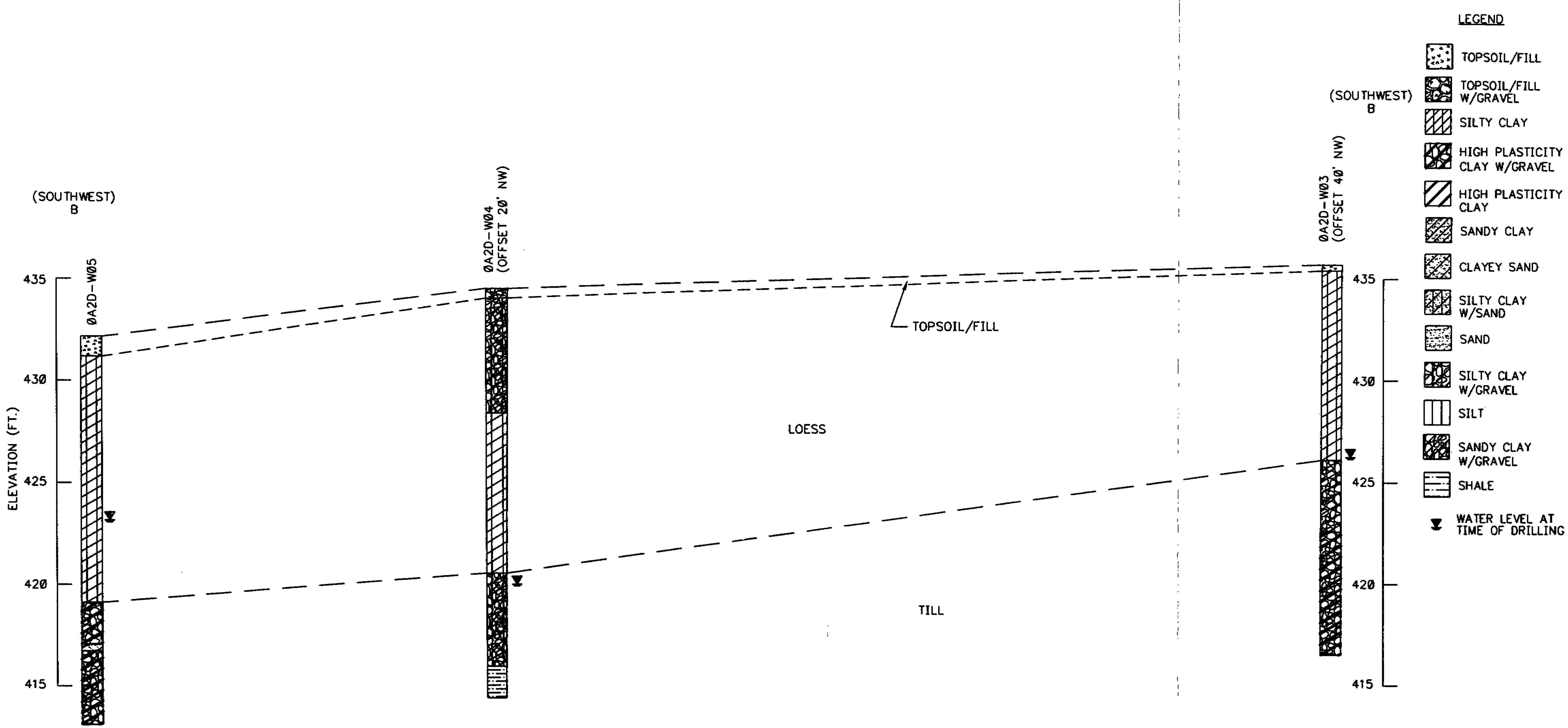


HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 5'

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS

DRN. BY:djd 10/17/00 DSGN. BY:are CHKD. BY:sea	Geologic Cross-Sections A-A' for Area 2D	FIG. NO. 4-7



HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 5'

PA/SI REPORT–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS

DRN. BY:djd 10/17/00 DSGN. BY:are CHKD. BY:sea	Geologic Cross-Section B-B' for Area 2D	FIG. NO. 4-8

File: E:\2320000026.00\PA-SI REPORT-AUS OU\FIG4-8.DWG Last edited: JUN. 21, 01 @ 11:08 a.m. URS Corp.

Area 2F was the Illinois Ordnance Plant (IOP) Fuze Loading Line, and has been used as an industrial facility since the 1950s. See the introduction to Section 3 for a general discussion of Area 2 and its location. The location of Area 2F (AUS-0A2F) is shown in Figure 3-1, along with the other sites in Area 2.

AUS Original Site Designations

Four of the original Additional and Uncharacterized Sites Operable Unit (AUS OU) sites designated in 1997-1999 by the United States Fish & Wildlife Service (USFWS) were located partially or entirely in or near Area 2F: AUS-0003, AUS-0007, AUS-0008, and AUS-0009. These original AUS OU sites have all been incorporated into the Area 2F site referred to as AUS-0A2F.

5.1 HISTORIC SEARCH INFORMATION

5.1.1 Site Description

Part of the Area 2F industrial facility, along with Area 2B and Area 2D, is bounded by a 6-foot (ft) chain link fence with secured access. Entrance to the site is controlled by the tenant, now General Dynamics Ordnance & Technical Systems, Inc. (GDO&TS).

5.1.2 Operational History and Waste Characteristics

The Area 2F group of buildings was originally built for fuse loading during World War II. All building numbers in this group have prefixes starting with F-2. Area 2F originally contained 15 buildings. Some of these buildings were razed after World War II.[1,2] The original configuration of Area 2F is shown in Figure 5-1. The building numbers, the operator/lessees, and their products and functions are listed in Table 5-1.

The Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department), operated the Fuse Load Line during World War II from 1942 through 1945. Two and possibly three principal tenants have leased buildings in Area 2B since the end of World War II.

Universal Match Corporation (UMC) (later Crane/Unidynamics-Phoenix, now Crane Co.) leased buildings in this area from 1959 through 1961.

Central Technologies, Inc. (CTI) was a known tenant in Area 2 and was possibly present in Area 2F[3] sometime between 1962 and 1970.

Olin Corporation and its successors have leased Area 2F since 1970. Olin's ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end of 1996.

[1] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[2] Changes to structure in Area 2F observed during the site reconnaissance on April 13, 1999.
[3] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.

General Dynamics Corporation acquired Primex in January 2001. Primex became a wholly owned subsidiary of General Dynamics and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS).[4,5] GDO&TS is the current tenant in Area 2F. Table 3-4 of this report lists types of products manufactured by Olin and its successors in the area.

Lease documents indicate Olin was occupying some of the buildings in the northwestern half of Area 2F (F-2-2, F-2-3, F-2-4, & F-2-11—see Figure 5-1) in 1980.[6] A fence was observed in the 1980 aerial photograph that separated the southeastern half of Area 2F which appeared to be unused, from the northwestern half of Area 2F which appeared to be occupied.[7] In 1986, Olin was awarded a contract to manufacture 120mm ammunition. To fulfill that contract, Olin signed a lease addendum and began occupying (or re-occupying) all of Area 2F.[8,9]

Other possible Area 2 tenants have been identified, but the building locations are unknown. Table 3-2 lists all the tenants identified in Area 2.

5.1.2.1 Area 2F Products and Constituents

IOP Products and Constituents

During World War II, Area 2F was used to manufacture delays and fuses for bombs, artillery and anti-tank mines. The description of SWDC/War Department operations in this section is based on interpretation of the IOP drawings referenced in the 1944 War Department Facilities Inventory, and published information about fuse production. SWDC/War Department probably performed two basic loading activities in Area 2F prior to assembling fuses: the loading of delay columns and the loading of primers with primer mix. The assembly of detonators, relays, primers, boosters, and inert components completed the manufacture of fuses.[10,11,12] The loading of delay columns and primers would have been the only direct handling of ignitable compounds

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[4] General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.

[5] Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.

[6] Building Lease Contract No. 14-16-0003-81-526, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980.

[7] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.

[8] DPRA Document No. 0007435. Olin Corporation, Letter to Crab Orchard National Wildlife Refuge requesting permission to lease the remaining buildings in the F Area, dated May 12, 1986.

[9] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

[10] Because primer mix, booster pellets, and fuse detonators were produced in other portions of Area 2 it appears that fuse manufacture did not duplicate these efforts. Instead, black powder loading (pouring) into the inert potion of the delay column and primer mix loading (pouring) into the relay portion of the fuse and assembly of components were the major operations performed for fuse manufacture.

[11] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[12] All information on the manufacturing process for fuses was determined from the logical order of manufacture and the Fuse Loading Line plan documents referred to above.

during fuse manufacture. Once these two components were made the final step was assembly of all the components to produce a fuse.

The fuses used in the ordnance manufactured at IOP are called "delays" by the U.S Army's Military Explosives Technical Manual.[13,14] According to the manual, a delay is an element that consists of an initiator, a delay column, and an output charge or relay in a specially designed inert housing…[while a] fuse is a cord of combustible material."[15] Delays "provide an interval between initiation and functioning of a device."[16] The delay uses a column of ignitable materials that burns for a certain amount of time.[17] The M48 "fuse" used in the 105mm artillery shell manufactured at IOP used black powder in its delay column, along with initiating detonators, primer charges, and lead azide initiating pellets.[18] Fuses for tank mines reportedly contained lead azide, antimony sulfide, carborundum, potassium chlorate, and tetryl.[19]

UMC Products and Constituents

UMC leased Area 2F from 1959 to 1961.[20,21] There is little information about UMC's activities in Area 2F. Small amounts of isopropyl alcohol, toluene and trichloroethylene (TCE) were reportedly dumped on the ground by UMC throughout Areas 2B, 2D and 2F.[22]

Olin Products and Constituents

Olin began leasing buildings at Area 2F in 1970. At that time they began manufacturing metal projectiles for 105 mm, 81 mm, 60 mm and 57 mm artillery.[23] These projectiles were made of copper, aluminum and steel parts. Olin handled no explosive components in the metal fabrication area,[24,25] however, this metal fabrication operation used degreasers (including TCE and/or methylene chloride) as well as cutting oils.[26,27] This area has also been used as a storage facility for components and finished products,[28] as well as for fuels and oxidizers (magnesium,

[13] Department of the Army, 1984, Military Explosive Technical Manual, (NTIS #TM 9-1300-214), Page 3-3.
[14] U.S. Army Corp of Engineers, 1993, Ordnance and Explosive Waste Archives Search Report for Former Illinois Ordnance Plant Marion, Illinois, Project Number E05IL000203, Appendix D-12D, Page 7-43.
[15] Department of the Army, 1984, Military Explosive Technical Manual, (NTIS #TM 9-1300-214), Page 3-3.
[16] Department of the Army, 1984, Military Explosive Technical Manual, (NTIS #TM 9-1300-214), Page 3-3.
[17] Department of the Army, 1984, Military Explosive Technical Manual, (NTIS #TM 9-1300-214), Page 3-3.
[18] U.S. Army Corp of Engineers, 1993, Ordnance and Explosive Waste Archives Search Report for Former Illinois Ordnance Plant Marion, Illinois, Project Number E05IL000203, Appendix D-12D, Page 7-43.
[19] NAR 000227. Illinois Ordnance Plant, 1943, Illinois Ordnance Plant Historical Record, 04/01/43 – 08/17/43, Exhibit 9.
[20] DPRA Document No. 00009371. U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, 1959, Page 19.
[21] FWM 001322 – FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.
[22] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[23] Deposition of Charles Funk, April 9, 1998, Pages 7-8.
[24] Deposition of Charles Funk, April 9, 1998, Pages 15-18.
[25] Deposition of Harvey Pitt, November 19, 1997, Page 80.
[26] Rudy Okolski, personal interview, June 30, 1999.
[27] Deposition of Charles Funk, April 9, 1998, Pages 15-18.
[28] Paul Moore, personal interview, July 14, 1999.

boron, perchlorates, nitrates, peroxides).[29] There has also reportedly been some manufacturing for large artillery rounds done in Area 2F by Olin,[30] as well as propellant system work for automobile air bags[31] and gas generator manufacturing.[32]

5.1.2.2 Area 2F Processes and Operations

Building F-2-1

Building F-2-1 was designated on IOP drawings as an Assembly, Packing and Shipping Building.[33]

Ordill Foundry and Manufacturing Company, Inc. (Ordill), makers of iron castings,[34] began leasing Building F-2-1 in 1947.[35] In 1953, Ordill sold their business to Charles Wood Corporation (Wood Corporation)[36] who remained in F-2-1 until 1957.[37]

In 1959, UMC signed a lease addendum for most of the buildings in Area 2F.[38] The addendum provided that rent would commence for the remaining buildings, which included F-2-1, when UMC took occupancy, but by no later than December 1, 1960. According to a Refuge narrative report, UMC actually occupied the remaining 31,081 square ft of space in Area 2F in December 1960.[39] It is likely that UMC used Building F-2-1 for storage.[40] By the end of the addendum term, April 1961, it appears UMC left Area 2F.[41,42]

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[29] PRI-009228. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.
[30] PRI-009229. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.
[31] Deposition of George T. Wisely, July 15, 1999, Page 32.
[32] Paul Moore, personal interview, July 14, 1999.
[33] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[34] CRO 001575 A. Newspaper article form the Herrin Daily Journal, dated March 30, 1949.
[35] DPRA Document No. 00009075. Undated Refuge lease information document showing new leases up until 10/1/49, from the CONWR files.
[36] CRO 000212. Crab Orchard National Wildlife Refuge, Analysis of Industrial Tenants employing labor, dated March 18, 1955.
[37] CRO 000789. U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, May through August, 1975, Page 14.
[38] FWM 001322 – FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.
[39] CRO000872 – CRO 000873. U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries & Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, September thru December, 1960, Page 26 and Table No. VIII.
[40] FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.
[41] FWM 001322. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.
[42] CRO 000897. U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries & Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1961, Table No. IV; and, CRO 000907 U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries & Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1961, Table No. IV. These narrative reports indicate a significant decrease in lease space for Universal Match from April to May 1961. The square footage decrease is very close to the amount of space UMC leased in Area 2F. Universal Match signed a new lease to continue renting space in other areas of the Refuge, but no other lease or addendum was found indicating they continued to occupy space in Area 2F.

Olin leased Building F-2-1 for "Industrial Use" from 1971 to 1973.[43,44] A former Olin employee stated F-2-1 was used for storage of metal fabrication materials during the 1970s.[45]

Building F-2-1 is located in the southeastern part of Area 2F, which, as discussed above in Subsection 5.1.2, was apparently unused from sometime before 1980 until 1986, when Olin re-occupied it.[46] Olin's use of this building after 1986 was not determined. In 1986, asbestos was noted in this building.[47]

Primex leased Building F-2-1 from 1997 to 2001 for cold storage.[48] GDO&TS is the current tenant in this building.[49]

Building F-2-2

During the IOP operations, Building F-2-2 was used as an Assembly, Packing and Shipping Building.[50] This building contained ten staking machines.[51] Fuses were assembled in this building. Equipment layout diagrams for this building identified five locations along the west side of the building with the note "Drip – Waste to Open Ditch".[52] These notes were shown on the drawings at points 100, 160, 180, 200 and 220 ft south of the northwesternmost corner of the building.[53] Another "Drip – Waste to Open Ditch" notation was found on the drawing on the easternmost wall of the building, approximately 160 ft south of the northeasternmost corner of the building.[54] The type of waste was not indicated in this drawing.

UMC occupied Building F-2-2 from 1959 to 1961 for unspecified "business and manufacturing purposes."[55]

[43] CRO 001463. United States Department of the Interior, Special Use Permit, number SUP-3-72, dated August 19, 1971.
[44] CRO 001466. Olin Corporation, Amendment No. 1 – Special Use Permit No. SUP-04-73, dated October 18, 1973.
[45] Paul Moore, personal interview, July 14, 1999.
[46] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.
[47] PRI-016529. Olin inter office memo entitled "F Area," dated November 11, 1986.
[48] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[49] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[50] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[51] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.
[52] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Pages 16 and 17.
[53] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Pages 16 and 17.
[54] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 17.
[55] FWM 001322. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.

Olin has occupied Building F-2-2 since 1970.[56] Special Use Permits issued by the United States Department of the Interior (DOI) indicate Olin used F-2-2 for both industrial purposes and storage during the 1970s.[57] In 1980, Olin signed a lease for Building F-2-2.[58]

From about 1970 to 1973,[59,60,61] Olin had a metal fabrication operation in Area 7 (see Section 11) and Building F-2-2. The metal fabrication involved the production of 105 mm, 81 mm, 60 mm and 57 mm projectiles. The 105 mm projectiles were also referred to as howitzers because of their use. According to Charles Funk, a former Olin manager involved with the operation, metal fabrication included: cold forming and phosphatizing, which was done in Area 7, and final machining and assembly, which was done in Building F-2-2. The phosphatized projectiles ("rounds") would be brought from Area 7, and, according to Harvey Pitt, a former Olin manager, were stored outside Building F-2-2, awaiting the final machining.[62] Mr. Pitt reported that zinc chromates were used in the phosphatizing process. Mr. Funk reported that the equipment in Building F-2-2 included multi-spindle lathes and a large screw machine. During the lathing process, cutting oils were used to facilitate the cutting. Degreasers would also be used during these operations.[63] Another former Olin employee, Rudy Okolski, reported that F-2-2 was used for manufacturing howitzer rounds. The press and dip operation for the howitzer rounds was in Area 7. Machining was done in F-2-2, after the rounds were "dipped" at Area 7. Machine cuttings were put in barrels, about 4 ft in diameter and 3 ft tall. For awhile they were disposed of and then Olin started recycling them. Methylene chloride or TCE was reportedly used for cleaning in this area.[64] Mr. Funk confirmed solvents were used in this process.[65] During the tenure of Olin's metal fabrication operation, turnings soaked with cutting oil were stored in open containers south of Building F-2-2. During heavy rain periods, these containers (55-gallon drums) would overflow and the cutting oil would reportedly spill on the grounds.[66] The metal fabrication did not involve the use of explosives.[67,68] Mr. Pitt offered his opinion that most likely contaminants associated with the machining operations were TCE, cutting oils, and "washoff" from the phosphatizing.[69] According to Mr. Funk, the principal wastes associated with metal fabricating operations were metal shavings, oils, and cleaning solvents.[70]

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[56] CRO 001461 - United States Department of the Interior, Special Use Permit, number SUP-72-70, dated August 5, 1970

[57] CRO 001461, CRO 001463, CRO 001465, CRO 001467, CRO 001468, CRO 001470, CRO 001472, CRO 001474, and CRO 001475 (various Special Use Permits issued to Olin for Building F-2-2).

[58] Building Lease Contract No. 14-16-0003-81-526, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980.

[59] Deposition of Charles Funk, April 9, 1998, Page 22.

[60] Deposition of Harvey Pitt, November 19, 1997, Page 90.

[61] Harvey Pitt lists the period of operation of the metal fabrication operation as 1969 to 1973 and Charles Funk lists the period of operation as 1970 to 1973 or 1974.

[62] Deposition of Harvey Pitt, November 19, 1997, Pages 101 and 102. In his deposition, Funk stated that he reported to Pitt, whom he described as the production control manager.

[63] Deposition of Harvey Pitt, November 19, 1997, Pages 85 and 90.

[64] Rudy Okolski, personal interview, June 30, 1999.

[65] Deposition of Charles Funk, April 9, 1998, Page 18.

[66] Deposition of Harvey Pitt, November 19, 1997, Page 104.

[67] Deposition of Charles Funk, April 9, 1998, Pages 17-18.

[68] Deposition of Harvey Pitt, November 19, 1997, Page 80.

[69] Deposition of Harvey Pitt, November 19, 1997, Page 102.

[70] Deposition of Charles Funk, April 9, 1998, Page 29.

From at least 1981 to 1986, Olin used Building F-2-2 for storage of suspected polychlorinated biphenyl (PCB)-containing transformers. A detailed description of these transformers and their PCB contents is in Section 5.1.2.3.

In 1986, Olin was using Building F-2-2 as a 90-day hazardous waste accumulation area.[71] A 1987 Olin document indicated this building was targeted for asbestos removal but it is not known if this was completed.[72] At that time, Olin was using F-2-2 for Trident storage.[73]

In 1987 and 1988, Olin reported that this building was used as a warehouse for mixed storage of fuels and oxidizers (magnesium, boron, etc., with perchlorates, nitrates, peroxides, sidewinder mix, contaminated mix, and aluminum powder).[74,75,76,77,78] Other chemicals and explosives-related materials were stored in this building, along with barrels marked "cutting oils."[79] Three 1987 Olin receiving reports listed receipt of 100 pounds of strontium nitrate, 1,000 pounds of potassium perchlorate, and 1,000 pounds of aluminum powder, with a location of F-2-2.[80,81,82] Another Olin receiving report for the same year listed 150 pounds of barium nitrate, 150 pounds of potassium perchlorate, and 150 pounds of strontium nitrate with a location of F-2-2.[83]

Primex leased Building F-2-2 from 1997 to 2001 for cold storage.[84] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[85]

GDO&TS is the current tenant in this building, [86] which is being used for empty drum storage.

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[71] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996.
[72] PRI-017202. Olin, Asbestos Removal Action Plan, dated July 3, 1987.
[73] PRI-017202. Olin, Asbestos Removal Action Plan, dated July 3, 1987.
[74] PRI-009228. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.
[75] PRI-010165. Olin Corporation, Safety Action Needed Report.
[76] PRI-012880. Olin Defense Systems Ordnance, Receiving Report, dated December 28, 1987, Page 1.
[77] PRI-012598. Olin Defense Systems Ordnance, Receiving Report, dated January 4, 1988, Page 1.
[78] PRI-018494. Olin Defense Systems Ordnance, Receiving Report, dated January 18, 1988, Page 1.
[79] PRI-009229. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.
[80] DPRA Document No. 00014236/PRI-012917. Olin Defense Systems Ordnance, Receiving Report dated December 4, 1987.
[81] DPRA Document No. 00011599/PRI-012598. Olin Defense Systems Ordnance, Receiving Report dated December 16, 1987.
[82] DPRA Document No. 00026873/PRI-012598. Olin Defense Systems Ordnance, Receiving Report dated December 16, 1987.
[83] DPRA Document No. 00014253/PRI-018494. Olin Defense Systems Ordnance, Receiving Report, dated December 16, 1987.
[84] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[85] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[86] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building F-2-2A

This building is known from references in documents but the location has not been determined; however, it is probably associated with Building F-2-2.

Primex leased Building F-2-2A from 1997 to 2001 for cold storage.[87] GDO&TS is the current tenant in this building.[88] No other information was found regarding this building.

Building F-2-2B

The location of this building was not determined; it is probably associated with Building F-2-2. The existence of this building is known only from lease records.

Primex leased Building F-2-2B from 1997 to 2001 for cold storage.[89] GDO&TS is the current tenant in this building.[90]

Building F-2-3

Building F-2-3 is designated on IOP drawings as a Paint and Solvent Storage Building.[91]

UMC occupied Building F-2-3 from 1960 to 1961 for unspecified "business and manufacturing purposes."[92]

Olin leased Building F-2-3 from 1971 to 1973,[93] and occupied this building again in 1980.[94]

Olin also used Building F-2-3 for storage of suspected PCB-containing transformers from 1979 to 1981(See discussion in Section 5.1.2.3).

Primex leased Building F-2-3 from 1997 to 2001 for cold storage.[95] GDO&TS is the current tenant in this building.[96]

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[87] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[88] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[89] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[90] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[91] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[92] FWM 001322 and FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959. *Refer to Building F-2-1 description for UMC occupancy details in Area 2F.*
[93] CRO 001462, CRO 001463, CRO 001465, CRO 001466. Various Special Use Permits issued to Olin for Building F-2-3.
[94] Building Lease Contract No. 14-16-0003-81-526, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980.
[95] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[96] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building F-2-4

Building F-2-4 was designated on IOP drawings as a Detonator and Relay Service Magazine.[97]

UMC occupied Building F-2-4 from 1960 to 1961 for unspecified "business and manufacturing purposes."[98]

Lease documents indicate Olin and its successors have occupied Building F-2-4 since 1980.[99] Olin also used F-2-4 for storage of suspected PCB-containing transformers (See Section 5.1.2.3).

Primex was the tenant in Building F-2-4 from 1997 to 2001 for cold storage.[100] GDO&TS is the current tenant in this building.[101]

Building F-2-5

Building F-2-5, an IOP Primer Dry House,[102] contained a primer dryer.[103]

UMC occupied Building F-2-5 from 1960 to 1961 for unspecified "business and manufacturing purposes."

Building F-2-5 is located in the southeastern part of Area 2F, which, as discussed above in Subsection 5.1.2, was apparently unused from sometime before 1980 until 1986.[104] In 1986 Olin leased the building and intended to use it for propellant storage (black powder) and igniter bag assembly.[105] This building was noted as containing asbestos.[106]

Olin reportedly produced some gas generator products in Building F-2-5. During the early 1990s, this building was used to test and assemble air bags. Sodium azide was used in this process.[107] It is not clear what processes occurred in these buildings, but it is assumed that operations were similar to those in other gas generator process buildings (e.g., Buildings D-1-6

[97] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[98] FWM 001322 and FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959. *Refer to Building F-2-1 description for UMC occupancy details in Area 2F.*
[99] Building Lease Contract No. 14-16-0003-81-526, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980.
[100] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[101] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[102] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[103] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.
[104] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.
[105] DPRA Document No. 00007460. Olin Corporation's proposed renovation document entitled "Olin Corporation – Marion Operations, 120mm FSED Production Area, Pages 1, 3, and 6.
[106] PRI-016529. Olin inter office memo entitled "F Area," dated November 11, 1986.
[107] Paul Moore, personal interview, July 14, 1998.

through D-1-8).[108] These operations would include propellant pressing and loading and component assembly. Primex leased Building F-2-5 from 1997 to 2001 for manufacturing purposes.[109] GDO&TS is the current tenant in this building.[110]

Building F-2-6

Building F-2-6 was an IOP Detonator and Relay Service Magazine.[111] It was razed prior to 1965.[112]

Building F-2-7

During the IOP operations, Building F-2-7 was used as a Booster Service Magazine.[113]

This building was razed prior to 1965.[114]

Building F-2-8

During the IOP operations, Building F-2-8 was used as a Black Powder Rest House.[115]

UMC occupied Building F-2-8 from 1959 to 1961 for unspecified "business and manufacturing purposes."[116]

Building F-2-8 is located in the southeastern part of Area 2F which as discussed above, in Subsection 5.1.2, was apparently unused from sometime before 1980 until 1986.[117] Olin began occupying Building F-2-8 in 1986.[118] Olin's use of this building was not determined. Primex

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[108] It is not known what processes occurred in these buildings during Olin's tenure. Because of their proximity to the plant road and to each other, it is assumed that propellant mixing operations have not occurred in these buildings.

[109] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.

[110] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[111] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[112] Entech, Inc., 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 9.

[113] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[114] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 9.

[115] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[116] FWM 001322. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.

[117] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

[118] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

leased Building F-2-8 from 1997 to 2001 for cold storage.[119] GDO&TS is the current tenant in this building.[120]

Building F-2-9

During the IOP operations, Building F-2-9 was used as a Delay Load Building.[121] This building contained a dipping machine (steel roller for dipping safety locks), two staking machines and twelve to eighteen presses.[122,123] There were reportedly four different delay holders loaded in this building: M103, AN-M100A1, M48 and M51.[124] The general loading procedures involved inserting black powder pellets into the delay holders and compressing or consolidating them. Finally, the delay holders would be packed. The M48 and M51 delay holders were dipped in a "Shellac Dye Solution" prior to loading.[125] This process was located in the westernmost portion of the building fairly close to a doorway that was located from 27 to 33 ft southeast of the western corner of the building.[126] Spillage of this solution may have washed out this doorway onto the ground.

UMC occupied Building F-2-9 from 1959 to 1961 for unspecified "business and manufacturing purposes".[127]

Based on aerial photographs, this building was apparently occupied in 1971; in the photos, trucks were observed at a loading dock.[128] Olin leased Building F-2-9 for "General Storage" from 1972 to 1973.[129] Building F-2-9 is located in the southeastern part of Area 2F, which, as discussed above in Subsection 5.1.2, was apparently unused from sometime before 1980 until 1986.[130] Olin again occupied Building F-2-9 beginning in 1986.[131] Olin's specific use of this building

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[119] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.

[120] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[121] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[122] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.

[123] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 13.

[124] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 13.

[125] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 13.

[126] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 13.

[127] FWM 001322. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.

[128] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 10.

[129] CRO 001464, CRO 001465, and CRO 001466. - Various Special Use Permits (and one amendment) issued to Olin for Building F-2-9.

[130] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

[131] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

was not determined. In June of 1986, seven 55-gallon drums with unknown contents were being stored in Building F-2-9; asbestos tile was noted here as well.[132]

Primex leased Building F-2-9 from 1997 to 2001 for cold storage.[133] GDO&TS is the current tenant in this building.[134]

Building F-2-10

During the IOP operations, Building F-2-10 was used as a Primer Load Building.[135]

UMC occupied Building F-2-10 from 1959 to 1961 for unspecified "business and manufacturing purposes."[136]

From 1972 to 1973, Olin used Building F-2-10 for "General Storage."[137]

Olin signed a lease addendum in 1986 for buildings, including F-2-10, for 120 mm production.[138,139] It was Olin's intent to move the smaller loading, assembly, and pack out (LAP) production of the 120 mm from Building F-2-11 into Building F-2-10; this building was also intended for possible large caliber R&D [Research & Development] programs.[140] A paint line was proposed for Building F-2-10. [141]

Olin has reportedly produced some gas generator products in Building F-2-10. During the early 1990s, this building was used to test and assemble air bags. Sodium azide was used in this process.[142] It is assumed that operations in these buildings are similar to those in other gas generator process buildings (e.g., Buildings D-1-6 through D-1-8).[143] These operations would include propellant pressing and loading and component assembly.

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[132] PRI-016533. Olin inter office memo entitled "F Area Regulatory Compliance Review," dated June 13, 1986, Page 1.
[133] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[134] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[135] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[136] FWM 001322. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.
[137] CRO 001464, CRO 001465, and CRO 001466. - Various Special Use Permits (and one amendment) issued to Olin for Building F-2-10.
[138] DPRA Document No. 0007435. Olin Corporation, Letter to Crab Orchard National Wildlife Refuge requesting permission to lease the remaining buildings in the F Area, dated May 12, 1986.
[139] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.
[140] DPRA Document No. 00007460. Olin Corporation's proposed renovation document entitled "Olin Corporation – Marion Operations, 120mm FSED Production Area, Pages 1, 3, and 6.
[141] DPRA Document No. 00007460. Olin Corporation's proposed renovation document entitled "Olin Corporation – Marion Operations, 120mm FSED Production Area, Pages 1 and 4.
[142] Paul Moore, personal interview, July 14, 1999.
[143] It is not known what processes occurred in these buildings during Olin's tenure. Because of their proximity to the plant road and to each other, it is assumed that propellant mixing operations have not occurred in these buildings.

Olin reported asbestos in Building F-2-10.[144]

Primex leased Building F-2-10 from 1997 to 2001 for manufacturing purposes.[145] GDO&TS is the current tenant in this building.[146]

Building F-2-11

Building F-2-11 was designated on IOP drawings as a Change House.[147] Wash waters from this building may have contained explosives/organic solvent residues, and they either drained into the sewer system or into drainage ditches located near the building.

UMC occupied Building F-2-10 from 1959 to 1961 for unspecified "business and manufacturing purposes."[148]

Olin and its successors have occupied Building F-2-11 since 1970.[149] Special Use Permits issued to Olin by DOI indicate Olin used F-2-11 for both industrial purposes and storage during the 1970s.[150] In 1980, Olin signed a lease for Building F-2-11.[151]

During Olin's tenure, Building F-2-11 housed some manufacturing processes for large artillery rounds.[152,153] Additionally, a propellant shaving operation was reported to have been located in Building F-2-11.[154]An Olin map from its Section 104(e) response identified this building as being used for assembly of 120 mm cartridges.[155] In the propellant handling area of this building (located on the north end of the building), the primer was inserted, the propellant was loaded and the cartridge was assembled.[156] There was also a paint booth room in this building that was

[144] PRI-016533. Olin inter office memo entitled "F Area Regulatory Compliance Review," dated June 13, 1986, Page 1.
[145] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[146] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[147] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[148] FWM 001322. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959.
[149] CRO 001461 - United States Department of the Interior, Special Use Permit, number SUP-72-70, dated August 5, 1970
[150] CRO 001461, CRO 001463, CRO 001465, CRO 001467, CRO 001468, CRO 001470, CRO 001472, CRO 001474, and CRO 001475. Various Special Use Permits issued to Olin for Building F-2-11.
[151] Building Lease Contract No. 14-16-0003-81-526, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980.
[152] PRI-009229. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.
[153] DPRA Document No. 00007460. Olin Corporation's proposed renovation document entitled "Olin Corporation – Marion Operations, 120mm FSED Production Area, Page 3.
[154] PRI-009229. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.
[155] PRI-016814. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86.
[156] PRI-016814. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86.

probably used for painting the cartridges.[157] This paint booth had an exhaust stack located on the southwest side of the building.[158]

In 1986, Olin was monitoring radiation in Building F-2-11.[159] Also, it is possible Olin stored and/or used nitroglycerin in this building.[160,161]

Primex leased Building F-2-11 from 1997 to 2001 for cold storage.[162] GDO&TS is the current tenant in this building.[163]

Building F-2-12

During the IOP operations, Building F-2-12 was used as a Change House.[164]

UMC occupied Building F-2-12 from 1960 to 1961 for unspecified "business and manufacturing purposes."[165]

Olin occupied Building F-2-12 from 1970 to 1980[166] for both "industrial purposes and storage." Building F-2-12 is located in the southeastern part of Area 2F, which, as discussed above in Subsection 5.1.2, was apparently unused from sometime before or around 1980 until 1986.[167]

Olin again occupied Building F-2-12 beginning in 1986.[168] Primex leased Building F-2-12 from 1997 to 2001 for cold storage.[169] GDO&TS is the current tenant in this building.[170]

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[157] PRI-016814. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86.
[158] PRI-016814. Olin Corporation, Olin-Marion Wastewater Program – Status 07/30/86.
[159] PRI-012974. Olin inter office memo entitled "September 1986, Radiation Safety Committee Meeting," dated October 9, 1986.
[160] PRI-008556. Olin inter office memo entitled "April, 1987 Hi-Lite Report," dated April 24, 1987.
[161] PRI-008545. Olin inter office memo entitled "June, 1987 Hi-Lite Report," dated June 24, 1987.
[162] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[163] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[164] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).
[165] FWM 001322 and FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959. *Refer to Building F-2-1 description for UMC occupancy details in Area 2F.*
[166] CRO 001461, CRO 001463, CRO 001465, CRO 001467, CRO 001468, CRO 001470, CRO 001472, CRO 001474, and CRO 001475. Various Special Use Permits issued to Olin for Building F-2-11.
[167] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.
[168] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.
[169] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[170] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building F-2-13

During the IOP operations, Building F-2-13 was used as a Timekeepers Building.[171]

UMC occupied Building F-2-13 from 1960 to 1961 for unspecified "business and manufacturing purposes."[172]

This building was razed sometime between 1965 and 1971.[173]

Building F-2-14

During the IOP operations, Building F-2-14 was used as a Line Office.[174]

This building was razed prior to 1965.[175]

Building F-2-15

During the IOP operations, Building F-2-15 was used as a Pump House.[176]

UMC occupied Building F-2-15 from 1960 to 1961 for "business and manufacturing purposes." UMC's specific use of this building was not determined.[177]

Building F-2-15 is located in the southeastern part of Area 2F, which, as discussed above in Subsection 5.1.2, was apparently unused from sometime before 1980 until 1986.[178] Olin occupied Building F-2-15 beginning in1986.[179] Primex leased Building F-2-15 from 1997 to 2001 for cold storage.[180] GDO&TS is the current tenant in this building.[181]

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[171] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[172] FWM 001322 and FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959. *Refer to Building F-2-1 description for UMC occupancy details in Area 2F.*

[173] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figures 9 and 10.

[174] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[175] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.

[176] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 17 (Plan No. 6544-101.40).

[177] FWM 001322 and FWM 001323. Amendment No. 3 to Lease Contract No. 14-19-003-2631, Universal Match Corporation, dated April 29, 1959. *Refer to Building F-2-1 description for UMC occupancy details in Area 2F.*

[178] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

[179] DOI 001639. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.

[180] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.

[181] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building F-2-20

Building F-2-20 is not an original IOP building. Olin began leasing this building in 1986 for cold storage.[182] It is located southwest of Building F-2-11 on the west side of the F Area perimeter road (Figure 5-2).[183] A 1987 Olin receiving report listed 1,725 pounds of "1.1.1 Trichlorethane" with a location description of F-2-20.[184]

Primex leased Building F-2-20 from 1997 to 2001 for cold storage.[185] GDO&TS is the current tenant in this building.[186]

Building F-2-24A and F-2-33

These buildings were referenced in a Primex document as areas where Primex accumulated hazardous wastes on-site for less than 90 days.[187] No other information was found. However, buildings designated as F-2-33A and F-2-33B were noted on a 1997 Primex map of the F Area, located slightly northwest of Building F-2-11 (Figure 5-2).[188]

Buildings F-2-25, F-2-26, F-2-31

These buildings were identified in a 1997 Primex map of Area 2F.[189] The buildings are located around Building F-2-10: F-2-25 is located slightly southeast of F-2-10; F-2-26 is located northeast of Building F-2-10; and Building F-2-31 is located south of F-2-2-10 (Figure 5-2). No other information was found regarding these buildings.

Building F-2-36

Building F-2-36 is not an original IOP building. Primex constructed this 1,360 square foot building in 1998 and used it as a propellant grain pressing building.[190,191] It is located between Buildings F-2-5 and F-2-10 (Figure 5-2).[192]

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[182] DPRA Document No. 00018844/DOI-0016939. Amendment No. 5 to Building Lease Contract No. 14-16-0003-81-526, Olin Corporation, dated December 1, 1986.
[183] DPRA Document No. 00017575. Attachment to DPRA Document No. 00017649 – Primex Technologies, F-Area Site Plan.
[184] DPRA Document No. 00026872. Olin Defense Systems Ordnance, Receiving Report for 1,725 pounds of "1.1.1 Trichlorethane" with a location description of F-2-20, dated August 12, 1987.
[185] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.
[186] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[187] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Pages 12 and 15.
[188] DPRA Document No. 00017575. Attachment to DPRA Document No. 00017649 – Primex Technologies, F-Area Site Plan.
[189] DPRA Document No. 00017575. Attachment to DPRA Document No. 00017649 – Primex Technologies, F-Area Site Plan.
[190] DPRA Document No. 00017574. Primex, Letter to CONWR requesting approval to construct a new propellant grain pressing building in the F-area, dated November 13, 1997.

GDO&TS is the current tenant in this building.[193]

Former Facility West of Original Area 2F Buildings

The 1965 aerial photographs show a group of nine new buildings that were constructed just to the west of the original Area 2F buildings.[194] These buildings were not on site in 1960 when UMC occupied Area 2F. In the 1965 aerial photograph the original Area 2F buildings appeared to be unoccupied.[195] The new nine-building facility was removed from the site prior to 1971.[196] It was not determined who built this facility or what operations were conducted at it.

The 1965 aerial photograph also identified a series of small horizontal tanks at the northern edge of the nine-building facility.[197] It is not known what was stored in these tanks. They were removed by 1971, along with the rest of the facility.[198]

Building F-6-45 is in the location of the former nine-building facility. Olin referred to this building as the gymnasium and used it as a storage facility for components and finished products (mixed storage of primers and MXU4A/A).[199] A 1988 Olin air source inventory indicates this building housed a vapor degreaser which used trichloroethane,[200] and a 1991 Olin receiving report listed 50 pounds of oxamide with a location of "F-645."[201]

George Wisely indicated the Job Corps occupied this building at one time, calling it a gymnasium[202] and using it to possibly work on school buses and other auto mechanic work.[203]

Primex leased Building F-6-45 from 1997 to 2001 for cold storage.[204] GDO&TS is the current tenant in this building.[205]

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[191] DPRA Document No. 00017649. Amendment No. 2 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., dated July 1, 1998.

[192] DPRA Document No. 00017575. Attachment to DPRA Document No. 00017649 – Primex Technologies, F-Area Site Plan.

[193] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[194] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 9.

[195] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 9.

[196] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 10.

[197] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 9.

[198] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 10.

[199] PRI-009228. Olin inter office memo entitled "Staff Safety Audit," dated May 25, 1988.

[200] DPRA Document No. 00027180. Olin, Air Source Inventory/OP/Marion/RC, dated November 25, 1988, Page 00008.

[201] DPRA Document No. 00014080/PRI-013217. Olin Defense Systems Ordnance, Receiving Report dated February 2, 1991.

[202] Assumed George Wisely's reference to a gymnasium is F-6-45.

[203] Deposition of George Wisely, July 15, 1999, Page 37.

Vertical Aboveground Storage Tanks

In the 1980 aerial photograph, there was a group of three bermed aboveground storage tanks (ASTs) observed to the north-northeast of Building F-2-3 (in line with Buildings F-2-1 and F-2-2).[206] It is likely that Olin was responsible for these three ASTs, since they appeared during Olin's tenure. These ASTs are no longer present on site.

5.1.2.3 Miscellaneous Area 2F Information

IOP Decontamination

After the IOP operations ended at CONWR, the IOP was to be decontaminated in accordance with a manual developed by the Ordnance Field Director of Ammunition Plants (OFDAP), called "*Shut-Down and Decontamination Procedures for F.D.A.P Facilities*."[207] This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.[208] According to this document, there were several cleaning compounds used for desensitizing various explosives (for a list of and brief discussion of the compounds, see section 3.1.2.3.).

Post-World War II military records are inadequate to determine if this area was decontaminated and, if so, whether it was adequately decontaminated, and if decontamination instructions were followed.

Polychlorinated Biphenyls (PCBs)

Electrical transformers have been located in Area 2F since the IOP era. In 1946, IOP documented six pole-mounted transformers in Area 2F:[209,210]

- one three-phase transformer bank of three (3) 7.5-KVA pole-mounted transformers located southwest of Building F-2-12; and
- one three-phase transformer bank of three (3) 50-KVA pole-mounted transformers located northeast of Building F-2-2.

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204 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 4.

205 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

206 Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 11.

207 ACO-5047 through ACO-5109 – Office of Field Director of Ammunition Plants, "Shut-Down and Decontamination Procedures for F.D.A.P. Facilities."

208 ACO-4979 through ACO-4980 – CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.

209 DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Pages 22 and 23.

210 DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Plan No. 6544-502.75, Plate No. 10, Page 102.

By 1979, Olin began to inventory their "PCB transformers" at the Refuge, including transformers being stored in Area 2F.[211] Following is a table that describes the storage location history and other details of transformers (including their PCB content values) that were stored in Buildings F-2-2, F-2-3, and F-2-4.

[211] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	*F-2-3*	*F-2-4*		
25543	50		1980		<50 ppm	A 1980 Olin document indicates this transformer contained less than 50 ppm PCBs and was sent to a landfill for disposal. No documentation was found to support the PCB content value noted.[212]
25553	50		1979		5.5 ppm	In 1979, Olin stated this transformer was exempt from 40 CFR 761 and transported it to a landfill.[213,214]
25561	50	1986			5 ppm[a]	Removed from service in 1986; stored in F-2-2.[215]
25563	50	1986			5 ppm[a]	In 1980, this transformer was pulled from unknown storage location and put into service in the I area. It was stored again in 1986.[216,217]
25564	50	1981-1982 1986	<1979 -1980	1983	5 ppm[a]	It is unknown where this transformer was located from 1984 to 1985.[218,219,220,221,222]
25567	37.5	1985-1986			5 ppm[a]	Removed from service in 1985; stored in F-2-2.[223]
25569	50	1986			5 ppm[a]	Removed from service in 1986; stored in F-2-2.[224]
25572	50	1981-1982 1985	1979–1980		5 ppm[a]	Transformer removed from storage in 1982 and put into service in Area 2D. It was back in storage by 1985.[225,226,227,228,229]
25672	37.5	1981-1982	1981	1983-1984	181 ppm	Transformer removed from service in 1984; received by CECOS for disposal in 1985.[230,231,232,233,234,235,236]

[212] PRI-00597. 1980 PCB Annual Document.
[213] DOI 004323. 1979 PCB Annual Document.
[214] PRI-00635. Envirodyne Engineers, Report of Analysis, dated October 20, 1979.
[215] DOI 004413. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[216] DOI 004413. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[217] ACO 002489. 1980 PCB Annual Document.
[218] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[219] DOI 004336. 1981 PCB Inventory, F-Area Storage.
[220] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[221] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[222] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[223] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[224] DOI 004413. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[225] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
[226] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[227] DOI 004336. 1981 PCB Inventory, F-Area Storage.
[228] DOI 004338. 1982 PCB Inventory for "PCB Transformers in Storage."
[229] DOI 004413. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[230] DOI 004324. 1981 PCB Annual Document.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	*F-2-3*	*F-2-4*		
25670	37.5	1981-1982	1981	1983-1984	134 ppm	Transformer removed from service in 1984; received by CECOS for disposal in 1985.[237,238,239,240,241,242,243]
25677	37.5	1981-1982	1981	1983-1984	115 ppm	Transformer removed from service in 1984; received by CECOS for disposal in 1985.[244,245,246,247,248,249,250]
25691	37.5		1979		<1 ppm	In 1979, Olin stated this transformer was exempt from 40 CFR 761 and transported it to a landfill.[251,252]
25697	37.5	1982		1983	57 ppm	Transformer received by CECOS for disposal in 1983.[253,254,255,256,257]
25698	37.5			1985	54 ppm	Transformer received by CECOS for disposal in 1985.[258,259,260]

231 DOI 004336. 1981 PCB Inventory, F-Area Storage.
232 DOI 004348. 1982 PCB Inventory, F-Area Storage.
233 DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
234 DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
235 DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
236 DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
237 DOI 004324. 1981 PCB Annual Document.
238 DOI 004336. 1981 PCB Inventory, F-Area Storage.
239 DOI 004348. 1982 PCB Inventory, F-Area Storage.
240 DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
241 DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
242 DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
243 DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
244 DOI 004324. 1981 PCB Annual Document.
245 DOI 004336. 1981 PCB Inventory, F-Area Storage.
246 DOI 004348. 1982 PCB Inventory, F-Area Storage.
247 DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
248 DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
249 DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
250 DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
251 DOI 004323. 1979 PCB Annual Document.
252 PRI-00635. Envirodyne Engineers, Report of Analysis, dated October 20, 1979.
253 DOI 004348. 1982 PCB Inventory, F-Area Storage.
254 PRI-002092. Cephus Industries, Inc., Report No. #643, dated August 9, 1982.
255 PRI-002090. Olin, inter office memo entitled "PCB Transformer S/N 25697," dated August 12, 1982.
256 DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
257 DOI 004365. Special Waste Hauling Manifest No. 080981, dated November 22, 1983.
258 DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	F-2-3	F-2-4		
25704	75	1985-1986			5 ppm[a]	Transformer removed from service and stored in F-2-2 in 1985. Document shows "25701" but this was probably a typographical error.[261]
25703	75	1985-1986			5 ppm[a]	Transformer removed from service and stored in F-2-2 in 1985.[262]
25705	75	1981-1982 1986		1983	5 ppm[a]	In 1979, this transformer was put into service in Area 2D. It was removed from service stored in 1981. Its location is unknown in both 1984 and 1985.[263,264,265,266]
25706	75		1979		<1 ppm	In 1979, Olin stated this transformer was exempt from 40 CFR 761 and transported it to a landfill.[267]
26050	150	1985-1986			5 ppm[a]	In 1985, transformer was noted as "burned out," and was stored in F-2-2. It is unknown what "burned out" means.[268]
1751681	75	1986			5 ppm[a]	In 1983, transformer was removed from service, but remained at its location in the I area. The location of this transformer is unknown from 1984 to 1985.[269,270]
1751682	75	1986			5 ppm[a]	In 1983, transformer was removed from service, but remained at its location in the I area. The location of this transformer is unknown from 1984 to 1985.[271,272]
1751683	75	1986			5 ppm[a]	In 1983, transformer was removed from service, but remained at its location in the I area. The location of this transformer is unknown from 1984 to 1985.[273,274]

[259] DOI 004398 – DOI 004399. Uniform Hazardous Waste Manifest, Document Number 1211047, dated November 20, 1985.
[260] DOI 004415. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00004.
[261] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[262] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[263] DOI 004336. 1981 PCB Inventory, F-Area Storage.
[264] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[265] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[266] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[267] DOI 004323. 1979 PCB Annual Document.
[268] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[269] DOI 004350. Olin, 1983 PCB Annual Document, "PCB and PCB Items in Service or Projected for Disposal," Page 2.
[270] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[271] DOI 004350. Olin, 1983 PCB Annual Document, "PCB and PCB Items in Service or Projected for Disposal," Page 2.
[272] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[273] DOI 004350. Olin, 1983 PCB Annual Document, "PCB and PCB Items in Service or Projected for Disposal," Page 2.
[274] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	*F-2-3*	*F-2-4*		
275013	10			1985	69 ppm	Transformer removed from service and received by CECOS for disposal in 1985.[275,276,277]
275020	10	1981-1982	<1979–1980	1983-1984	65 ppm	Olin decommissioned this transformer in 1984 and it was received by CECOS for disposal in 1985.[278,279,280,281,282,283]
275021	10			1985	59 ppm	Transformer received by CECOS for disposal in 1985.[284,285,286]
275516				1985	5 ppm[a]	Transformer was first noted in 1965, located in FAM warehouse area. By 1979, transformer in service in Area 2D. The location of this transformer is unknown in 1984. In 1985, it was noted that the transformer was "empty," and was sent to a landfill, however no documentation was found to support this.[287,288]
504578	167	1986				Document shows transformer as "5U4580," but this was probably a typographical error.[289]
741025	37.5	1985-1986			11 ppm[a]	In 1979, this transformer was put into service Area 2P. It was removed from service and stored in 1985.[290,291]
827424	75	1986			5 ppm[a]	The only information found regarding this transformer is it was near "T-1-2" in the test range in 1980; and then was in storage by 1986. Nothing was found for the years 1981 to 1985.[292,293]

[275] DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984, Page 2.
[276] DOI 004398 – DOI 004399. Uniform Hazardous Waste Manifest, Document Number 1211047, dated November 20, 1985.
[277] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[278] DOI 004336. 1981 PCB Inventory, F-Area Storage.
[279] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[280] DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
[281] DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
[282] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[283] DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[284] DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984.
[285] DOI 004394 – DOI 004395. Uniform Hazardous Waste Manifest, Document Number 1310998, dated May 5, 1985.
[286] DOI 004415. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00004.
[287] PRI-00511. Olin, Letter to Fish &Wildlife Service regarding installing transformer in "D" Area, dated April 8, 1965.
[288] DOI 004415. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00004.
[289] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[290] ACO 002490. 1979 PCB Annual Document.
[291] DOI 004413. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[292] PRI-00598. 1980 PCB Inventory, Test Range.
[293] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	*F-2-3*	*F-2-4*		
18D4535-5	100	1982			Unknown	New transformer put into service in 1981 (Area 2D). In 1982, transformer was pulled from service and stored in F-2-2.[294,295]
5L39918	10	1981-1982 1986	<1979-1980	1983	5 ppm[a]	It is unknown where this transformer was located from 1984 to 1985.[296,297,298,299,300,301]
5L39920	10	1981-1982 1986	<1979-1980	1983	5 ppm[a]	It is unknown where this transformer was located from 1984 to 1985.[302,303,304,305,306,307]
5L39928	10	1981-1982 1986	<1979-1980	1983	5 ppm[a]	It is unknown where this transformer was located from 1984 to 1985.[308,309,310,311,312,313]
5T32197 (5T34137)	25	1982			Unknown	Removed from service in 1982 and taken to storage. No other information has been found regarding this transformer.[314]
5T57977	37.5			1985	118 ppm	Transformer received by CECOS for disposal in 1985.[315,316,317]

[294] DOI 004324. 1981 PCB Annual Document.
[295] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[296] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
[297] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[298] DOI 004335. 1981 PCB Inventory, F-Area Storage.
[299] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[300] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[301] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[302] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
[303] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[304] DOI 004335. 1981 PCB Inventory, F-Area Storage.
[305] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[306] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[307] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[308] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
[309] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[310] DOI 004335. 1981 PCB Inventory, F-Area Storage.
[311] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[312] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[313] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
[314] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[315] DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984, Page 2.
[316] DOI 004394 – DOI 004395. Uniform Hazardous Waste Manifest, Document Number 1310998, dated May 2, 1985.
[317] DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	F-2-3	F-2-4		
5T59348	37.5	1981		1985-1986	2236 ppm	In 1982, this transformer was pulled from storage and put into service in Area 2P. It remained in service until 1985.[318,319,320]
5T59347	37.5	1982			Unknown	In 1982, this transformer was removed from service and stored in F-2-2. After 1982, the location of this transformer is unknown.[321]
57C10281	10	1981-1982	<1979–1980	1983-1984	111 ppm	Olin decommissioned this transformer in 1984 and it was received by CECOS for disposal in 1985.[322,323,324,325,326,327,328,329]
57C33831	10			1985	761 ppm	Transformer removed from service and received by CECOS for disposal in 1985.[330,331,332]
57C33915	10			1985	278 ppm	Transformer removed from service and received by CECOS for disposal in 1985.[333,334,335]
57C17934	50				Unknown	In 1979, this transformer was put into service Area 2P. It was remained in service at least up to 1982; no other information was found regarding this transformer.[336,337,338,339]

318 DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984, Page 2.
319 DOI 004394 – DOI 004395. Uniform Hazardous Waste Manifest, Document Number 1310998, dated May 2, 1985.
320 DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
321 DOI 004348. 1982 PCB Inventory, F-Area Storage.
322 PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
323 PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
324 DOI 004335. 1981 PCB Inventory, F-Area Storage.
325 DOI 004348. 1982 PCB Inventory, F-Area Storage.
326 DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
327 DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
328 DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
329 DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
330 DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984, Page 2.
331 DOI 004398 – DOI 004399. Uniform Hazardous Waste Manifest, Document Number 1310998, dated May 2, 1985.
332 DOI 004415. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00004.
333 DOI 004402. Industrial Testing Laboratories, Inc., Report No., 84-7-165, dated August 8, 1984, Page 2.
334 DOI 004398 – DOI 004399. Uniform Hazardous Waste Manifest, Document Number 1310998, dated May 2, 1985.
335 DOI 004414. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00003.
336 DOI 004323. 1979 PCB Annual Document.
337 PRI-00602. 1980 PCB Inventor, P-Area.
338 DOI 004330. 1981 PCB Inventory, P-Area.
339 DOI 004348. 1982 PCB Inventory, P-Area.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	*F-2-3*	*F-2-4*		
57F11375	10	1981-1982	<1979–1980	1983-1984	78 ppm	Olin decommissioned this transformer in 1984 and it was received by CECOS for disposal in 1985.[340,341,342,343,344,345,346,347]
57F11420	10	1981-1982	<1979–1980	1983-1984	305 ppm	Olin decommissioned this transformer in 1984 and it was received by CECOS for disposal in 1985.[348,349,350,351,352,353,354,355]
61AB556	37.5	1986			5 ppm[a]	In service in Area 2P until 1986.[356]
F6696156-7P	100			1985	210 ppm[a]	New transformer installed in Area 2B in 1982. Transformer received by CECOS for disposal in 1985.[357,358,359]
L83088YDA	50		1979–1980		5 ppm[a]	Transformer removed from storage in 1981 and put into service in Area 2B. It was still in service by 1986.[360,361]
L782288Y74AA	50		1979–1980		5 ppm[a]	Transformer removed from storage in 1981 and put into service in Area 2B. It was still in service by 1986.[362,363]

[340] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
[341] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[342] DOI 004335. 1981 PCB Inventory, F-Area Storage.
[343] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[344] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[345] DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[346] DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
[347] DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
[348] PRI-00627. Olin, "Oct. 1979 PCB Transformer Inventory, (F-Area)."
[349] PRI-00610. Olin, PCB Storage and Marking (Transformers) from the 1980 PCB Annual Document (referring to storage in 1979).
[350] DOI 004335. 1981 PCB Inventory, F-Area Storage.
[351] DOI 004348. 1982 PCB Inventory, F-Area Storage.
[352] DOI 004358. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[353] DOI 004376. Table I, F-2-4 Olin-Marian Storage for Olin-Marion Transformers.
[354] DOI 004328A. Uniform Hazardous Waste Manifest, Document No. 1195313, dated January 4, 1985.
[355] DOI 004385. Applied Research & Development Laboratory, PCB Transformers, dated January 18, 1984.
[356] DOI 004413. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00002.
[357] DOI 004337. 1982 PCB Annual Document for "PCB Transformers in Service."
[358] DOI 004398 – DOI 004399. Uniform Hazardous Waste Manifest, Document Number 1310998, dated May 2, 1985.
[359] DOI 004415. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00004.
[360] DOI 004324. 1981 PCB Annual Document.
[361] DOI 004412. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[362] DOI 004324. 1981 PCB Annual Document.
[363] DOI 004412. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.

Serial No.	Capacity (kva)	Storage Dates			PCB Content	Notes
		F-2-2	*F-2-3*	*F-2-4*		
L806535YCLA	50		1979–1980		5 ppm[a]	Transformer removed from storage in 1981 and put into service in Area 2B. It was still in service by 1986.[364,365]

[a] This PCB content values was found in an Olin transformer inventory document.[366] Some of the PCB values were followed by the letters "LT." However, it is unclear what this means. This document contained a column for entries regarding PCB certification by either "Letter" or "Analysis," but the document did not indicate the origin of the letter or who performed the analysis. No other documentation was found to substantiate these PCB values.

Note, not all transformers had documentation regarding shipment to and/or arrival at an approved hazardous waste disposal site. Those that did were listed in the above table. There was no information regarding PCB transformers found after 1986; therefore, the location of the remaining transformers, whether in service or in storage, is unknown.

[364] DOI 004324. 1981 PCB Annual Document.
[365] DOI 004412. Transformer Inventory-Olin/OP/RC, dated February 13, 1986, Page 00001.
[366] DOI 004412 – DOI 004425. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986.

Solvent Use and Disposal

In many cases in the early days of industrial activity at the Refuge, solvent wastes were disposed of by dumping. Statements by former employees of both UMC and Olin indicate that dumping of organic chemicals (solvents) onto the grounds surrounding process buildings was common.[367,368] This type of activity was probably also prevalent during the IOP era. Solvents reportedly used and/or dumped by industrial tenants include methylene chloride, methyl ethyl ketone, acetone, trichloroethylene, and hexane.[369,370,371] Rudy Okolski, a former Olin employee, reported that TCE was the universal cleaning agent and that it was dropped off everywhere in 55-gallon drums. This was during the 1964 through 1980 time period.[372]

Other Olin Chemicals of Concern

The following chemicals, among others, were listed on an obsolete Olin MSDS list.[373]

- Trichloroethylene
- Toluene
- Xylene
- Boron
- Barium nitrate
- Chromic acid, solid
- Mercury
- Copper sulfate
- Zinc oxide
- Acetone
- Methyl isobutyl ketone
- Methyl ethyl ketone
- Trichlorotrifluoroethane
- Methylene chloride
- Chloroform
- Benzene
- 4,4-methylene bis(2-chloroanaline)
- Pyridine
- Triethylamine
- Aniline
- Cresol
- Carbon tetrachloride
- Carbon disulfide

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[367] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[368] Paul Moore, personal interview, July 14, 1999.
[369] Vic Modglin, personal interview, TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page B-18.
[370] Rudy Okolski, personal interview, June 30, 1999.
[371] Deposition of George Wisely, June 28, 1999, Page 178.
[372] Rudy Okolski, personal interview, June 30, 1999.
[373] DOI-001780 through DOI-001782. This is an obsolete MSDS list from Olin's file. It contains an index of chemicals on file prior to the OSHA hazard communication law.

- Diethyl ether
- Dimethyl ether
- 4-di-isocyanate
- Ethylene diamine
- Perchloroethylene
- Di-(2ethylhexyl)phthalate
- Dimethyl phthalate
- Dibutyl phthalate
- Cobalt (6%) naphthenate solution

The following wastes, among others, were identified in a 1981 letter from J.E. Redden, Vice President of Olin's Technical Systems Operations to Refuge Manager Wayne Adams.[374] Redden indicates that the information was being provided as requested by Adams, and listed wastes "which it may be necessary to store in Refuge buildings pending arrangements for disposal":

- RCRA Code F002, Spent hologinated (sic) solvent, maximum 1,000 pounds (lbs)
- RCRA Code U102, Dimethyl phthalate, maximum 50 lbs.
- RCRA Code U107, Di-n-octyl phthalate, maximum 50 lbs
- RCRA Code U160, Methyl ethyl ketone peroxide, maximum 50 lbs
- RCRA Code U196, Pyridine, maximum 50 lbs
- RCRA Code U223, Toluene di-isocyanate, maximum 50 lbs
- RCRA Code U002, Acetone, maximum 200 lbs
- RCRA Code U226, 1-1-1 Trichloroethane, maximum 150 lbs
- RCRA Code U228, Trichloroethane, maximum 150 lbs
- RCRA Code P015, Beryllium dust, maximum 50 lbs
- RCRA Code D005, Barium salts, maximum 500 lbs
- RCRA Code D006, Cadmium salts, maximum 50 lbs
- RCRA Code D007, Chromium salts, maximum 50 lbs
- RCRA Code D008, Lead salts, maximum 100 lbs
- RCRA Code D009, Mercury salts, maximum 50 lbs
- RCRA Code D010, Selenium salts, maximum 5 lbs
- RCRA Code D011, Silver salts, maximum 50 lbs.

In a 1983 Generator Annual Hazardous Waste Report to the State of Illinois, Olin listed the following wastes, among others:[375]

- RCRA Code F005, Spent pyridine, solidified (Karl Fisher), 55 gallons
- RCRA Code D006, Cadmium and lead/debris from fired generator/Ajax ash, 55 gallons
- RCRA Code D001, Ignitable and spent toluene and spent methyl isobutyl ketone (spent thinner and adhesive mixture, solidified), 55 gallons
- RCRA Code U158, 4,4'-methylene bis (2-chloroaniline), 110 gallons
- RCRA Code D009, Mercury/lab pack/mercury contaminated material, 55 gallons.

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[374] FWM 000098 - FWM 000099. Olin Corporation, Letter to Crab Orchard National Wildlife Refuge regarding special wastes and the possibility of storing them in Refuge buildings, dated May 8, 1981.
[375] DOI 002359. Olin Corporation, Illinois Environmental Protection Agency, Generator Annual Hazardous Waste Report, dated February 23, 1984, Page 002.

The following constituents of waste explosive compounds and compositions, among others, were listed in another Olin document:[376]

- Ammonium dichromate
- Barium nitrate
- 2-nitrodiphenylamine (described as a constituent of Fluid Ball Powder Type A and Type B)

5.1.3 Area 2F Previous Sampling Results

O'Brien & Gere, 1988—Site 20

One site in Area 2F was investigated as part of the original Remedial Investigation (RI) for the Refuge (O'Brien & Gere, 1988). Site 20 (D Area South Drainage Channel), shown in Figure 4-3, consists of a ditch originating near the northeast corner of Building F-2-2.[377] (Note that the site name is a misnomer; it is actually in Area 2F). The swale flows east outside of the fenced area and a sheen was reported on the water in this ditch.[378] There was a 4-inch pipe that drained into this ditch from the north side of the service road.[379] It was not determined what this pipe drained since no buildings have been identified north of this roadway. O'Brien & Gere reported that chemicals were dumped here,[380] although no source was reported for this information. One sediment composite (0-1 ft) was collected.[381] The sediment was resampled for full organics analysis. Sediment results are reported in wet weight. Results reported here are estimated.[382] In the sediment sample, the following semi-volatile organic compounds (SVOCs) exceeded either United States Environmental Protection Agency (USEPA) ECOTOX and/or Canadian Sediment Quality Guidelines (CSEQGs) screening values: Dibenzofuran (0.144 milligrams per kilogram (mg/kg)), fluoranthene (0.057 mg/kg), 2-methylnaphthalene (0.321 mg/kg), naphthalene (0.069 mg/kg), and phenanthrene (0.247 mg/kg).

Woodward Clyde Consultants, 1996—Site 20

Site 20 (Figure 5-1a) was included in the 1996 Miscellaneous Areas Operable Unit (MISCA OU) RI.[383] One composite/discrete soil sample pair and a duplicate pair were collected from the same ditch sampled during the 1988 O'Brien & Gere RI (discussed above). The discrete sample and duplicate were collected from a depth of 1.5 ft below ground surface (bgs) and analyzed for the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) Target Compound List (TCL) volatile organic compounds (VOCs). The composite sample and duplicate were taken over the depth interval from 1 to 2 ft bgs and analyzed for the CERCLA Target Analyte List (TAL) inorganics and TCL organics (except VOCs), plus explosives and dioxins/furans. No organic compounds were detected and no preliminary levels of concern were

[376] DOI 002616. Olin Corporation, Hazardous Waste Facility Closure Plan, Ordill Industrial Area, S.O.P. 90,356, REV. K 9/88, dated October 4, 1988, Page 39.
[377] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 27-1.
[378] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 27-1.
[379] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 27-1.
[380] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 27-1.
[381] O'Brien & Gere 1988. Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Figure 27-1.
[382] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987.
[383] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.

exceeded for the inorganic constituents. The 1996 RI did not recommend further investigation at this site.

USEPA Sampling, 1998

USEPA 1998 sample locations in Area 2F are shown in Figures 5-2, 5-3, and 5-4. Samples from the original AUS-0003 –0008, and –0009 were located in Area 2F. The results for all detected constituents are listed in Table 5-1A.

Two samples (labeled 3-01 and 3-02) were collected from original AUS-0003 (Fuse Loading Line, Area 2F). Benzo[a]anthracene (0.22 mg/kg), benzo[b]fluoranthene (0.58 mg/kg), and benzo[a]pyrene (0.25 mg/kg) were detected above USEPA Soil Screening Levels (SSLs). Arsenic (23 mg/kg) and nickel (48 mg/kg) exceeded USEPA SSLs and Refuge background levels. Mercury (0.08 mg/kg) exceeded Refuge background levels.[384] Copper (130 mg/kg), lead (180 mg/kg), and zinc (310 mg/kg) exceeded New Dutchlist Soil Optimum Levels (DSOLs) and Refuge background levels.

Six samples (8-01 through 8-06) were collected from original AUS-0008 (Dumped organics in Areas 2D, 2B and 2F). The results from sample 8-01 could not be found. The following results are based on the remaining samples (8-02 through 8-06). The following SVOC compounds were detected at the site above either USEPA SSLs and/or CSOQGs: benzo[b]fluoranthene (1.7 mg/kg), indeno[1,2,3-cd]pyrene (1.4 mg/kg), dibenz[a,h]anthracene (1.8 mg/kg), and benzo[k]fluoranthene (1.7 mg/kg). Cadmium (9.7 mg/kg), nickel (34 mg/kg), silver (2.3 mg/kg), and mercury (0.11 mg/kg) exceeded USEPA SSLs and Refuge background levels.[385] Zinc (550 mg/kg), copper (120 mg/kg), and lead (120 mg/kg) exceeded DSOLs and Refuge background levels.

One sample (9-1) was collected from original AUS-009 (Dump East of Area 2F). Benzo(a)anthracene (0.36 mg/kg), benzo(b)fluoranthene (0.54 mg/kg) and benzo(a)pyrene (0.29 mg/kg) were detected above USEPA SSLs and Refuge background levels. Zinc (280 mg/kg) exceeded DSOLs and Refuge background.[386]

5.1.4 Observations During Site Visit

A large area that has been used as a dumping ground was observed during the site reconnaissance, at the north end of Area 2F. The materials dumped in the area include soil, trees, construction debris and three boilers. The dumping ground is located just south of the existing northern patrol road.[387] This dumping ground was also apparently original AUS OU Site AUS-0009 (Dump East of Area 2F) since it is east of Buildings F-2-2 and F-2-3.

There were four areas of stressed vegetation observed in the original portion of Area 2F. One was located along the north and west side of Building F-2-3. A second was located along the south side of Building F-2-2 (possible location of former stored phosphatized projectiles and

[384] See Table 1-11 of this report for Refuge background soil values used for the PA.
[385] See Table 1-11 of this report for Refuge background soil values used for the PA.
[386] See Table 1-11 of this report for Refuge background soil values used for the PA.
[387] The dumping ground was identified during the site reconnaissance on April 13, 1999.

spillage from cutting oil drums). The third was located to the east of Building F-2-1 (in the approximate location of former Building F-2-6). Finally, the fourth was located to the east of former Building F-2-7.

There were several drainage ditches observed throughout the area during the site reconnaissance.

5.1.5 Recommendations Based on Preliminary Assessment

Information from the historic record search indicates that all potential releases from Area 2F were not addressed in previous investigations. Results from the 1998 USEPA sampling exceeded PA screening criteria. Based on this information, Area 2F (AUS-0A2F) was included in the SI.

5.2 SITE INVESTIGATION INFORMATION

URS conducted a Site Investigation at AUS-0A2F from March 28 through May 16, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)[388] for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 5.1) has been updated to include that information. The sampling locations discussed below are based on the information that was available at the time the FSP was developed, and may not address all areas of potential releases.

AUS OU SI sample locations are shown on Figures 5-2, 5-3, and 5-4. Survey coordinates for all sample locations in Area 2F are found in Table 5-2. Table 5-4 lists the sample locations and the matrix sampled at that location. All samples are soil unless otherwise indicated. Groundwater samples were collected at all monitoring well locations.

5.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. The field investigation is summarized in this section, following the same order of description of site features as Section 5.1.2.2 of this report.

Building F-2-1

Sample 0A2F-006 was collected from a drainage ditch that appears to originate along the eastern side of Building F-2-1. This ditch likely receives drainage from this building. Building F-2-1 was used by SWDC/War Department for the assembly and loading of fuses.

Sample 0A2F-004 was collected from an area of stressed vegetation that was located to the east of Building F-2-1. This area of stressed vegetation may have resulted from activities in Building F-2-1 or from activities in former Building F-2-6 (former Detonator and Relay Service Magazine.

[388] U.S. Fish & Wildlife Service, Department of the Interior, March 2000, Draft Final Field Sampling Plan Site Inspection, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County), prepared by URS Corporation.

Building F-2-2

One soil sample (0A2F-009) was collected and one monitoring well (0A2F-W01) installed along the northeast side of Building F-2-2. Fuses were assembled in Building F-2-2 by SWDC/War Department, with wastes from this process draining to the open ditches surrounding the building. Olin had a metal fabrication operation in this building for approximately four years. Degreasers such as TCE were used in these processes. Sample 0A2F-009 was collected from a drainage ditch that originates along the eastern side of Building F-2-2. (Note: Sample 0A2F-009 was supposed to be collected near former Building F-2-4, however it was moved further north to a spot where the drainage ditch was more evident.) Monitoring well 0A2F-W01 was installed to the east of Building F-2-2 (between this building and Building F-2-4), to detect potential contamination in groundwater resulting from dumping of degreasers such as TCE, onto the ground during cleaning operations. Both a groundwater and soil sample were collected from 0A2F-W01.

To the south of Building F-2-2, turnings soaked in cutting oils were stored in open containers along the southern end of this building, and these oils would overflow the containers during heavy periods of rain. Also outside the southern doorway to this facility, phosphatized projectiles were stored, and zinc chromates may have leached off the rounds during storage. Sample 0A2F-003 was collected from an area of stressed vegetation located along the south end of this building, since the stressed vegetation may have resulted from either of the storage activities that were reported in this area. Monitoring well 0A2F-W02 was installed to the south of Building F-2-2. Both a groundwater and soil sample were collected here. This monitoring well was also installed to detect potential groundwater contamination associated with spillage of cutting oils or degreasers such as TCE, or with leaching of zinc chromates off phosphatized projectiles.

Building F-2-3

Sample 0A2F-001 was collected from an area of stressed vegetation located along the southern and eastern sides of Building F-2-3. During the IOP operations, Building F-2-3 was used as a Paint and Solvent Storage Building. Later tenants also used this building.

Building F-2-4

Monitoring well 0A2F-W01 was located along the eastern side of Building F-2-2, between this building and Building F-2-4. The monitoring well was located closer to Building F-2-2 than to Building F-2-4 (former IOP Detonator and Relay Service Magazine). Both a groundwater and soil sample were collected here.

Building F-2-6

Sample 0A2F-004 was collected near former Building F-2-6, which was used as a Detonator and Relay Service Magazine. This sample was collected from an area of stressed vegetation observed during the site reconnaissance.

Building F-2-7

There was an area of stressed vegetation noted to the east of Building F-2-7, which was used by the IOP as a Booster Service Magazine. Sample 0A2F-005 (soil) was collected from this area.

Building F-2-9

Sample location 0A2F-008 (soil and surface water) was from a drainage ditch located to the east of Building F-2-9 (IOP Delay Load Building). During the IOP era, this building contained a dipping machine that contained a "Shellac Dye Solution" and it contained twelve to eighteen presses (thus indicating the potential for contamination related to cutting oils and degreasers). Spillage of these materials is possible and the spilled materials may have flowed into the drainage ditches. Black powder pellets were loaded into delay holders inside this building. Later tenants also used this building.

Building F-2-10

Monitoring well 0A2F-W03 was located to the west of Building F-2-10 (IOP Primer Load Building). Olin reportedly produced some gas generator products in Building F-2-10. These gas generator products were made with sodium azide. It is assumed that Olin operations in these buildings were similar to those in other gas generator process buildings (e.g., Buildings D-1-6 to D-1-8.

Former Facility West of Original Area 2F Buildings

Samples 0A2F-011 and 0A2F-012 were at the former location of several horizontal ASTs that were identified in historical aerial photographs next to a facility that was built between 1960 and 1965 and razed before 1971. This former facility was located to the west of the original Area 2F buildings, and the ASTs were located just north of this facility.

Vertical ASTs

Sample 0A2F-013 was placed in the former location of a group of three bermed ASTs observed in the 1980 aerial photograph, to the northwest of Building F-2-3 (in line with Buildings F-2-1 and F-2-2).[389]

Dumping Ground at North End of Area 2F

Sample 0A2F-002 was placed in the dumping grounds observed during the site reconnaissance in the northern portion of Area 2F (east of Building F-2-3 and south of the patrol road). Samples locations 0A2F-007 and 0A2F-010 were in a drainage ditch just south of the dumping grounds. This ditch appears to drain the dumping grounds and the rest of the north end of Area 2F. Location 0A2F-007 included both soil and surface water.

[389] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.

5.2.2 Field Results

5.2.2.1 Site Conditions

5.2.2.1.1 Geologic Conditions

Figure 5-5 is a geologic cross section based on the boring information obtained from the three monitoring wells installed at the site. The cross section location is shown in Figure 5-4. Boring logs are included in Appendix A and monitoring well construction diagrams are in Appendix B.

A 5-inch layer of fill material (topsoil) overlays the site. The fill material at Well 0A2F-W01 includes white crushed limestone, gravel, coke, and coal, and at Well 0A2F-W03 the fill also includes white crushed rock. Underlying the fill is a 7.5 to 14-ft thick layer of low plastic silty clay loess, which overlies glacial till. In Wells 0A2F-W02 and 0A2F-W03, the till is 4.5 to 6-ft thick and consists of high plastic clay with gravel. Well 0A2F-W03 overlies shale bedrock, which was encountered at a depth of 16 ft. In Well 0A2F-W01, the boring was terminated at a depth of 18.8 ft, in the till which consisted of low to high plastic clay with gravel.

5.2.2.1.2 Hydrogeologic Conditions

At AUS-0A2F groundwater was encountered in all three soil borings during drilling at depths ranging from 9.5 to 14 ft bgs as shown in Figure 5-5.

Figure 3-8 is a groundwater contour map of Area 2 based on data from the eighteen monitoring wells installed at Area 2, obtained during October 2000. Table 3-7 presents the groundwater elevations measured in the Area 2 wells in May, July, September, and October 2000. As shown in this groundwater contour map, the overall flow direction of the groundwater appears to be toward Crab Orchard Lake (toward the southwest).

Slug tests were performed on each of the three wells that were installed within Area 2F during the AUS OU investigation, resulting in hydraulic conductivity values that ranged from 3.70E-06 to 2.16E-05 centimeters per second (cm/sec). Slug test results are summarized in Table 5-3. Data are included in Appendix C. According to the Illinois Environmental Protection Agency (IEPA), based on these hydraulic conductivity results, the groundwater at this site is classified as Class II groundwater.

5.2.2.1.3 Hydrologic Conditions

Area 2F is on a gently sloping hillside that drains to a south-flowing stream located east and south of Area 2F (Figure 3-1). This stream flows south to Crab Orchard Lake. A portion of the stream appears on the east side of Figure 5-2. Area 2F was leveled as part of the IOP construction. Construction included perimeter ditches along roadways which lead to natural drainageways that in turn flow into the creek on the south and east of the site. There are no permanent water bodies in Area 2F.

5.2.2.2 Chemical Results

The sample analytical results are summarized as follows:

- Table 5-5 -- soil sample results,
- Table 5-6 -- groundwater results, and
- Table 5-7 -- surface water results.

These tables list all the chemicals detected in Area 2F during this investigation, along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report (QCSR).

Sample results are presented on figures as follows:

- Figure 5-2 -- organic results for soil,
- Figure 5-3 -- inorganic results for soil, and
- Figure 5-4 -- all results for surface water and groundwater samples at this site.

5.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 5-8 through 5-12 as follows:

- Table 5-8--human health risk screening for soils,
- Table 5-9--human health risk screening for groundwater,
- Table 5-10--human health risk screening for surface water,
- Table 5-11--ecological risk screening for soils, and
- Table 5-12--ecological risk screening for surface water.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A2F. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

Chemicals that are shaded in the tables are those that exceeded the screening criteria, and are identified as chemicals of potential concern (COPCs) for human health risk, and chemicals of potential ecological concern (COPECs) for ecological risk. The only COPCs/COPECs not shaded in the table are those inorganic constituents that exceeded the screening criteria but were detected at levels below Refuge background.

In cases where the chemical was analyzed but not detected, the HQ is the ratio between the maximum reporting limit and the screening concentration. Chemicals not detected are identified with a "U" qualifier in the qualifier column. When these HQ values exceed one, they are not shaded. These constituents are not identified as COPCs/COPECs, but rather as uncertainties.

In Figures 5-2 through 5-4 the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 5-13 (human health risk) and 5-14 (ecological risk) list all the analytes and corresponding media sampled and indicate whether each is a COPC (or COPEC), not a COPC (or COPEC), or an uncertainty. The codes in the tables indicate the rationale for each classification. All COPCs (Table 5-13) and COPECs (Table 5-14) are shaded in the tables.

5.3.1 Human Health Risk

5.3.1.1 Soil

Human health screening results for soil samples are presented in Table 5-8. For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil Preliminary Remediation Goals (PRGs) as screening values. The cancer risk was derived by calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values. These ratios were then multiplied by 1×10^{-6}. In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (Dilution Attenuation Factor (DAF)=1), the Illinois Tiered Approach to Corrective Action Objectives (TACO) Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

5.3.1.2 Groundwater

Human health screening results for groundwater are presented in Table 5-9. The maximum groundwater concentrations from AUS-0A2F were screened against MCLs and Illinois Class I groundwater standards. These screening values may be conservative since the groundwater may be Class II.

5.3.1.3 Surface Water

Human health risk screening results for chemicals in surface water at Area 2F are presented in Table 5-10. The maximum concentrations from AUS-0A2F were screened against the Illinois EPA General Use Surface Water Quality Criteria – Human Health.

5.3.2 Ecological Risk

5.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 5-11. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[390]
- Environment Canada (1995)[391]

[390] USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.
[391] Environment Canada. 1995. Toxicity Testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Guidelines Division, Evaluation and interpretation Branch, Environmental Conservation Directorate, Environment Canada. Hull, Quebec.

- Talmage *et al.* (1999)[392]
- Efroymson *et al.* (1997a, 1997b)[393]
- CCME (1999)[394]
- MHSPE (1994)[395]
- Other Sources

A detailed discussion of the screening concentration selection is presented in Appendix G.

The screening approach for ingestion pathway exposures was based on the potential for a chemical to bioaccumulate. The potential for a chemical to bioaccumulate was based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. The document *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991)[396] used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

5.3.2.2 Surface Water

Ecological screening results for surface water samples are presented in Table 5-12. TRVs for direct exposure by aquatic organisms in surface water were obtained from:

- Illinois water quality standards
- National Recommended Ambient Water Quality Criteria (USEPA 1999a)[397]
- EcoTox (USEPA 1996[398])
- USEPA Region IV Freshwater Screening Values (1999b)[399]

[392] Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E Welsh, F. M. Cretella, P.H. Reno, and F. B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev Environ. Contam. Toxicol 161:1-156.

[393] Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-126/R2.

[394] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

[395] Ministry of Housing, Spatial Planning, and the Environment (MHSPE). 1994. *Intervention Values and Target Values – Soil Quality Standards.* Directorate General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

[396] USEPA 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

[397] USEPA. 1999a. National Recommended Water Quality Criteria--Correction. Office of Water. EPA 822-Z-99-001. April.

[398] USEPA. 1996. ECO Update: Ecotox Thresholds. EPA-540/F-95/038. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. 12pp.

[399] USEPA. 1999b. Region IV Ecological Risk Assessment Bulletins – Supplement to RAGS. Available at http://www.epa.gov/region4/waste/oftecser/ecolbul.htm.

- Maximum Acceptable Toxicant Concentrations (MATCs) or lowest observed effect concentrations (LOECs) obtained from the USEPA Assessment Tools for the Evaluation of Risk database (ASTER 2000)[400]
- Other sources

The Illinois water quality standards are believed to be the most relevant, followed by national recommended ambient water quality criteria. EcoTox reports values based on ambient water quality criteria, and Tier II water quality criteria have been developed in the absence of sufficient information to support a national recommended water quality criterion using guidelines outlined in the Great Lakes Water Quality Initiative. Remaining sources were prioritized based on relevance to the area and professional judgment. The detailed discussion of the approach for selecting a single ecological screening value (ESV) from among the multiple sources is presented in Appendix G.

The screening approach for ingestion pathway exposures was the same as for soils as presented in Section 5.3.2.1.

5.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A2F, based on exceedances of the SI screening criteria.

This report recommends that inorganic constituents that exceeded project screening criteria but were within Refuge background levels not be retained as COPCs/COPECs for further evaluation. These are the constituents coded with "D" on the COPC list, Table 5-13; and on the COPEC list, Table 5-14. COPCs in this category include silver in surface water; and barium, chromium, and selenium in soil. COPECs coded with "D" on Table 5-14 include selenium and silver in surface water; and chromium, manganese, and selenium in soil. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method; if new information on site usage suggests they should be evaluated; or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 5-15.

Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. These issues will be addressed in the work plan for the RI. The discussion of past usage included in this section should be carefully reviewed during work plan development, since this information was updated after the field investigation, and all potential release areas at this site may not have been investigated in the SI.

[400] ASTER. 2000. Assessment Tools for Evaluation of Risk Database. United States Environmental Protection Agency, Office of Research and Development.

TABLE 5-1
AREA 2F OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
Building F-2-1	1942-1945	SWDC/War Dep't	Assembly Packing and Shipping Building
	1953-1957	Ordill Foundry & Manufacturing Co, Inc.	Makers of iron castings
	1960-1961	UMC	Unspecified storage
	?-1997	Olin	Industrial use; storage of metal fabrication materials
	1997-2001	Primex	Unspecified Storage
	2001	GDO&TS	Unknown
Building F-2-2	1942-1945	SWDC/War Dep't	Assembly Packing and Shipping Building
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Metal fabrication operations; shipping and receiving warehouse; storage of suspected PCB-containing transformers; 90-day hazardous waste accumulation area
	1997-2001	Primex	Storage (empty drum storage in 1999) / 90-day hazardous waste accumulation area
	2001	GDO&TS	Empty drum storage
Olin Building F-2-2A	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Olin Building F-2-2B	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building F-2-3	1942-1945	SWDC/War Dep't	Paint and Solvent Storage Building
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Gas generator production (1980); testing and assembly of air bags (1990s); storage of suspected PCB-containing transformers (1979-1981)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building F-2-4	1942-1945	SWDC/War Dep't	Detonator and Relay Service Magazine
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Storage of suspected PCB-containing transformers (1983-1986)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building F-2-5	1942-1945	SWDC/War Dep't	Primer Dry House
	1959-1961	UMC	Unspecified business and manufacturing purposes
	1986	Olin	Propellant storage and igniter bag assembly (1986); gas generator production, testing and assembly of air bags (1990)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building F-2-6	1942-1945	SWDC/War Dep't	Detonator and Relay Service Magazine
Building F-2-7	1942-1945	SWDC/War Dep't	Booster Service Magazine
Building F-2-8	1942-1945	SWDC/War Dep't	Black Powder Pellet Rest House
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown

Sheet 1 of 2

TABLE 5-1
AREA 2F OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
Building F-2-9	1942-1945	SWDC/War Dep't	Delay Load Building
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Unspecified storage (1972-1973)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building F-2-10	1942-1945	SWDC/War Dep't	Primer Load Building
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Unspecified storage (1972-1973); 120mm LAP (1986); gas generator products (1990); large caliber R&D; possible paint line
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building F-2-11	1942-1945	SWDC/War Dep't	Change House
	1959-1961	UMC	Unspecified business and manufacturing purposes
	?-1997	Olin	Manufactured large artillery rounds/propellant shaving; industrial purposes and storage; cartridge painting; NG storage (1986)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building F-2-12	1942-1945	SWDC/War Dep't	Change House
	1959-1961	UMC	Unspecified business and manufacturing purposes
	1970-1980	Olin	Unknown
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown
Building F-2-13	1942	SWDC/War Dep't	Timekeeper's Building
	1960-1961	UMC	Unspecified business and manufacturing purposes
Building F-2-14	1942	SWDC/War Dep't	Line Office
Building F-2-15	1942	SWDC/War Dep't	Pump House
	1960-1961	UMC	Unspecified business and manufacturing purposes
	1986-1997	Olin	?
	1997-2001	Primex	Storage
	2001	GDO&TS	?
Building F-2-20	?-1997	Olin	Storage of 1.1.1-Trichloroethane (1987); unspecified storage (1986)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building F-2-24A	1997	Primex	90-day hazardous waste accumulation area
Building F-2-25	1997	Primex	Unknown
Building F-2-26	1997	Primex	Unknown
Building F-2-31	1997	Primex	Unknown
Building F-2-33	1997	Primex	90-day hazardous waste accumulation area
Building F-2-36	1998	Primex	Grain pressing
	2001	GDO&TS	Unknown
Building F-6-45	?	Job Corps	Auto mechanic work
	?	Olin	Storage facility for components and finished products
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown

Sheet 2 of 2

TABLE 5-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
3-01	Benzo[a]anthracene	0.22J
	Benzo[a]pyrene	0.25J
	Benzo[b]fluoranthene	0.58J
	Benzo[g,h,i]perylene	0.11J
	Benzo[k]fluoranthene	0.16J
	Bis(2-Ethylhexyl)phthalate	0.49
	Chrysene	0.27J
	Fluoranthene	0.33J
	Indeno[1,2,3-c,d]pyrene	0.13J
	Phenanthrene	0.12J
	Pyrene	0.28J
	Aluminum	7,600
	Barium	79
	Calcium	6,000
	Chromium	40
	Cobalt	9.3
	Copper	130
	Iron	79,000
	Lead	180
	Magnesium	2,200
	Manganese	770
	Mercury	0.08
	Nickel	48
	Potassium	630
	Vanadium	24
	Zinc	310
3-02	Benzo[a]anthracene	0.18J
	Benzo[a]pyrene	0.19J
	Benzo[b]fluoranthene	0.46J
	Benzo[k]fluoranthene	0.15J
	Bis(2-Ethylhexyl)phthalate	0.11J
	Chrysene	0.23J
	Fluoranthene	0.24J
	Pyrene	0.26J
	Aluminum	8,700
	Arsenic	23
	Barium	86
	Beryllium	0.4
	Calcium	8,600
	Chromium	39
	Cobalt	13
	Copper	110
	Iron	86,000
	Lead	140
	Magnesium	2,200
	Manganese	940
	Mercury	0.07
	Nickel	33

Sheet 1 of 4

TABLE 5-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
3-02	Potassium	690
	Vanadium	51
	Zinc	210
8-02	Aluminum	12,000
	Barium	110
	Beryllium	0.7
	Calcium	4,200
	Chromium	16
	Cobalt	9.5
	Copper	18
	Iron	18,000
	Lead	22
	Magnesium	2,000
	Manganese	420
	Mercury	0.07
	Nickel	13
	Potassium	880
	Vanadium	28
	Zinc	550
8-03	Anthracene	0.9J
	Benzo[b]fluoranthene	1.7J
	Benzo[k]fluoranthene	1.7J
	Bis(2-Ethylhexyl)phthalate	0.16J
	Dibenz[a,h]anthracene	1.1J
	Fluoranthene	1.0J
	Indeno[1,2,3-c,d]pyrene	1.4J
	Phenanthrene	0.7J
	Pyrene	0.8J
	Aluminum	6,900
	Barium	87
	Beryllium	0.4
	Calcium	77,000
	Chromium	13
	Cobalt	5.8
	Copper	16
	Iron	14,000
	Lead	34
	Magnesium	22,000
	Manganese	430
	Nickel	15
	Potassium	1,100
	Vanadium	18
	Zinc	100
8-04	Aluminum	11,000
	Barium	96
	Beryllium	0.6
	Calcium	17,000
	Chromium	18
	Cobalt	7.7

Sheet 2 of 4

TABLE 5-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
8-04	Copper	18
	Iron	16,000
	Lead	50
	Magnesium	7,100
	Manganese	320
	Mercury	0.04
	Nickel	22
	Potassium	1,000
	Vanadium	28
	Zinc	110
8-05	Bis(2-Ethylhexyl)phthalate	0.25J
	Butylbenzylphthalate	0.16J
	Dibenz[a,h]anthracene	1.8J
	Aluminum	7,800
	Barium	64
	Beryllium	0.4
	Cadmium	9.7
	Calcium	13,000
	Chromium	44
	Cobalt	9.9
	Copper	120
	Iron	49,000
	Lead	120
	Magnesium	9,200
	Manganese	540
	Mercury	0.11
	Nickel	34
	Potassium	1,300
	Silver	2.3
	Vanadium	11
	Zinc	480
8-06	Aluminum	12,000
	Barium	120
	Beryllium	0.7
	Calcium	3,000
	Chromium	18
	Cobalt	10
	Copper	14
	Iron	18,000
	Lead	19
	Magnesium	2,600
	Manganese	610
	Nickel	18
	Potassium	690
	Vanadium	33
	Zinc	66
9-1	2-Methylnaphthalene	0.95
	Benzo[a]anthracene	0.36J
	Benzo[a]pyrene	0.29J

Sheet 3 of 4

TABLE 5-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
9-1	Benzo[b]fluoranthene	0.54
	Benzo[g,h,i]perylene	0.12J
	Benzo[k]fluoranthene	0.18J
	Chrysene	0.40J
	Dibenzofuran	0.27J
	Fluoranthene	0.37J
	Indeno[1,2,3-c,d]pyrene	0.15J
	Naphthalene	0.54
	Phenanthrene	0.51
	Pyrene	0.41J
	Aluminum	10,000
	Barium	110
	Beryllium	0.6
	Calcium	18,000
	Chromium	12
	Cobalt	7
	Copper	15
	Iron	16,000
	Lead	21
	Magnesium	8,300
	Manganese	710
	Nickel	12
	Potassium	1,200
	Vanadium	26
	Zinc	280

Sheet 4 of 4

mg/kg = milligrams per kilogram
J = Estimated

TABLE 5-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A2F

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A2F-001	386175.6	776450.6	429.41	NA	
0A2F-002	386199.2	776651.9	430.12	NA	
0A2F-003	385750.9	776607.6	429.35	NA	
0A2F-004	385553.9	776879.6	430.32	NA	
0A2F-005	385449.5	777046.9	429.66	NA	
0A2F-006	385412.8	776940.5	429.14	NA	
0A2F-007	386194.8	776887.2	427.64	NA	
0A2F-008	385721.0	777073.8	427.27	NA	
0A2F-009	386039.8	776537.7	428.55	NA	
0A2F-010	386112.2	776563.3	427.42	NA	
0A2F-011	385563.5	775866.8	429.64	NA	
0A2F-012	385534.9	775809.2	430.08	NA	
0A2F-013	386295.6	776259.7	433.39	NA	
0A2F-W01	385916.5	776629.0	432.41	435.01	New monitoring well
0A2F-W02	385741.1	776615.3	431.45	434.13	New monitoring well
0A2F-W03	385740.8	776896.9	431.49	434.18	New monitoring well

Sheet 1 of 1

NA = Not Applicable

TABLE 5-3
SLUG TEST RESULTS

Well ID Number	Hydraulic Conductivity (cm/sec)
0A2F-W01	3.70E-06
0A2F-W02	1.05E-05
0A2F-W03	2.16E-05

Sheet 1 of 1

cm/sec = centimeters per second

TABLE 5-4
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A2F

Soil	Groundwater	Surface Water
AUS-0A2F-001	AUS-0A2F-W01	AUS-0A2F-007
AUS-0A2F-002	AUS-0A2F-W02	AUS-0A2F-008
AUS-0A2F-003	AUS-0A2F-W03	
AUS-0A2F-004		
AUS-0A2F-005		
AUS-0A2F-006*		
AUS-0A2F-007*		
AUS-0A2F-008*		
AUS-0A2F-009*		
AUS-0A2F-010*		
AUS-0A2F-011*		
AUS-0A2F-012*		
AUS-0A2F-013*		
AUS-0A2F-W01		
AUS-0A2F-W02		
AUS-0A2F-W03		

Sheet 1 of 1

* Note that the samples at this location were originally designated as sediment, but are actually soil samples.

TABLE 5-5
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compound		
Carbon Disulfide	1/20	6 ug/kg
cis-1,2-Dichloroethylene	1/20	29 ug/kg
Trichloroethylene (TCE)	3/20	4 ug/kg to 96 ug/kg
Semivolatile Organic Compound		
4-Methylphenol (p-Cresol)	1/4	870 ug/kg
Benzo(a)anthracene	1/4	49 ug/kg
Benzo(a)pyrene	1/4	48 ug/kg
Benzo(b)fluoranthene	1/4	55 ug/kg
Benzo(k)fluoranthene	1/4	64 ug/kg
Bis(2-ethylhexyl) phthalate	1/4	55 ug/kg
Chrysene	1/4	77 ug/kg
Fluoranthene	1/4	68 ug/kg
Pyrene	1/4	79 ug/kg
Metals		
Aluminum	16/16	4,290 mg/kg to 15,800 mg/kg
Antimony	7/16	0.35 mg/kg to 1 mg/kg
Arsenic	16/16	2.8 mg/kg to 15.2 mg/kg
Barium	16/16	59.6 mg/kg to 167 mg/kg
Beryllium	3/16	0.58 mg/kg to 0.61 mg/kg
Boron	12/16	1.1 mg/kg to 14.2 mg/kg
Cadmium	7/16	0.28 mg/kg to 1.8 mg/kg
Calcium	16/16	555 mg/kg to 59,100 mg/kg
Chromium, Total	16/16	7.8 mg/kg to 20.1 mg/kg
Cobalt	12/16	4.8 mg/kg to 9.4 mg/kg
Copper	16/16	6.6 mg/kg to 57.1 mg/kg
Iron	16/16	9,290 mg/kg to 39,600 mg/kg
Lead	16/16	13.9 mg/kg to 101 mg/kg
Magnesium	16/16	1,110 mg/kg to 14,700 mg/kg
Manganese	16/16	104 mg/kg to 1,280 mg/kg
Mercury	11/16	0.02 mg/kg to 0.1 mg/kg
Nickel	16/16	7.1 mg/kg to 19.9 mg/kg
Potassium	16/16	216 mg/kg to 747 mg/kg
Selenium	14/16	0.36 mg/kg to 0.94 mg/kg
Silver	7/16	0.22 mg/kg to 1.3 mg/kg
Sodium	3/16	49.9 mg/kg to 308 mg/kg
Thallium	2/16	0.18 mg/kg to 0.6 mg/kg
Vanadium	16/16	14.7 mg/kg to 32 mg/kg
Zinc	16/16	45.4 mg/kg to 231 mg/kg

Sheet 1 of 2

TABLE 5-5
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Other Inorganics		
Total Organic Carbon	2/2	34,200 mg/kg to 38,000 mg/kg

Sheet 2 of 2

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are included only when the duplicate results exceeded the screening criteria and the original sample results did not, or when an analyte was detected in a duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/20/01

TABLE 5-6
GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compound		
1,1-Dichloroethene	1/3	1 ug/L
cis-1,2-Dichloroethylene	2/3	5 ug/L to 210 ug/L
Tetrachloroethylene(PCE)	1/3	2 ug/L
trans-1,2-Dichloroethene	1/3	6 ug/L
Trichloroethylene (TCE)	2/3	5 ug/L to 2,400 ug/L
Metals		
Aluminum	3/3	191 ug/L to 455 ug/L
Barium	3/3	41.1 ug/L to 48.8 ug/L
Boron	2/3	11.3 ug/L to 49.9 ug/L
Calcium	3/3	36,100 ug/L to 72,700 ug/L
Chromium, Total	1/3	2.9 ug/L
Copper	1/3	1.7 ug/L
Iron	3/3	175 ug/L to 399 ug/L
Magnesium	3/3	13,900 ug/L to 25,000 ug/L
Manganese	3/3	5.1 ug/L to 35 ug/L
Nickel	1/3	1.7 ug/L
Potassium	2/3	758 ug/L to 1,090 ug/L
Selenium	1/3	3.3 ug/L
Sodium	3/3	23,500 ug/L to 124,000 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are included only when the duplicate results exceeded the screening criteria and the original sample results did not, or when an analyte was detected in a duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/20/01

TABLE 5-7
SURFACE WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Aluminum	2/2	981 ug/L to 2,540 ug/L
Barium	2/2	58.6 ug/L to 78.1 ug/L
Boron	1/2	26.6 ug/L
Calcium	2/2	33,600 ug/L to 57,600 ug/L
Iron	2/2	1,090 ug/L to 3,650 ug/L
Magnesium	2/2	10,300 ug/L to 19,800 ug/L
Manganese	2/2	150 ug/L to 198 ug/L
Potassium	2/2	2,730 ug/L to 3,490 ug/L
Selenium	2/2	2 ug/L to 2.1 ug/L
Silver	1/2	6.7 ug/L
Sodium	1/2	11,500 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are included only when the duplicate results exceed screening criteria and the original sample results did not, or when an analyte was detected in a duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

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TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Volatile Organic Compounds								
71-55-6	1,1,1-Trichloroethane	8	U	UG/KG			2.40E-06	8.00E-02
79-34-5	1,1,2,2-Tetrachloroethane	8	U	UG/KG		8.91E-09	2.05E-06	4.00E+01
79-00-5	1,1,2-Trichloroethane	8	U	UG/KG		4.21E-09	5.26E-05	8.89E+00
75-34-3	1,1-Dichloroethane	8	U	UG/KG			3.88E-06	8.00E-03
75-35-4	1,1-Dichloroethene	8	U	UG/KG		6.74E-08	1.19E-04	2.67E+00
107-06-2	1,2-Dichloroethane (EDC)	8	U	UG/KG		1.05E-08	2.27E-04	8.00E+00
540-59-0	1,2-Dichloroethene (total)	8	U	UG/KG			5.43E-05	4.00E-01
78-87-5	1,2-Dichloropropane	8	U	UG/KG		1.04E-08	3.76E-04	8.00E+00
78-93-3	2-Butanone (MEK)	17	U	UG/KG			6.13E-07	
591-78-6	2-Hexanone	17	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	17	U	UG/KG			5.89E-06	
67-64-1	Acetone	18	U	UG/KG			2.89E-06	2.25E-02
71-43-2	Benzene	8	U	UG/KG		5.46E-09	3.30E-04	4.00E+00
75-27-4	Bromodichloromethane	8	U	UG/KG		3.39E-09	7.66E-06	2.67E-01
75-25-2	Bromoform	8	U	UG/KG		2.56E-11	4.54E-07	2.00E-01
74-83-9	Bromomethane	8	U	UG/KG			6.09E-04	8.00E-01
75-15-0	Carbon disulfide	6	J	UG/KG			4.96E-06	3.00E-03
56-23-5	Carbon tetrachloride	8	U	UG/KG		1.51E-08	1.14E-03	2.67E+00
108-90-7	Chlorobenzene	8	U	UG/KG			1.47E-05	1.14E-01
75-00-3	Chloroethane	8	U	UG/KG		1.23E-09	4.24E-07	
67-66-3	Chloroform	8	U	UG/KG		1.54E-08	6.21E-03	2.67E-01
74-87-3	Chloromethane	8	U	UG/KG		3.01E-09		
156-59-2	cis-1,2-Dichloroethene	29		UG/KG			1.97E-04	1.45E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
10061-01-5	cis-1,3-Dichloropropene	8	U	UG/KG		4.50E-08	1.82E-04	
124-48-1	Dibromochloromethane	8	U	UG/KG		3.01E-09	5.02E-06	4.00E-01
100-41-4	Ethylbenzene	8	U	UG/KG			1.34E-06	1.14E-02
75-09-2	Methylene chloride	8	U	UG/KG		3.90E-10	8.18E-07	8.00E+00
110-54-3	N-Hexane	8	U	UG/KG			1.98E-05	
100-42-5	Styrene	8	U	UG/KG			3.91E-07	4.00E-02
127-18-4	Tetrachloroethylene (PCE)	8	U	UG/KG		4.29E-10	4.70E-06	2.67E+00
108-88-3	Toluene	8	U	UG/KG			4.03E-06	1.33E-02
1330-20-7	total Xylenes	8	U	UG/KG			1.80E-06	8.00E-04
156-60-5	trans-1,2-Dichloroethene	8	U	UG/KG			3.74E-05	2.67E-01
10061-02-6	trans-1,3-Dichloropropene	8	U	UG/KG		4.50E-08	1.82E-04	
79-01-6	Trichloroethylene (TCE)	96	J	UG/KG		1.57E-08	1.21E-03	3.20E+01
75-01-4	Vinyl chloride	8	U	UG/KG		1.64E-07		1.14E+01
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	440	U	UG/KG			5.78E-05	1.47E+00
95-50-1	1,2-Dichlorobenzene	440	U	UG/KG			1.33E-04	4.89E-01
541-73-1	1,3-Dichlorobenzene	440	U	UG/KG			8.50E-03	
106-46-7	1,4-Dichlorobenzene	440	U	UG/KG		5.41E-08	2.29E-04	4.40E+00
95-95-4	2,4,5-Trichlorophenol	2200	U	UG/KG			2.50E-05	2.20E-01
88-06-2	2,4,6-Trichlorophenol	440	U	UG/KG		1.96E-09		5.50E+01
120-83-2	2,4-Dichlorophenol	440	U	UG/KG			1.66E-04	8.80E+00
105-67-9	2,4-Dimethylphenol	440	U	UG/KG			2.50E-05	1.10E+00
51-28-5	2,4-Dinitrophenol	2200	U	UG/KG			1.25E-03	2.20E+02
91-58-7	2-Chloronaphthalene	440	U	UG/KG			1.61E-05	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
95-57-8	2-Chlorophenol	440	U	UG/KG			1.82E-03	2.20E+00
91-57-6	2-Methylnaphthalene	440	U	UG/KG			8.11E-06	2.20E-03
95-48-7	2-Methylphenol	440	U	UG/KG			9.99E-06	5.50E-01
88-74-4	2-Nitroaniline	2200	U	UG/KG			4.37E-02	
88-75-5	2-Nitrophenol	440	U	UG/KG			6.24E-05	
91-94-1	3,3'-Dichlorobenzidine	440	U	UG/KG		8.03E-08		1.47E+03
99-09-2	3-Nitroaniline	2200	U	UG/KG			4.37E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2200	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	440	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	440	U	UG/KG			9.99E-06	
106-47-8	4-Chloroaniline	880	U	UG/KG			2.50E-04	2.93E+01
7005-72-3	4-Chlorophenyl phenyl ether	440	U	UG/KG				
106-44-5	4-Methylphenol	870		UG/KG			1.98E-04	
100-01-6	4-Nitroaniline	2200	U	UG/KG			4.37E-02	
100-02-7	4-Nitrophenol	2200	U	UG/KG			3.12E-04	
83-32-9	Acenaphthene	440	U	UG/KG			1.15E-05	1.47E-02
208-96-8	Acenaphthylene	440	U	UG/KG			8.11E-06	2.20E-03
120-12-7	Anthracene	440	U	UG/KG			1.13E-06	7.33E-04
56-55-3	Benzo(a)anthracene	49	J	UG/KG		1.70E-08		6.13E-01
50-32-8	Benzo(a)pyrene	48	J	UG/KG		1.66E-07		1.20E-01
205-99-2	Benzo(b)fluoranthene	55	J	UG/KG		1.91E-08		2.75E-01
191-24-2	Benzo(g,h,i)perylene	440	U	UG/KG			8.11E-06	2.20E-03
207-08-9	Benzo(k)fluoranthene	64	J	UG/KG		2.22E-09		3.20E-02
111-91-1	bis(2-Chloroethoxy)methane	440	U	UG/KG				

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
111-44-4	bis(2-Chloroethyl) ether	440	U	UG/KG		7.10E-07		2.20E+04
108-60-1	bis(2-Chloroisopropyl) ether	440	U	UG/KG		5.45E-08	1.04E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	55	J	UG/KG		3.12E-10	3.12E-06	
85-68-7	Butyl benzyl phthalate	440	U	UG/KG			2.50E-06	5.50E-04
86-74-8	Carbazole	440	U	UG/KG		3.57E-09		1.47E+01
218-01-9	Chrysene	77	J	UG/KG		2.67E-10		9.63E-03
84-74-2	Di-n-butyl phthalate	440	U	UG/KG			4.99E-06	1.47E-03
117-84-0	Di-n-octyl phthalate	440	U	UG/KG			2.50E-05	4.40E-05
53-70-3	Dibenz(a,h)anthracene	440	U	UG/KG		1.52E-06		5.50E+00
132-64-9	Dibenzofuran	440	U	UG/KG			8.69E-05	
84-66-2	Diethyl phthalate	440	U	UG/KG			6.24E-07	
131-11-3	Dimethyl phthalate	440	U	UG/KG			4.99E-08	
206-44-0	Fluoranthene	68	J	UG/KG			2.26E-06	3.40E-04
86-73-7	Fluorene	440	U	UG/KG			1.33E-05	1.47E-02
118-74-1	Hexachlorobenzene	440	U	UG/KG		2.85E-07	6.24E-04	4.40E+00
87-68-3	Hexachlorobutadiene	440	U	UG/KG		1.39E-08	2.50E-03	4.40E+00
77-47-4	Hexachlorocyclopentadiene	440	U	UG/KG			7.46E-05	2.20E-02
67-72-1	Hexachloroethane	440	U	UG/KG		2.50E-09	4.99E-04	2.20E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	440	U	UG/KG		1.52E-07		6.29E-01
78-59-1	Isophorone	440	U	UG/KG		1.69E-10	2.50E-06	1.47E+01
621-64-7	N-Nitroso-di-n-propylamine	440	U	UG/KG		1.25E-06		2.20E+05
86-30-6	N-Nitrosodiphenylamine	440	U	UG/KG		8.74E-10		7.33E+00
91-20-3	Naphthalene	440	U	UG/KG			2.33E-03	1.10E-01
87-86-5	Pentachlorophenol	2200	U	UG/KG		1.98E-07	1.54E-04	2.20E+03

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
85-01-8	Phenanthrene	440	U	UG/KG			8.11E-06	2.20E-03
108-95-2	Phenol	440	U	UG/KG			8.32E-07	8.80E-02
129-00-0	Pyrene	79	J	UG/KG			1.46E-06	3.95E-04
Explosives								
99-35-4	1,3,5-Trinitrobenzene	450	U	UG/KG			1.70E-05	
99-65-0	1,3-Dinitrobenzene	450	U	UG/KG			5.11E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	890	U	UG/KG		1.08E-08	2.02E-03	
121-14-2	2,4-Dinitrotoluene	450	U	UG/KG			2.55E-04	1.13E+04
606-20-2	2,6-Dinitrotoluene	890	U	UG/KG			1.01E-03	2.97E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	890	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	890	U	UG/KG				
99-08-1	3-Nitrotoluene	890	U	UG/KG			4.38E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	890	U	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	890	U	UG/KG			4.38E-04	
2691-41-0	HMX	890	U	UG/KG			2.02E-05	
98-95-3	Nitrobenzene	450	U	UG/KG			3.93E-03	
121-82-4	RDX	890	U	UG/KG		3.97E-08	3.37E-04	
479-45-8	Tetryl	1300	U	UG/KG			1.48E-04	
Metals								
7429-90-5	Aluminum	15800		MG/KG	5.49E-01		9.42E-03	
7440-36-0	Antimony	1		MG/KG	1.20E+00		1.22E-03	3.33E+00
7440-38-2	Arsenic	15.2		MG/KG	1.13E+00	5.57E-06	3.46E-02	1.52E+01
7440-39-3	Barium	167		MG/KG	8.56E-01		1.34E-03	2.09E+00
7440-41-7	Beryllium	0.61	J	MG/KG	8.03E-01	2.72E-10	1.65E-04	2.03E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-42-8	Boron	14.2		MG/KG	2.68E+00		1.79E-04	
7440-43-9	Cadmium	1.8		MG/KG	9.47E+00	6.02E-10	2.22E-03	4.50E+00
7440-70-2	Calcium	59100		MG/KG	2.37E+01			
7440-47-3	Chromium	20.1		MG/KG	7.98E-01	4.48E-08		1.01E+01
7440-48-4	Cobalt	9.4		MG/KG	4.33E-01		7.67E-05	
7440-50-8	Copper	57.1		MG/KG	5.05E+00		7.52E-04	
7439-89-6	Iron	39600		MG/KG	2.05E+00		6.47E-02	
7439-92-1	Lead	101		MG/KG	4.32E+00			
7439-95-4	Magnesium	14700		MG/KG	9.47E+00			
7439-96-5	Manganese	1280		MG/KG	3.52E-01		3.97E-02	
7439-97-6	Mercury	0.1		MG/KG	1.67E+00			
7440-02-0	Nickel	19.9		MG/KG	1.05E+00		4.87E-04	2.84E+00
2023695	Potassium	747		MG/KG	1.20E+00			
7782-49-2	Selenium	0.94		MG/KG	4.02E-01		9.20E-05	3.13E+00
7440-22-4	Silver	1.3		MG/KG	2.24E+00		1.27E-04	6.50E-01
7440-23-5	Sodium	308		MG/KG	1.81E+00			
7440-28-0	Thallium	0.6	J	MG/KG	1.46E+00		4.19E-06	
7440-62-2	Vanadium	32		MG/KG	6.78E-01		2.24E-03	1.07E-01
7440-66-6	Zinc	231	J	MG/KG	4.49E+00		3.77E-04	3.85E-01
Other Parameters								
TOC	TOC	38000		MG/KG	1.21E+00			

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TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	8	U	UG/KG			4.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	8	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	8	U	UG/KG	9.76E-07	9.76E-07	4.00E-01
75-34-3	1,1-Dichloroethane	8	U	UG/KG	4.00E-08	4.00E-08	3.48E-04
75-35-4	1,1-Dichloroethene	8	U	UG/KG	4.44E-07	4.44E-06	1.33E-01
107-06-2	1,2-Dichloroethane (EDC)	8	U	UG/KG	1.27E-04	5.71E-06	4.00E-01
540-59-0	1,2-Dichloroethene (total)	8	U	UG/KG	4.00E-07	4.00E-07	2.00E-02
78-87-5	1,2-Dichloropropane	8	U	UG/KG	9.52E-05	4.44E-06	2.67E-01
78-93-3	2-Butanone (MEK)	17	U	UG/KG			
591-78-6	2-Hexanone	17	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	17	U	UG/KG			
67-64-1	Acetone	18	U	UG/KG	9.00E-08	9.00E-08	1.13E-03
71-43-2	Benzene	8	U	UG/KG	4.00E-05	1.86E-06	2.67E-01
75-27-4	Bromodichloromethane	8	U	UG/KG	8.70E-05	4.00E-06	1.33E-02
75-25-2	Bromoform	8	U	UG/KG	1.11E-05	5.00E-07	1.00E-02
74-83-9	Bromomethane	8	U	UG/KG	2.76E-06	8.00E-06	4.00E-02
75-15-0	Carbon disulfide	6	J	UG/KG	3.00E-08	3.00E-07	1.88E-04
56-23-5	Carbon tetrachloride	8	U	UG/KG	1.82E-04	1.95E-05	1.14E-01
108-90-7	Chlorobenzene	8	U	UG/KG	1.95E-07	1.95E-06	8.00E-03
75-00-3	Chloroethane	8	U	UG/KG			
67-66-3	Chloroform	8	U	UG/KG	8.51E-06	4.00E-06	1.33E-02
74-87-3	Chloromethane	8	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	29		UG/KG	1.45E-06	1.45E-06	7.25E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
10061-01-5	cis-1,3-Dichloropropene	8	U	UG/KG			
124-48-1	Dibromochloromethane	8	U	UG/KG	1.95E-07	1.95E-07	2.00E-02
100-41-4	Ethylbenzene	8	U	UG/KG	4.00E-08	4.00E-07	6.15E-04
75-09-2	Methylene chloride	8	U	UG/KG	1.05E-05	6.67E-07	4.00E-01
110-54-3	N-Hexane	8	U	UG/KG			
100-42-5	Styrene	8	U	UG/KG	1.95E-08	1.95E-07	2.00E-03
127-18-4	Tetrachloroethylene (PCE)	8	U	UG/KG	7.27E-05	3.33E-06	1.33E-01
108-88-3	Toluene	8	U	UG/KG	1.95E-08	1.95E-08	6.67E-04
1330-20-7	total Xylenes	8	U	UG/KG	8.00E-09	1.95E-08	5.33E-05
156-60-5	trans-1,2-Dichloroethene	8	U	UG/KG	1.95E-07	1.95E-07	1.14E-02
10061-02-6	trans-1,3-Dichloropropene	8	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	96	J	UG/KG	1.85E-04	8.00E-05	1.60E+00
75-01-4	Vinyl chloride	8	U	UG/KG	2.67E-03	1.23E-04	8.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	440	U	UG/KG	2.20E-05	2.20E-04	8.80E-02
95-50-1	1,2-Dichlorobenzene	440	U	UG/KG	2.44E-06	2.44E-05	2.59E-02
541-73-1	1,3-Dichlorobenzene	440	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	440	U	UG/KG			2.20E-01
95-95-4	2,4,5-Trichlorophenol	2200	U	UG/KG	1.10E-05	1.10E-05	8.15E-03
88-06-2	2,4,6-Trichlorophenol	440	U	UG/KG	8.46E-04	4.00E-05	2.20E+00
120-83-2	2,4-Dichlorophenol	440	U	UG/KG	7.21E-05	7.21E-04	4.40E-01
105-67-9	2,4-Dimethylphenol	440	U	UG/KG	1.07E-05	1.07E-05	4.89E-02
51-28-5	2,4-Dinitrophenol	2200	U	UG/KG	5.37E-04	5.37E-03	1.10E+01
91-58-7	2-Chloronaphthalene	440	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	440	U	UG/KG	4.40E-05	4.40E-05	1.10E-01
91-57-6	2-Methylnaphthalene	440	U	UG/KG	7.21E-06	7.21E-06	1.05E-04
95-48-7	2-Methylphenol	440	U	UG/KG	4.40E-06	4.40E-06	2.93E-02
88-74-4	2-Nitroaniline	2200	U	UG/KG			
88-75-5	2-Nitrophenol	440	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	440	U	UG/KG	3.38E-02	1.57E-03	6.29E+01
99-09-2	3-Nitroaniline	2200	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2200	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	440	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	440	U	UG/KG			
106-47-8	4-Chloroaniline	880	U	UG/KG	1.07E-04	1.07E-03	1.26E+00
7005-72-3	4-Chlorophenyl phenyl ether	440	U	UG/KG			
106-44-5	4-Methylphenol	870		UG/KG			
100-01-6	4-Nitroaniline	2200	U	UG/KG			
100-02-7	4-Nitrophenol	2200	U	UG/KG			
83-32-9	Acenaphthene	440	U	UG/KG	3.67E-06	3.67E-06	7.72E-04
208-96-8	Acenaphthylene	440	U	UG/KG	7.21E-06	7.21E-06	1.05E-04
120-12-7	Anthracene	440	U	UG/KG	7.21E-07	7.21E-07	3.67E-05
56-55-3	Benzo(a)anthracene	49	J	UG/KG	6.13E-03	2.88E-04	2.45E-02
50-32-8	Benzo(a)pyrene	48	J	UG/KG	6.00E-02	2.82E-03	6.00E-03
205-99-2	Benzo(b)fluoranthene	55	J	UG/KG	6.88E-03	3.24E-04	1.10E-02
191-24-2	Benzo(g,h,i)perylene	440	U	UG/KG	7.21E-06	7.21E-06	1.05E-04
207-08-9	Benzo(k)fluoranthene	64	J	UG/KG	8.21E-04	3.76E-05	1.31E-03
111-91-1	bis(2-Chloroethoxy)methane	440	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-44-4	bis(2-Chloroethyl) ether	440	U	UG/KG	8.80E-02	5.87E-03	1.10E+03
108-60-1	bis(2-Chloroisopropyl) ether	440	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	55	J	UG/KG	1.34E-04	1.34E-05	1.53E-05
85-68-7	Butyl benzyl phthalate	440	U	UG/KG	1.07E-06	1.07E-06	4.73E-04
86-74-8	Carbazole	440	U	UG/KG	1.52E-03	7.10E-05	7.33E-01
218-01-9	Chrysene	77	J	UG/KG	9.87E-05	4.53E-06	4.81E-04
84-74-2	Di-n-butyl phthalate	440	U	UG/KG	2.20E-06	2.20E-06	1.91E-04
117-84-0	Di-n-octyl phthalate	440	U	UG/KG	1.07E-05	1.07E-04	4.40E-05
53-70-3	Dibenz(a,h)anthracene	440	U	UG/KG	5.50E-01	2.59E-02	2.20E-01
132-64-9	Dibenzofuran	440	U	UG/KG			
84-66-2	Diethyl phthalate	440	U	UG/KG	4.40E-07	4.40E-07	9.36E-04
131-11-3	Dimethyl phthalate	440	U	UG/KG			
206-44-0	Fluoranthene	68	J	UG/KG	8.29E-07	8.29E-07	1.58E-05
86-73-7	Fluorene	440	U	UG/KG	5.37E-06	5.37E-06	7.86E-04
118-74-1	Hexachlorobenzene	440	U	UG/KG	1.10E-01	5.64E-03	2.20E-01
87-68-3	Hexachlorobutadiene	440	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	440	U	UG/KG	3.14E-05	3.14E-05	1.10E-03
67-72-1	Hexachloroethane	440	U	UG/KG	2.20E-04	2.20E-04	8.80E-01
193-39-5	Indeno(1,2,3-c,d)pyrene	440	U	UG/KG	5.50E-02	2.59E-03	3.14E-02
78-59-1	Isophorone	440	U	UG/KG	1.07E-06	1.07E-06	5.50E-02
621-64-7	N-Nitroso-di-n-propylamine	440	U	UG/KG	5.50E-01	2.44E-02	8.80E+03
86-30-6	N-Nitrosodiphenylamine	440	U	UG/KG	3.67E-04	1.76E-05	4.40E-01
91-20-3	Naphthalene	440	U	UG/KG	5.37E-06	5.37E-05	5.24E-03
87-86-5	Pentachlorophenol	2200	U	UG/KG	9.17E-02	4.23E-03	7.33E+01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
85-01-8	Phenanthrene	440	U	UG/KG	7.21E-06	7.21E-06	1.05E-04
108-95-2	Phenol	440	U	UG/KG	4.40E-07	3.67E-06	4.40E-03
129-00-0	Pyrene	79	J	UG/KG	1.30E-06	1.30E-06	1.88E-05
Explosives							
99-35-4	1,3,5-Trinitrobenzene	450	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	450	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	890	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	450	U	UG/KG	5.36E-02	2.50E-03	5.63E+02
606-20-2	2,6-Dinitrotoluene	890	U	UG/KG	1.06E-01	4.94E-03	1.27E+03
35572-78-2	2-Amino-4,6-Dinitrotoluene	890	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	890	U	UG/KG			
99-08-1	3-Nitrotoluene	890	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	890	U	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	890	U	UG/KG			
2691-41-0	HMX	890	U	UG/KG			
98-95-3	Nitrobenzene	450	U	UG/KG	4.50E-04	4.50E-04	4.50E+00
121-82-4	RDX	890	U	UG/KG			
479-45-8	Tetryl	1300	U	UG/KG			
Metals							
7429-90-5	Aluminum	15800		MG/KG			
7440-36-0	Antimony	1		MG/KG	1.22E-03	1.22E-02	2.00E-01
7440-38-2	Arsenic	15.2		MG/KG	5.07E+00	2.49E-01	5.43E-01
7440-39-3	Barium	167		MG/KG	1.19E-03	1.19E-02	1.39E-01
7440-41-7	Beryllium	0.61	J	MG/KG	6.10E-01	2.10E-02	9.24E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-42-8	Boron	14.2		MG/KG	7.89E-05	7.89E-04	
7440-43-9	Cadmium	1.8		MG/KG	9.00E-04	9.00E-03	4.86E-01
7440-70-2	Calcium	59100		MG/KG			
7440-47-3	Chromium	20.1		MG/KG	2.01E-03	4.90E-03	7.18E-01
7440-48-4	Cobalt	9.4		MG/KG	7.83E-05	7.83E-04	
7440-50-8	Copper	57.1		MG/KG	6.96E-04	6.96E-03	5.19E-03
7439-89-6	Iron	39600		MG/KG			
7439-92-1	Lead	101		MG/KG	2.53E-01	2.53E-01	
7439-95-4	Magnesium	14700		MG/KG			
7439-96-5	Manganese	1280		MG/KG	1.33E-02	1.33E-01	
7439-97-6	Mercury	0.1		MG/KG	1.64E-04	1.64E-03	6.67E-01
7440-02-0	Nickel	19.9		MG/KG	4.85E-04	4.85E-03	2.62E-01
2023695	Potassium	747		MG/KG			
7782-49-2	Selenium	0.94		MG/KG	9.40E-05	9.40E-04	3.92E-01
7440-22-4	Silver	1.3		MG/KG	1.30E-04	1.30E-03	8.67E-01
7440-23-5	Sodium	308		MG/KG			
7440-28-0	Thallium	0.6	J	MG/KG	3.75E-03	3.75E-03	2.50E-01
7440-62-2	Vanadium	32		MG/KG	2.29E-03	2.29E-02	3.27E-02
7440-66-6	Zinc	231	J	MG/KG	3.79E-04	3.79E-03	6.42E-02
Other Parameters							
TOC	TOC	38000		MG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-9

HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2F (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	1	U	UG/L		1.26E-03	5.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	1	U	UG/L	1.81E-05	2.74E-03	
79-00-5	1,1,2-Trichloroethane	1	U	UG/L	5.01E-06	4.11E-02	2.00E-01
75-34-3	1,1-Dichloroethane	1	U	UG/L		1.23E-03	
75-35-4	1,1-Dichloroethene	1	J	UG/L	2.19E-05	1.83E-02	1.43E-01
107-06-2	1,2-Dichloroethane (EDC)	1	U	UG/L	8.12E-06	9.88E-02	2.00E-01
78-87-5	1,2-Dichloropropane	1	U	UG/L	6.07E-06	1.45E-01	2.00E-01
78-93-3	2-Butanone (MEK)	5	U	UG/L		2.63E-03	
591-78-6	2-Hexanone	5	U	UG/L			
108-10-1	4-Methyl-2-pentanone (MIBK)	5	U	UG/L		3.17E-02	
67-64-1	Acetone	5	U	UG/L		8.22E-03	
71-43-2	Benzene	1	U	UG/L	2.44E-06	8.92E-02	2.00E-01
75-27-4	Bromodichloromethane	1	U	UG/L	5.53E-06	8.22E-03	
75-25-2	Bromoform	1	U	UG/L	1.18E-07	1.37E-03	
74-83-9	Bromomethane	1	U	UG/L.		1.15E-01	
75-15-0	Carbon disulfide	1	U	UG/L		9.59E-04	
56-23-5	Carbon tetrachloride	1	U	UG/L	5.84E-06	2.35E-01	2.00E-01
108-90-7	Chlorobenzene	1	U	UG/L		9.43E-03	1.00E-02
75-00-3	Chloroethane	1	U	UG/L	2.16E-07	1.16E-04	
67-66-3	Chloroform	1	U	UG/L	6.08E-06	1.60E+00	
74-87-3	Chloromethane	1	U	UG/L	6.62E-07		
156-59-2	cis-1,2-Dichloroethene	210		UG/L		3.45E+00	3.00E+00
10061-01-5	cis-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2F (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
124-48-1	Dibromochloromethane	1	U	UG/L	7.50E-06	8.22E-03	
100-41-4	Ethylbenzene	1	U	UG/L		7.46E-04	1.43E-03
75-09-2	Methylene chloride	1	U	UG/L	2.34E-07	6.16E-04	2.00E-01
110-54-3	N-Hexane	1	U	UG/L		2.85E-03	
100-42-5	Styrene	1	U	UG/L		6.09E-04	1.00E-02
127-18-4	Tetrachloroethylene (PCE)	2		UG/L	1.85E-06	7.88E-03	4.00E-01
108-88-3	Toluene	1	U	UG/L		1.38E-03	1.00E-03
1330-20-7	total Xylenes	1	U	UG/L		6.99E-04	1.00E-04
156-60-5	trans-1,2-Dichloroethene	6	J	UG/L		4.93E-02	6.00E-02
10061-02-6	trans-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	
79-01-6	Trichloroethylene (TCE)	2400		UG/L	1.46E-03	6.58E+01	4.80E+02
75-01-4	Vinyl chloride	1	U	UG/L	5.06E-05		5.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		5.14E-02	1.43E-01
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		2.70E-02	1.67E-02
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		1.83E+00	
106-46-7	1,4-Dichlorobenzene	10	U	UG/L	1.99E-05	5.48E-02	1.33E-01
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		1.37E-02	
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L	1.64E-06		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		9.13E-02	
105-67-9	2,4-Dimethylphenol	10	U	UG/L		1.37E-02	
51-28-5	2,4-Dinitrophenol	50	U	UG/L		6.85E-01	
91-58-7	2-Chloronaphthalene	10	U	UG/L		2.05E-02	
95-57-8	2-Chlorophenol	10	U	UG/L		3.29E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2F (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
91-57-6	2-Methylnaphthalene	10	U	UG/L		5.48E-02	
95-48-7	2-Methylphenol	10	U	UG/L		5.48E-03	
88-74-4	2-Nitroaniline	50	U	UG/L		2.40E+01	
88-75-5	2-Nitrophenol	10	U	UG/L		3.42E-02	
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L	1.34E-04		
99-09-2	3-Nitroaniline	50	U	UG/L		2.40E+01	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L			
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L			
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		5.48E-03	
106-47-8	4-Chloroaniline	20	U	UG/L		1.37E-01	
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L			
106-44-5	4-Methylphenol	10	U	UG/L		5.48E-02	
100-01-6	4-Nitroaniline	50	U	UG/L		2.40E+01	
100-02-7	4-Nitrophenol	50	U	UG/L		1.71E-01	
83-32-9	Acenaphthene	10	U	UG/L		2.74E-02	
208-96-8	Acenaphthylene	10	U	UG/L		5.48E-02	
120-12-7	Anthracene	10	U	UG/L		5.48E-03	
56-55-3	Benzo(a)anthracene	10	U	UG/L	1.09E-04		
50-32-8	Benzo(a)pyrene	10	U	UG/L	1.09E-03		5.00E+01
205-99-2	Benzo(b)fluoranthene	10	U	UG/L	1.09E-04		
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		5.48E-02	
207-08-9	Benzo(k)fluoranthene	10	U	UG/L	1.09E-05		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L			
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L	1.02E-03		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2F (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L	3.64E-05	4.11E-02	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L	2.08E-06	1.37E-02	
85-68-7	Butyl benzyl phthalate	10	U	UG/L		1.37E-03	
86-74-8	Carbazole	10	U	UG/L	2.97E-06		
218-01-9	Chrysene	10	U	UG/L	1.09E-06		
84-74-2	Di-n-butyl phthalate	10	U	UG/L		2.74E-03	
117-84-0	Di-n-octyl phthalate	10	U	UG/L		1.37E-02	
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L	1.09E-03		
132-64-9	Dibenzofuran	10	U	UG/L		4.11E-01	
84-66-2	Diethyl phthalate	10	U	UG/L		3.42E-04	
131-11-3	Dimethyl phthalate	10	U	UG/L		2.74E-05	
206-44-0	Fluoranthene	10	U	UG/L		6.85E-03	
86-73-7	Fluorene	10	U	UG/L		4.11E-02	
118-74-1	Hexachlorobenzene	10	U	UG/L	2.38E-04	3.42E-01	1.00E+01
87-68-3	Hexachlorobutadiene	10	U	UG/L	1.16E-05	1.37E+00	
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		3.91E-02	2.00E-01
67-72-1	Hexachloroethane	10	U	UG/L	2.08E-06	2.74E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L	1.09E-04		
78-59-1	Isophorone	10	U	UG/L	1.41E-07	1.37E-03	
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L	1.04E-03		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L	7.29E-07		
91-20-3	Naphthalene	10	U	UG/L		1.61E+00	
87-86-5	Pentachlorophenol	50	U	UG/L	8.92E-05	4.57E-02	5.00E+01
85-01-8	Phenanthrene	10	U	UG/L		5.48E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2F (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
108-95-2	Phenol	10	U	UG/L		4.57E-04	1.00E-01
129-00-0	Pyrene	10	U	UG/L		5.48E-02	
Explosives							
99-35-4	1,3,5-Trinitrobenzene	0.25	U	UG/L		2.28E-04	
99-65-0	1,3-Dinitrobenzene	0.25	U	UG/L		6.85E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L	2.23E-07	2.74E-02	
121-14-2	2,4-Dinitrotoluene	0.25	U	UG/L		3.42E-03	
606-20-2	2,6-Dinitrotoluene	0.5	U	UG/L		1.37E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L			
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L			
99-08-1	3-Nitrotoluene	0.5	U	UG/L		8.22E-03	
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L			
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		8.22E-03	
2691-41-0	HMX	0.5	U	UG/L		2.74E-04	
98-95-3	Nitrobenzene	0.25	U	UG/L		7.36E-02	
121-82-4	RDX	0.5	U	UG/L	8.18E-07	4.57E-03	
479-45-8	Tetryl	0.75	U	UG/L		2.05E-03	
Metals							
7429-90-5	Aluminum	455		UG/L		1.25E-02	
7440-36-0	Antimony	6	U	UG/L		4.11E-01	1.00E+00
7440-38-2	Arsenic	10	U	UG/L	2.23E-04	9.13E-01	2.00E-01
7440-39-3	Barium	48.8	J	UG/L		1.91E-02	2.44E-02
7440-41-7	Beryllium	5	U	UG/L		6.85E-02	1.25E+00
7440-42-8	Boron	49.9	J	UG/L		1.52E-02	2.50E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2F (AUS-0A2D)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
7440-43-9	Cadmium	5	U	UG/L		2.74E-01	1.00E+00
7440-70-2	Calcium	72700		UG/L			
7440-47-3	Chromium	2.9	J	UG/L			2.90E-02
7440-48-4	Cobalt	50	U	UG/L		2.28E-02	5.00E-02
7440-50-8	Copper	1.7	J	UG/L		1.25E-03	2.62E-03
7439-89-6	Iron	399		UG/L		3.64E-02	7.98E-02
7439-92-1	Lead	3	U	UG/L			4.00E-01
7439-95-4	Magnesium	25000		UG/L			
7439-96-5	Manganese	35		UG/L		4.00E-02	2.33E-01
7439-97-6	Mercury	0.2	U	UG/L			1.00E-01
7440-02-0	Nickel	1.7	J	UG/L		2.33E-03	1.70E-02
2023695	Potassium	1090		UG/L			
7782-49-2	Selenium	3.3	J	UG/L		1.81E-02	6.60E-02
7440-22-4	Silver	10	U	UG/L		5.48E-02	2.00E-01
7440-23-5	Sodium	124000		UG/L			
7440-28-0	Thallium	10	U	UG/L		3.91E+00	5.00E+00
7440-62-2	Vanadium	50	U	UG/L		1.96E-01	
7440-66-6	Zinc	20	U	UG/L		1.83E-03	4.00E-03
Other Parameters							
7601-90-3	Perchlorate	500	U	UG/L		2.74E+01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
Explosives						
99-35-4	1,3,5-Trinitrobenzene	0.25	U	UG/L		
99-65-0	1,3-Dinitrobenzene	0.25	U	UG/L		
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L		
121-14-2	2,4-Dinitrotoluene	0.25	U	UG/L		
606-20-2	2,6-Dinitrotoluene	0.5	U	UG/L		
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L		
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L		
99-08-1	3-Nitrotoluene	0.5	U	UG/L		
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L		
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		
2691-41-0	HMX	0.5	U	UG/L		
98-95-3	Nitrobenzene	0.25	U	UG/L		
121-82-4	RDX	0.5	U	UG/L		
479-45-8	Tetryl	0.75	U	UG/L		
Metals						
7429-90-5	Aluminum	2540	J	UG/L	1.27E+01	
7440-36-0	Antimony	6	U	UG/L	1.00E+00	
7440-38-2	Arsenic	10	U	UG/L	1.00E+00	
7440-39-3	Barium	78.1	J	UG/L	3.44E+00	1.56E-02
7440-41-7	Beryllium	5	U	UG/L	1.00E+00	
7440-42-8	Boron	26.6	J	UG/L		2.66E-02
7440-43-9	Cadmium	5	U	UG/L	1.00E+00	
7440-70-2	Calcium	57600		UG/L	8.00E+00	
7440-47-3	Chromium	10	U	UG/L	1.00E+00	
7440-48-4	Cobalt	50	U	UG/L	1.00E+00	
7440-50-8	Copper	10	U	UG/L	1.00E+00	
7439-89-6	Iron	3650		UG/L	3.65E+01	3.65E+00
7439-92-1	Lead	5.7	U	UG/L	2.85E+00	
7439-95-4	Magnesium	19800		UG/L	7.81E+00	
7439-96-5	Manganese	198	J	UG/L	3.40E-01	1.98E-01
7439-97-6	Mercury	0.5	U	UG/L	2.50E+00	4.17E+01
7440-02-0	Nickel	10	U	UG/L	1.00E+00	1.00E-02
2023695	Potassium	3490		UG/L	2.16E+00	
7782-49-2	Selenium	2.1	J	UG/L	7.78E-01	2.10E-03
7440-22-4	Silver	6.7	J	UG/L	6.70E-01	1.34E+00
7440-23-5	Sodium	11500		UG/L	3.63E+00	
7440-28-0	Thallium	10	U	UG/L	1.00E+00	
7440-62-2	Vanadium	50	U	UG/L	1.00E+00	
7440-66-6	Zinc	23	U	UG/L	1.15E+00	2.30E-02
Other Parameters						
7601-90-3	Perchlorate	500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		8	U	UG/KG	2.68E-04	
79-34-5	1,1,2,2-Tetrachloroethane		8	U	UG/KG	6.29E-02	
79-00-5	1,1,2-Trichloroethane		8	U	UG/KG	2.80E-04	
75-34-3	1,1-Dichloroethane		8	U	UG/KG	3.98E-04	
75-35-4	1,1-Dichloroethene		8	U	UG/KG	9.66E-04	
107-06-2	1,2-Dichloroethane (EDC)		8	U	UG/KG	3.77E-04	
540-59-0	1,2-Dichloroethene (total)		8	U	UG/KG	1.02E-02	
78-87-5	1,2-Dichloropropane		8	U	UG/KG	1.14E-05	
78-93-3	2-Butanone (MEK)		17	U	UG/KG	1.90E-04	
591-78-6	2-Hexanone		17	U	UG/KG	1.35E-03	
108-10-1	4-Methyl-2-pentanone (MIBK)		17	U	UG/KG	3.84E-05	
67-64-1	Acetone		18	U	UG/KG	7.20E-03	
71-43-2	Benzene		8	U	UG/KG	5.00E-04	
75-27-4	Bromodichloromethane		8	U	UG/KG	1.48E-02	
75-25-2	Bromoform		8	U	UG/KG	5.03E-04	
74-83-9	Bromomethane		8	U	UG/KG	3.40E-02	
75-15-0	Carbon disulfide		6	J	UG/KG	6.37E-02	
56-23-5	Carbon tetrachloride		8	U	UG/KG	8.00E-06	
108-90-7	Chlorobenzene		8	U	UG/KG	2.00E-04	
75-00-3	Chloroethane		8	U	UG/KG		
67-66-3	Chloroform		8	U	UG/KG	6.72E-03	
74-87-3	Chloromethane		8	U	UG/KG	7.69E-04	
156-59-2	cis-1,2-Dichloroethene		29		UG/KG	3.68E-02	
10061-01-5	cis-1,3-Dichloropropene		8	U	UG/KG	2.01E-02	
124-48-1	Dibromochloromethane		8	U	UG/KG	3.90E-03	
100-41-4	Ethylbenzene		8	U	UG/KG	1.60E-03	
75-09-2	Methylene chloride		8	U	UG/KG	1.98E-03	
110-54-3	N-Hexane		8	U	UG/KG		
100-42-5	Styrene		8	U	UG/KG	2.67E-05	
127-18-4	Tetrachloroethylene (PCE)		8	U	UG/KG	6.15E-04	
108-88-3	Toluene		8	U	UG/KG	2.67E-03	
1330-20-7	total Xylenes		8	U	UG/KG	1.33E-02	
156-60-5	trans-1,2-Dichloroethene		8	U	UG/KG	1.02E-02	
10061-02-6	trans-1,3-Dichloropropene		8	U	UG/KG	2.01E-02	
79-01-6	Trichloroethylene (TCE)		96	J	UG/KG	1.07E-02	
75-01-4	Vinyl chloride		8	U	UG/KG	1.24E-02	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		440	U	UG/KG	2.20E-02	
95-50-1	1,2-Dichlorobenzene		440	U	UG/KG	1.49E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
541-73-1	1,3-Dichlorobenzene		440	U	UG/KG	1.17E-02	
106-46-7	1,4-Dichlorobenzene		440	U	UG/KG	2.20E-02	
95-95-4	2,4,5-Trichlorophenol		2200	U	UG/KG	5.50E-01	
88-06-2	2,4,6-Trichlorophenol		440	U	UG/KG	4.40E-02	
120-83-2	2,4-Dichlorophenol		440	U	UG/KG	5.03E-03	
105-67-9	2,4-Dimethylphenol		440	U	UG/KG	4.40E+01	
51-28-5	2,4-Dinitrophenol		2200	U	UG/KG	1.10E-01	
91-58-7	2-Chloronaphthalene		440	U	UG/KG	3.61E+01	
95-57-8	2-Chlorophenol		440	U	UG/KG	1.81E+00	
91-57-6	2-Methylnaphthalene		440	U	UG/KG	1.36E-01	
95-48-7	2-Methylphenol		440	U	UG/KG	1.09E-02	
88-74-4	2-Nitroaniline		2200	U	UG/KG	2.97E-02	
88-75-5	2-Nitrophenol		440	U	UG/KG	2.75E-01	
91-94-1	3,3'-Dichlorobenzidine		440	U	UG/KG	6.81E-01	
99-09-2	3-Nitroaniline		2200	U	UG/KG	6.96E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2200	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		440	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		440	U	UG/KG	5.53E-02	
106-47-8	4-Chloroaniline		880	U	UG/KG	8.00E-01	
7005-72-3	4-Chlorophenyl phenyl ether		440	U	UG/KG		
106-44-5	4-Methylphenol		870		UG/KG	5.34E-03	
100-01-6	4-Nitroaniline		2200	U	UG/KG	1.00E-01	
100-02-7	4-Nitrophenol		2200	U	UG/KG	3.14E-01	
83-32-9	Acenaphthene		440	U	UG/KG	6.45E-04	
208-96-8	Acenaphthylene		440	U	UG/KG	6.45E-04	
120-12-7	Anthracene		440	U	UG/KG	2.97E-04	
56-55-3	Benzo(a)anthracene		49	J	UG/KG	9.40E-03	YES
50-32-8	Benzo(a)pyrene		48	J	UG/KG	1.09E-05	YES
205-99-2	Benzo(b)fluoranthene		55	J	UG/KG	9.20E-04	YES
191-24-2	Benzo(g,h,i)perylene		440	U	UG/KG	3.70E-03	
207-08-9	Benzo(k)fluoranthene		64	J	UG/KG	1.07E-03	YES
111-91-1	bis(2-Chloroethoxy)methane		440	U	UG/KG	1.45E+00	
111-44-4	bis(2-Chloroethyl) ether		440	U	UG/KG	1.86E-02	
108-60-1	bis(2-Chloroisopropyl) ether		440	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		55	J	UG/KG	5.94E-02	YES
85-68-7	Butyl benzyl phthalate		440	U	UG/KG	1.84E+00	
86-74-8	Carbazole		440	U	UG/KG		
218-01-9	Chrysene		77	J	UG/KG	1.63E-02	YES
84-74-2	Di-n-butyl phthalate		440	U	UG/KG	2.20E-03	
117-84-0	Di-n-octyl phthalate		440	U	UG/KG	6.21E-04	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
53-70-3	Dibenz(a,h)anthracene		440	U	UG/KG	2.39E-02	
132-64-9	Dibenzofuran		440	U	UG/KG		
84-66-2	Diethyl phthalate		440	U	UG/KG	4.40E-03	
131-11-3	Dimethyl phthalate		440	U	UG/KG	2.20E-03	
206-44-0	Fluoranthene		68	J	UG/KG	5.57E-04	YES
86-73-7	Fluorene		440	U	UG/KG	1.47E-02	
118-74-1	Hexachlorobenzene		440	U	UG/KG	4.40E-04	
87-68-3	Hexachlorobutadiene		440	U	UG/KG	1.11E+01	
77-47-4	Hexachlorocyclopentadiene		440	U	UG/KG	4.40E-02	
67-72-1	Hexachloroethane		440	U	UG/KG	7.38E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		440	U	UG/KG	4.04E-03	
78-59-1	Isophorone		440	U	UG/KG	3.17E-03	
621-64-7	N-Nitroso-di-n-propylamine		440	U	UG/KG	8.09E-01	
86-30-6	N-Nitrosodiphenylamine		440	U	UG/KG	2.20E-02	
91-20-3	Naphthalene		440	U	UG/KG	1.77E-03	
87-86-5	Pentachlorophenol		2200	U	UG/KG	3.67E-01	
85-01-8	Phenanthrene		440	U	UG/KG	9.63E-03	
108-95-2	Phenol		440	U	UG/KG	1.10E-02	
129-00-0	Pyrene		79	J	UG/KG	1.01E-03	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		450	U	UG/KG	1.20E+00	
99-65-0	1,3-Dinitrobenzene		450	U	UG/KG	6.87E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		890	U	UG/KG	2.97E-02	
121-14-2	2,4-Dinitrotoluene		450	U	UG/KG	3.52E-01	
606-20-2	2,6-Dinitrotoluene		890	U	UG/KG	2.71E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		890	U	UG/KG	1.11E-02	
88-72-2	2-Nitrotoluene (ONT)		890	U	UG/KG		
99-08-1	3-Nitrotoluene		890	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		890	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		890	U	UG/KG		
2691-41-0	HMX		890	U	UG/KG	3.56E-02	
98-95-3	Nitrobenzene		450	U	UG/KG	1.13E-02	
121-82-4	RDX		890	U	UG/KG	8.90E-03	
479-45-8	Tetryl		1300	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	15800		MG/KG		
7440-36-0	Antimony	0.83	1		MG/KG	2.00E-01	
7440-38-2	Arsenic	13.5	15.2		MG/KG	1.69E+00	
7440-39-3	Barium	195	167		MG/KG	3.34E-01	
7440-41-7	Beryllium	0.76	0.61	J	MG/KG	6.10E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-42-8	Boron	5.3	14.2		MG/KG	2.84E+01	
7440-43-9	Cadmium	0.19	1.8		MG/KG	6.21E-02	
7440-70-2	Calcium	2497	59100		MG/KG		
7440-47-3	Chromium	25.2	20.1		MG/KG	4.02E+00	
7440-48-4	Cobalt	21.7	9.4		MG/KG	4.70E-01	
7440-50-8	Copper	11.3	57.1		MG/KG	1.84E+00	
7439-89-6	Iron	19306	39600		MG/KG	1.98E+02	
7439-92-1	Lead	23.4	101		MG/KG	2.33E-01	
7439-95-4	Magnesium	1552	14700		MG/KG		
7439-96-5	Manganese	3640	1280		MG/KG	1.28E+01	
7439-97-6	Mercury	0.06	0.1		MG/KG	1.43E-02	YES
7440-02-0	Nickel	18.9	19.9		MG/KG	6.63E-01	
2023695	Potassium	625	747		MG/KG		
7782-49-2	Selenium	2.34	0.94		MG/KG	9.40E-01	YES
7440-22-4	Silver	0.58	1.3		MG/KG	6.50E-01	
7440-23-5	Sodium	170	308		MG/KG		
7440-28-0	Thallium	0.41	0.6	J	MG/KG	6.00E-01	
7440-62-2	Vanadium	47.2	32		MG/KG	6.96E-01	
7440-66-6	Zinc	51.4	231	J	MG/KG	1.93E+00	
Other Parameters							
TOC	TOC	31393	38000		MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2F (AUS-0A2F)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
Explosives							
99-35-4	1,3,5-Trinitrobenzene		0.25	U	UG/L	8.33E-03	
99-65-0	1,3-Dinitrobenzene		0.25	U	UG/L	1.25E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)		0.5	U	UG/L	1.25E-02	
121-14-2	2,4-Dinitrotoluene		0.25	U	UG/L	1.09E-03	
606-20-2	2,6-Dinitrotoluene		0.5	U	UG/L	1.19E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene		0.5	U	UG/L	2.50E-02	
88-72-2	2-Nitrotoluene (ONT)		0.5	U	UG/L	6.85E-05	
99-08-1	3-Nitrotoluene		0.5	U	UG/L	6.02E-05	
19406-51-0	4-Amino-2,6-Dinitrotoluene		0.5	U	UG/L	9.26E-04	
99-99-0	4-Nitrotoluene (PNT)		0.5	U	UG/L	7.14E-05	
2691-41-0	HMX		0.5	U	UG/L	1.52E-03	
98-95-3	Nitrobenzene		0.25	U	UG/L	9.26E-04	
121-82-4	RDX		0.5	U	UG/L	2.63E-03	
479-45-8	Tetryl		0.75	U	UG/L		
Metals							
7429-90-5	Aluminum	200	2540	J	UG/L	2.92E+01	
7440-36-0	Antimony	6	6	U	UG/L	2.00E-01	
7440-38-2	Arsenic	10	10	U	UG/L	5.26E-02	
7440-39-3	Barium	22.7	78.1	J	UG/L	1.56E-02	
7440-41-7	Beryllium	5	5	U	UG/L	9.43E+00	
7440-42-8	Boron		26.6	J	UG/L	2.66E-02	
7440-43-9	Cadmium	5	5	U	UG/L	4.55E+00	
7440-70-2	Calcium	7197	57600		UG/L	4.97E-01	
7440-47-3	Chromium	10	10	U	UG/L	4.83E-02	
7440-48-4	Cobalt	50	50	U	UG/L	2.17E+01	
7440-50-8	Copper	10	10	U	UG/L	8.47E-01	
7439-89-6	Iron	100	3650		UG/L	3.65E+00	
7439-92-1	Lead	2	5.7	U	UG/L	2.84E-01	
7439-95-4	Magnesium	2534	19800		UG/L	2.41E-01	
7439-96-5	Manganese	582	198	J	UG/L	1.98E-01	
7439-97-6	Mercury	0.2	0.5	U	UG/L	3.85E-01	
7440-02-0	Nickel	10	10	U	UG/L	1.00E-02	
2023695	Potassium	1613	3490		UG/L	6.58E-02	
7782-49-2	Selenium	2.7	2.1	J	UG/L	2.10E-03	YES
7440-22-4	Silver	10	6.7	J	UG/L	1.34E+00	
7440-23-5	Sodium	3169	11500		UG/L	1.69E-02	
7440-28-0	Thallium	10	10	U	UG/L	2.50E+00	
7440-62-2	Vanadium	50	50	U	UG/L	2.63E+00	
7440-66-6	Zinc	20	23	U	UG/L	2.30E-02	
Other Parameters							
7601-90-3	Perchlorate		500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 5-13, AUS-0A2F
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Volatile Organic Compounds								
1,1,1-Trichloroethane	NA	NA	No	A	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1,2-Trichloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1-Dichloroethane	NA	NA	No	A	NA	NA	No	A
1,1-Dichloroethene	NA	NA	Yes	E	NA	NA	Uncertainty	B
1,2-Dichloroethane (EDC)	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2-Butanone (MEK)	NA	NA	No	A	NA	NA	No	A
2-Hexanone	NA	NA	No	C	NA	NA	No	C
4-Methyl-2-pentanone (MIBK)	NA	NA	No	A	NA	NA	No	A
Acetone	NA	NA	No	A	NA	NA	No	A
Benzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Bromodichloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Bromoform	NA	NA	No	A	NA	NA	No	A
Bromomethane	NA	NA	No	A	NA	NA	No	A
Carbon disulfide	NA	NA	No	A	NA	NA	No	F
Carbon tetrachloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Chlorobenzene	NA	NA	No	A	NA	NA	No	A
Chloroethane	NA	NA	No	A	NA	NA	No	A
Chloroform	NA	NA	Uncertainty	B	NA	NA	No	A
Chloromethane	NA	NA	No	A	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	Yes	E	NA	NA	Yes	E
cis-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Dibromochloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Ethylbenzene	NA	NA	No	A	NA	NA	No	A
Methylene chloride	NA	NA	No	A	NA	NA	Uncertainty	B
N-Hexane	NA	NA	No	A	NA	NA	No	A
Styrene	NA	NA	No	A	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	Yes	E	NA	NA	Uncertainty	B
Toluene	NA	NA	No	A	NA	NA	No	A
total Xylenes	NA	NA	No	A	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	No	F	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	Yes	E	NA	NA	Yes	E
Vinyl chloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	NA	NA	No	A	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	NA	NA	No	A	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	Uncertainty	B	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	NA	NA	No	A	NA	NA	No	A

TABLE 5-13, AUS-0A2F
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trichlorophenol	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2,4-Dichlorophenol	NA	NA	No	A	NA	NA	Uncertainty	B
2,4-Dimethylphenol	NA	NA	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	No	A	NA	NA	Uncertainty	B
2-Chloronaphthalene	NA	NA	No	A	NA	NA	No	A
2-Chlorophenol	NA	NA	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	No	A	NA	NA	No	A
2-Methylphenol	NA	NA	No	A	NA	NA	No	A
2-Nitroaniline	NA	NA	Uncertainty	B	NA	NA	No	A
2-Nitrophenol	NA	NA	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
3-Nitroaniline	NA	NA	Uncertainty	B	NA	NA	No	A
4,6-Dinitro-2-methylphenol	NA	NA	No	C	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	No	C	NA	NA	No	C
4-Chloro-3-methylphenol	NA	NA	No	A	NA	NA	No	A
4-Chloroaniline	NA	NA	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	NA	NA	No	C	NA	NA	No	C
4-Methylphenol	NA	NA	No	A	NA	NA	No	F
4-Nitroaniline	NA	NA	Uncertainty	B	NA	NA	No	A
4-Nitrophenol	NA	NA	No	A	NA	NA	No	A
Acenaphthene	NA	NA	No	A	NA	NA	No	A
Acenaphthylene	NA	NA	No	A	NA	NA	No	A
Anthracene	NA	NA	No	A	NA	NA	No	A
Benzo(a)anthracene	NA	NA	Uncertainty	B	NA	NA	Yes	J
Benzo(a)pyrene	NA	NA	Uncertainty	B	NA	NA	Yes	J
Benzo(b)fluoranthene	NA	NA	Uncertainty	B	NA	NA	Yes	J
Benzo(g,h,i)perylene	NA	NA	No	A	NA	NA	No	A
Benzo(k)fluoranthene	NA	NA	Uncertainty	B	NA	NA	No	F
bis(2-Chloroethoxy)methane	NA	NA	No	C	NA	NA	No	C
bis(2-Chloroethyl) ether	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	NA	NA	Uncertainty	B	NA	NA	No	A
bis(2-Ethylhexyl) phthalate	NA	NA	Uncertainty	B	NA	NA	No	F
Butyl benzyl phthalate	NA	NA	No	A	NA	NA	No	A
Carbazole	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Chrysene	NA	NA	Uncertainty	B	NA	NA	No	F
Di-n-butyl phthalate	NA	NA	No	A	NA	NA	No	A
Di-n-octyl phthalate	NA	NA	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	NA	NA	Uncertainty	B	NA	NA	Yes	J
Dibenzofuran	NA	NA	No	A	NA	NA	No	A
Diethyl phthalate	NA	NA	No	A	NA	NA	No	A
Dimethyl phthalate	NA	NA	No	A	NA	NA	No	A
Fluoranthene	NA	NA	No	A	NA	NA	No	F

TABLE 5-13, AUS-0A2F
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Fluorene	NA	NA	No	A	NA	NA	No	A
Hexachlorobenzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorobutadiene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	No	A	NA	NA	No	A
Hexachloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	NA	NA	Uncertainty	B	NA	NA	Yes	J
Isophorone	NA	NA	No	A	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	NA	NA	No	A	NA	NA	Uncertainty	B
Naphthalene	NA	NA	Uncertainty	B	NA	NA	No	A
Pentachlorophenol	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Phenanthrene	NA	NA	No	A	NA	NA	No	A
Phenol	NA	NA	No	A	NA	NA	No	A
Pyrene	NA	NA	No	A	NA	NA	No	F
Metals and Inorganics								
Aluminum	Uncertainty	G	No	F	NA	NA	No	F
Antimony	No	C	Uncertainty	B	NA	NA	Yes	E
Arsenic	No	C	Uncertainty	B	NA	NA	Yes	E
Barium	No	F	No	F	NA	NA	Yes	D
Beryllium	No	C	Uncertainty	B	NA	NA	No	F
Boron	No	F	No	F	NA	NA	No	F
Cadmium	No	C	Uncertainty	B	NA	NA	Yes	E
Calcium	No	H	No	H	NA	NA	No	H
Chromium	No	C	No	F	NA	NA	Yes	D
Cobalt	No	C	No	A	NA	NA	No	F
Copper	No	C	No	F	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Yes	E	No	F	NA	NA	No	F
Lead	No	C	No	A	NA	NA	No	F
Magnesium	No	H	No	H	NA	NA	No	H
Manganese	No	F	No	F	NA	NA	No	F
Mercury	Uncertainty	B	No	A	NA	NA	No	F
Nickel	No	A	No	F	NA	NA	Yes	E
Potassium	No	H	No	H	NA	NA	No	H
Selenium	No	F	No	F	NA	NA	Yes	D
Silver	Yes	D	No	A	NA	NA	Yes	J
Sodium	No	H	No	H	NA	NA	No	H
Thallium	No	C	Uncertainty	B	NA	NA	No	F
Vanadium	No	C	No	A	NA	NA	No	F
Zinc	No	A	No	A	NA	NA	No	F
Explosives								
1,3,5-Trinitrobenzene	No	C	No	A	NA	NA	No	A
1,3-Dinitrobenzene	No	C	No	A	NA	NA	No	A

TABLE 5-13, AUS-0A2F
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	C	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
2-Nitrotoluene (ONT)	No	C	No	C	NA	NA	No	C
3-Nitrotoluene	No	C	No	A	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
4-Nitrotoluene (PNT)	No	C	No	A	NA	NA	No	A
HMX	No	C	No	A	NA	NA	No	A
Nitrobenzene	No	C	No	A	NA	NA	Uncertainty	B
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	NA	NA
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	No	C	No	A	NA	NA	No	A
Tetryl	No	C	No	A	NA	NA	No	A
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	NA	NA	NA	NA	NA	NA

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 5-14, AUS-0A2F
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	NA	NA	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	No	A
1,1,2-Trichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethene	NA	NA	NA	NA	No	A
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	No	A
1,2-Dichloroethene (total)	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	NA	NA	No	A
2-Butanone (MEK)	NA	NA	NA	NA	No	A
2-Hexanone	NA	NA	NA	NA	No	A
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	No	A
Acetone	NA	NA	NA	NA	No	A
Benzene	NA	NA	NA	NA	No	A
Bromodichloromethane	NA	NA	NA	NA	No	A
Bromoform	NA	NA	NA	NA	No	A
Bromomethane	NA	NA	NA	NA	No	A
Carbon disulfide	NA	NA	NA	NA	No	F
Carbon tetrachloride	NA	NA	NA	NA	No	A
Chlorobenzene	NA	NA	NA	NA	No	A
Chloroethane	NA	NA	NA	NA	No	C
Chloroform	NA	NA	NA	NA	No	A
Chloromethane	NA	NA	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	NA	NA	No	F
cis-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Dibromochloromethane	NA	NA	NA	NA	No	A
Ethylbenzene	NA	NA	NA	NA	No	A
Methylene chloride	NA	NA	NA	NA	No	A
N-Hexane	NA	NA	NA	NA	No	C
Styrene	NA	NA	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	NA	NA	No	A
Toluene	NA	NA	NA	NA	No	A
total Xylenes	NA	NA	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	NA	NA	No	F
Vinyl chloride	NA	NA	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	NA	NA	NA	NA	No	A
1,2-Dichlorobenzene	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	No	A
2,4,5-Trichlorophenol	NA	NA	NA	NA	No	A

TABLE 5-14, AUS-0A2F
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trichlorophenol	NA	NA	NA	NA	No	A
2,4-Dichlorophenol	NA	NA	NA	NA	No	A
2,4-Dimethylphenol	NA	NA	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	NA	NA	No	A
2-Chloronaphthalene	NA	NA	NA	NA	Uncertainty	B
2-Chlorophenol	NA	NA	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	No	A
2-Methylphenol	NA	NA	NA	NA	No	A
2-Nitroaniline	NA	NA	NA	NA	No	A
2-Nitrophenol	NA	NA	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	NA	NA	No	A
3-Nitroaniline	NA	NA	NA	NA	No	A
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	NA	NA	No	C
4-Chloro-3-methylphenol	NA	NA	NA	NA	No	A
4-Chloroaniline	NA	NA	NA	NA	No	A
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	No	C
4-Methylphenol	NA	NA	NA	NA	No	F
4-Nitroaniline	NA	NA	NA	NA	No	A
4-Nitrophenol	NA	NA	NA	NA	No	A
Acenaphthene	NA	NA	NA	NA	No	A
Acenaphthylene	NA	NA	NA	NA	No	A
Anthracene	NA	NA	NA	NA	No	A
Benzo(a)anthracene	NA	NA	NA	NA	Yes	E
Benzo(a)pyrene	NA	NA	NA	NA	Yes	E
Benzo(b)fluoranthene	NA	NA	NA	NA	Yes	E
Benzo(g,h,i)perylene	NA	NA	NA	NA	No	A
Benzo(k)fluoranthene	NA	NA	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	Uncertainty	B
bis(2-Chloroethyl) ether	NA	NA	NA	NA	No	A
bis(2-Chloroisopropyl) ether	NA	NA	NA	NA	No	C
bis(2-Ethylhexyl) phthalate	NA	NA	NA	NA	Yes	E
Butyl benzyl phthalate	NA	NA	NA	NA	Uncertainty	B
Carbazole	NA	NA	NA	NA	No	C
Chrysene	NA	NA	NA	NA	Yes	E
Di-n-butyl phthalate	NA	NA	NA	NA	No	A
Di-n-octyl phthalate	NA	NA	NA	NA	No	A
Dibenz(a,h)anthracene	NA	NA	NA	NA	Yes	J
Dibenzofuran	NA	NA	NA	NA	No	C
Diethyl phthalate	NA	NA	NA	NA	No	A
Dimethyl phthalate	NA	NA	NA	NA	No	A
Fluoranthene	NA	NA	NA	NA	Yes	E

TABLE 5-14, AUS-0A2F
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Fluorene	NA	NA	NA	NA	No	A
Hexachlorobenzene	NA	NA	NA	NA	No	A
Hexachlorobutadiene	NA	NA	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	NA	NA	No	A
Hexachloroethane	NA	NA	NA	NA	No	A
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	NA	Yes	J
Isophorone	NA	NA	NA	NA	No	A
N-Nitroso-di-n-propylamine	NA	NA	NA	NA	No	A
N-Nitrosodiphenylamine	NA	NA	NA	NA	No	A
Naphthalene	NA	NA	NA	NA	No	A
Pentachlorophenol	NA	NA	NA	NA	No	A
Phenanthrene	NA	NA	NA	NA	No	A
Phenol	NA	NA	NA	NA	No	A
Pyrene	NA	NA	NA	NA	Yes	E
Metals and Inorganics						
Aluminum	Yes	E	NA	NA	Uncertainty	I
Antimony	No	A	NA	NA	No	F
Arsenic	No	A	NA	NA	Yes	E
Barium	No	F	NA	NA	No	F
Beryllium	Uncertainty	B	NA	NA	No	F
Boron	No	F	NA	NA	Yes	E
Cadmium	Uncertainty	B	NA	NA	No	F
Calcium	No	F,H	NA	NA	Uncertainty	G,H
Chromium	No	A	NA	NA	Yes	D
Cobalt	Uncertainty	B	NA	NA	No	F
Copper	No	A	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	NA	NA
Iron	Yes	E	NA	NA	Yes	E
Lead	No	A	NA	NA	No	F
Magnesium	No	F,H	NA	NA	Uncertainty	G,H
Manganese	No	F	NA	NA	Yes	D
Mercury	No	A	NA	NA	Yes	E
Nickel	No	A	NA	NA	Yes	J
Potassium	No	F,H	NA	NA	Uncertainty	G,H
Selenium	Yes	D	NA	NA	Yes	D
Silver	Yes	D	NA	NA	Yes	J
Sodium	No	F,H	NA	NA	Uncertainty	G,H
Thallium	Uncertainty	B	NA	NA	No	F
Vanadium	Uncertainty	B	NA	NA	No	F
Zinc	No	A	NA	NA	Yes	E
Explosives						
1,3,5-Trinitrobenzene	No	A	NA	NA	Uncertainty	B
1,3-Dinitrobenzene	No	A	NA	NA	No	A

TABLE 5-14, AUS-0A2F
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	A	NA	NA	No	A
2,6-Dinitrotoluene	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	A	NA	NA	No	A
2-Nitrotoluene (ONT)	No	A	NA	NA	No	C
3-Nitrotoluene	No	A	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	No	A	NA	NA	No	C
4-Nitrotoluene (PNT)	No	A	NA	NA	No	C
HMX	No	A	NA	NA	No	A
Nitrobenzene	No	A	NA	NA	No	A
Nitroglycerin	NA	NA	NA	NA	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	No	A	NA	NA	No	A
Tetryl	No	C	NA	NA	No	C

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.

J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 5-15
AUS-0A2F - IOP FUSE LOADING LINE
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum[1]	Soil	Sediment	Ground Water	Surface Water
VOCs					
1,1-Dichloroethene			NA	**H**	NA
cis-1,2-Dichloroethene		**H**	NA	**H**	NA
Tetrachloroethylene (PCE)			NA	**H**	NA
Trichloroethylene (TCE)		**H**	NA	**H**	NA
SVOCs					
Benzo(a)anthracene		**H,E**	NA		NA
Benzo(a)pyrene		**H,E**	NA		NA
Benzo(b)fluoranthene		**H,E**	NA		NA
Benzo(k)fluoranthene		**E**	NA		NA
bis(2-Ethylhexyl)phthalate		**E**	NA		NA
Chrysene		**E**	NA		NA
Dibenz(a,h)anthracene		**H,E**	NA		NA
Fluoranthene		**E**	NA		NA
Indeno(1,2,3-c,d)pyrene		**H,E**	NA		NA
Pyrene		**E**	NA		NA
Metals					
Aluminum			NA		**E**
Antimony		**H**	NA		
Arsenic		**H,E**	NA		
Boron		**E**	NA		
Cadmium		**H**	NA		
Copper		**E**	NA		
Iron		**E**	NA		**H,E**
Mercury		**E**	NA		
Nickel		**H,E**	NA		
Silver		**H,E**	NA		
Zinc		**E**	NA		

Key:
[1] Drums were not present at this site.
NA = not analyzed
H = human health screening criteria exceeded
E = ecological screening criteria exceeded

SOURCES:

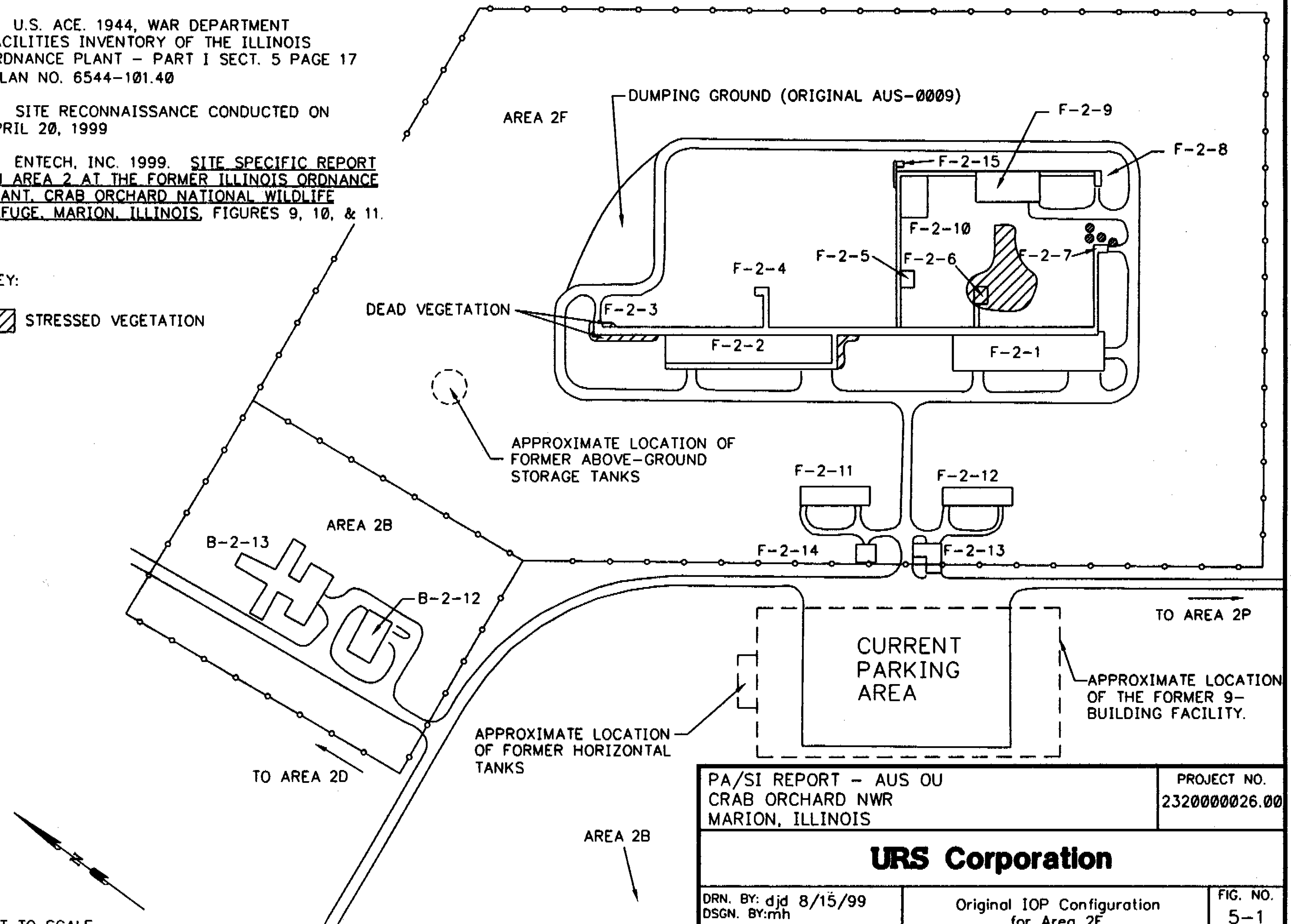
1. U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT – PART I SECT. 5 PAGE 17 (PLAN NO. 6544-101.40

2. SITE RECONNAISSANCE CONDUCTED ON APRIL 20, 1999

3. ENTECH, INC. 1999. SITE SPECIFIC REPORT ON AREA 2 AT THE FORMER ILLINOIS ORDNANCE PLANT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS, FIGURES 9, 10, & 11.

KEY:

STRESSED VEGETATION

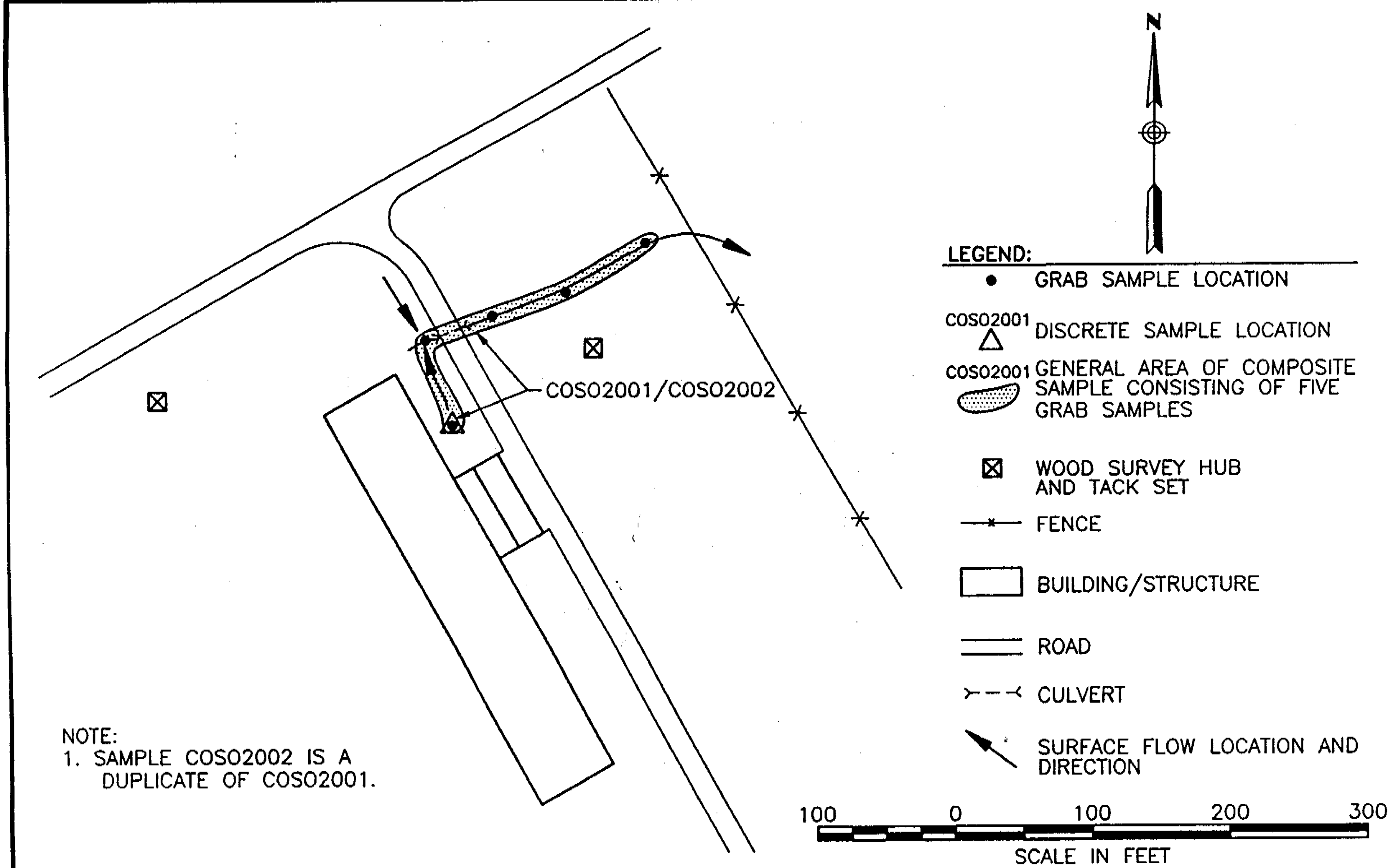


NOT TO SCALE

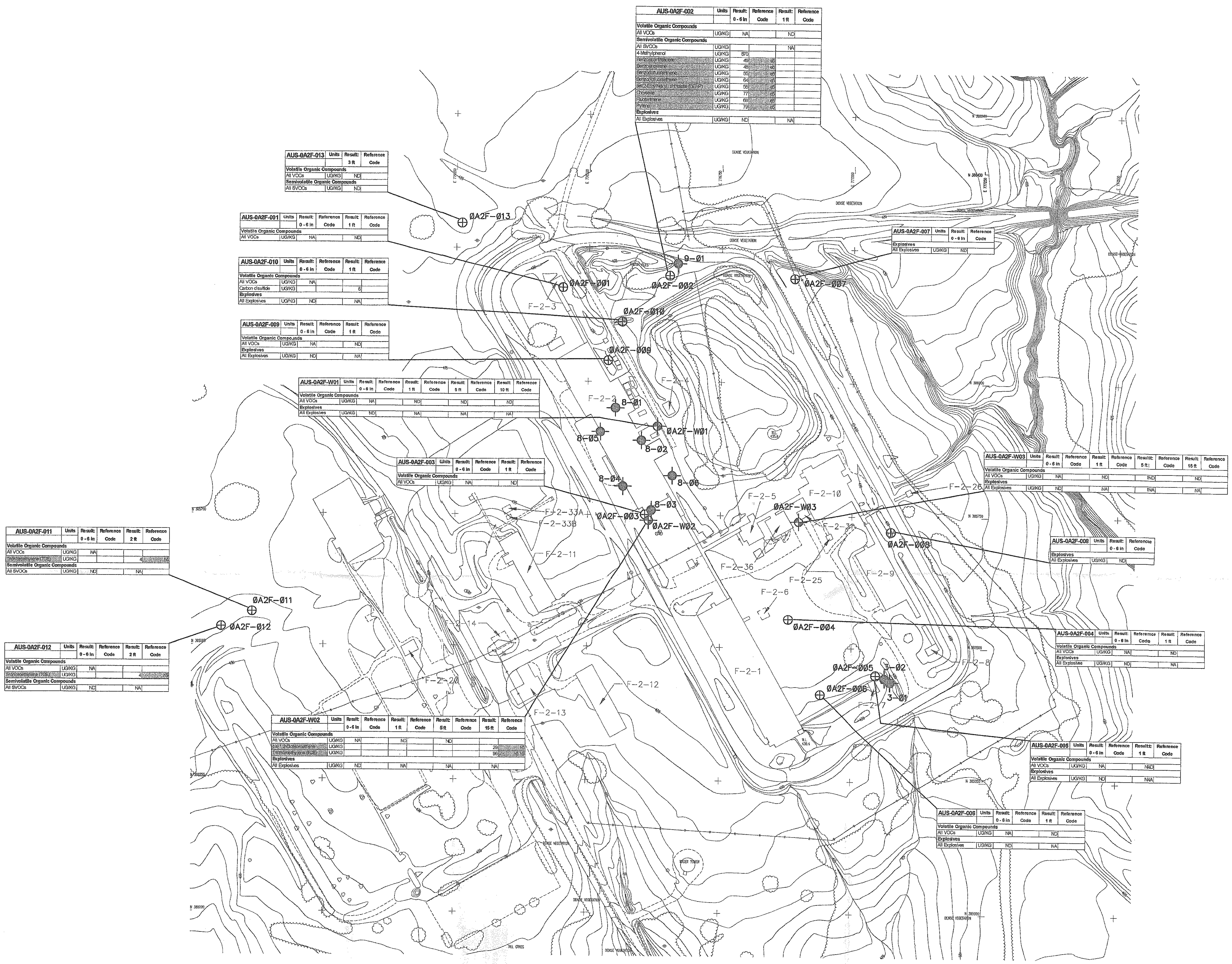
PA/SI REPORT – AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS Corporation

DRN. BY: djd 8/15/99 DSGN. BY: mh CHKD. BY: cmw	Original IOP Configuration for Area 2F	FIG. NO. 5-1



CLIENT/PROJECT						TITLE		
W-C/CRAB ORCHARD RI /IL						SITE 20 PHASE-I SAMPLE LOCATIONS		
DRAWN MRM	CHECKED WGB	REVIEWED WGB	DATE 2-24-95	SCALE AS SHOWN	FILE NAME 8168153	JOB NO. 933-8168	DWG NO.	FIGURE 5-1a



LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

N

100 0 100
SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.

2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES AND/OR ROADS.

3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.

4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–ØA2F
Sample Locations and Detections of Organic Compounds in Soils

Date: 11/14/ØØ	Project Number: 2320000026.00	Figure Number: 5–2
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-SAMPLE LOCATION 2\AUS-0A2F.DWG Last edited: SEP. 21, 01 @ 10:24 a.m. URS Corp.

AUS-0A2F-013	Units	Result: 3 ft	Reference Code
Metals			
Aluminum	MG/KG	15800	
Arsenic	MG/KG	8.7	h1,h5,h7
Barium	MG/KG	128	h5
Beryllium	MG/KG	0.58	
Calcium	MG/KG	555	
Chromium	MG/KG	18.5	e1,h5
Cobalt	MG/KG	4.8	
Copper	MG/KG	13.1	b1
Iron	MG/KG	21300	b1,e1
Lead	MG/KG	19.5	
Magnesium	MG/KG	2270	b1
Manganese	MG/KG	651	e1
Nickel	MG/KG	10.9	h5
Potassium	MG/KG	601	
Selenium	MG/KG	0.36	e5,h5
Sodium	MG/KG	308	b1
Vanadium	MG/KG	30.9	
Zinc	MG/KG	50.2	

AUS-0A2F-002	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6040	
Arsenic	MG/KG	2.8	h1,h5
Barium	MG/KG	99.5	h5
Boron	MG/KG	2.9	e1
Calcium	MG/KG	2900	b1
Chromium	MG/KG	8.3	e1,h5
Copper	MG/KG	6.6	
Iron	MG/KG	9290	e1
Lead	MG/KG	16.6	
Magnesium	MG/KG	1240	
Manganese	MG/KG	104	e1
Nickel	MG/KG	7.1	h5
Potassium	MG/KG	595	
Selenium	MG/KG	0.72	e5,h5
Silver	MG/KG	0.31	
Thallium	MG/KG	0.18	
Vanadium	MG/KG	15.7	
Zinc	MG/KG	45.4	

AUS-0A2F-007	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6940	
Antimony	MG/KG	0.48	h5
Arsenic	MG/KG	7.3	h1,h5,h7
Barium	MG/KG	114	h5
Boron	MG/KG	4.2	e1
Calcium	MG/KG	3830	b1
Chromium	MG/KG	12.2	e1,h5
Cobalt	MG/KG	6.9	
Copper	MG/KG	10.7	
Iron	MG/KG	18400	e1
Lead	MG/KG	18.6	
Magnesium	MG/KG	1440	
Manganese	MG/KG	608	e1
Mercury	MG/KG	0.08	b1,e5
Nickel	MG/KG	11	h5
Potassium	MG/KG	519	
Selenium	MG/KG	0.93	e5,h5
Vanadium	MG/KG	28.2	
Zinc	MG/KG	65.1	b1

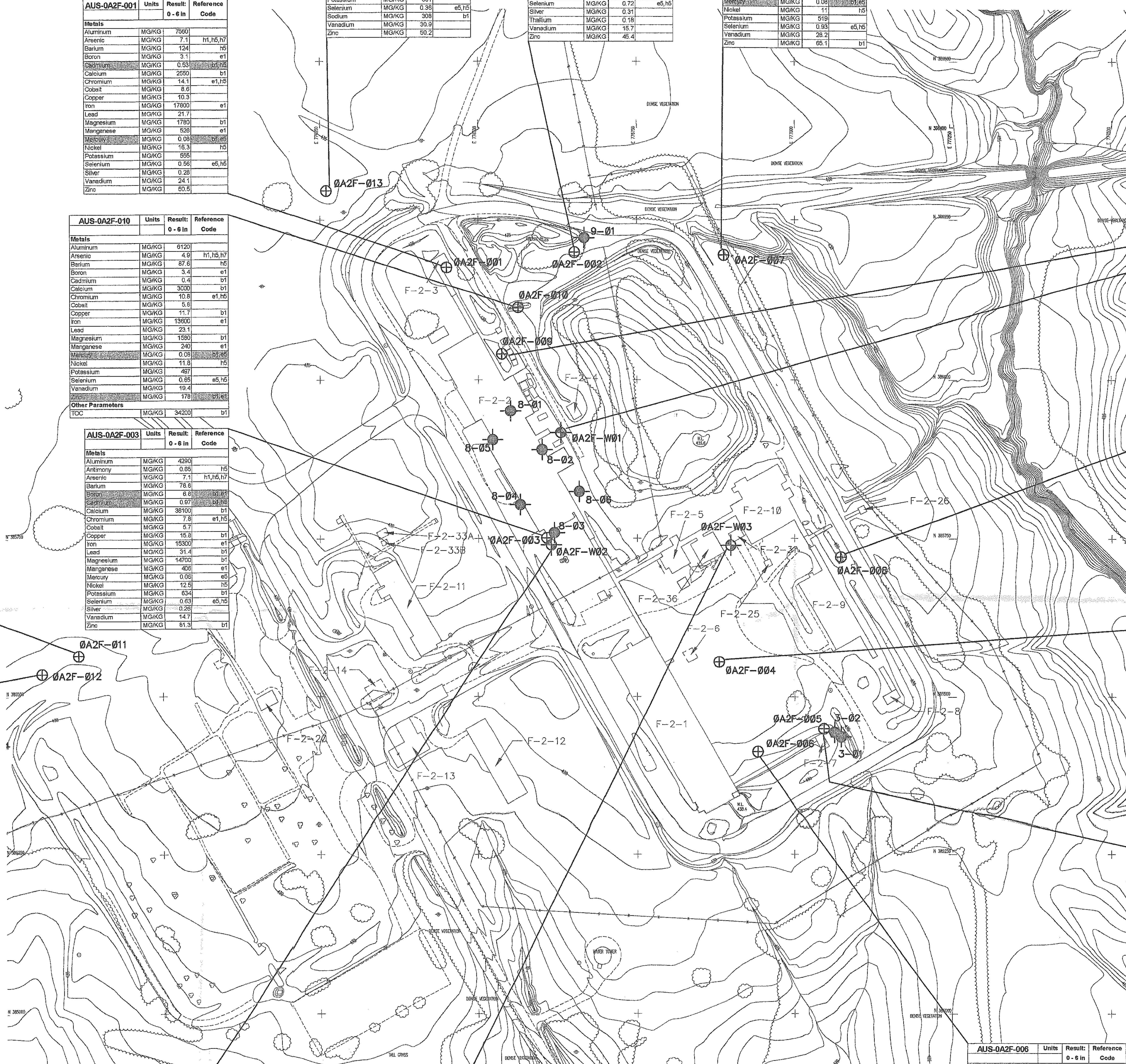
AUS-0A2F-001	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7560	
Arsenic	MG/KG	7.1	h1,h5,h7
Barium	MG/KG	124	h5
Boron	MG/KG	3.1	e1
Cadmium	MG/KG	0.53	b1,h5
Calcium	MG/KG	2550	b1
Chromium	MG/KG	14.1	e1,h5
Cobalt	MG/KG	8.6	
Copper	MG/KG	10.3	
Iron	MG/KG	17800	e1
Lead	MG/KG	21.7	
Magnesium	MG/KG	1780	b1
Manganese	MG/KG	526	e1
Mercury	MG/KG	0.08	b1,e5
Nickel	MG/KG	16.3	h5
Potassium	MG/KG	555	
Selenium	MG/KG	0.56	e5,h5
Silver	MG/KG	0.28	
Vanadium	MG/KG	24.1	
Zinc	MG/KG	50.5	

AUS-0A2F-010	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6120	
Arsenic	MG/KG	4.9	h1,h5,h7
Barium	MG/KG	87.6	h5
Boron	MG/KG	3.4	e1
Cadmium	MG/KG	0.4	b1
Calcium	MG/KG	3000	b1
Chromium	MG/KG	10.8	e1,h5
Cobalt	MG/KG	5.8	
Copper	MG/KG	11.7	b1
Iron	MG/KG	13600	e1
Lead	MG/KG	23.1	
Magnesium	MG/KG	1580	b1
Manganese	MG/KG	240	e1
Mercury	MG/KG	0.08	b1,e5
Nickel	MG/KG	11.8	h5
Potassium	MG/KG	497	
Selenium	MG/KG	0.65	e5,h5
Vanadium	MG/KG	19.4	
Zinc	MG/KG	178	b1,e1
Other Parameters			
TOC	MG/KG	34200	b1

AUS-0A2F-011	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	13400	
Arsenic	MG/KG	8.5	h1,h5,h7
Barium	MG/KG	146	h5
Beryllium	MG/KG	0.61	
Calcium	MG/KG	3870	b1
Chromium	MG/KG	18.5	e1,h5
Cobalt	MG/KG	9.4	
Copper	MG/KG	14	b1
Iron	MG/KG	21000	b1,e1
Lead	MG/KG	15.8	
Magnesium	MG/KG	3670	b1
Manganese	MG/KG	681	e1
Mercury	MG/KG	0.02	e5
Nickel	MG/KG	14	h5
Potassium	MG/KG	648	b1
Selenium	MG/KG	0.39	e5,h5
Sodium	MG/KG	58.2	
Vanadium	MG/KG	32	
Zinc	MG/KG	48.1	

AUS-0A2F-003	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4290	
Antimony	MG/KG	0.65	h5
Arsenic	MG/KG	7.1	h1,h5,h7
Barium	MG/KG	78.6	
Boron	MG/KG	6.8	b1,e1
Cadmium	MG/KG	0.97	b1,h5
Calcium	MG/KG	38100	b1
Chromium	MG/KG	7.8	e1,h5
Cobalt	MG/KG	5.7	
Copper	MG/KG	15.8	b1
Iron	MG/KG	15300	e1
Lead	MG/KG	31.4	b1
Magnesium	MG/KG	14700	b1
Manganese	MG/KG	406	e1
Mercury	MG/KG	0.06	e5
Nickel	MG/KG	12.5	h5
Potassium	MG/KG	634	b1
Selenium	MG/KG	0.63	e5,h5
Silver	MG/KG	0.26	
Vanadium	MG/KG	14.7	
Zinc	MG/KG	81.3	b1

AUS-0A2F-012	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	11600	
Arsenic	MG/KG	8.4	h1,h5,h7
Barium	MG/KG	142	h5
Beryllium	MG/KG	0.58	
Boron	MG/KG	1.1	e1
Calcium	MG/KG	2820	b1
Chromium	MG/KG	16.7	e1,h5
Cobalt	MG/KG	8.4	
Copper	MG/KG	14.5	b1
Iron	MG/KG	19400	b1,e1
Lead	MG/KG	13.9	
Magnesium	MG/KG	2710	b1
Manganese	MG/KG	582	e1
Mercury	MG/KG	0.028	e5
Nickel	MG/KG	15.5	h5
Potassium	MG/KG	682	b1
Sodium	MG/KG	49.9	
Thallium	MG/KG	0.6	b1
Vanadium	MG/KG	30.1	
Zinc	MG/KG	47.8	



AUS-0A2F-009	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5140	
Antimony	MG/KG	0.82	h5
Arsenic	MG/KG	7.2	h1,h5,h7
Barium	MG/KG	101	h5
Boron	MG/KG	5.5	b1,e1
Cadmium	MG/KG	1.8	b1,h5
Calcium	MG/KG	2620	b1
Chromium	MG/KG	18.2	e1,h5
Cobalt	MG/KG	8	
Copper	MG/KG	25.5	b1
Iron	MG/KG	19900	b1,e1
Lead	MG/KG	51.1	b1
Magnesium	MG/KG	1300	
Manganese	MG/KG	319	e1
Nickel	MG/KG	14	h5
Potassium	MG/KG	216	
Selenium	MG/KG	0.91	e5,h5
Silver	MG/KG	0.42	
Vanadium	MG/KG	23	
Zinc	MG/KG	231	b1,e1

AUS-0A2F-W01	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8710	
Arsenic	MG/KG	8	h1,h5,h7
Barium	MG/KG	167	h5
Calcium	MG/KG	1900	
Chromium	MG/KG	15.4	e1,h5
Cobalt	MG/KG	7.9	
Copper	MG/KG	20.8	b1
Iron	MG/KG	18200	e1
Lead	MG/KG	101	b1
Magnesium	MG/KG	1590	b1
Manganese	MG/KG	1280	e1
Nickel	MG/KG	12	h5
Potassium	MG/KG	422	
Selenium	MG/KG	0.94	e5,h5
Vanadium	MG/KG	23.1	
Zinc	MG/KG	47.6	

AUS-0A2F-008	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8010	
Arsenic	MG/KG	7.2	h1,h5,h7
Barium	MG/KG	94.5	h5
Boron	MG/KG	4.1	e1
Calcium	MG/KG	24700	b1
Chromium	MG/KG	13.2	e1,h5
Cobalt	MG/KG	6.2	
Copper	MG/KG	15.2	b1
Iron	MG/KG	18800	e1
Lead	MG/KG	27	b1
Magnesium	MG/KG	14700	b1
Manganese	MG/KG	400	e1
Nickel	MG/KG	18.7	h5
Potassium	MG/KG	639	b1
Vanadium	MG/KG	24.9	
Zinc	MG/KG	71.9	b1

AUS-0A2F-004	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	9500	
Antimony	MG/KG	1	b1,h5
Arsenic	MG/KG	15.2	b1,e1,h1,h5,h7
Barium	MG/KG	69.9	
Boron	MG/KG	14.2	b1,e1
Cadmium	MG/KG	0.77	b1,h5
Calcium	MG/KG	59100	b1
Chromium	MG/KG	20.1	e1,h5
Cobalt	MG/KG	6.4	
Copper	MG/KG	57.1	b1,e1
Iron	MG/KG	29200	b1,e1
Lead	MG/KG	84.6	b1
Magnesium	MG/KG	3700	b1
Manganese	MG/KG	953	e1
Mercury	MG/KG	0.09	b1,e5
Nickel	MG/KG	19.9	b1,h5
Potassium	MG/KG	747	b1
Selenium	MG/KG	0.72	e5,h5
Silver	MG/KG	0.34	
Vanadium	MG/KG	26.4	
Zinc	MG/KG	100	b1

AUS-0A2F-005	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6390	
Antimony	MG/KG	0.45	h5
Arsenic	MG/KG	8.9	h1,h5,h7
Barium	MG/KG	59.6	
Boron	MG/KG	7.2	b1,e1
Cadmium	MG/KG	0.28	b1
Calcium	MG/KG	4070	b1
Chromium	MG/KG	13.1	e1,h5
Copper	MG/KG	30.7	b1
Iron	MG/KG	39600	b1,e1
Lead	MG/KG	59	b1
Magnesium	MG/KG	1110	
Manganese	MG/KG	468	e1
Mercury	MG/KG	0.06	e5
Nickel	MG/KG	14.1	h5
Potassium	MG/KG	403	
Selenium	MG/KG	0.81	e5,h5
Silver	MG/KG	1.3	b1
Vanadium	MG/KG	19.7	
Zinc	MG/KG	99.4	b1

AUS-0A2F-W02	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6720	
Arsenic	MG/KG	8.5	h1,h5,h7
Barium	MG/KG	122	h5
Calcium	MG/KG	11200	b1
Chromium	MG/KG	10.4	e1,h5
Copper	MG/KG	12.2	b1
Iron	MG/KG	14900	e1
Lead	MG/KG	24.8	b1
Magnesium	MG/KG	6670	b1
Manganese	MG/KG	523	e1
Mercury	MG/KG	0.1	b1,e5
Nickel	MG/KG	10.8	h5
Potassium	MG/KG	458	
Selenium	MG/KG	0.48	e5,h5
Silver	MG/KG	0.22	
Vanadium	MG/KG	20.3	
Zinc	MG/KG	51.8	b1

AUS-0A2F-W03	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7760	
Antimony	MG/KG	0.66	h5
Arsenic	MG/KG	9.7	e1,h1,h5,h7
Barium	MG/KG	71.1	
Boron	MG/KG	9.1	b1,e1
Cadmium	MG/KG	0.73	b1,h5
Calcium	MG/KG	58300	b1
Chromium	MG/KG	15.9	e1,h5
Copper	MG/KG	24.5	b1
Iron	MG/KG	28200	b1,e1
Lead	MG/KG	33.3	b1
Magnesium	MG/KG	9720	b1
Manganese	MG/KG	682	e1
Mercury	MG/KG	0.07	b1,e5
Nickel	MG/KG	10.9	h5
Potassium	MG/KG	623	
Selenium (duplicate)	MG/KG	0.63	e5,h5
Vanadium	MG/KG	18.7	
Zinc	MG/KG	65.2	b1

AUS-0A2F-006	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6970	
Antimony	MG/KG	0.35	h5
Arsenic	MG/KG	6.8	h1,h5,h7
Barium	MG/KG	88.3	h5
Boron	MG/KG	4.7	e1
Calcium	MG/KG	3100	b1
Chromium	MG/KG	12.2	e1,h5
Cobalt	MG/KG	5.1	
Copper	MG/KG	19.5	b1
Iron	MG/KG	23000	b1,e1
Lead	MG/KG	41.7	b1
Magnesium	MG/KG	1700	b1
Manganese	MG/KG	458	e1
Mercury (duplicate)	MG/KG	0.06	e5
Nickel	MG/KG	13	h5
Potassium	MG/KG	494	
Selenium (duplicate)	MG/KG	0.71	e5,h5
Vanadium	MG/KG	22.1	
Zinc	MG/KG	74.6	b1
Other Parameters			
TOC	MG/KG	38000	b1

LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

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100 0 100
SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES AND/OR ROADS.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–ØA2F
Sample Locations and Detections of Inorganic Compounds in Soils

Date: 7/7/ØØ	Project Number: 2320000026.ØØ	Figure Number: 5-3
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-SAMPLE LOCATION 2\AUS-0A2F.DWG Last edited: AUG. 30, 01 @ 09:01 a.m. URS Corp.

AUS-0A2F-007-SW-00	Units	Result	Screening Codes
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	981	b3,e3
Barium	UG/L	78.1	b3
Boron	UG/L	26.6	
Calcium	UG/L	57600	b3
Iron	UG/L	1090	b3,e3,e4,h10
Magnesium	UG/L	19800	b3
Manganese	UG/L	150	
Potassium	UG/L	2730	b3
Selenium	UG/L	2	e5
Silver	UG/L	6.7	e3,e4,h10
Sodium	UG/L	11500	b3

AUS-0A2F-W01-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
cis-1,2-Dichloroethene	UG/L	5	
Tetrachloroethylene (PCE)	UG/L	2	h3
Trichloroethylene (TCE)	UG/L	5	h3
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	191	
Barium	UG/L	48.8	
Boron	UG/L	49.9	
Calcium	UG/L	72700	
Chromium	UG/L	2.9	
Iron	UG/L	175	
Magnesium	UG/L	25000	
Manganese	UG/L	5.2	
Potassium	UG/L	1090	
Sodium	UG/L	23500	
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2F-W03-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	455	
Barium	UG/L	41.1	
Boron	UG/L	11.3	
Calcium	UG/L	36100	
Copper	UG/L	1.7	
Iron	UG/L	399	
Magnesium	UG/L	13900	
Manganese	UG/L	35	
Nickel	UG/L	1.7	
Selenium	UG/L	3.3	
Sodium	UG/L	124000	
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2F-W02-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
1,1-Dichloroethene	UG/L	1	h3
cis-1,2-Dichloroethene	UG/L	210	h4,h6
trans-1,2-Dichloroethene	UG/L	6	
Trichloroethylene (TCE)	UG/L	2400	h3,h4,h6
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	361	
Barium	UG/L	43.9	
Calcium	UG/L	46400	
Iron	UG/L	288	
Magnesium	UG/L	18800	
Manganese	UG/L	5.1	
Potassium	UG/L	758	
Sodium	UG/L	96000	

AUS-0A2F-008-SW-00	Units	Result	Screening Codes
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	2540	b3,e3
Barium	UG/L	58.6	b3
Calcium	UG/L	33600	b3
Iron	UG/L	3650	b3,e3,e4,h10
Magnesium	UG/L	10300	b3
Manganese	UG/L	198	
Potassium	UG/L	3490	b3
Selenium	UG/L	2.1	e5
Other Parameters			
Perchlorate	UG/L	ND	

LEGEND

- MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

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SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2ØØØ. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES AND/OR ROADS.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.
4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

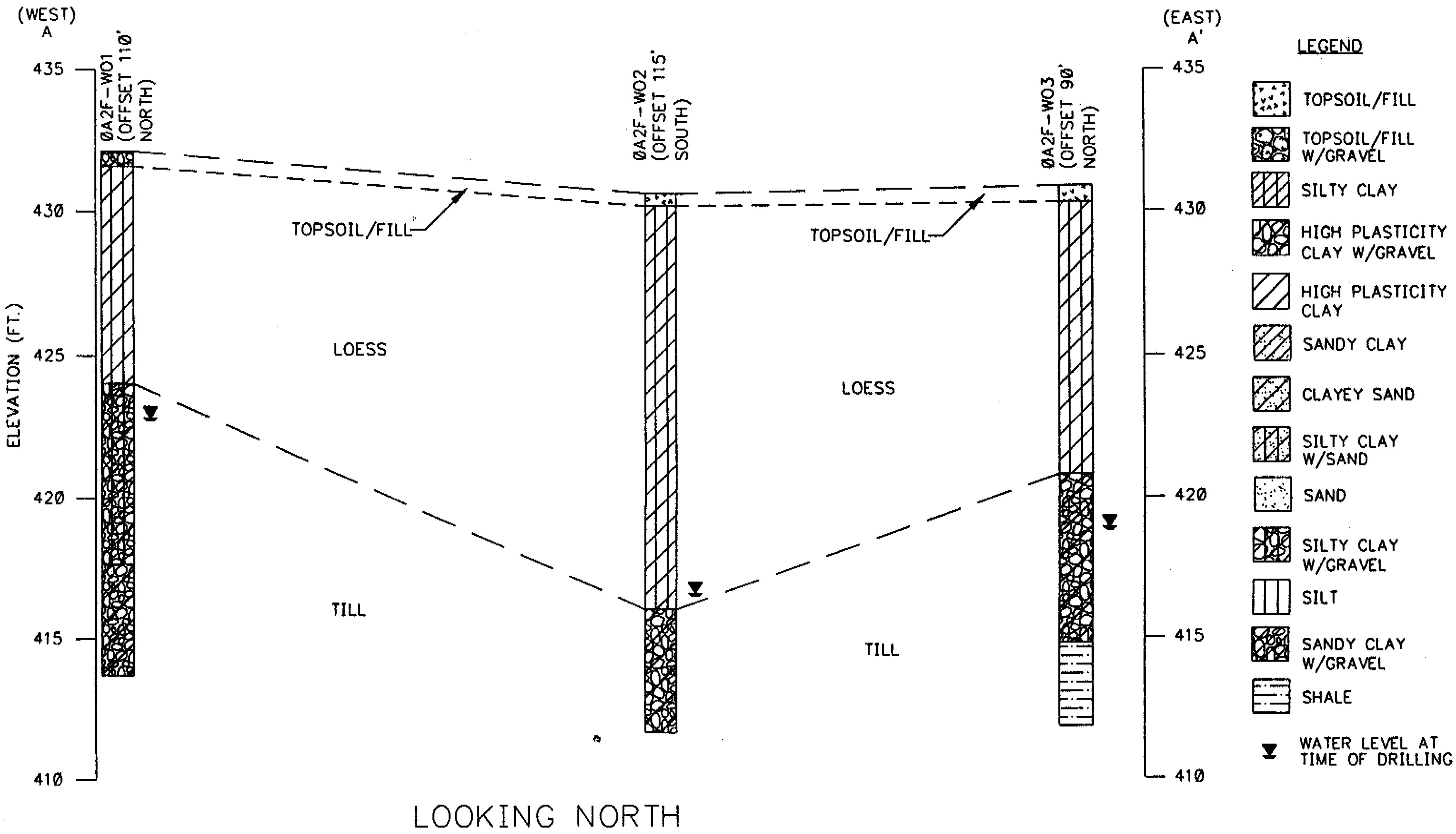
REVISIONS

PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–ØA2F
Sample Locations and Detections in Surface Water and Groundwater

Date: 11/14/ØØ	Project Number: 232ØØØØØ26.ØØ	Figure Number: 5–4
Drawn by: DJD	Design by: MM	Checked by: CMW

URS



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1' = 5'

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

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DRN. BY:djd 10/17/00 DSGN. BY:ore CHKD. BY:sea	Geologic Cross-Section A-A' for Area 2F	FIG. NO. 5-5

Area 2P was the Illinois Ordnance Plant (IOP) Primer Loading Line, and has been used as an industrial facility since the 1950s. See the introduction to Section 3 for a general discussion of Area 2 and its location. The location of Area 2P (AUS-0A2P) is shown in Figure 3-1, along with the other sites in Area 2.

AUS Original Site Designations

Two of the original Additional and Uncharacterized Sites Operable Unit (AUS OU) sites designated in 1997-1999 by the United States Fish & Wildlife Service (USFWS) were located in Area 2P: AUS-0004 and AUS-0010. These original AUS OU sites have been incorporated into the Area 2P site referred to as AUS-0A2P.

6.1 HISTORIC SEARCH INFORMATION

6.1.1 Site Description

Area 2P is an active industrial facility bounded on all four sides by a 6-foot (ft) chain link fence with secured access. Entrance to the site is controlled by the tenant, now General Dynamics Ordnance & Tactical Systems, Inc. (GDO&TS).

6.1.2 Operational History and Waste Characteristics

Area 2P at the IOP originally contained the 14 buildings shown on Figure 6-1.[1] Since the end of World War II, some buildings have been removed and others added.[2] The current configuration of Area 2P is shown on Figure 6-2.

Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department), operated the Artillery Primer Loading Line during World War II, from 1942 through 1945.

Records indicate that Great Lakes Terminal and Transport Inc. leased Building P-1-13 from 1951 to 1971 for the storage of chemicals.[3] However, this building was moved to Area 7 and Great Lakes leased it there, not in Area 2P.

In 1957, Olin Corporation (formerly Olin Mathieson Chemical Corporation) began leasing eight buildings in Area 2P for a solid propellant plant and for gas generator research and development and production.[4,5] Olin's ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end of 1996. In January 2001, General Dynamics Corporation acquired Primex. Primex became a wholly-owned subsidiary of General Dynamics and changed its name

[1] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[2] Changes in structure to the original layout of Area 2P were noted during the Phase I Site Assessment on April 13, 1998.
[3] DOI 001069. Great Lakes Terminal & Transport, Crab Orchard National Wildlife Refuge NPL Site, First Set of Information Requests, Answer to Question No. 5.
[4] DOI 001199. Olin Corporation, Crab Orchard National Wildlife Refuge, Response of Olin to First Set of Information Requests, Page 4.
[5] FWM 001076. Second Amendment of Lease, dated January 1957, Page 3.

to General Dynamics Ordnance and Tactical Systems, Inc (hereafter referred to as GDO&TS).[6,7] GDO&TS is the current tenant in Area 2P.[8]

Building numbers in Area 2P and the general building functions are listed in Table 6-1, along with building operator/lessees over time. SWDC/War Department and Olin and its successors were the principal occupants in this area. Their products and operations are discussed below in greater detail.

6.1.2.1 Area 2P Products and Constituents

IOP Products and Constituents

The first products in Area 2P were primers for artillery shells.[9] Primers were constructed of inert components such as cartridge brass, onion skin paper, percussion cup and beeswax. They also contained ignitable components such as percussion compounds and black powder, which is made up of potassium nitrate, sulfur, and charcoal.[10][11]

Olin/Primex/GDO&TS Products and Constituents

In 1957 Olin began research and development (R&D) and some production of solid propellants in Area 2P.[12] A small portion of Olin's work in the P area was developing ball powder propellant which included materials such as nitroglycerin, plasticizers, and dioctyl phthalate.[13] Initially, a larger part of Olin's activity in Area 2P involved work in the field of gas generators which included the use of ammonium nitrate with a plastic/rubber base.[14] Olin was attempting to develop ballistic modifiers for the gas generators.[15]

The buildings originally occupied by Olin are shown in Table 6-1. Solid propellant R&D activities involved the small scale mixing of solid propellants and their subsequent testing. During the 1970s, Olin began ammunition production in Area 9 and the R&D for the ammunition product lines was moved into Area 2P.[16] The chemicals used during the R&D at Area 2P are the same as the constituents listed in Table 3-4. Other chemicals used in Area 2P

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[6] General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.
[7] Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.
[8] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[9] NAR 000042. Illinois Ordnance Plant, 1943, Illinois Ordnance Plant, Historical Record, August 18th, 1941 to December 31st, 1942, Page 37.
[10] U.S. Army Corp of Engineers, 1993, Ordnance and Explosive Waste Archives Search Report for Former Illinois Ordnance Plant Marion, Illinois, Project Number E05IL000203, Appendix D-12C, Page 510.
[11] Kohler, J. and R. Meyer, Explosives, VCH Publishers, 1993, page 33.
[12] Deposition of John Miller, April 9, 1998, Pages 5, 6, & 33.
[13] Deposition of John Miller, April 9, 1998, Pages 7-8.
[14] Deposition of John Miller, April 9, 1998, Page 8.
[15] Deposition of John Miller, April 9, 1998, Page 8.
[16] Deposition of John Miller, April 9, 1998, Page 123 & 124.

include degreasers[17] and solvents used in solid propellant production. Rudy Okolski, a former Olin employee, reported that trichlorethylene (TCE) was the universal cleaning agent and that it was dropped off everywhere in 55-gallon drums during 1964 through 1980.[18]

A 1986 Olin map indicated explosive quantities and types in Area 2P buildings as well as the classification of these explosives. Table 6-1B summarizes the information from this map.

6.1.2.2 Area 2P Processes and Operations

Area 2P processes and operations are discussed on a building-by-building basis.

Building P-1-1

The processes SWDC/War Department used for the manufacture of primers in Area 2P, included screening and blending of black powder, pelletizing, and component loading.[19,20] During the IOP era, Building P-1-1 was used as a Primer Loading Building.[21] Black powder pellets from Building P-1-10 (Black Powder Pelleting Building) were loaded into primer cartridges that were prepared in Building P-1-3 (Primer Preparation Building).[22] The primers were then sealed using small amounts of beeswax and shellac,[23] and taken to Building P-1-2 (Primer Rest House) [24] for temporary storage. Building P-1-1 contained eight loading rooms, each of which was constructed using 1-ft thick concrete walls to minimize damage from explosions.[25]

Olin's research and development activities began in laboratories at Buildings P-1-1 and P-1-11.[26] In 1975, Building P-1-1 contained engineering and development offices, labs and Pilot Scale Manufacturing Activities.[27,28,29] It is likely that the Pilot Propellant Plant[30] was relocated into this building from Area 11 where it was previously located. Building P-1-1 also contained mixers that produced propellant mixes.[31] It also contained propellant lathes, a sander, and a mill

[17] Deposition of John Miller, April 9, 1998, Page 57.
[18] Rudy Okolski, personal interview, June 30, 1999.
[19] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[20] U.S. Army Corp of Engineers, 1993, Ordnance and Explosive Waste Archives Search Report for Former Illinois Ordnance Plant Marion, Illinois, Project Number E05IL000203, Appendix D-12C, Page 510.
[21] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[22] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[23] U.S. Army Corp of Engineers, 1993, Ordnance and Explosive Waste Archives Search Report for Former Illinois Ordnance Plant Marion, Illinois, Project Number E05IL000203, Appendix D-12C, Page 510.
[24] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[25] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I Section 8, Page 15.
[26] Deposition of John Miller, April 9, 1998, Pages 17-18.
[27] Paul Moore, personal interview, July 14, 1999.
[28] PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[29] PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
[30] Richard Altekruse, personal interview, July 14, 1999.
[31] PRI-006616. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00008.

for the shaping of propellant grains.[32] In 1985, the floor drain in the Ammonium Nitrate/Propellant Granulation area was closed.[33] This floor drain previously would have received wash waters containing ammonium nitrate dust.[34]

A 1984 Olin receiving report listed "Copper Chromite Catalyst Powder" sent to P-1-1.[35] By 1985, Olin was using hexane, ethyl alcohol, and acetone in this building.[36]

A sump was also located on the north side of Building P-1-1 (Figure 6-2).[37] Two sinks in the "Wet Lab" of this building discharged into this sump,[38] and therefore the sump probably received miscellaneous chemicals, including solvents[39]. The standard sump cleaning procedure was to discharge the fluids onto the ground surface in the area of the sump and to collect, package, and transport for disposal all of the precipitated solids. By August 1985, a pump was installed in the sump and a line to the sewer system was also installed,[40] probably so that the sump would no longer need to be bailed onto the ground surface during cleaning.

In this building, explosives were blended with No. 2 fuel oil in preparation for transportation off site.[41]

Primex leased Building P-1-1 from 1997 to 2001 for manufacturing purposes.[42] GDO&TS is the current tenant in this building.[43]

Building P-1-2

During the IOP operations, Building P-1-2 was used as a Primer Rest House.[44] After the primers were loaded and sealed in Building P-1-1 (Primer Loading Building), they were taken to Building P-1-2 for temporary storage. They would be loaded onto trucks from this building, for distribution.

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[32] PRI-006616. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00008.
[33] PRI-006598. Olin, Olin-Marion Wastewater Discharges/Sources: Group A, Status Report 11 November 1985.
[34] PRI-016717. Olin, Wastewater Point Source Survey, Final Draft, 11 September 1984.
[35] DPRA Document No. 00011216/PRI-012406. Olin, Marion, Illinois, Receiving Report for 1 pound of "Copper Chromite Catalyst Powder" with a notation "sent to P-1-1 Attn: L. Markovitch), dated September 4, 1984.
[36] PRI-006616. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00009.
[37] PRI-016597 and PRI-016599. Attachments to Olin inter office memo entitled "Explosive Sumps," dated June 3, 1997
[38] PRI-016715. Olin, Wastewater Point Source Survey, Final Draft, 11 September 1984.
[39] Deposition of George T. Wisely, July 15, 1999, Pages 40-41.
[40] PRI-016661. Olin-Marion Wastewater Discharges/Sources: Group A, Status Report 23 August 1985.
[41] DOI-002499. Olin document, Attachment 2 of the Part A Application, Manufacturing Operations Description, dated March 1987.
[42] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.
[43] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[44] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).

According to aerial photographic interpretation, P-1-2 was removed from Area 2P before 1951.[45] According to Refuge personnel, P-1-2 was moved to "S-2-2"[46] (likely Area 4). 1965 aerial photographs indicate another building in this location; however, by 1993, this new building is gone.[47] Olin likely used this building; however, its specific use was not determined.

Building P-1-3

During the IOP operation, Building P-1-3 was used as a Primer Preparation Building.[48] Primer cartridges were probably cleaned and prepared and percussion elements from Building P-1-4 (Percussion Element Service Building) loaded into the cases in Building P-1-3.[49] This building contained four presses and one degreaser.[50] The primer cartridges were taken from Building P-1-3 to Building P-1-1 (Primer Loading Building), for loading.

During Olin's tenure in Area 2P in 1977, Building P-1-3 contained a Pressure Test Room.[51] In 1975 this building had a gas generator machine shop, an x-ray lab, and a welding area (on the east side of the building).[52,53] There was a quality control lab[54] in the center of the building.[55]

According to Robert Myers, a former Olin truck driver and laborer, P-1-3 also housed a machine shop where Olin filled 55-gallon drums full of scrap metal (metal turnings) that came off of the lathes. Solvents and oils used in here were also put into the drums.[56] Mr. Myers picked up waste solvents and oils from this building, and P-1-11, and dumped them for burning.[57]

In 1975 gas generators were assembled on the west side of the building,[58] for smaller production contracts.[59] According to Mr. John Miller, a former Olin chemist and manager, P-1-3 was used

[45] 1951 aerial photograph from the National Archives and Records Administration, College Park, Maryland (same photograph used by Entech, Inc.).
[46] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[47] 1965 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[48] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[49] These processes are assumed to have been performed in building P-1-3 due to the proximity of the solvent storage building (P-1-13) and the percussion element service magazine (P-1-4). Therefore it is likely that solvent cleaning of the brass cartridges was performed (with solvent from P-1-13) and then percussion elements were loaded into the primer cases.
[50] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.
[51] PRI-006682. Olin inter office memo entitled "Safety Audit – P Area," dated July 13, 1977.
[52] PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[53] Paul Moore, personal interview, on July 14, 1999.
[54] PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
[55] Paul Moore, personal interview, July 14, 1999.
[56] Deposition of Robert Myers, April 10, 1998, Pages 47-48
[57] Deposition of Robert Myers, April 10, 1998, Page 49.
[58] PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[59] Deposition of John Miller, April 9, 1998, Pages 18-19.

as a machine shop and as a loading area for contract gas generator work.[60] George Wisely, a former Olin chemist and manager, reported that Building P-1-3 housed a gas generator assembly facility and that there was a "fairly large" degreaser, about 6 or 7 ft tall, in the building. This was used in the gas generator manufacturing process, which involved bonding materials to metals. The metals had to be very clean before bonding. He didn't know which solvent was used with the degreaser, but "it comes to mind that it would have been a chlorinated solvent, but I'm not for sure."[61] Mr. Miller stated that Olin built gas generators for both the Minute Man and the Polaris, as well as for parachutes and safety chutes for airplanes, and diesel engine starters.[62]

In 1973, Olin was using the following chemicals in Building P-1-3: nitroglycerin casting solvent, double base propellant, and ammonium and potassium perchlorate propellant.[63]

There was a solvent storage shed near the northwest corner of the building.[64] During the middle to early 1980s (at least), Building P-1-3 was used as a research and development laboratory (also as a metallurgical laboratory[65]).[66] As of 1986, this operation was connected to the sewer system.[67]

During 1981, Building P-1-3 housed solvents and other chemicals such as methanol, toluene, methyl ethyl ketone, Epirez 510 (resin), and triacetin.[68] In January 1982, there was an ammonium nitrate spill in this building.[69] By August 1982, Olin decided to paint the floor of this building so to suppress the ammonium nitrate crystals that had formed on the floor.[70] Olin planned to use this building for hazardous waste storage;[71] and at least by 1987, Olin was doing so.[72]

According to a former employee, MOCA[73] [4,4'–Methylenebis (2-chloreoaniline)] was also used in this building.[74]

Primex leased Building P-1-3 from 1997 to 2001 for manufacturing purposes.[75] Primex also used this building (dock annex) as an area where hazardous wastes were accumulated on-site for less than 90 days.[76]

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60 Deposition of John Miller, April 9, 1998, Page 17.
61 Deposition of George Wisely, July 15, 1999, Page 38.
62 Deposition of John Miller, April 9, 1998, Page 17.
63 PRI-013438. Olin, Standard Operating Procedure, Scrapping of Hazardous Material, Building P-1-3, dated November 6, 1973.
64 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
65 PRI-006599. Olin, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report 11 November 1985.
66 PRI-016550. Olin, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report 1 June 1987.
67 PRI-016535. Olin, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report, dated December 30, 1986.
68 PRI-010601. Attachment to Olin inter office memo entitled "Liquid Materials," dated April 8, 1981.
69 PRI-016285. Olin inter office memo entitled "Magazines, Warehouses, and Incinerator/Retort Status," dated January 11, 1982.
70 PRI-016272. Olin inter office memo entitled "Ammonium Nitrate on floor in P-1-3," dated August 12, 1982.
71 PRI-016272. Olin inter office memo entitled "Ammonium Nitrate on floor in P-1-3," dated August 12, 1982.
72 DOI 002502, DOI 002504, and DOI 002505. Winchester Ordnance Products, Hazardous Waste Facility Closure Plan, Ordill Industrial Area, S.O.P. 90,356 Rev. G 3/87, pages 1, 3, and 4.
73 MOCA is a chemical associated with propellant manufacturing.
74 Paul Moore, personal interview, July 14, 1999.

GDO&TS is the current tenant in this building.[77]

Building P-1-4

During the IOP operations, IOP Building P-1-4 was used as a Percussion Element Service Building.[78] Percussion elements were stored in this building until they were needed in Building P-1-3 (Primer Preparation Building).

According to Refuge personnel, Building P-1-4, from Area 2P, was moved to the Booster Load Line[79] to the location between Building B-2-1 and B-2-2.[80,81] Therefore, it is likely that former Building P-1-4 is UMC Building B-2-3 (refer to Section 3). This move took place sometime between 1951 and 1960.[82]

Building P-1-42 later occupied the same location as former Building P-1-4 but aerial photographic interpretation was unable to determine when this occurred. See later discussion for Building P-1-42.

Building P-1-5 (Building P-1-81)

During the IOP era, Building P-1-5 was used as a Black Powder Service Magazine.[83] Black powder would be delivered to this magazine via truck, for storage prior to transporting it to Building P-1-6 (Black Powder Screening Building) for screening.

Several added buildings in the north end of Area 2P were used for solid propellant operations. Olin Building P-1-81 was used for propellant grain casting.[84,85] This building was either rebuilt or restored sometime after 1980. The area this building was located in (the northern portion of

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[75] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.
[76] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 12.
[77] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[78] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[79] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[80] Original IOP Plan No.6544-101.34, last revision, December 9, 1945 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[81] Undated USFWS map of Area 2-B with notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[82] 1951 aerial photograph from the National Archives and Records Administration, College Park, Maryland; and, 1960 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[83] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[84] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.
[85] Note: Building P-1-81 is in the same location as the former IOP black powder service magazine building P-1-5. See Figure 6-1 and Figure 6-2 for details.

Area 2P) was abandoned from sometime between 1960 and 1965 through at least 1980.[86] This northern portion of Area 2P was restored to use sometime after 1980[87] and Building P-1-81 is currently being used by Olin's successor (GDO&TS).

Building P-1-6 (Building P-1-83)

During the IOP, Building P-1-6 was used as a Black Powder Screening Building.[88] Black powder screening took place in Building P-1-6, and then the black powder was moved to Building P-1-7 (Black Powder Rest House) for temporary storage prior to drying.[89] Building P-1-6 contained a screening room (which contained a black powder sifter),[90,91] a screening charge room and a powder rest room, each of which were constructed using 1-ft thick concrete walls to minimize damage from explosions.[92]

Olin reportedly used this building (or a different building at the same location), which they designated Building P-1-83, as a Utility Building.[93] This building was either rebuilt or restored sometime after 1980.[94] This northern portion of Area 2P was restored to use sometime after 1980,[95] Building P-1-83 is currently being used by Olin's successor.

In 1988, Olin proposed to use Building P-1-83 for dispensing TMETN and TEGDN.[96] They also intended to use Building P-1-83 for large-scale synthesis of an energetic polymer which involved chemicals such as diethylene glycol and dicyanoethyl-diamino-propane.[97]

Primex leased Building P-1-83 from 1997 to 2001 for cold storage.[98] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[99] GDO&TS is the current tenant in this building.[100]

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[86] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12. The Entech reports analyze historic aerial overflight photographs of industrial areas at the Refuge, from 1943 to 1993 (except in Area 2, which was analyzed from 1960-1993). The photos were obtained from the National Archives and Records Administration (NARA) and the U.S. Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS).

[87] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Page 7.

[88] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).

[89] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).

[90] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.

[91] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 10.

[92] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 17.

[93] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.

[94] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Page 6 and Figure 12.

[95] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Page 7.

[96] PRI-010177. Olin inter office memo entitled "P Area Storage Facilities," dated March 10, 1988.

[97] PRI-010185 – PRI-010186. Olin inter office memo entitled "Energetic Polymer Synthesis," and attached notes, dated May 11, 1988.

Building P-1-7

During the IOP operations, Building P-1-7 was used as a Black Powder Rest House.[101] The black powder was probably moved from Building P-1-6 (Black Powder Screening Building) to Building P-1-7 for temporary storage prior to drying in Building P-1-8 (Black Powder Dry House).[102]

Olin reportedly used Building P-1-7 for "H.E. Ammo" (high explosive ammunition).[103] In 1985, Olin likely housed up to 190 pounds of projectiles and cartridges in this building.[104]

Primex leased Building P-1-7 from 1997 to 2001 for cold storage.[105] GDO&TS is the current tenant in this building.[106]

Building P-1-8

During the IOP era, Building P-1-8 was used as a Black Powder Dry House.[107] After the black powder was screened in Building P-1-6 (Black Powder Screening Building) and temporarily stored in Building P-1-7 (Black Powder Rest House), it was probably transported to Building P-1-8 for drying. Building P-1-8 contained three "rest" rooms, each of which was constructed using 1-ft thick concrete walls to minimize damage from explosions.[108] This building also contained a black powder dryer.[109] After drying, it was probably transported to Building P-1-10 (Black Powder Pelleting Building) for pelletizing.

[98] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[99] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 12.
[100] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[101] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[102] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[103] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
[104] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
[105] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.
[106] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[107] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[108] DPRA Document No. CO01262. Illinois Ordnance Plant Drawing entitled "Black Powder Dry House, Bldg P-1-8, Artillery Primer Line, Plans, Elevations, Sections & Details, Plan No. 200.88, dated November 7, 1941.
[109] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.

Olin reportedly used Building P-1-8 for storage of chemicals.[110,111] According to Paul Moore, a former Olin employee, the following materials were stored in either Building P-1-8 or P-1-9: epalm, DTA[112], epoxy mixes, MOCA, and adaprene.[113] According to Mr. Moore, these two buildings may have contained solvents, but this was not the primary solvent storage area for the P area.

Primex leased Building P-1-8 from 1997 to 2001 for cold storage.[114] GDO&TS is the current tenant in this building.[115]

Building P-1-9

During the IOP era, Building P-1-9 was used as a Fan House.[116] It is assumed that this building was used in conjunction with Building P-1-8 (Black Powder Dry House) for drying the screened black powder.

Olin reportedly used Building P-1-9 for "Primed Cases Squibs."[117,118] As described under Building P-1-8, Olin also reportedly used Building P-1-9 for chemical storage and possibly some solvent storage.

According to Rudy Okolski, propellant was spread on the landscaped areas located between Buildings P-1-9 and P-1-10. He reported that it caught fire sometime in the mid-1970s.[119]

Primex leased Building P-1-9 from 1997 to 2001 for cold storage.[120] GDO&TS is the current tenant in this building.[121]

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[110] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

[111] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[112] No information was found regarding the definition of this acronym.

[113] Paul Moore, personal interview, July 14, 1999.

[114] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.

[115] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[116] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).

[117] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

[118] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[119] Rudy Okolski, personal interview, June 30, 1999.

[120] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.

[121] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building P-1-10

During the IOP era, Building P-1-10 was used as a Black Powder Pelleting Building.[122] After the powder was dried in Building P-1-8 (Black Powder Dry House), it was pelletized in Building P-1-10. This building was a long compartmentalized building with three pellet pressing areas and pelleting presses[123,124] that were separated by 1-ft thick concrete walls[125] for explosion control. Black powder pellets were made by compressing the black powder into shape using press machines. From this building, they were probably transported to the Primer Loading Building (Building P-1-1) for loading into primer cartridges.

Olin research and development activities in Area 2P included testing products. Building P-1-10 was reported by Olin to be a Ballistic Test Building.[126,127] A former employee reported that Building P-1-10 was the test range building (a firing range for gas generators).[128] John Miller also stated that a building on the west side of the P Area (likely P-1-10) was used as a test area for firing gas generators.[129]

During the middle 1970s, all product testing was transferred to Olin property located off the Refuge in Energy, Illinois.[130,131] At that time Building P-1-10 changed from a research and development testing facility to a pressing facility for the production of ammunition products that were being introduced at Olin's facility,[132] specifically the 20 mm MPT-SD (XM940) and the 25 mm PCB projectiles.[133,134]

By 1985, Building P-1-10 also housed a research and development operation associated with the loading of depleted uranium (DU) ammunition for the Navy.[135] Also by the 1980s, the equipment in Building P-1-10 included a degreaser for metal cleaning.[136] The degreasing solvent was reported as "trichlorethane"[137] at one time, and "GENESOLV 5535,"[138] at another.

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[122] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[123] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 2, Page 5.
[124] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III, Section 1, Page 9.
[125] DPRA Document No. CO01509. Illinois Ordnance Plant Drawing entitled "Black Powder Pelleting Bldg, Bldg P-1-10, Artillery Primer Line, Elevations, Sections & Details, Plan No. 6544-205.43, dated January 29, 1942.
[126] PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
[127] PRI-008156. Olin inter office memo entitled "Marion Loss Prevention Audit, December 5-7, 1972," dated January 10, 1973.
[128] Paul Moore, personal interview, July 14, 1999.
[129] Deposition of John Miller, April 9, 1998, Page 19.
[130] Deposition of John Miller, April 9, 1998, Page 143.
[131] Rudy Okolski, personal interview, June 30, 1999.
[132] Deposition of John Miller, April 9, 1998, Page 19.
[133] PRI-009822. Olin, Standard Operating Procedure, S.O.P. No. 8309001, Pressing Trace Mix, Page 1.
[134] PRI-008533. Olin inter office memo entitled "August, 1987 Hi-Lite Report," dated August 27, 1987.
[135] Deposition of John Miller, April 9, 1998, Pages 146-151.
[136] PRI-013783. Olin, Standard Operating Procedures, S.O.P. Number 90270, Operation of Vapor Degreaser – Building P-1-10, Page 1.
[137] PRI-006617. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00009.

Primex leased Building P-1-10 from 1997 to 2001 for manufacturing purposes.[139] GDO&TS is the current tenant in this building.[140]

P-1-10A

Building P-1-10A was located adjacent to the south of Building P-1-10.[141] According to aerial photographic interpretation, P-1-10A first appears on site sometime between 1971 and 1980[142] (during Olin's tenure in Area 2P). Olin likely used this building. No other information was found regarding this building.

Building P-1-11

During the IOP era, Building P-1-11 was used as a Change House.[143] Wash waters from this building may have contained explosives/organic solvent residues. Wash waters from this building either drained into the sewer system or into drainage ditches that were located nearby the building.

Olin's research engineering and development activities began in offices and laboratories at Buildings P-1-11 and P-1-1; a hazards testing laboratory was located upstairs in Building P-1-11 after the chemical laboratory moved out.[144,145] Research and development activities also included testing of the products. A hazards testing lab was set up in the upstairs portion of Building P-1-11.[146,147] An office was set up in the downstairs portion of this building. In 1963, administration as well as a lab was present in this building.[148]

By 1973 and 1974, Building P-1-11 contained hazardous materials/wastes such as ball powder,[149] ammonium nitrate propellant, nitroglycerin casting solvent, double base propellant,

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138 PRI-013783. Olin, Standard Operating Procedures, S.O.P. Number 90270, Operation of Vapor Degreaser – Building P-1-10, Page 1.
139 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.
140 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
141 Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
142 1971 and 1980 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
143 U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
144 PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
145 John Miller Deposition, April 9, 1998, Pages 17-19.
146 John Miller Deposition, April 9, 1998, Pages 17,18.
147 Deposition of George T. Wisely, July 15, 19999, Page 43.
148 PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
149 PRI-013356. Olin, Standard Operating Procedure, S.O.P. No. 90,177, Operation of Incinerator, Disposal of Scrap Explosives.

ammonium and potassium perchlorate propellant, pyrotechnic and flare products, solvents, and gas generators.[150]

Robert Myers stated that he picked up waste solvents and oils from this building, and P-1-11, and dumped them for burning.[151]

Primex leased Building P-1-11 from 1997 to 2001 for cold storage.[152] GDO&TS is the current tenant in this building.[153]

Building P-1-12

During the IOP era, Building P-1-12 was used as a Timekeepers Building for Area 2P.[154]

Olin later used this building as a Guard Office.[155] Primex leased Building P-1-12 from 1997 to 2001 for manufacturing purposes.[156] GDO&TS is the current tenant in this building.[157]

Building P-1-13

During the IOP era, Building P-1-13 was used as a Solvent Storage Building.[158] This building was used in association with Building P-1-3 (Primer Preparation Building). It was not determined what types of solvents were stored in this building. It is likely a chemical laboratory was located in this building sometime during Olin's tenure.[159]

This building was apparently re-located to Area 7[160,161,162] sometime between 1943 and 1951.[163] Refer to the discussion in Section 11 (Area 7) for more information about this building and its tenants.

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[150] PRI-013455. Olin, Standard Operating Procedure, S.O.P. No. 90,164, Scrapping of Hazardous Material – Bldg. P-1-11, Page 4.
[151] Deposition of Robert Myers, April 10, 1998, Page 49.
[152] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 6.
[153] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[154] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[155] PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
[156] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[157] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[158] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[159] John Miller Deposition, April 9, 1998, Page 17.
[160] DPRA Document No. 00006467. List of Areas, Army Building Numbers, Leased Square Ft, and Refuge Square Ft; undated.
[161] DPRA Document No. 00006449. Annual Cost CY 1975, dated April 20, 1976.

Building P-1-14

During the IOP era, Building P-1-14 was used as a Boiler House for Area 2P.[164] This boiler house used coal-fired boilers according to the original IOP plans for this building.[165] These plans may have been modified, or a fuel oil underground storage tank (UST) may have later been added later near this building since an October 1981 USFWS contract[166] was found that provided for the removal of a UST from near this building. No closure report was found associated with this reported UST, nor is it known as to whether any contamination was associated with the removal. An area of surficial discoloration, which may be associated with fuel (i.e. coal or oil) loading activities for the boiler house, was observed in the 1943 aerial photographs along the west side of the building. [167] This surficial discoloration was still present in 1951.[168]

Olin also used this building, presumably as a boiler house. By 1960, there was a small fill/scarred area observed in the aerial photographs, along the outer, southeastern edge of the road that loops around the building.[169] In 1963, Olin was still using this boiler house.[170] By 1965, the area of scarring had expanded and it appeared that the scarred area was the result of a liquid release.[171] There appeared to be a small body of liquid along the western portion of the scar.[172] By 1971, there was some possible surficial scarring observed to the south of the boiler house; by 1980 it appeared as if the boiler house was no longer in use.[173]

A 1980 Olin document[174] indicates 30 empty 30-gallon boiler treatment chemical solution drums were being stored outside the boiler house. These drums contained solutions of monosodium phosphate, caustic soda (NaOH), sodium sulfite, sodium meta bisulfite, and cyclo hexylamine solution. The drums were to be drained completely and then rinsed, and the rinse water was to be poured on the ground sloping away from the boiler house.

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[162] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[163] 1943 and 1951 aerial photographs from the National Archives and Records Administration, College Park, Maryland (same photographs used by Entech, Inc.).
[164] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).
[165] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 22.
[166] U.S. FWS Contract No. 14-16-0003-81-126.
[167] Entech, Inc. 1999. Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites – AUS OU, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[168] Entech, Inc. 1999. Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites – AUS OU, C7rab Orchard National Wildlife Refuge, Marion, Illinois.
[169] Entech, Inc. 1999. Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites – AUS OU, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[170] PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
[171] Entech, Inc. 1999. Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites – AUS OU, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[172] Entech, Inc. 1999. Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites – AUS OU, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[173] Entech, Inc. 1999. Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites – AUS OU, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[174] PRI-016222. Olin inter office memo entitled "Empty Boiler Treatment Drums," dated April 1, 1980.

The boiler house in Area 2P burned down in June 1984.[175]

In 1977, Olin reported that the "fuel oil USTs" at the "P" Area Boiler House, still contained fuel oil.[176] It is possible that Olin installed these USTs since they were not part of the original IOP plans for Building P-1-14. The locations of these USTs were not determined. Olin had boilers in at least two other buildings (P-1-48 and P-1-54) so the USTs may have been installed at one of those buildings.

Boilers used by Olin were reportedly blown down to the ground surface daily.[177] Heavy metals contamination is possible in the area of the boiler blow-down. Six chemicals or materials were periodically added by Olin to the water in the boilers: phosphate, alkaline solution, sulphite, ammonia, zeolite and salt brine.[178]

Building P-1-15

Building P-1-15 was built sometime prior to 1965 as observed in the aerial photographs.[179]

Olin used ovens in Building P-1-15 for drying propellant grains.[180,181] This building may have also been used for "Weather Mod. Manufacturing."[182] In 1987, Olin used this building for R&D of explosives.[183]

Primex leased Building P-1-15 from 1997 to 2001 for cold storage.[184] GDO&TS is the current tenant in this building.[185]

Building P-1-16

Building P-1-16[186] was built sometime prior to 1965,[187] and was located northeast of Building P-1-11. At another time, P-1-16 was located north of Building P-1-4 (later known as P-1-42).[188]

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[175] PRI-002072. Olin, Releases/Spills Incident/Notification Forms, dated June 14, 1984.
[176] PRI-00523. Olin, Letter to Wayne Adams at Fish & Wildlife Service regarding Olin continuing to maintain storage of fuel oil in underground tanks at "P" Area Boiler House, dated November 7, 1977.
[177] PRI-016298. Olin inter office memo entitled "Water Discharges," dated February 12, 1982.
[178] PRI-016299. Olin inter office memo entitled "Water Discharges," dated February 12, 1982.
[179] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
[180] PRI-006617. Olin, 1985 Air Source Inventory/OP/Marion/RC, dated October 7, 1985, Page 00009.
[181] PRI-00506. Olin Matheson Chemical Corporation, Olin Matheson Chemical Corporation, Ordill Works, Marion Illinois, Plant Building Directory, March 1963, Page 5.
[182] PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[183] PRI-017483. Olin, Attachment 1, Facility Description to NESHAP Notification.
[184] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[185] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[186] PRI-016721. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984, Fig. 1.
[187] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
[188] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.

Aerial photographic interpretation was unable to determine when it appeared at this location. It is no longer on site in either location.

Building P-1-17 and P-1-18

Buildings P-1-17 and P-1-18 were located north of Building P-1-3.[189] Currently these locations house Buildings P-1 –47 and P-1-48, respectively. No other information was found regarding P-1-17 and P-1-18.

Building P-1-19

Building P-1-19 was located just west of Building P-1-10[190] in the current location of Building P-1-43. No other information was found regarding this building.

Building P-1-20

Sometime between 1965 and 1971, Building P-1-20 was located north of Building P-1-51.[191,192] At another time, P-1-20 was located just north and almost adjacent to Building P-1-10.[193] It is no longer on site in either of these locations.

Building P-1-23

Building P-1-23 was built sometime between 1965 and 1971.[194] Olin used this building as an "oven."[195]

Building P-1-25

Building P-1-25 was built sometime after 1965[196] and was located approximately 180 ft southeast of Building P-1-3.[197]

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[189] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[190] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[191] PRI-016721. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984, Fig. 1.
[192] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
[193] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[194] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
[195] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
[196] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
[197] PRI-002633. Map of I Area included as an attachment to Olin document entitled 1975 Safety Performance, Technical Systems Operation, Marion, Illinois.

At least during the 1970s, Olin Building P-1-25 was used as a Scrap Storage Magazine for Class 7 propellant (from Building P-1-3), igniter scrap, and ammonium nitrate propellant grains.[198,199]

In 1977, this magazine reportedly housed canisters of hydrogen fluoride and cyanogen and one unidentified bottle.[200]

Building P-1-26

Building P-1-26 was built sometime after 1965[201] and was located approximately 180 ft southeast of Building P-1-3.[202]

At least during the 1970s, Olin Building P-1-26 was used as a Scrap Storage Magazine for igniter scrap and ammonium nitrate propellant grains.[203]

Building P-1-27 (Building P-1-76)

Olin Building P-1-27[204] was built sometime after 1965.[205]

Olin later replaced this building with Building P-1-76. Olin began using Building P-1-76 as a storage building for incendiary mixes in October 1984.[206,207,208] In 1997 Primex assumed all of Olin's leases and leased this building until 2001 for cold storage.[209] GDO&TS is the current tenant in this building.[210]

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198 PRI-002775. Olin Corporation, Standard Operating Procedures, Mixers in Building P-1-1, Page 3.
199 PRI-013438 – PRI-013439. Olin, Standard Operating Procedure, Scrapping of Hazardous Material – Bldg. P-1-3, S.O.P. No. 90,168, dated November 6, 1973.
200 PRI-006672. Olin inter office memo entitled "P Area Safety Audit, 13 October 1977," dated October 18, 1977, Page 2.
201 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
202 PRI-002633. Map of I Area included as an attachment to Olin document entitled 1975 Safety Performance, Technical Systems Operation, Marion, Illinois.
203 PRI-013438 – PRI-013439. Olin, Standard Operating Procedure, Scrapping of Hazardous Material – Bldg. P-1-3, S.O.P. No. 90,168, dated November 6, 1973.
204 PRI-016721. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984, Fig. 1.
205 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
206 DOI 001733. Olin, Building Usage, Lease #14-19-008-2675, July-September 1984.
207 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
208 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
209 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 7, and 10.
210 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Buildings P-1-28 through P-1-36

Buildings P-1-28 through P-1-36 were built sometime before 1965.[211]

A 1975 Olin document[212] indicates that there were two parallel east-west rows of similar buildings located south of P-1-49, P-1-10, P-1-53, and the Equipment Building. Building P-1-28 was the westernmost building in the northern row of buildings (P-1-29, -30, -31, and -32). The southern row consisted of Buildings P-1-33, -34, -35, and –36). The use of the buildings was not determined, and they are no longer present. These buildings were removed sometime between 1980 and 1993.[213]

Building P-1-38

Building P-1-38[214] was built sometime between 1965 and 1971.[215] Olin's use of this building was not determined. This building was removed sometime between 1980 and 1993.[216]

Building P-1-42

Building P-1-42 was in the location of former Building P-1-4.[217] Aerial photographic interpretation was unable to determine when P-1-42 originally appeared on site. Primex leased Building P-1-42 from 1997 to 2001 for cold storage.[218] GDO&TS is the current tenant in this building.[219]

Building P-1-43

Building P-1-43 was built sometime prior to 1965.[220] Olin leased this building at sometime prior to 1980.[221] Olin used this building as a compressor house.[222]

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[211] PRI-002633. Map of I Area included as an attachment to Olin document entitled 1975 Safety Performance, Technical Systems Operation, Marion, Illinois.

[212] PRI-002633. Map of I Area included as an attachment to Olin document entitled 1975 Safety Performance, Technical Systems Operation, Marion, Illinois.

[213] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[214] PRI-016721. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984, Fig. 1.

[215] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.

[216] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[217] Original IOP Plan No.6544-101.12, last revision June 30, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.

[218] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[219] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[220] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.

Primex leased Building P-1-43 from 1997 to 2001 for cold storage.[223] GDO&TS is the current tenant in this building.[224]

Building P-1-44

Building P-1-44 was built sometime after 1965.[225]

A 1975 Olin document[226] indicates Building P-1-44 was located next to (and possibly attached to) Building P-1-43. This building was removed sometime between 1975 and 1980.[227]

Buildings P-1-45 and P-1-47

Buildings P-1-45 and P-1-47 were built sometime prior to 1965.[228] In 1985, Olin likely housed igniter material in Building P-1-45.[229] No other information was found regarding these buildings.

Building P-1-48

Building P-1-48 was built sometime prior to 1965.[230] Building P-1-48 was not one of the original IOP buildings. Olin used this building, which contained a boiler.[231]

Building P-1-49

Building P-1-49 was not one of the original IOP buildings. It was built sometime between 1965 and 1971.[232] In 1985, Olin likely used this building for storage of inert metal parts.[233]

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221 DPRA Document No. 00014205. Olin, Rental Adjustment Thru 31 August 1980, Lease Contract No. 14-19-008-2675 and 14-16-0003-12613U, dated August 8, 1980, Page 5.
222 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
223 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
224 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
225 PRI-002633. Map of I Area included as an attachment to Olin document entitled 1975 Safety Performance, Technical Systems Operation, Marion, Illinois.
226 PRI-002633. Map of I Area included as an attachment to Olin document entitled 1975 Safety Performance, Technical Systems Operation, Marion, Illinois.
227 1980 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photograph used by Entech, Inc.).
228 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
229 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
230 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
231 PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
232 Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
233 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

Primex leased Building P-1-49 from 1997 to 2001 for cold storage.[234] GDO&TS is the current tenant in this building.[235]

Building P-1-50

Building P-1-50 was built sometime between 1971 and 1980.[236] In 1985, Olin likely used this building for storage of inert metal parts.[237] Primex leased Building P-1-50 from 1997 to 2001 for cold storage.[238] GDO&TS is the current tenant in this building.[239]

Building P-1-51

Building P-1-51 was built sometime between 1971 and 1980.[240] Olin used this building for "Weather Mod. Storage".[241] In 1985, Olin likely used this building for storage of inert metal parts.[242]Primex leased Building P-1-51 from 1997 to 2001 for cold storage.[243] GDO&TS is the current tenant in this building.[244]

Building P-1-52

Building P-1-52 was not one of the original IOP buildings. Building P-1-52 appears in Area 2P sometime between 1971 and 1980.[245]

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[234] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[235] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[236] 1971 and 1980 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[237] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[238] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[239] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[240] 1971 and 1980 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[241] PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

[242] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[243] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[244] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[245] 1971 and 1980 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

Olin used Building P-1-52 for "Oxidizers".[246] In 1985, Olin likely housed up to 1,000 pounds of oxidizers in this building.[247]

Primex leased Building P-1-52 from 1997 to 2001 for cold storage.[248] GDO&TS is the current tenant in this building.[249]

Building P-1-53

Building P-1-53[250] was built sometime after 1971.[251] In 1985, Olin likely housed up to 500 pounds of propellant in this building.[252]

Primex leased Building P-1-53 from 1997 to 2001 for cold storage.[253] GDO&TS is the current tenant in this building.[254]

Building P-1-54

Building P-1-54 was built sometime between 1971 and 1980.[255] This building contained a boiler that was previously blown down onto the ground surface.[256,257] By June 1987, this boiler blowdown was connected to the sewer system.[258] Heavy metals contamination is possible in the area of the boiler blow-down. Six chemicals or materials were periodically added by Olin to the water in the boilers: phosphate, alkaline solution, sulphite, ammonia, zeolite and salt brine.[259]

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[246] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

[247] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[248] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[249] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[250] PRI-016721. Olin Corporation, Wastewater Point Source Survey Report, Final Draft, 11 September 1984, Fig. 1.

[251] Entech, Inc., 1999, Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.

[252] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[253] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[254] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[255] 1971 and 1980 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[256] PRI-002648. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.

[257] PRI-016298. Olin inter office memo entitled "Water Discharges," dated February 12, 1982.

[258] PRI-016550. Olin, Olin-Marion Wastewater Discharges/Sources: Group B, Status Report 1 June 1987.

[259] PRI-016299. Olin inter office memo entitled "Water Discharges," dated February 12, 1982.

Primex leased Building P-1-54 from 1997 to 2001.[260] GDO&TS is the current tenant in this building.[261]

Buildings P-1-55 and P-1-59

Buildings P-1-55 and P-1-59 were not original IOP buildings. The locations of these buildings were not determined.

Olin likely used these buildings. Primex assumed all of Olin's leases in 1997 and Primex leased Buildings P-1-55 and P-1-59 from 1997 to 2001. These buildings are ramps, hallways, utility systems, or boiler rooms, and were not used as part of manufacturing or cold storage.[262] GDO&TS is the current tenant in both buildings.[263]

Building P-1-60

Building P-1-60 was not one of the original IOP buildings. The location of this building was not determined. The existence of this building is known from references in documents and the location has not been determined.

Olin likely used this building because Primex assumed Olin's leases, and Primex leased Building P-1-60 from 1997 to 2001 for cold storage.[264] GDO&TS is the current tenant in this building.[265]

Building P-1-61

Building P-1-61 was not an original IOP building. The location of this building was not determined. The existence of this building is known from references in documents and the location has not been determined.

Primex assumed all of Olin's leases in 1997, and Primex leased Building P-1-61 from 1997 to 2001. This building is either a ramp, hallway, utility system, or boiler room, and was not used as part of manufacturing or cold storage.[266] GDO&TS is the current tenant in this building.[267]

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[260] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[261] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[262] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 7, and 10.

[263] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[264] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 7, and 10.

[265] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[266] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 7, and 10.

Building P-1-62

Building P-1-62 was built sometime between 1980 and 1993.[268] Olin used Building P-1-62 for storing explosive waste scrap,[269,270,271] as well as up to at least 1000 pounds (lbs.) of ammonium nitrate by 1988.[272] In 1985, Olin likely housed up to 2,000 pounds of explosive waste in this building.[273]

Primex leased Building P-1-62 from 1997 to 2001 for cold storage.[274] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[275]

GDO&TS is the current tenant in this building.[276]

Building P-1-63

Building P-1-63, which Olin designated "Propellants,"[277] was built sometime between 1980 and 1993.[278] In 1985, Olin likely housed up to 2,000 pounds of propellant in this building.[279] Primex

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[267] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[268] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[269] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

[270] DOI 003204. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), March 1987, Page 3.

[271] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996.

[272] PRI-010177. Olin inter office memo entitled "P Area Storage Facilities," dated March 10, 1988.

[273] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

[274] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

[275] DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 12.

[276] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[277] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

[278] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[279] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

leased Building P-1-63 from 1997 to 2001 for cold storage.[280] GDO&TS is the current tenant in this building.[281]

Building P-1-64

Building P-1-64, which Olin designated "Primers,"[282] was built sometime between 1980 and 1993.[283] Primex leased Building P-1-64 from 1997 to 2001 for cold storage.[284] GDO&TS is the current tenant in this building.[285]

Building P-1-65

Building P-1-65, which Olin designated "Trace Mix,"[286] was built sometime between 1980 and 1993.[287] Primex leased Building P-1-65 from 1997 to 2001 for cold storage.[288] GDO&TS is the current tenant in this building.[289]

Building P-1-66

Building P-1-66, which Olin designated "Working Magazine,"[290] was built sometime between 1980 and 1993.[291] In 1985, Olin likely stored Department of Transportation Class 1.1, 1.2, and

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280 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

281 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

282 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

283 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

284 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

285 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

286 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

287 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

288 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

289 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

290 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

291 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

1.3 explosives in this building.[292,293] Primex leased Building P-1-66 from 1997 to 2001 for cold storage.[294] GDO&TS is the current tenant in this building.[295]

Building P-1-67

Building P-1-67, which Olin designated "Igniters,"[296] was built sometime between 1980 and 1993.[297] In 1985, Olin likely housed both igniters and fuses in this building.[298]Primex leased Building P-1-67 from 1997 to 2001 for cold storage.[299] GDO&TS is the current tenant in this building.[300]

Building P-1-68

Building P-1-68, which Olin designated "Blast Caps,"[301] was built sometime between 1980 and 1993.[302] Primex leased Building P-1-68 from 1997 to 2001 for cold storage.[303] GDO&TS is the current tenant in this building.[304]

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[292] These classifications, obtained from the Department of Transportation Hazmat Transport Regulations, indicate explosives ranging from those characterized as mass explosion hazards to those characterized with dangerous projections hazards and radiant heat or violent burning hazards. (See Table 6-1B).
[293] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
[294] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[295] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[296] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
[297] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[298] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
[299] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[300] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[301] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
[302] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[303] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[304] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building P-1-69

Building P-1-69, which Olin designated "High Explosives (A-4, C-4, RDX [Royal Demolition Explosive])," [305] was built sometime between 1980 and 1993.[306] Primex leased Building P-1-69 from 1997 to 2001 for cold storage.[307] GDO&TS is the current tenant in this building.[308]

Building P-1-70

Building P-1-70 was not an original IOP building.

Olin Building P-1-70 was a new storage building in 1982[309] used for storing explosive waste scrap.[310,311,312,313]

Primex leased Building P-1-70 from 1997 to 2001 for cold storage.[314] Primex also used this building as an area where hazardous wastes were accumulated on-site for less than 90 days.[315]

GDO&TS is the current tenant in this building.[316]

Building P-1-71

Building P-1-71 was not an original IOP building.

Olin Building P-1-71 was a new storage building in 1982[317] used for Metal Fuel.[318,319]

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305 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

306 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

307 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

308 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

309 DOI 001747. Olin, Building Usage, Lease #14-19-008-2675, October-December 1982.

310 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.

311 DOI 003204. Olin Corporation, Certification Regarding Potential Releases from Solid Waste Management Units (Closure Plan Review), March 1987, Page 3.

312 DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996.

313 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.

314 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.

315 DPRA Document No. 00015017. Primex Technologies, Attachment C, Procedure 4.13: Plant Emergency Procedures, Procedure 4.14: Contingency Plan Arrangements for Emergencies with Local Authorities, dated December 1996, Page 12.

316 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Primex leased Building P-1-71 from 1997 to 2001 for cold storage.[320] GDO&TS is the current tenant in this building.[321]

Building P-1-72

Building P-1-72 was not an original IOP building.

Olin Building P-1-72 was a new storage building in 1982[322] used for "H.E. Ammo."[323]

Primex leased Building P-1-72 from 1997 to 2001 for cold storage.[324] GDO&TS is the current tenant in this building.[325]

Building P-1-73

Building P-1-73 was not an original IOP building.

Olin Building P-1-73 was a new storage building in 1982[326] used for "T.P. Ammo."[327] In 1985, Olin likely housed projectiles and cartridges in this building.[328] No other information was found regarding this building.

Building P-1-74

Building P-1-74 was not an original IOP building.

Olin Building P-1-74 was a new storage building in 1982[329] used for Propellant Storage,[330] such as ammonium nitrate.[331] By 1988, Olin intended to use P-1-74 for storage of plasticizers TMETN [Trimethylolethane Trinitrate] and TEGDN [Triethylene Glycol Dinitrate].[332,333]

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317 DOI 001747. Olin, Building Usage, Lease #14-19-008-2675, October-December 1982.
318 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
319 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
320 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
321 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
322 DOI 001747. Olin, Building Usage, Lease #14-19-008-2675, October-December 1982.
323 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
324 DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
325 Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
326 DOI 001747. Olin, Building Usage, Lease #14-19-008-2675, October-December 1982.
327 PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
328 DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
329 DOI 001747. Olin, Building Usage, Lease #14-19-008-2675, October-December 1982.

Primex leased Building P-1-74 from 1997 to 2001 for cold storage.[334] GDO&TS is the current tenant in this building.[335]

Building P-1-75

Building P-1-75 was not one of the original IOP buildings.

Olin used building P-1-75 as a new storage building beginning in 1982.[336] In 1985, Olin likely housed propellant in this building.[337] By 1988, Olin intended to use P-1-75 for storage of plasticizers TMETN and TEGDN.[338]

Primex leased Building P-1-75 from 1997 to 2001 for cold storage.[339] GDO&TS is the current tenant in this building.[340]

Building P-1-76

See discussion under P-1-27.

Building P-1-77

Building P-1-77 was not one of the original IOP buildings.

Olin Building P-1-77 was used for Energetic Plasticizer Storage.[341,342] This building was likely built sometime after 1980, since the area in which this building was located (the northern portion of Area 2P), was abandoned from sometime between 1960 and 1965 through at least 1980.[343] This northern portion of Area 2P was restored to use sometime after 1980[344] and Buildings P-1-

[330] PRI-006639. Attachment 13 to Olin inter office memo entitled "Air Source Inventory & Regulation Review/Recommendations," dated October 9, 1985.
[331] PRI-010177. Olin inter office memo entitled "P Area Storage Facilities," dated March 10, 1988.
[332] PRI-010177. Olin inter office memo entitled "P Area Storage Facilities," dated March 10, 1988.
[333] PRI-010175. Olin inter office memo entitled "High Energy Propellant Meeting, 25 February 1988."
[334] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[335] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[336] DOI 001747. Olin, Building Usage, Lease #14-19-008-2675, October-December 1982.
[337] DPRA Document No. CO02161. Olin Ordnance Products, Q-D Map P Area, Drawing No. 6030125, dated May 21, 1985.
[338] PRI-010177. Olin inter office memo entitled "P Area Storage Facilities," dated March 10, 1988.
[339] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1 and 7.
[340] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[341] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.
[342] PRI-010175. Olin inter office memo entitled "High Energy Propellant Meeting, 25 February 1988."
[343] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.
[344] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Page 7.

77, P-1-78, P-1-79, P-1-80, P-1-82, and P-1-84 were built. Olin, and possibly Primex, used these buildings. No evidence of these buildings was found on site. The former locations of Buildings P-1-77, P-1-79, P-1-80, P-1-82, and P-1-84 are shown in Figure 6-2.

Building P-1-78

This building was built after 1980 and Olin used it for propellant storage.[345] See discussion under Building P-1-77 above.

Building P-1-79

This building was built after 1980 and Olin designated it a Propellant Process Building (likely for gas generator loading activities).[346] See discussion under Building P-1-77 above.

Building P-1-80

This building was built after 1980 and Olin used it a Propellant Mix House. See discussion under Building P-1-77 above.

Building P-1-81

See discussion under P-1-5.

Building P-1-82

This building was built after 1980 and Olin used it for propellant curing operations (possibly oven curing).[347] See discussion under Building P-1-77 above.

Building P-1-83

See discussion under Building P-1-6.

Building P-1-84

This building was built after 1980 and Olin used it for waste storage.[348] See discussion under Building P-1-77 above.

Building P-1-85

Building P-1-85 was not one of the original IOP buildings. The location of this building was not found. The existence of this building is known from references in documents.

Olin probably used this building before Primex assumed Olin's leases in 1997. Primex leased Building P-1-85 from 1997 to 2001 for cold storage.[349] GDO&TS is the current tenant in this building.[350]

[345] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.
[346] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.
[347] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.
[348] PRI-010182. Attachment to Olin inter office memo entitled "P-1-84," dated April 26, 1988.

6.1.2.3 Miscellaneous Area 2P Information

IOP Decontamination

After the IOP operations ended at CONWR, the IOP was to be decontaminated in accordance with a manual developed by the Ordnance Field Director of Ammunition Plants (OFDAP), called "*Shut-Down and Decontamination Procedures for F.D.A.P Facilities*."[351] This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.[352] According to this document, there were several cleaning compounds used for desensitizing various explosives (for a list of and brief discussion of the compounds, see section 3.1.2.3.).

Post-World War II military records are inadequate to determine if this area was decontaminated and, if so, whether it was adequately decontaminated, and if decontamination instructions were followed.

Possible Open Dump North of Industrial Portion of Area 2P

A small, possible open dump was observed in the 1965 aerial photograph, to the north of the industrialized portion of Area 2P and along the edge of a stream.[353] The possible dump appeared as light-toned earthen deposits with no visible debris. The site was accessible via a well-maintained access road and, according to Entech, there appeared to be some bins located near the end of the access road.[354] By 1971, the light-toned materials were gone but the access road was still well maintained and the bins and a couple of dumpsters were still present.[355] The bins Entech identified in this location were probably the Refuge's sewage lift station, as shown on an original IOP drawing[356] and a USFWS drawing of Area 2P.[357]

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[349] DPRA Document No. 00007524. Building and Igloo Lease Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Pages 1, 7, and 10.

[350] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

[351] ACO-5047 through ACO-5109 – Office of Field Director of Ammunition Plants, "Shut-Down and Decontamination Procedures for F.D.A.P. Facilities."

[352] ACO-4979 through ACO-4980 – CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.

[353] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.

[354] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois, Figure 12.

[355] Entech, Inc. 1999. Site Specific Report on Area 2 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.

[356] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 6 (Plan No. 6544-101.12).

[357] Undated USFWS map of Area 2-B with notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.

Polychlorinated Biphenyls (PCBs)

Electrical transformers have been located in Area 2P from at least as far back as the IOP days. In 1946, IOP documented 12 pole-mounted transformers in Area 2P:[358,359]

- one three-phase transformer bank of three (3) 5-KVA pole-mounted transformers located south of Building P-1-11;
- one three-phase transformer bank of three (3) 10-KVA pole-mounted transformers located northwest of Building P-1-10;
- one three-phase transformer bank of three (3) 15-KVA pole-mounted transformers located north of Building P-1-5; and,
- one three-phase transformer bank of three (3) 37.5-KVA pole-mounted transformers located northeast of Building P-1-2.

By 1979, Olin began to inventory their "PCB transformers" at the Refuge, including a listing of transformers in Area 2P. The following table is a summary of the history of these transformers and their replacements.

[358] DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Pages 19 and 20.
[359] DPRA Document No. 00009327. Illinois Ordnance Plant, Report on Condition for Extended Non-use of Illinois Ordnance Plant, Carbondale, Illinois, for Reconstruction Finance Corporation, Office of Defense Plants, dated January 1, 1946, Plan No. 6544-502.75, Plate No. 10, Page 102.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
North of **P-1-1**	25553	Pole	50	5.5 ppm	• 1979 – Transformer removed from service and stored in F-2-3; replaced with S/N 57C17934; transported to a landfill.[360] • 1979 – Analytical results for transformer oil indicate 5.5 ppm PCBs.[361]
North of **P-1-1**	57C17934	Pole	50	Unknown	• 1979 – Replaced transformer S/N 25553.[362] • 1982 – Transformer still in service in 1982; however, no other information was found regarding the location of this transformer after 1982.[363]
North of **P-1-1**	25691	Ground	37.5	<1 ppm	• 1979 – Transformer removed from service and stored In F-2-3; replaced with S/N 741025; transported to a landfill.[364] • 1979 – Analytical results for transformer oil Indicate <1 ppm PCBs.[365]
North of **P-1-1**	741025	Ground	37.5	11 ppm[a]	• 1979 – Replaced transformer S/N 25553.[366] • 1985 – Transformer removed from service; replaced with S/N 742J03001; stored in F-2-2.[367] • It is unknown if this transformer remains in storage. No other documentation regarding its location has been found.
North of **P-1-1**	742J030001	Pole	37.5	0 ppm[a]	• 1985 – Transformer initially installed at P-1-1; later that year it was moved to Area D.[368]
North of **P-1-1**	5T57977	Ground	37.5	118 ppm	• Documented as early as 1979.[369] • 1984 - Analytical results for transformer oil indicate 118 ppm PCBs.[370] • 1985 – Transformer removed from service; replaced with S/N 84ZJ030002; stored in F-2-4.[371] • 1985 – Transformer received by CECOS for disposal.[372]

[360] DOI 004323. Olin, 1979 PCB Annual Document.
[361] PRI-00635. Envirodyne Engineers, Report of Analysis, dated October 30, 1979.
[362] DOI 004323. Olin, 1979 PCB Annual Document.
[363] DOI 004343. Olin, 1982 PCB Inventory, P-Area.
[364] DOI 004323. Olin, 1979 PCB Annual Document.
[365] PRI-00635. Envirodyne Engineers, Report of Analysis, dated October 30, 1979.
[366] DOI 004323. Olin, 1979 PCB Annual Document.
[367] DOI 004412 and DOI 004413. Olin, Transformer Inventory-Olin/OP/RC, Pages 00001 and 00002.
[368] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, Page 00001.
[369] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[370] DOI 004403. Industrial Testing Laboratories, Inc., Report No. 84-7-166, dated August 8, 1984, Page 2.
[371] DOI 004412 and DOI 004414. Olin, Transformer Inventory-Olin/OP/RC, Pages 00001 and 00003.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
North of **P-1-1**	84ZJ030002	Pole	37.5	0 ppm[a]	• 1985 – Transformer initially installed at P-1-1; later that year it was moved to Area D.[373]
North of **P-1-1**	5T59347	Ground	37.5	Unknown	• Documented as early as 1979[374] • 1982 – Transformer removed from service; replaced with S/N 5T5938; stored in F-2-2[375] • The location of this transformer after 1982 is unknown.
North of **P-1-1**	5T59348	Ground	37.5	2,236 ppm	• 1982 – Replaced transformer S/N 5T59347.[376] • 1984 - Analytical results for transformer oil indicate 2236 ppm PCBs.[377] • 1985 – Transformer removed from service; replaced with S/N 84ZJ030034; stored in F-2-4.[378] • 1985 – Transformer received by CECOS for disposal.[379]
North of **P-1-1**	84ZJ030034	Ground	37.5	0 ppm[a]	• 1985 – Transformer replaced S/N 5T59348; only in service at this location for 6 months before it "burned out;" noted as remaining in P Area.[380]
North of **P-1-1**	57C17926	Pole	50	13 ppm[a]	• Documented as early as 1979.[381] • 1986 – Transformer remains in service.[382] • It is unknown if this transformer is still in service today.
North of **P-1-1**	57C17925	Pole	50	13 ppm[a]	• Documented as early as 1979.[383] • 1986 – Transformer remains in service.[384] • It is unknown if this transformer is still in service today.

[372] DOI 004394. Uniform Hazardous Waste Manifest, Document Number IL 1310998, dated May 2, 1985.
[373] DOI 004412. Olin, Transformer Inventory-Olin/OP/RC, Page 00001.
[374] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[375] DOI 004338. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[376] DOI 004338. Olin, 1982 PCB Annual Document for "PCB Transformers in Service."
[377] DOI 004403. Industrial Testing Laboratories, Inc., Report No. 84-7-166, dated August 8, 1984, Page 2.
[378] DOI 004414 and DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Pages 00003 and 00005.
[379] DOI 004394. Uniform Hazardous Waste Manifest, Document Number IL 1310998, dated May 2, 1985.
[380] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[381] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[382] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[383] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[384] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
North of **P-1-1**	4650471183	Pole	50	50 ppm[a]	• 1986 – First documentation found for this transformer – indicates in service at P-1-1; also indicates this was an original transformer.[385] • It is unknown if this transformer is still in service today.
South of **P-1-3**	61AA3698	Pole	37.5	5 ppm[a]	• Documented as early as 1979.[386] • 1986 – Transformer remains in service.[387] • It is unknown if this transformer is still in service today.
South of **P-1-3**	61AA5102	Pole	37.5	5 ppm[a]	• Documented as early as 1979.[388] • 1986 – Transformer remains in service.[389] • It is unknown if this transformer is still in service today.
South of **P-1-3**	61AB556	Pole	37.5	5 ppm[a]	• Documented as early as 1979.[390] • 1986 – Transformer removed from service; replaced with S/N 84ZF012018; stored in F-2-2.[391] • The location of this transfer since storage is unknown.
South of **P-1-3**	84ZF012018	Pole	37.5	5 ppm[a]	• 1986 – Transformer replaced S/N 61AB556; remains in service in 1986.[392] • It is unknown if this transformer is still in service today.
Southeast of **P-1-10**	5T32195	Pole	25	5 ppm[a]	• Documented as early as 1979.[393] • 1986 – Transformer remains in service.[394] • It is unknown if this transformer is still in service today.
Southeast of **P-1-10**	5T32196	Pole	25	5 ppm[a]	• Documented as early as 1979.[395] • 1986 – Transformer remains in service.[396] • It is unknown if this transformer is still in service today.

[385] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[386] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[387] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[388] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[389] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[390] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[391] DOI 004413 and DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Pages 00002 and 00005.
[392] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[393] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[394] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[395] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
Southeast of **P-1-10**	5T32197	Pole	25	Unknown	• Documented as early as 1979[397] • 1982 – Transformer also identified as S/N 5T34137.[398] • 1982 – Transformer removed from service; replaced with S/N 2821-601-11; stored in F-2-2.[399] • No other information was found regarding this transformer.
Southeast of **P-1-10**	2821-601-11	Pole	25	5 ppm[a]	• 1982 – Transformer replaced S/N 5T32197 (5T34147).[400] • 1986 – Transformer remains in service; noted as an original transformer.[401] • It is unknown if this transformer is still in service today.
East of **P-1-11**	275013	Pole	10	69 ppm	• Documented as early as 1979[402] • 1984 - Analytical results for transformer oil indicate 69 ppm PCBs.[403] • 1985 – Transformer removed from service; replaced with S/N 5000126; stored in F-2-4.[404] • 1985 – Transformer received by CECOS for disposal.[405]
East of **P-1-11**	5000126	Pole	10	5.5 ppm[a]	• 1985 – Transformer replaced S/N 275013.[406] • It is unknown if this transformer is still in service today.
East of **P-1-11**	57C33915	Pole	10	278 ppm	• Documented as early as 1979.[407] • 1984 - Analytical results for transformer oil indicate 278 ppm PCBs.[408] • 1985 – Transformer removed from service; replaced with S/N 4772685; stored in F-2-4.[409] • 1985 – Transformer received by CECOS for disposal.[410]

[396] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[397] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[398] DOI 004348. Olin, 1982 PCB Inventory, F-Area Storage.
[399] DOI 004337. Olin, 1982 PCB Annual Document for "PCB Transformers in Storage."
[400] DOI 004337. Olin, 1982 PCB Annual Document for "PCB Transformers in Storage."
[401] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[402] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[403] DOI 004403. Industrial Testing Laboratories, Inc., Report No. 84-7-166, dated August 8, 1984, Page 2.
[404] DOI 004414 and DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Pages 00003 and 00005.
[405] DOI 004398. Uniform Hazardous Waste Manifest, Document Number IL 1311047, dated November 20, 1985.
[406] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[407] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."

Location	Transformer Serial No.	Type	Capacity (kva)	PCB Content	Notes
East of **P-1-11**	4772685	Pole	10	18 ppm[a]	• 1985 – Transformer replaced S/N 275013.[411] • It is unknown if this transformer is still in service today.
East of **P-1-11**	57C33831	Pole	10	761 ppm	• Documented as early as 1979.[412] • 1984 - Analytical results for transformer oil indicate 761 ppm PCBs.[413] • 1985 – Transformer removed from service; replaced with S/N4499009 ; stored in F-2-4.[414] • 1985 – Transformer received by CECOS for disposal.[415]
East of **P-1-11**	4499009	Pole	10	1 ppm[a]	• 1985 – Transformer replaced S/N 275013.[416] • It is unknown if this transformer is still in service today.

[a] These PCB content values were found in an Olin transformer inventory document.[417] The letters "LT" followed some of the PCB values. However, it is unclear what this means. This document contained a column for entries regarding PCB certification by either "Letter" or "Analysis," but the document did not indicate the origin of the letter or who performed the analysis. No other documentation was found to substantiate these PCB values.

[408] DOI 004403. Industrial Testing Laboratories, Inc., Report No. 84-7-166, dated August 8, 1984, Page 2.
[409] DOI 004414 and DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Pages 00003 and 00005.
[410] DOI 004398. Uniform Hazardous Waste Manifest, Document Number IL 1311047, dated November 20, 1985.
[411] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[412] PRI-00625. Olin, "Oct. 1979 PCB Transformer Inventory, (P-Area)."
[413] DOI 004403. Industrial Testing Laboratories, Inc., Report No. 84-7-166, dated August 8, 1984, Page 2.
[414] DOI 004415 and DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Pages 00004 and 00005.
[415] DOI 004398. Uniform Hazardous Waste Manifest, Document Number IL 1311047, dated November 20, 1985.
[416] DOI 004416. Olin, Transformer Inventory-Olin/OP/RC, Page 00005.
[417] DOI 004412 – DOI 004425. Olin, Transformer Inventory-Olin/OP/RC, dated February 13, 1986.

Explosive Scrap Pickup

In 1958, Olin reported the following scraps were generated in Area 2P (research and development area):[418]

- J-66 type ammonium perchlorate – rubber base propellant
- Ammonium Nitrate Rubber (Type 448A)
- Perchlorate Propellant with iron oxide burn rate modifier
- Composite double base propellant containing aluminum and ammonium perchlorate
- Ethyl acetate with scrap propellant (from cleanup of mixers or other equipment).

Olin identified these explosive scrap pickup points in Area 2P in 1975:[419]

- P-1-1 – Engineering and Development Laboratory
- P-1-3 – Gas generators.

The explosive scrap was collected from these two points and transported to the burning grounds for disposal.[420] The location of the burning grounds depended on when the scrap was generated. John Miller, indicated in his deposition that Olin moved from one burning ground to another as they outgrew the previous burn area, and that all of Olin's manufacturing operations on the Refuge used the same burn area at the same time.[421] Olin documents indicate that they moved their burning grounds from Area 12 to Area 2D in 1965, from Area 2D to Area 9 in 1967 and from Area 9 to Area 10 in 1968.[422] The Area 10 burn area was in operation until open burning was banned at the Refuge in July 1970. [423] According to John Miller, explosive wastes were not disposed of at Olin's off-Refuge Test Range in Energy, Illinois until 1973, when the incinerator at that location was approved.[424] It was not determined what Olin did with their explosive wastes between July of 1970 and 1973.

Sumps

In addition to the sump located next to Building P-1-1, two other sumps were mentioned in an Olin interoffice memo in Area 2P. These two sumps were reportedly located next to the two MK-24 mix houses.[425] In 1977, these two sumps were cleaned out and filled in, to prepare the area for 30mm storage facilities.[426] The location of these two mix houses and the two sumps were not determined.

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[418] PRI-002241. Olin Mathieson Chemical Corporation Inter-Office memo entitled "Identity of RCB Scrap sent to Burning Grounds for 6/5/58," dated June 10, 1958.
[419] PRI-002629. Olin, 1975 Safety Performance Technical Systems Operation, Marion, Illinois.
[420] Olin's burning grounds for explosive materials were moved from place to place during the time open burning was allowed on the Refuge. Refer to Section 14 of this report for the various locations of the burning grounds.
[421] Deposition of Mr. John Miller, April 9, 1998, Pages 80 and 81.
[422] DOI 004465, DOI 004467, and DOI 004469. Olin document submitted as part of their Section 104(e) response regarding open burning at the Refuge.
[423] CRO 001662. CONWR, Letter to Trojan – U. S. Powder regarding discontinuing open burning at the Refuge, dated March 17, 1970.
[424] Deposition of Mr. John Miller, April 9, 1998, Pages 131 and 132.
[425] PRI-016594. Olin inter office memo entitled "Explosive Sumps," dated June 3, 1977.
[426] PRI-016594. Olin inter office memo entitled "Explosive Sumps," dated June 3, 1977.

Other Olin/Primex/GDO&TS Chemicals of Concern

The following chemicals, among others, were listed in an Olin document[427] which shows a list of chemicals used in Area 2P:

- Chromic Acid
- Activated Aluminum 4093
- Alumina F-20
- Aluminum Metal Powder
- Aluminum Nitride
- Aluminum Paint
- Ammonium Nitrate
- Boron
- Ceric Ammonium Nitrate
- Chromium Octoate
- Chromium Oxide
- Chromium Trioxide
- Copper Chromite Catalyst
- Copper Chromite Powder E105
- Ferric Chloride
- Iron Blue G (X-3434) Hisperse
- Lead Dioxide
- Lead Oxide
- Magnesium 40/200
- Magnesium Carbonate
- Magnesium Metal
- Magnesium Molybdate
- Magnesium Oxide
- Magnesium Perchlorate
- Magnesium Sulfate
- Nitrogen UN 1066
- Nitromethane
- Perchloric Acid
- Phosphoric Acid
- Phosphoric Acid A-260
- Silver Cystallene Powder
- Silver Nitrate
- Silver Nitrate (crystal)
- Silver Powder
- Trichlorethylene
- Triethylamine
- Zetax
- Zinc Chromate Primer (MIL-P-8116)
- Zinc Metal
- Zinc Oxide

[427] PRI-009681 – PRI-009698. Olin document showing a list of suppliers for materials used in Area 2P.

- Zinc Oxide Powder
- Zinc Stearate

6.1.3 Area 2P Previous Sampling Results

O'Brien & Gere, 1988

The following sites in or near Area 2P, shown in Figure 4-3, were investigated as part of the original Remedial Investigation (RI) for the Refuge (O'Brien & Gere, 1988):

- Site 9 -- P Area NW Drainage
- Site 10 -- Waterworks North Drainage
- Site 11 -- P Area SE Drainage
- Site 11A --P Area North

Site 9 -- P Area NW Drainage

One composite surface water sample and one composite sediment sample were collected from this drainageway, which shows as an intermittent stream on the United States Geological Survey (USGS) 7.5-minute quadrangle (Figure 3-1).[428] A portion of this stream is visible in the northwest corner of Figure 6-3. One sediment location was resampled for Contract Laboratory Program (CLP) organics analyses (sediment results reported in dry weight).

The sediment sample was collected from downstream of the possible open dump that was identified in aerial photographs to the north of the industrialized portion of Area 2P. Some results reported by O'Brien and Gere are not included here because they were determined to be not useable. Results reported here are estimated.[429] Barium (0.051 milligrams per Liter (mg/L)) in surface water exceeded United States Environmental Protection Agency (USEPA) ECOTOX. Some of the analytical results are shown on Figure 6-2a.

Site 10 -- Waterworks North Drainage

This site is located in the same drainageway as Site 9 (discussed above), only further downstream, and upstream of the former Refuge Waterworks (Figure 4-3).[430] One composite surface water sample and two composite sediment samples (0-1 ft) were collected at this site in Phase I (sediment results reported in dry weight except where noted).

Some results reported by O'Brien and Gere are not included here because they were determined to be not useable. Results reported here are estimated.[431] The detections of bis(2-

[428] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 15-1.
[429] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987. The letter reports that the data for the following constituents are not useable: 2-butanone, vinyl acetate, 4-methyl-2-pentanone, aniline, bis(2-chloro-isopropyl)ether, 4-chloroaniline, 2-nitro-sodiphenylamine, benzidine, di-n-octyl-phthalate, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, cyanide, Ag, As, Be, Cd, Cu, Ni, Pb, Se, Zn, and Hg.
[430] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Figure 12-1.
[431] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987. The letter reports that the data for the following constituents are not useable: 2-butanone, vinyl acetate, 4-methyl-2-pentanone, aniline, bis(2-chloro-isopropyl)ether, 4-chloroaniline, 2-nitro-

ethylhexyl)phthalate (540 micrograms per kilogram (ug/kg) wet weight (wt)) and n-nitrosodimethylamine (270 ug/kg wet wt) from the Phase I investigation[432] are shown in Figure 6-2a. Five grab sediment samples and one surface water composite were collected in Phase II. In surface water, barium (0.044 mg/L) exceeded USEPA ECOTOX.

The following semi-volatile organic compounds (SVOCs) were detected above Canadian Sediment Quality Guidelines (CSEQGs), USEPA ECOTOX, and/or USEPA Region IV screening values in the sediment samples: benzo[a]anthracene (0.025 mg/kg), di-n-butyl phthalate (4.8 mg/kg), 2-methylnaphthalene (0.004 mg/kg), and pyrene (0.038 mg/kg). Some of the Phase II analytical results are shown in Figure 6-2c.

Site 11 -- P Area SE Drainage

Site 11 is located within the drainage channel that flows to the southeast, in the southeast corner of Area 2P (Figure 6-2a).[433] This drainageway is visible in the southeast part of Figure 6-3. One composite surface water sample and two composite sediment samples (0-1 ft) were collected in Phase I.[434] Results reported here are estimated.[435] Bromodichloromethane (3 micrograms per Liter (ug/L)), chloroform (31 ug/L), and HMX [Her Majesty's Explosive] (8 mg/L) were detected in the surface water sample. In the sediment sample, n-nitrosodimethylamine (63 ug/kg wet wt) and 1,1-dichloroethene (14 ug/kg wet wt) were detected.

Site 11A -- P Area North

Site 11A was located outside of the fence north of the Olin P Area (in the area around Buildings P-1-5 and P-1-6 (see Figures 4-3, 6-1, and 6-2b).[436] It appears that in 1988, this portion of Area 2P was not in use. This site consisted of abandoned L-shaped covered walkways, a loading dock, and a steamhouse with a concrete pit. Eight soil and sediment composite samples (0-1 ft) were collected.[437] One soil sample was resampled and analyzed for the full CLP analyses. Soil land sediment results are reported in dry weight. Some results reported by O'Brien and Gere are not included here because they were determined to be not useable. Results reported here are estimated.[438]

The following SVOC compounds were detected above either USEPA Region IV, CSEQG, and/or USEPA ECOTOX screening values in the sediment samples: 2-methylnaphthalene (3 ug/kg), butyl benzyl phthalate (49 ug/kg), and di-n-butyl phthalate (24 ug/kg). In the sediment,

sodiphenylamine, benzidine, di-n-octyl-phthalate, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, cyanide, Ag, As, Be, Cd, Cu, Ni, Pb, Se, Zn, and Hg.

[432] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 16-1.

[433] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Figure 12-1.

[434] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 17-1.

[435] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987.

[436] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Figure 18-1.

[437] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 18-1.

[438] DPRA Document No. 00018887. Letter from Richard Boice to Dick Ruelle of USFWS regarding Crab Orchard Lake RI/FS, dated February 18, 1987. The letter reports that the data for the following constituents are not useable: 2-butanone, vinyl acetate, 4-methyl-2-pentanone, aniline, bis(2-chloro-isopropyl)ether, 4-chloroaniline, 2-nitro-sodiphenylamine, benzidine, di-n-octyl-phthalate, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, cyanide, Ag, As, Be, Cd, Cu, Ni, Pb, Se, Zn, and Hg.

Arochlor 1254 (0.892 mg/kg) was detected above USEPA Region IV screening values, and antimony (11 mg/kg) was detected above USEPA Region IV.[439] In one composite soil sample, n-nitrosodimethylamine (262 ug/kg) was detected.[440] (See Figure 6-2b.) Note that Figure 6-2b shows the PCB results as total PCBs rather than by Arochlor.

Woodward Clyde Consultants, 1996

Site 11, 9, 11A, and 10 were included in the 1996 Miscellaneous Areas Operable Unit (MISCA OU) RI and are discussed below[441].

Site 9 -- P Area NW Drainage

One composite/discrete soil sample pair was collected from the same drainageway sampled during the 1988 RI (Figure 6-2a). The discrete sample was collected from a depth of 2.0 to 2.1 feet below ground surface (bgs) and analyzed for the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) Target Compound List (TCL) volatile organic compounds (VOCs). The composite sample was taken over the depth interval from 2.0 to 2.1 feet bgs and analyzed for the CERCLA Target Analyte List (TAL) inorganics and TCL organics (except VOCs), and explosives. No organic compounds were detected, and all inorganic detections were within the background range for the Refuge. The 1996 RI concluded that no further investigations were necessary at this site.[442]

Site 10 -- Waterworks North Drainage

In the Phase I RI, two composite/discrete soil sample pairs (Figure 6-2a) were collected from the same drainageways sampled during the 1988 RI. The site includes two separate parts of the drainage, as shown in Figure 4-3—a northwest segment and a southeast segment. One sample pair was collected in each segment. All samples were collected from about 1.5 to 2.3 ft bgs. The discrete samples were analyzed for the CERCLA TCL VOCs. The composite samples were analyzed for the CERCLA TAL inorganics and TCL organics (except VOCs), and explosives. Inorganic detections were within Refuge background levels in both stream segments. No organic compounds were detected in the sample pair from the northwest segment. In the sample from the southeast segment (which drains parts of Areas 2D, 2F, and 2P), benzo(a)anthracene and benzo(b)fluoranthene were detected at 250 and 340 ug/kg, respectively, both above their 1996 RI preliminary levels of concern (PLCs). Acetone, methyl ethyl ketone, bis(2-ethylhexyl)phthalate and several other polynuclear aromatic hydrocarbons (PAHs) were detected, but were below their respective PLCs[443]. Results are shown in Figures 6-2a and 6-2c.

[439] See Table 1-11 of this report for Refuge background soil values used for the PA.

[440] O'Brien & Gere, 1988, Remedial Investigation Report – Crab Orchard National Wildlife Refuge, Page 18-2.

[441] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.

[442] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, page 5-7 and page ES-ii.

[443] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, page 5-7 and 5-8.

No PAHs were detected in sediment samples collected during Phase II of the 1996 RI. In surface water samples chloroform, trichloroethene and 1,2 dichloroethene were detected[444], but the concentrations were well below their PLCs, and were not evaluated further. A human health risk assessment was not done for this site because human use is restricted. The RI concluded that a completed exposure pathway for human risk does not exist at this site.[445]

Site 11 -- P Area SE Drainage

One composite/discrete soil sample pair (Figure 6-2a) was collected from the same drainageway sampled during the 1988 RI. The discrete sample was collected from a depth of 1.3 feet bgs and analyzed for the CERCLA TCL VOCs. The composite sample was taken over the depth interval from 1.7 to 1.9 feet bgs and analyzed for the CERCLA TAL inorganics and TCL organics (except VOCs), and explosives. The only organic compound detected was acetone with an estimated detection of 280 ug/kg, below the PLC. The 1996 RI concluded that no further investigations were necessary at this site[446].

Site 11A -- P Area North

Soil samples were taken from an area of former walkway structures in the northern part of Area 2P. Four composite/discrete soil sample pairs and one duplicate pair were collected (Figure 6-2b). All samples were collected from around 1.5 to 1.9 ft bgs. The discrete samples were analyzed for the CERCLA TCL VOCs. The composite samples were analyzed for the CERCLA TAL inorganics and TCL organics (except VOCs), and explosives. All results were below PLCs, except that heptachlor epoxide was detected at 4.4 ug/kg and there was no PLC established. The following organic constituents were detected: 2,4,6-trinitrotoluene (380 ug/kg), acetone (52 ug/kg), methyl ethyl ketone (4 and 14 ug/kg). The 1996 RI concluded that no further investigations were necessary at this site.[447]

USEPA Sampling, 1998

One sample (AUS 10-1) was collected for analysis. The location is shown in Figures 6-3, 6-4, and 6-5. The results for all detected constituents are listed in Table 6-1A. There were no SVOC target compounds detected in this sample; however, reporting limits were elevated.

6.1.4 Observations During Site Visit

Several drainage ditches were observed throughout the area during the site reconnaissance. In general, the northern and western portions of Area 2P drain off site to the northwest via drainage

[444] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, page 5-44 and Table 5-13b. The text incorrectly states that trichloroethane was detected. See Table 5-13b. One of the surface water samples was collected upstream of Site 10, which is Site 9, as shown in Figure 4-3.
[445] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, page 5-32.
[446] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, page 5-9 and page ES-ii.
[447] Woodward-Clyde Consultants, 1996, Remedial Investigation Report—Miscellaneous Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, page 5-10 and page ES-ii.

ditches. The southern and eastern portions of Area 2P generally drain off site to the southeast via drainage ditches. Two sewer manholes were observed during the site reconnaissance, just to the north of Building P-1-11 (former IOP Change House).

6.1.5 Recommendations Based on Preliminary Assessment

Both original AUS OU sites, AUS-0004 (Artillery Primer Loading Line – Area 2P) and AUS-0010 (Boiler House South of Area 2P) were retained in the AUS OU Site Investigation (SI), along with the remainder of Area 2P. AUS-0A2P was included in the SI primarily because the historic search report results indicated that all potential releases had not been investigated.

6.2 SITE INVESTIGATION INFORMATION

URS conducted a Site Investigation at AUS-0A2P from March 29 through May 17, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)[448] for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 6.1) has been updated to include that information. The sampling locations discussed below are based on the information that was available at the time the FSP was developed, and may not address all areas of potential releases.

AUS OU SI sample locations are shown on Figures 6-3, 6-4, and 6-5. Survey coordinates for all sample locations in Area 2P are found in Table 6-2. Table 6-4 lists the sample locations and the matrix sampled at that location. All samples are soil unless otherwise indicated. Groundwater samples were collected at all monitoring well locations.

6.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. The field investigation is summarized in this section, following the same order of description of site features as Section 6.1.2.2 of this report.

Building P-1-1

Four shallow samples (0A2P-008, 0A2P-009, 0A2P-015 and 0A2P-017) were collected and two monitoring wells (0A2P-W04 and 0A2P-W06) installed in the area surrounding Building P-1-1. Note that sample location 0A2P-009 was moved east from its planned location. During the IOP, primer cartridges were loaded and sealed in this building. Olin had a research and development laboratory in this building as well mixers for mixing propellants and a mill for shaping the propellants into grains. There was also a sump located on the north side of this building. Monitoring well 0A2P-W04 was placed next to this former sump in an area that would have likely received discharge waters from the sump. Monitoring well 0A2P-W06 was located on the south side of Building P-1-1 in an area the may have been impacted by wash waters from inside the building. It is also located next to an east-flowing drainage ditch.

[448] U.S. Fish & Wildlife Service, Department of the Interior, March 2000, Draft Final Field Sampling Plan Site Inspection, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County), prepared by URS Corporation.

Sample location 0A2P-008 was located in a drainage ditch that heads northward from near the northwest corner of Building P-1-1. Sample location 0A2P-015 was in a second northward-flowing drainage ditch just to the west of the ditch that contained sample 0A2P-008. Sample location 0A2P-009 was located in a drainage ditch that appears to originate near the northeast corner of Building P-1-1 and it flows eastward from this point. Sample location 0A2P-017 was located in a drainage ditch that flows eastward along the south side of the building.

Building P-1-3

Three shallow samples (0A2P-006, 0A2P-007 and 0A2P-011) and two monitoring wells (0A2P-W02 and 0A2P-W03) were located in the area surrounding Building P-1-3. Primer cartridges were cleaned, prepared and loaded with percussion elements in Building P-1-3 during the IOP era. This building contained four presses and one degreaser.[449] Olin used building P-1-3 as a research and development laboratory, as a machine shop which likely used solvents and degreasers, and for loading gas generators. Monitoring well 0A2P-W02 was located on the north side of Building P-1-3, in between this building and Building P-1-48. Monitoring well 0A2P-W03 was located on the south side of Building P-1-3. Both of these monitoring wells were placed in areas that were likely to have been impacted by the Building P-1-3 activities. Cleaning operations inside the building also likely impacted these areas.

Sample 0A2P-006 was located in a drainage ditch that flows eastward along the north side of Building P-1-3. Sample 0A2P-007 was located in a drainage ditch that flows southward from near the southeast corner of this building. This drainage ditch collects drainage from the loading dock area for Building P-1-3. Sample 0A2P-011 was located in a drainage ditch that flows northward along the west side of Building P-1-3 and collects drainage from the west sides of both Buildings P-1-1 and P-1-3. All three of these ditches likely received runoff from the areas surrounding Building P-1-3 and therefore may have been impacted by the activities performed in this building.

Building P-1-4

Sample 0A2P-004 was located in a drainage ditch that flows northward and passes next to Building P-1-4 (IOP Percussion Element Service Building).

Building P-1-5

Building P-1-5 was used as a Black Powder Service Magazine by the IOP and for propellant grain casting by Olin. Sample 0A2P-004 was located in a drainage ditch that flows northward on the east side of Building P-1-5. This drainage ditch likely received drainage from the area surrounding this building. Sample 0A2P-002 is located in this same drainage ditch, only further downstream of Building P-1-5.

Building P-1-6/P-1-83

[449] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part III Section 2 Page 5.

Sample 0A2P-001 was located in a drainage ditch that leads northwestward from the former location of Building P-1-6 (present location of Building P-1-83). This building was a Black Powder Screening Building during the IOP, and used by Olin as a Utility Building. Sample 0A2P-005 was located in a drainage ditch just to the southeast of this building. Both of these drainage ditches may have received runoff from the areas surrounding this building.

Building P-1-7

Sample 0A2P-005 was located in a north-flowing drainage ditch that flows along the east side of Building P-1-7. This drainage ditch likely receives drainage from the areas surrounding this building. During the IOP, Building P-1-7 was used as a Black Powder Rest House, and Olin reportedly used this building for H.E. Ammo.

Building P-1-8

Sample 0A2P-012 was collected from a drainage ditch to the south of Building P-1-8 that flows westward. This building was the IOP Black Powder Dry House, and Olin reportedly used it for storage of chemicals.

Building P-1-9

Sample 0A2P-020 was located to the west of Building P-1-9, in a drainage ditch that was located on the other side of the roadway. This drainage ditch may or may not have received drainage from the area surrounding Building P-1-9. This building was the IOP Fan House and Olin designated it for "Primed Cases Squibs." It may have also been used for solvent storage.

Building P-1-10

Monitoring well 0A2P-W05 was installed next to the south side of Building P-1-10 in an area that may have been impacted by cleaning activities from this building. Building P-1-10 was the IOP Black Powder Pelleting Building, and there were three pelleting presses located in this building. Olin used the building as a research and development testing facility, a pressing facility for the production of ammunition products, and for a research and development operation involving the loading of depleted uranium. This building also contained a degreaser during Olin's tenure.

According to Rudy Okolski, propellant was spread on the landscaped areas located between Buildings P-1-9 and P-1-10, and reportedly caught fire in the mid-1970s. Sample 0A2P-013 was originally planned to be collected from the area between these two buildings. However, sample 0A2P-013 was moved farther north from Building P-1-10 than originally planned.

Building P-1-14

Samples 0A2P-021 and 0A2P-022 were collected near Building P-1-14, the IOP Boiler House. Sample 0A2P-021 was located in an area of surficial discoloration observed in historical aerial photographs along the west side of the building, that may be associated with fuel (i.e. coal or oil) loading activities for the boiler house. Sample 0A2P-022 was collected from a small fill/scarred area observed in the historical aerial photographs, along the outer, southeastern edge of the road that loops around the building. In the 1965 aerial photograph, the scarred area appeared to be the result of a liquid release. There appeared to be a small body of liquid along the westernmost portion of the scar. There are no present day features associated with this apparent historic liquid release, and coordinates obtained from the historic aerial photograph determined the sample location.[450]

All samples were collected in accordance with the tables in the Field Sampling Plan with the following exceptions:

- AUS-0A2P-021-SD-0X Sample was added.
- AUS-0A2P-021-SD-02 Sample was added.
- AUS-0A2P-022-SD-0X Sample was added.
- AUS-0A2P-022-SD-0X Sample was added.

Building P-1-15

Sample 0A2P-015 was located in a drainage ditch that likely receives runoff from the area surrounding Building P-1-15. This drainage ditch was located to the east of this building; it also received drainage from the western portions of Buildings P-1-1 and P-1-3. Olin used Building P-1-15 as an oven house.

Building P-1-48

Building P-1-48 was not one of the original IOP buildings. Olin used this building, which contained a boiler. Monitoring well 0A2P-W02 was located between this building and Building P-1-3—mainly to evaluate contamination related to the operations done in Building P-1-3. Sample location 0A2P-006 was located in a drainage ditch that ran along the south side of Building P-1-48. This ditch flowed to the east and likely received drainage from the areas surrounding both Buildings P-1-48 and P-1-3.

Building P-1-53

Sample 0A2P-014 was planned to be located in a drainage ditch to the southeast of Building P-1-10. However, it was located on the east side of Building P-1-10, with two buildings, P-1-85 and another unknown pad or building, between the sample location and Building P-1-10. The use of Building P-1-53 was not determined.

Building P-1-54

Sample 0A2P-016 was located in a drainage ditch that receives drainage from the southwest portion of the facility, including the areas surrounding Buildings P-1-54 and P-1-70. Building P-1-54 contained a boiler, and Building P-1-70 was used for scrap.

[450] At the beginning of the project, a test was conducted to estimate the accuracy of locating features from historic aerial photos. Using conventional methods, survey coordinates were obtained of a number of existing features at the Refuge that also appeared on a series of historic photos (for example, the corners of IOP buildings that are still existing). Entech independently obtained coordinates from the aerial photos. The coordinates obtained from the aerial photos were found to be in agreement with the coordinates obtained by conventional methods, within a few ft, and therefore, acceptable for locating site features such as this one.

Buildings P-1-64 through P-1-69

Buildings P-1-64 (Primers), P-1-65 (Trace Mix), P-1-66 (Working Magazine), P-1-67 (Igniters), P-1-68 (Blast Caps) and P-1-69 (High Explosives—A-4, C-4, RDX) were all located along the west side of the westernmost service road in Area 2P. The areas surrounding these buildings likely drained to the ditch that flows northward along the west side of the service road. Sample 0A2P-010 was located in this ditch, just downstream of Building P-1-69. Sample 0A2P-020 was located in this ditch, downstream of all of these buildings and west of Building P-1-9.

Building P-1-79

Samples 0A2P-002 and 0A2P-003 were located in the area surrounding Building P-1-79. Note that 0A2P-003 was planned to be located to the east of former Building P-1-79, however it was actually located to the west of this former building. This was Olin's Propellant Process Building (likely used for gas generator loading activities). Sample 0A2P-002 was located in the westward flowing ditch at the north side of the former building. Sample 0A2P-003 is located along the east side of the former building. Both samples were located in areas that would likely have been impacted by activities in this building.

Building P-1-80

Monitoring well 0A2P-W01 was located just west of former Building P-1-80. This was Olin's Propellant Mix House. Cleaning activities in this building may have impacted the soils in this area.

Building P-1-82

Sample 0A2P-004 is located in a north-flowing drainage ditch, just downstream of Building P-1-82. This drainage ditch is on the east side of this building, and it would likely have received any runoff from the area surrounding this building. Building P-1-82 was used by Olin for propellant curing operations (possibly oven curing).

Miscellaneous Drainageways in Area 2P

Sample locations 0A2P-018 and 0A2P-019 were located in a southeast-flowing drainage ditch that appears to drain the southeast portion of Area 2P. Sample location 0A2P-019 also included a surface water sample. Sample 0A2P-018 appears to receive drainage from Buildings P-1-1, P-1-2 and P-1-3. Sample location 0A2P-019 is slightly further downstream than 0A2P-018 and it receives drainage from these same buildings and also from Building P-1-11.

Possible Open Dump North of Industrial Portion of Area 2P

A small, possible open dump was observed in the historical aerial photographs, to the north of the industrialized portion of Area 2P and along the edge of a stream. Note that sample location 0A2P-023 was planned next to the creek, however it was located at least 100 ft away from the creek. The possible dump appeared as light-toned earthen deposits with no visible debris. The site is accessible via an access road.

All other samples were collected in accordance to the tables in the Field Sampling Plan with the following exceptions:

- AUS-0A2P-023-SD-0X Sample was added.
- AUS-0A2P-023-SD-02 Sample was added.

6.2.2 Field Results

6.2.2.1 Site Conditions

6.2.2.1.1 Geologic Conditions

Figures 6-6 and 6-7 are geologic cross-sections that were developed from the soil boring information from the six monitoring wells installed at this site. Cross section locations are shown in Figure 6-5. Boring logs and monitoring well construction diagrams are included in Appendices A and B, respectively. Boring depths ranged from 19 to 24 ft bgs.

As shown in the geologic cross-sections in Figures 6-6 and 6-7, a 4-inch to 1-ft-thick layer of fill material (gravel, topsoil, etc) overlies the site. Below the fill, there is a 7.5 to 14.5-ft thick layer of silty clay loess. The loess overlies a four to 12 ft thick layer of highly heterogeneous glacial till consisting of silt, low to high plastic clay, and sand. Some of the material also contains gravel. All borings were terminated in the glacial till.

6.2.2.1.2 Hydrogeologic Conditions

At AUS-0A2P groundwater was encountered in all six soil borings during drilling at depths ranging from nine to 15 ft bgs as shown in Figures 6-6 and 6-7. Figure 3-8 is a groundwater contour map of Area 2 based on data from the eighteen monitoring wells installed at Area 2, obtained during October 2000. Table 3-7 presents the groundwater elevations measured in the Area 2 wells in May, July, September, and October 2000. As shown in this groundwater contour map, the overall flow direction of the groundwater appears to be toward Crab Orchard Lake (toward the southwest). Slug tests were performed on each of the six wells that were installed within Area 2P during the AUS OU investigation, resulting in hydraulic conductivity values that ranged from 3.30E-05 to 1.91E-04 centimeters per second (cm/sec). Slug test results are summarized in Table 6-3. Slug tests are included in Appendix C.

The classification of groundwater at this site by State of Illinois standards is uncertain. Only one of the six wells exceeded the hydraulic conductivity trigger criterion of 1E-04 cm/sec for State of Illinois Class I groundwater (35 IAC 620). This was Well No. 0A2P-W05, where the measured hydraulic conductivity was 1.91E-04 cm/sec.

6.2.2.1.3 Hydrologic Conditions

Area 2P is on a gently sloping ridge near Crab Orchard Lake (Figure 3-1). Area 2P was leveled as part of the IOP construction and drainage ditches were built along roadways. These ditches flow to natural drainageways located to the northwest and southeast. Part of the site drains to stream located northwest of the site, which flows into Crab Orchard Lake. A portion of this stream appears on the northwest corner of Figure 6-3. This is the same stream that receives most of the drainage from Area 2F. It also flows along the east side of Area 2D. The southeast part of Area 2P flows to a natural drainageway southeast of the site, which also then leads to Crab Orchard Lake.

There are no permanent water bodies on this site.

6.2.2.2 Chemical Results

The sample analytical results are summarized as follows:

- Table 6-5 – soil sample results,
- Table 6-6 – groundwater sample results, and
- Table 6-7 – surface water sample results.

These tables list all the chemicals detected in Area 2P during this investigation, along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report (QCSR).

Sample results are presented on figures as follows:

- Figure 6-3 – organic results for soil samples,
- Figure 6-4 – inorganic results for soil samples, and
- Figure 6-5 – all results for surface water and groundwater samples at this site.

6.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 6-8 through 6-12 as follows:

- Table 6-8--human health risk screening for soils,
- Table 6-9--human health risk screening for groundwater,
- Table 6-10--human health risk screening for surface water,
- Table 6-11--ecological risk screening for soils, and
- Table 6-12--ecological risk screening for surface water.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A2P. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

Chemicals that are shaded in the tables are those that exceeded the screening criteria, and are identified as chemicals of potential concern (COPCs) for human health risk, and chemicals of potential ecological concern (COPECs) for ecological risk. The only COPCs/COPECs not shaded in the table are those inorganic constituents that exceeded the screening criteria but were detected at levels below Refuge background.

In cases where the chemical was analyzed but not detected, the HQ is the ratio between the maximum reporting limit and the screening concentration. Chemicals not detected are identified with a “U” qualifier in the qualifier column. When these HQ values exceed one, they are not shaded. These constituents are not identified as COPCs/COPECs, but rather as uncertainties.

In Figures 6-3 through 6-5, the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with “J”) are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 6-13 (human health risk) and 6-14 (ecological risk) list all the analytes and corresponding media sampled and indicate whether each is a COPC (or COPEC), not a COPC (or COPEC), or an uncertainty. The codes in the tables indicate the rationale for each classification. All COPCs (Table 6-13) and COPECs (Table 6-14) are shaded in the tables.

6.3.1 Human Health Risk

6.3.1.1 Soil

Human health screening results for soil samples are presented in Table 6-8. For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil Preliminary Remediation Goals (PRGs) as screening values. The cancer risk was derived by calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values. These ratios were then multiplied by 1×10^{-6}. In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (Dilution Attenuation Factor (DAF)=1), the Illinois Tiered Approach to Corrective Action Objectives (TACO) Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

6.3.1.2 Groundwater

Human health screening results for groundwater are presented in Table 6-9. The maximum groundwater concentrations from Area 2P were screened against maximum contaminant levels (MCLs) and Illinois Class I groundwater standards. This may be conservative since the groundwater at the site may be Illinois Class II.

6.3.1.3 Surface Water

Human health risk screening results for chemicals in surface water at Area 2P are presented in Table 6-10. The maximum concentrations from Area 2P were screened against the Illinois Environmental Protection Agency (IEPA) General Use Surface Water Quality Criteria – Human Health.

6.3.2 Ecological Risk

6.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 6-11. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[451]
- Environment Canada (1995)[452]
- Talmage *et al.* (1999)[453]
- Efroymson *et al.* (1997a, 1997b)[454]
- CCME (1999)[455]
- MHSPE (1994)[456]
- Other sources

A detailed discussion of the screening concentration selection is presented in Appendix G.

The screening approach for ingestion pathway exposures was based on the potential for a chemical to bioaccumulate. The potential for a chemical to bioaccumulate was based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. The document *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991)[457] used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

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[451] USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.

[452] Environment Canada. 1995. Toxicity Testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Guidelines Division, Evaluation and interpretation Branch, Environmental Conservation Directorate, Environment Canada. Hull, Quebec.

[453] Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E Welsh, F. M. Cretella, P.H. Reno, and F. B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev Environ. Contam. Toxicol 161:1-156.

[454] Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-126/R2.

[455] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

[456] Ministry of Housing, Spatial Planning, and the Environment (MHSPE). 1994. *Intervention Values and Target Values – Soil Quality Standards.* Directorate General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

[457] USEPA 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

6.3.2.2 Surface Water

Ecological screening results for surface water samples are presented in Table 6-12. TRVs for direct exposure by aquatic organisms in surface water were obtained from:

- Illinois water quality standards
- National Recommended Ambient Water Quality Criteria (USEPA 1999a)[458]
- EcoTox (USEPA 1996[459])
- USEPA Region IV Freshwater Screening Values (1999b)[460]
- Maximum Acceptable Toxicant Concentrations (MATCs) or lowest observed effect concentrations (LOECs) obtained from the USEPA Assessment Tools for the Evaluation of Risk database (ASTER 2000)[461]
- Other sources

The Illinois water quality standards are believed to be the most relevant, followed by national recommended ambient water quality criteria. EcoTox reports values based on ambient water quality criteria, and Tier II water quality criteria have been developed in the absence of sufficient information to support a national recommended water quality criterion using guidelines outlined in the Great Lakes Water Quality Initiative. Remaining sources were prioritized based on relevance to the area and professional judgment. The detailed discussion of the approach for selecting a single ecological screening value (ESV) from among the multiple sources is presented in Appendix G.

The screening approach for ingestion pathway exposures was the same as for soils as presented in Section 6.3.2.1.

6.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A2P, based on exceedances of the SI screening criteria.

This report recommends that inorganic constituents that exceeded project screening criteria but were within Refuge background levels not be retained as COPCs/COPECs for further evaluation. These are the constituents coded with "D" on the COPC list, Table 6-13; and on the COPEC list, Table 6-14. Barium in soil is the only COPC in this category. The only COPEC coded with "D" on Table 6-14 is manganese in soil. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method; if new information on site usage suggests they should be evaluated; or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the

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[458] USEPA. 1999a. National Recommended Water Quality Criteria--Correction. Office of Water. EPA 822-Z-99-001. April.

[459] USEPA. 1996. ECO Update: Ecotox Thresholds. EPA-540/F-95/038. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. 12pp.

[460] USEPA. 1999b. Region IV Ecological Risk Assessment Bulletins – Supplement to RAGS. Available at http://www.epa.gov/region4/waste/oftecser/ecolbul.htm.

[461] ASTER. 2000. Assessment Tools for Evaluation of Risk Database. United States Environmental Protection Agency, Office of Research and Development.

RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 6-15.

Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. In particular, the historic open dump north of Area 2P was inadvertently not sampled, and should be included in the RI. Other issues will be addressed in the work plan for the RI. The discussion of past usage included in this section should be carefully reviewed during work plan development, since this information was updated after the field investigation, and all potential release areas at this site may not have been investigated in the SI.

TABLE 6-1
AREA 2P OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
Building P-1-1	1942-1945	SWDC/War Dep't	Primer Loading Building
	?-1997	Olin	Research and development laboratory; propellant mixing; engineering and development offices; pilot scale manufacturing activities;
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building P-1-2	1942-1945	SWDC/War Dep't	Primer Rest House
Building P-1-3	1942-1945	SWDC/War Dep't	Primer Preparation Building
	?-1997	Olin	Research and development laboratory; gas generator loading; machine shop; building contained nitroglycerin casting solvent, double base propellant, and ammonium and potassium perchlorate propellant; machine shop activities (welding, lathing, degreasing); research and development (and metallurgical) laboratory; housed solvents, methanol, toluene, methyl ethyl ketone, Epirez 510 (resin), and triacetin; possibly used for hazardous waste storage; ammonium nitrate spill in 1982
	1997-2001	Primex	Unspecified manufacturing/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
IOP Building P-1-4	1942-1945	SWDC/War Dep't	Percussion Element Service Building
IOP Building P-1-5 (Building P-1-81)	1942-1945	SWDC/War Dep't	Black Powder Service Magazine
	?-1997	Olin	Propellant grain casting
	Likely 1997-2001	Primex	Unknown
	2001	GDO&TS	Unknown
IOP Building P-1-6 (Building P-1-83)	1942-1945	SWDC/War Dep't	Black Powder Screening Building
	?-1997	Olin	Utility Building; possibly used to dispense TMETN and TEGDN
	1997-2001	Primex	Storage / 90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building P-1-7	1942-1945	SWDC/War Dep't	Black Powder Rest House
	?-1997	Olin	H.E. Ammo; projectile and cartridges
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-8	1942-1945	SWDC/War Dep't	Black Powder Dry House
	?-1997	Olin	Storage of chemicals
	1997-2001	Primex	Unspecified Storage
	2001	GDO&TS	Unknown
Building P-1-9	1942-1945	SWDC/War Dep't	Fan House
	?-1997	Olin	Primed Cases Squibs
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-10	1942-1945	SWDC/War Dep't	Black Powder Pelleting Building
	?-1997	Olin	Test Range Building (gas generators); ballistic testing; ammunition R&D; DU ammunition development; metal cleaning (degreasing);
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown

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TABLE 6-1
AREA 2P OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
Building P-1-10A	?	Olin	Unknown
Building P-1-11	1942-1945	SWDC/War Dep't	Change House
	?-1997	Olin	Engineering and Development Offices (1st floor) and Laboratories (2nd floor); building contained hazardous wastes (1973-1974)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-12	1942-1945	SWDC/War Dep't	Timekeeper's Building
	?-1997	Olin	Guard Shack (1957)
	1997-2001	Primex	Unspecified manufacturing
	2001	GDO&TS	Unknown
Building P-1-13	1942-1945	SWDC/War Dep't	Solvent Storage Building
Building P-1-14	1942-1945	SWDC/War Dep't	Boiler House
	?	Olin	Boiler House (1957)
Building P-1-15	?-1997	Olin	Oven house (drying of propellant grains); explosives R&D (1987)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-16	?	Olin	Unknown
Buildings P-1-17, P-1-18, P0109	?	Unknown	Unknown
Building P-1-20	?	Olin	Unknown
Building P-1-23	?	Olin	Oven
Building P-1-25	1970s	Olin	Scrap storage magazine; housed canisters of hydrogen fluoride and cyanogen (1977)
Building P-1-26	1970s	Olin	Scrap storage magazine
Building P-1-27 (Building P-1-76)	?-1997	Olin	Incendiary mixes
	1997-2001	Primex (likely)	Unknown
	2001	GDO&TS	Unknown
Buildings P-1-28, P-1-29, P-1-30, P-1-31, P-1-32, P-1-33, P-1-34, P-1-35, P-1-36, P-1-38	?	Olin	Unknown
Building P-1-42	?-1997	Olin (likely)	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-43	?-1997	Olin	Compressor House
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-44	?	Olin	Unknown
Building P-1-45	?	Olin	Igniter material
Building P-1-47	?	Olin	Unknown
Building P-1-48	?	Olin	Contained a Boiler (1987)
Building P-1-49	?-1997	Olin	Inert metal parts (1985)
	1997-2001	Primex	Unspecified Storage
	2001	GDO&TS	Unknown
Building P-1-50	?-1997	Olin	Inert metal parts (1985)
	1997-2001	Primex	Storage
	2001	GDO&TS	Unknown

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TABLE 6-1
AREA 2P OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
Building P-1-51	?-1997	Olin	Weather mod. storage; inert metal parts
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-52	?-1997	Olin	Oxidizers storage (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-53	?-1997	Olin	Propellants (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-54	?-1997	Olin	Contained a Boiler (1986)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-55	?-1997	Olin (likely)	Unknown
	1997-2001	Primex	Structure was either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building P-1-59	?-1997	Olin (likely)	Unknown
	1997-2001	Primex	Structure was either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building P-1-60	?-1997	Olin (likely)	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-61	?-1997	Olin (likely)	Unknown
	1997-2001	Primex	Structure was either a ramp, hallway, utility system, or boiler room
	2001	GDO&TS	Unknown
Building P-1-62	?-1997	Olin	Explosive waste scrap storage (1985)
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building P-1-63	?-1997	Olin	Propellants (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-64	?-1997	Olin	Primers (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-65	?-1997	Olin	Trace Mix (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-66	?-1997	Olin	Working Magazine
	1985	Olin	Explosives
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-67	?-1997	Olin	Igniters and Fuses (1985)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown

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TABLE 6-1
AREA 2P OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
Building P-1-68	?-1997	Olin	Blast Caps
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-69	?-1997	Olin	High Explosives (A-4, C-4, RDX)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-70	?-1997	Olin	Explosive waste storage (1982)
	1997-2001	Primex	Unspecified storage/90-day hazardous waste accumulation area
	2001	GDO&TS	Unknown
Building P-1-71	?-1997	Olin	Metal Fuel (1982)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-72	?-1997	Olin	H.E. Ammo (1982)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-73	?	Olin	T.P. Ammo (1982); projectiles and cartridges (1985)
Building P-1-74	?-1997	Olin	Propellant storage (1982); storage of plasticizers (TMETN and TEGDN) (1988)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-75	1982-	Olin	Propellant (1985); storage of plasticizers (TMETN and TEGDN) (1988)
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown
Building P-1-77	?	Olin	Energetic plastic storage (1988)
Building P-1-78	?	Olin	Propellant storage (1988)
Building P-1-79	?	Olin	Propellant process building (likely for gas generator loading) (1988)
Building P-1-80	?	Olin	Propellant mixing (1988)
Building P-1-82	?	Olin	Propellant curing operations (possibly oven curing) (1988)
Building P-1-84	?	Olin	Waste storage (1988)
Building P-1-85	?-1997	Olin (likely)	Unknown
	1997-2001	Primex	Unspecified storage
	2001	GDO&TS	Unknown

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References for this information can be found in associated text.

TABLE 6-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
10-1	Aluminum	11,000
	Barium	84
	Beryllium	0.5
	Calcium	12,000
	Chromium	14
	Cobalt	7.8
	Copper	9.9
	Iron	17,000
	Magnesium	7200
	Manganese	800
	Mercury	0.05
	Nickel	11
	Potassium	700
	Vanadium	29
	Zinc	36

Sheet 1 of 1

mg/kg = milligrams per kilogram

TABLE 6-1B OLIN EXPLOSIVES LOCATIONS IN AREA 2P (1985) [462]			
Building	Product	Department of Transportation (DOT) Classification[463]	Net Explosive Weight (in pounds)[464]
P-1-7	Projectiles, Cartridges	1.2, 1.1	190, 190
P-1-8	Chemical Storage	N/A	N/A
P-1-9	Primer Cases, Squibs	1.4	10
P-1-15	Propellant	N/A	N/A
P-1-45	Igniter Material	1.1	20
P-1-52	Oxidizers	1.3	1,000
P-1-53	Propellant	1.3	500
P-1-62	Explosive Waste	1.3	2000
P-1-63	Propellant	1.3	2000
P-1-64	Primers	1.2	50
P-1-65	Trace Mix	1.1	50
P-1-66	Storage	1.1, 1.2, or 1.3	50
P-1-67	Igniter, Fuses	1.2	50
P-1-68	Blasting Caps	1.1	50
P-1-69	High Explosives	1.1	100
P-1-70	Explosives Waste	1.1	50
P-1-71	Metal Fuels	1.4	500
P-1-72	Explosives	1.1	100
P-1-73	Projectiles, Cartridges	1.4	200
P-1-74	Propellant	1.1, 1.3	50 or 100
P-1-75	Propellant	1.1, 1.3	50 or 100
P-1-76	Incendiary Mix	1.1, 1.3	50
			Sheet 1 of 1

DOT Classifications:

1.1 Explosives characterized with a mass explosion hazard.
1.2 Explosives characterized with a dangerous projections hazard.
1.3 Explosives characterized with a radiant heat or violent buring, or both hazard, but no blast or projection hazard.
1.4 Explosives characterized with a small hazard with no mass explosion and no project of fragments of appreciable size or range.
N/A = This left blank on source document.

[462] DPRA Document No. CO02156. Olin Ordnance Products, Quantity/Distance B-Area Map, Drawing No. 6020063, dated June 1985. This map was likely developed to indicate explosives allowances in buildings and to ensure safe distances between these buildings based on the type of explosive and the amount present.
[463] These classifications were obtained from the Department of Transportation Hazmat Transport Regulations, 49 CFR 173.58: Assignment of class and division for new explosives.
[464] This indicated either the maximum amount allowed in a particular building/bay, or it indicated the amount that was actually located in these buildings at the time the map was created.

TABLE 6-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A2P

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A2P-001	384009.6	777661.1	423.14	NA	
0A2P-002	384011.1	777764.1	421.64	NA	
0A2P-003	383965.7	777706.4	425.23	NA	
0A2P-004	383959.9	777915.5	422.84	NA	
0A2P-005	383929.3	777708.4	423.93	NA	
0A2P-006	383690.7	778159.4	423.67	NA	
0A2P-007	383595.6	778147.6	421.73	NA	
0A2P-008	383518.4	777892.8	424.32	NA	
0A2P-009	383453.9	778145.9	420.71	NA	
0A2P-010	383176.6	777528.7	425.61	NA	
0A2P-011	383673.8	777860.2	424.97	NA	
0A2P-012	383572.6	777644.6	424.57	NA	
0A2P-013	383466.1	777577.4	425.93	NA	
0A2P-014	383373.0	777781.2	424.74	NA	
0A2P-015	383585.1	777861.7	424.99	NA	
0A2P-016	383153.2	777679.6	425.24	NA	
0A2P-017	383363.7	778103.5	421.02	NA	
0A2P-018	383290.1	778257.5	417.65	NA	
0A2P-019	383191.3	778306.6	416.28	NA	
0A2P-020	383604.3	777509.1	423.49	NA	
0A2P-021	382705.0	777245.7	423.52	NA	
0A2P-022	382689.5	777397.5	424.19	NA	
0A2P-023	384364.2	777769.2	413.00	NA	
0A2P-W01	384090.1	777811.0	426.36	428.69	New monitoring well
0A2P-W02	383707.7	778046.5	425.76	428.34	New monitoring well
0A2P-W03	383603.6	777971.3	424.36	427.11	New monitoring well
0A2P-W04	383480.3	777929.5	425.50	428.10	New monitoring well
0A2P-W05	383365.0	777617.0	425.63	428.24	New monitoring well
0A2P-W06	383371.6	778028.9	424.92	427.41	New monitoring well

Sheet 1 of 1

NA = Not Applicable

TABLE 6-3
SLUG TEST RESULTS

Well ID Number	Hydraulic Conductivity (cm/sec)
0A2P-W01	5.15E-05
0A2P-W02	4.13E-05
0A2P-W03	6.10E-05
0A2P-W04	6.57E-05
0A2P-W05	1.91E-04
0A2P-W06	3.30E-05

Sheet 1 of 1

cm/sec = centimeters per second

TABLE 6-4
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A2P

Soil	Groundwater	Surface Water
AUS-0A2P-001*	AUS-0A2P-W01	AUS-0A2P-019
AUS-0A2P-002*	AUS-0A2P-W02	
AUS-0A2P-003	AUS-0A2P-W03	
AUS-0A2P-004*	AUS-0A2P-W04	
AUS-0A2P-005*	AUS-0A2P-W05	
AUS-0A2P-006*	AUS-0A2P-W06	
AUS-0A2P-007*		
AUS-0A2P-008*		
AUS-0A2P-009*		
AUS-0A2P-010*		
AUS-0A2P-011*		
AUS-0A2P-012*		
AUS-0A2P-013		
AUS-0A2P-014*		
AUS-0A2P-015*		
AUS-0A2P-016*		
AUS-0A2P-017*		
AUS-0A2P-018*		
AUS-0A2P-019*		
AUS-0A2P-020*		
AUS-0A2P-021*		
AUS-0A2P-022*		
AUS-0A2P-023*		
AUS-0A2P-W01*		
AUS-0A2P-W02		
AUS-0A2P-W03*		
AUS-0A2P-W04		
AUS-0A2P-W05		
AUS-0A2P-W06*		

Sheet 1 of 1

* Note that the samples at this location were originally designated as sediment, but are actually soil samples.

TABLE 6-5
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
cis-1,2-Dichloroethylene	3/38	2 ug/kg to 8 ug/kg
Tetrachloroethylene(PCE)	1/38	15 ug/kg
Trichloroethylene (TCE)	4/38	4 ug/kg to 240 ug/kg
Semivolatile Organic Compounds		
1-Methylnaphthalene	2/2	130 ug/kg to 2,200 ug/kg
2-Methylnaphthalene	2/12	170 ug/kg to 6,700 ug/kg
Acenaphthene	1/12	95 ug/kg
Acenaphthylene	2/12	160 ug/kg to 3,700 ug/kg
Anthracene	3/12	72 ug/kg to 100 ug/kg
Benzo(a)anthracene	5/12	12 ug/kg to 500 ug/kg
Benzo(a)pyrene	5/12	13 ug/kg to 480 ug/kg
Benzo(b)fluoranthene	6/12	14 ug/kg to 510 ug/kg
Benzo(g,h,i)perylene	5/12	18 ug/kg to 330 ug/kg
Benzo(k)fluoranthene	5/12	7.8 ug/kg to 490 ug/kg
Benzyl butyl phthalate	6/10	60 ug/kg to 6,300 ug/kg
Bis(2-ethylhexyl) phthalate	3/10	72 ug/kg to 190 ug/kg
Carbazole	2/10	63 ug/kg to 66 ug/kg
Chrysene	6/12	36 ug/kg to 630 ug/kg
Dibenz(a,h)anthracene	1/12	130 ug/kg
Dibenzofuran	1/10	58 ug/kg
Diethyl Phthalate	1/12	140 ug/kg
Fluoranthene	6/12	42 ug/kg to 1,200 ug/kg
Fluorene	1/12	44 ug/kg
Indeno(1,2,3-c,d)pyrene	3/12	170 ug/kg to 310 ug/kg
Naphthalene	2/12	59 ug/kg to 1,600 ug/kg
Phenanthrene	5/12	76 ug/kg to 1,200 ug/kg
Pyrene	7/12	26 ug/kg to 980 ug/kg
Metals		
Aluminum	29/29	4,070 mg/kg to 12,000 mg/kg
Antimony	8/29	0.29 mg/kg to 1.6 mg/kg
Arsenic	29/29	3.9 mg/kg to 87.5 mg/kg
Barium	29/29	49.3 mg/kg to 139 mg/kg
Beryllium	6/29	0.27 mg/kg to 0.73 mg/kg
Boron	10/29	1.7 mg/kg to 7.3 mg/kg
Cadmium	7/29	0.03 mg/kg to 1.3 mg/kg
Calcium	29/29	1,580 mg/kg to 113,000 mg/kg
Chromium, Total	29/29	5.7 mg/kg to 28.6 mg/kg
Cobalt	19/29	5.1 mg/kg to 15.1 mg/kg
Copper	29/29	4 mg/kg to 186 mg/kg
Iron	29/29	2,400 mg/kg to 25,700 mg/kg
Lead	29/29	8.3 mg/kg to 60.5 mg/kg

Sheet 1 of 2

TABLE 6-5
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Magnesium	29/29	1,430 mg/kg to 57,200 mg/kg
Manganese	29/29	189 mg/kg to 1,090 mg/kg
Mercury	17/29	0.019 mg/kg to 0.32 mg/kg
Nickel	29/29	4.4 mg/kg to 22.7 mg/kg
Potassium	29/29	230 mg/kg to 886 mg/kg
Selenium	19/29	0.57 mg/kg to 3.7 mg/kg
Silver	12/29	0.29 mg/kg to 237 mg/kg
Sodium	4/29	61.4 mg/kg to 1,550 mg/kg
Thallium	4/29	0.17 mg/kg to 0.21 mg/kg
Vanadium	29/29	13.7 mg/kg to 31.8 mg/kg
Zinc	29/29	30.4 mg/kg to 612 mg/kg
Other Inorganics		
Total Organic Carbon	2/2	16,100 mg/kg to 20,200 mg/kg

Sheet 2 of 2

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/20/01

TABLE 6-6
GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compound		
1,1,1-Trichloroethane	1/6	7 ug/L
1,1,2-Trichloroethane	1/6	14 ug/L
1,1-Dichloroethene	1/6	5 ug/L
1,2-Dichloroethane	1/6	2 ug/L
Chloroform	1/6	0.6 ug/L
cis-1,2-Dichloroethylene	2/6	23 ug/L to 40 ug/L
Tetrachloroethylene(PCE)	1/6	230 ug/L
Toluene	1/6	1 ug/L
trans-1,2-Dichloroethene	1/6	1 ug/L
Trichloroethylene (TCE)	4/6	0.9 ug/L to 110,000 ug/L
Vinyl Chloride	1/6	0.7 ug/L
Explosives		
Perchloric Acid	1/6	1200 ug/L
Metals		
Aluminum	6/6	49.9 ug/L to 1,220 ug/L
Barium	6/6	31.6 ug/L to 61.7 ug/L
Boron	4/6	11.7 ug/L to 119 ug/L
Calcium	6/6	32,900 ug/L to 67,200 ug/L
Copper	2/6	1 ug/L to 1.2 ug/L
Iron	6/6	59 ug/L to 996 ug/L
Magnesium	6/6	15,900 ug/L to 30,700 ug/L
Manganese	6/6	7.6 ug/L to 24.6 ug/L
Nickel	1/6	1.7 ug/L
Potassium	1/6	725 ug/L
Selenium	3/6	3.2 ug/L to 6.2 ug/L
Sodium	6/6	18,500 ug/L to 89,700 ug/L
Other Inorganics		
Alkalinity, Total (as CaCO3)	2/2	223 mg/L to 346 mg/L
Nitrogen, Ammonia (as n)	2/2	0.11 mg/L to 0.31 mg/L
Nitrogen, Nitrate-Nitrite	5/5	0.27 mg/L to 4.6 mg/L
Phosphorus, Total (as P)	1/1	0.062 mg/L
Suspended Solids (Residue, Non-Filterable)	2/2	2.5 mg/L to 34.5 mg/L
Total Dissolved Solids (Residue, Filterable)	2/2	370 mg/L to 548 mg/L

Sheet 1 of 1

mg/L = milligrams per Liter
ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

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TABLE 6-7
SURFACE WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Aluminum	1/1	1,320 ug/L
Arsenic	1/1	2.1 ug/L
Barium	1/1	52.5 ug/L
Calcium	1/1	63,400 ug/L
Iron	1/1	1,260 ug/L
Magnesium	1/1	17,200 ug/L
Potassium	1/1	1,970 ug/L
Sodium	1/1	26,700 ug/L
Zinc	1/1	36.9 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/20/01

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Volatile Organic Compounds								
71-55-6	1,1,1-Trichloroethane	9	U	UG/KG			2.70E-06	9.00E-02
79-34-5	1,1,2,2-Tetrachloroethane	9	U	UG/KG		1.00E-08	2.30E-06	4.50E+01
79-00-5	1,1,2-Trichloroethane	9	U	UG/KG		4.73E-09	5.91E-05	1.00E+01
75-34-3	1,1-Dichloroethane	9	U	UG/KG			4.37E-06	9.00E-03
75-35-4	1,1-Dichloroethene	9	U	UG/KG		7.58E-08	1.34E-04	3.00E+00
107-06-2	1,2-Dichloroethane (EDC)	9	U	UG/KG		1.18E-08	2.56E-04	9.00E+00
540-59-0	1,2-Dichloroethene (total)	9	U	UG/KG			6.11E-05	4.50E-01
78-87-5	1,2-Dichloropropane	9	U	UG/KG		1.17E-08	4.23E-04	9.00E+00
78-93-3	2-Butanone (MEK)	18	U	UG/KG			6.49E-07	
591-78-6	2-Hexanone	18	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	18	U	UG/KG			6.24E-06	
67-64-1	Acetone	18	U	UG/KG			2.89E-06	2.25E-02
71-43-2	Benzene	9	U	UG/KG		6.14E-09	3.71E-04	4.50E+00
75-27-4	Bromodichloromethane	9	U	UG/KG		3.82E-09	8.62E-06	3.00E-01
75-25-2	Bromoform	9	U	UG/KG		2.88E-11	5.11E-07	2.25E-01
74-83-9	Bromomethane	9	U	UG/KG			6.85E-04	9.00E-01
75-15-0	Carbon disulfide	9	U	UG/KG			7.45E-06	4.50E-03
56-23-5	Carbon tetrachloride	9	U	UG/KG		1.70E-08	1.29E-03	3.00E+00
108-90-7	Chlorobenzene	9	U	UG/KG			1.66E-05	1.29E-01
75-00-3	Chloroethane	9	U	UG/KG		1.38E-09	4.77E-07	
67-66-3	Chloroform	9	U	UG/KG		1.73E-08	6.98E-03	3.00E-01
74-87-3	Chloromethane	9	U	UG/KG		3.38E-09		
156-59-2	cis-1,2-Dichloroethene	8		UG/KG			5.43E-05	4.00E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

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10061-01-5	cis-1,3-Dichloropropene	9	U	UG/KG		5.06E-08	2.04E-04	
124-48-1	Dibromochloromethane	9	U	UG/KG		3.39E-09	5.65E-06	4.50E-01
100-41-4	Ethylbenzene	9	U	UG/KG			1.51E-06	1.29E-02
75-09-2	Methylene chloride	9	U	UG/KG		4.38E-10	9.21E-07	9.00E+00
110-54-3	N-Hexane	9	U	UG/KG			2.23E-05	
100-42-5	Styrene	9	U	UG/KG			4.40E-07	4.50E-02
127-18-4	Tetrachloroethylene (PCE)	15		UG/KG		8.04E-10	8.81E-06	5.00E+00
108-88-3	Toluene	9	U	UG/KG			4.53E-06	1.50E-02
1330-20-7	total Xylenes	9	U	UG/KG			2.02E-06	9.00E-04
156-60-5	trans-1,2-Dichloroethene	9	U	UG/KG			4.20E-05	3.00E-01
10061-02-6	trans-1,3-Dichloropropene	9	U	UG/KG		5.06E-08	2.04E-04	
79-01-6	Trichloroethylene (TCE)	240	J	UG/KG		3.92E-08	3.04E-03	8.00E+01
75-01-4	Vinyl chloride	9	U	UG/KG		1.85E-07		1.29E+01
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	500	U	UG/KG			6.56E-05	1.67E+00
95-50-1	1,2-Dichlorobenzene	500	U	UG/KG			1.51E-04	5.56E-01
541-73-1	1,3-Dichlorobenzene	500	U	UG/KG			9.66E-03	
106-46-7	1,4-Dichlorobenzene	500	U	UG/KG		6.15E-08	2.60E-04	5.00E+00
95-95-4	2,4,5-Trichlorophenol	2500	U	UG/KG			2.84E-05	2.50E-01
88-06-2	2,4,6-Trichlorophenol	500	U	UG/KG		2.23E-09		6.25E+01
120-83-2	2,4-Dichlorophenol	500	U	UG/KG			1.89E-04	1.00E+01
105-67-9	2,4-Dimethylphenol	500	U	UG/KG			2.84E-05	1.25E+00
51-28-5	2,4-Dinitrophenol	2500	U	UG/KG			1.42E-03	2.50E+02
91-58-7	2-Chloronaphthalene	500	U	UG/KG			1.83E-05	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

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CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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95-57-8	2-Chlorophenol	500	U	UG/KG			2.07E-03	2.50E+00
90-12-0	1-Methylnaphthalene	2200		UG/KG			1.17E-02	5.50E-01
91-57-6	2-Methylnaphthalene	6700		UG/KG			1.24E-04	3.35E-02
95-48-7	2-Methylphenol	500	U	UG/KG			1.14E-05	6.25E-01
88-74-4	2-Nitroaniline	2500	U	UG/KG			4.97E-02	
88-75-5	2-Nitrophenol	500	U	UG/KG			7.09E-05	
91-94-1	3,3'-Dichlorobenzidine	500	U	UG/KG		9.12E-08		1.67E+03
99-09-2	3-Nitroaniline	2500	U	UG/KG			4.97E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2500	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	500	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	500	U	UG/KG			1.14E-05	
106-47-8	4-Chloroaniline	1000	U	UG/KG			2.84E-04	3.33E+01
7005-72-3	4-Chlorophenyl phenyl ether	500	U	UG/KG				
106-44-5	4-Methylphenol	500	U	UG/KG			1.14E-04	
100-01-6	4-Nitroaniline	2500	U	UG/KG			4.97E-02	
100-02-7	4-Nitrophenol	2500	U	UG/KG			3.55E-04	
83-32-9	Acenaphthene	95	J	UG/KG			2.48E-06	3.17E-03
208-96-8	Acenaphthylene	3700		UG/KG			6.82E-05	1.85E-02
120-12-7	Anthracene	100	J	UG/KG			2.57E-07	1.67E-04
56-55-3	Benzo(a)anthracene	500		UG/KG		1.73E-07		6.25E+00
50-32-8	Benzo(a)pyrene	480		UG/KG		1.66E-06		1.20E+00
205-99-2	Benzo(b)fluoranthene	510		UG/KG		1.77E-07		2.55E+00
191-24-2	Benzo(g,h,i)perylene	330		UG/KG			6.09E-06	1.65E-03
207-08-9	Benzo(k)fluoranthene	490		UG/KG		1.70E-08		2.45E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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111-91-1	bis(2-Chloroethoxy)methane	500	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	500	U	UG/KG		8.07E-07		2.50E+04
108-60-1	bis(2-Chloroisopropyl) ether	500	U	UG/KG		6.19E-08	1.18E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	190	J	UG/KG		1.08E-09	1.08E-05	
85-68-7	Butyl benzyl phthalate	6300		UG/KG			3.58E-05	7.88E-03
86-74-8	Carbazole	66	J	UG/KG		5.35E-10		2.20E+00
218-01-9	Chrysene	630		UG/KG		2.18E-09		7.88E-02
84-74-2	Di-n-butyl phthalate	500	U	UG/KG			5.68E-06	1.67E-03
117-84-0	Di-n-octyl phthalate	500	U	UG/KG			2.84E-05	5.00E-05
53-70-3	Dibenz(a,h)anthracene	130	J	UG/KG		4.50E-07		1.63E+00
132-64-9	Dibenzofuran	58	J	UG/KG			1.15E-05	
84-66-2	Diethyl phthalate	140	J	UG/KG			1.99E-07	
131-11-3	Dimethyl phthalate	500	U	UG/KG			5.68E-08	
206-44-0	Fluoranthene	1200		UG/KG			3.99E-05	6.00E-03
86-73-7	Fluorene	44	J	UG/KG			1.33E-06	1.47E-03
118-74-1	Hexachlorobenzene	500	U	UG/KG		3.24E-07	7.09E-04	5.00E+00
87-68-3	Hexachlorobutadiene	500	U	UG/KG		1.58E-08	2.84E-03	5.00E+00
77-47-4	Hexachlorocyclopentadiene	500	U	UG/KG			8.48E-05	2.50E-02
67-72-1	Hexachloroethane	500	U	UG/KG		2.84E-09	5.68E-04	2.50E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	310	J	UG/KG		1.07E-07		4.43E-01
78-59-1	Isophorone	500	U	UG/KG		1.93E-10	2.84E-06	1.67E+01
621-64-7	N-Nitroso-di-n-propylamine	500	U	UG/KG		1.42E-06		2.50E+05
86-30-6	N-Nitrosodiphenylamine	500	U	UG/KG		9.93E-10		8.33E+00
91-20-3	Naphthalene	1600		UG/KG			8.49E-03	4.00E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
87-86-5	Pentachlorophenol	2500	U	UG/KG		2.25E-07	1.75E-04	2.50E+03
85-01-8	Phenanthrene	1200		UG/KG			2.21E-05	6.00E-03
108-95-2	Phenol	500	U	UG/KG			9.46E-07	1.00E-01
129-00-0	Pyrene	980		UG/KG			1.81E-05	4.90E-03
Explosives								
99-35-4	1,3,5-Trinitrobenzene	380	U	UG/KG			1.44E-05	
99-65-0	1,3-Dinitrobenzene	380	U	UG/KG			4.31E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	760	U	UG/KG		9.24E-09	1.73E-03	
121-14-2	2,4-Dinitrotoluene	380	U	UG/KG			2.16E-04	9.50E+03
606-20-2	2,6-Dinitrotoluene	760	U	UG/KG			8.63E-04	2.53E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	760	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	760	U	UG/KG				
99-08-1	3-Nitrotoluene	760	U	UG/KG			3.74E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	760	U	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	760	U	UG/KG			3.74E-04	
2691-41-0	HMX	760	U	UG/KG			1.73E-05	
98-95-3	Nitrobenzene	380	U	UG/KG			3.32E-03	
55-63-0	Nitroglycerin	1500	U	UG/KG		8.51E-09		
78-11-5	Pentaerythritol tetranitrate (PETN)	3000	U	UG/KG				
121-82-4	RDX	760	U	UG/KG		3.39E-08	2.88E-04	
479-45-8	Tetryl	1100	U	UG/KG			1.25E-04	
Metals								
7429-90-5	Aluminum	12000		MG/KG	4.17E-01		7.16E-03	
7440-36-0	Antimony	1.6	J	MG/KG	1.93E+00		1.96E-03	5.33E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-38-2	Arsenic	87.5		MG/KG	6.48E+00	3.21E-05	1.99E-01	8.75E+01
7440-39-3	Barium	139		MG/KG	7.13E-01		1.12E-03	1.74E+00
7440-41-7	Beryllium	0.73	J	MG/KG	9.61E-01	3.26E-10	1.98E-04	2.43E-01
7440-42-8	Boron	7.3	J	MG/KG	1.38E+00		9.23E-05	
7440-43-9	Cadmium	1.3		MG/KG	6.84E+00	4.35E-10	1.60E-03	3.25E+00
7440-70-2	Calcium	113000		MG/KG	4.53E+01			
7440-47-3	Chromium	28.6		MG/KG	1.13E+00	6.38E-08		1.43E+01
7440-48-4	Cobalt	15.1		MG/KG	6.96E-01		1.23E-04	
7440-50-8	Copper	186		MG/KG	1.65E+01		2.45E-03	
7439-89-6	Iron	25700		MG/KG	1.33E+00		4.20E-02	
7439-92-1	Lead	60.5		MG/KG	2.59E+00			
7439-95-4	Magnesium	57200		MG/KG	3.69E+01			
7439-96-5	Manganese	1680	J	MG/KG	4.62E-01		5.21E-02	
7439-97-6	Mercury	0.32		MG/KG	5.33E+00			
7440-02-0	Nickel	22.7		MG/KG	1.20E+00		5.55E-04	3.24E+00
2023695	Potassium	886		MG/KG	1.42E+00			
7782-49-2	Selenium	3.7		MG/KG	1.58E+00		3.62E-04	1.23E+01
7440-22-4	Silver	237		MG/KG	4.09E+02		2.32E-02	1.19E+02
7440-23-5	Sodium	1590		MG/KG	9.35E+00			
7440-28-0	Thallium	0.21	J	MG/KG	5.12E-01		1.47E-06	
7440-62-2	Vanadium	31.8		MG/KG	6.74E-01		2.22E-03	1.06E-01
7440-66-6	Zinc	612		MG/KG	1.19E+01		9.99E-04	1.02E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Other Parameters								
TOC	TOC	20200		MG/KG	6.43E-01			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	9	U	UG/KG			4.50E-03
79-34-5	1,1,2,2-Tetrachloroethane	9	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	9	U	UG/KG	1.10E-06	1.10E-06	4.50E-01
75-34-3	1,1-Dichloroethane	9	U	UG/KG	4.50E-08	4.50E-08	3.91E-04
75-35-4	1,1-Dichloroethene	9	U	UG/KG	5.00E-07	5.00E-06	1.50E-01
107-06-2	1,2-Dichloroethane (EDC)	9	U	UG/KG	1.43E-04	6.43E-06	4.50E-01
540-59-0	1,2-Dichloroethene (total)	9	U	UG/KG	4.50E-07	4.50E-07	2.25E-02
78-87-5	1,2-Dichloropropane	9	U	UG/KG	1.07E-04	5.00E-06	3.00E-01
78-93-3	2-Butanone (MEK)	18	U	UG/KG			
591-78-6	2-Hexanone	18	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	18	U	UG/KG			
67-64-1	Acetone	18	U	UG/KG	9.00E-08	9.00E-08	1.13E-03
71-43-2	Benzene	9	U	UG/KG	4.50E-05	2.09E-06	3.00E-01
75-27-4	Bromodichloromethane	9	U	UG/KG	9.78E-05	4.50E-06	1.50E-02
75-25-2	Bromoform	9	U	UG/KG	1.25E-05	5.63E-07	1.13E-02
74-83-9	Bromomethane	9	U	UG/KG	3.10E-06	9.00E-06	4.50E-02
75-15-0	Carbon disulfide	9	U	UG/KG	4.50E-08	4.50E-07	2.81E-04
56-23-5	Carbon tetrachloride	9	U	UG/KG	2.05E-04	2.20E-05	1.29E-01
108-90-7	Chlorobenzene	9	U	UG/KG	2.20E-07	2.20E-06	9.00E-03
75-00-3	Chloroethane	9	U	UG/KG			
67-66-3	Chloroform	9	U	UG/KG	9.57E-06	4.50E-06	1.50E-02
74-87-3	Chloromethane	9	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	8		UG/KG	4.00E-07	4.00E-07	2.00E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
10061-01-5	cis-1,3-Dichloropropene	9	U	UG/KG			
124-48-1	Dibromochloromethane	9	U	UG/KG	2.20E-07	2.20E-07	2.25E-02
100-41-4	Ethylbenzene	9	U	UG/KG	4.50E-08	4.50E-07	6.92E-04
75-09-2	Methylene chloride	9	U	UG/KG	1.18E-05	7.50E-07	4.50E-01
110-54-3	N-Hexane	9	U	UG/KG			
100-42-5	Styrene	9	U	UG/KG	2.20E-08	2.20E-07	2.25E-03
127-18-4	Tetrachloroethylene (PCE)	15		UG/KG	1.36E-04	6.25E-06	2.50E-01
108-88-3	Toluene	9	U	UG/KG	2.20E-08	2.20E-08	7.50E-04
1330-20-7	total Xylenes	9	U	UG/KG	9.00E-09	2.20E-08	6.00E-05
156-60-5	trans-1,2-Dichloroethene	9	U	UG/KG	2.20E-07	2.20E-07	1.29E-02
10061-02-6	trans-1,3-Dichloropropene	9	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	240	J	UG/KG	4.62E-04	2.00E-04	4.00E+00
75-01-4	Vinyl chloride	9	U	UG/KG	3.00E-03	1.38E-04	9.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	500	U	UG/KG	2.50E-05	2.50E-04	1.00E-01
95-50-1	1,2-Dichlorobenzene	500	U	UG/KG	2.78E-06	2.78E-05	2.94E-02
541-73-1	1,3-Dichlorobenzene	500	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	500	U	UG/KG			2.50E-01
95-95-4	2,4,5-Trichlorophenol	2500	U	UG/KG	1.25E-05	1.25E-05	9.26E-03
88-06-2	2,4,6-Trichlorophenol	500	U	UG/KG	9.62E-04	4.55E-05	2.50E+00
120-83-2	2,4-Dichlorophenol	500	U	UG/KG	8.20E-05	8.20E-04	5.00E-01
105-67-9	2,4-Dimethylphenol	500	U	UG/KG	1.22E-05	1.22E-05	5.56E-02
51-28-5	2,4-Dinitrophenol	2500	U	UG/KG	6.10E-04	6.10E-03	1.25E+01
91-58-7	2-Chloronaphthalene	500	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	500	U	UG/KG	5.00E-05	5.00E-05	1.25E-01
90-12-0	1-Methylnaphthalene	2200		UG/KG	2.68E-05	2.68E-04	2.62E-02
91-57-6	2-Methylnaphthalene	6700		UG/KG	1.10E-04	1.10E-04	1.60E-03
95-48-7	2-Methylphenol	500	U	UG/KG	5.00E-06	5.00E-06	3.33E-02
88-74-4	2-Nitroaniline	2500	U	UG/KG			
88-75-5	2-Nitrophenol	500	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	500	U	UG/KG	3.85E-02	1.79E-03	7.14E+01
99-09-2	3-Nitroaniline	2500	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2500	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	500	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	500	U	UG/KG			
106-47-8	4-Chloroaniline	1000	U	UG/KG	1.22E-04	1.22E-03	1.43E+00
7005-72-3	4-Chlorophenyl phenyl ether	500	U	UG/KG			
106-44-5	4-Methylphenol	500	U	UG/KG			
100-01-6	4-Nitroaniline	2500	U	UG/KG			
100-02-7	4-Nitrophenol	2500	U	UG/KG			
83-32-9	Acenaphthene	95	J	UG/KG	7.92E-07	7.92E-07	1.67E-04
208-96-8	Acenaphthylene	3700		UG/KG	6.07E-05	6.07E-05	8.81E-04
120-12-7	Anthracene	100	J	UG/KG	1.64E-07	1.64E-07	8.33E-06
56-55-3	Benzo(a)anthracene	500		UG/KG	6.25E-02	2.94E-03	2.50E-01
50-32-8	Benzo(a)pyrene	480		UG/KG	6.00E-01	2.82E-02	6.00E-02
205-99-2	Benzo(b)fluoranthene	510		UG/KG	6.38E-02	3.00E-03	1.02E-01
191-24-2	Benzo(g,h,i)perylene	330		UG/KG	5.41E-06	5.41E-06	7.86E-05
207-08-9	Benzo(k)fluoranthene	490		UG/KG	6.28E-03	2.88E-04	1.00E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-91-1	bis(2-Chloroethoxy)methane	500	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	500	U	UG/KG	1.00E-01	6.67E-03	1.25E+03
108-60-1	bis(2-Chloroisopropyl) ether	500	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	190	J	UG/KG	4.63E-04	4.63E-05	5.28E-05
85-68-7	Butyl benzyl phthalate	6300		UG/KG	1.54E-05	1.54E-05	6.77E-03
86-74-8	Carbazole	66	J	UG/KG	2.28E-04	1.06E-05	1.10E-01
218-01-9	Chrysene	630		UG/KG	8.08E-04	3.71E-05	3.94E-03
84-74-2	Di-n-butyl phthalate	500	U	UG/KG	2.50E-06	2.50E-06	2.17E-04
117-84-0	Di-n-octyl phthalate	500	U	UG/KG	1.22E-05	1.22E-04	5.00E-05
53-70-3	Dibenz(a,h)anthracene	130	J	UG/KG	1.63E-01	7.65E-03	6.50E-02
132-64-9	Dibenzofuran	58	J	UG/KG			
84-66-2	Diethyl phthalate	140	J	UG/KG	1.40E-07	1.40E-07	2.98E-04
131-11-3	Dimethyl phthalate	500	U	UG/KG			
206-44-0	Fluoranthene	1200		UG/KG	1.46E-05	1.46E-05	2.79E-04
86-73-7	Fluorene	44	J	UG/KG	5.37E-07	5.37E-07	7.86E-05
118-74-1	Hexachlorobenzene	500	U	UG/KG	1.25E-01	6.41E-03	2.50E-01
87-68-3	Hexachlorobutadiene	500	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	500	U	UG/KG	3.57E-05	3.57E-05	1.25E-03
67-72-1	Hexachloroethane	500	U	UG/KG	2.50E-04	2.50E-04	1.00E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	310	J	UG/KG	3.88E-02	1.82E-03	2.21E-02
78-59-1	Isophorone	500	U	UG/KG	1.22E-06	1.22E-06	6.25E-02
621-64-7	N-Nitroso-di-n-propylamine	500	U	UG/KG	6.25E-01	2.78E-02	1.00E+04
86-30-6	N-Nitrosodiphenylamine	500	U	UG/KG	4.17E-04	2.00E-05	5.00E-01
91-20-3	Naphthalene	1600		UG/KG	1.95E-05	1.95E-04	1.90E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8

HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
87-86-5	Pentachlorophenol	2500	U	UG/KG	1.04E-01	4.81E-03	8.33E+01
85-01-8	Phenanthrene	1200		UG/KG	1.97E-05	1.97E-05	2.86E-04
108-95-2	Phenol	500	U	UG/KG	5.00E-07	4.17E-06	5.00E-03
129-00-0	Pyrene	980		UG/KG	1.61E-05	1.61E-05	2.33E-04
Explosives							
99-35-4	1,3,5-Trinitrobenzene	380	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	380	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	760	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	380	U	UG/KG	4.52E-02	2.11E-03	4.75E+02
606-20-2	2,6-Dinitrotoluene	760	U	UG/KG	9.05E-02	4.22E-03	1.09E+03
35572-78-2	2-Amino-4,6-Dinitrotoluene	760	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	760	U	UG/KG			
99-08-1	3-Nitrotoluene	760	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	760	U	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	760	U	UG/KG			
2691-41-0	HMX	760	U	UG/KG			
98-95-3	Nitrobenzene	380	U	UG/KG	3.80E-04	3.80E-04	3.80E+00
55-63-0	Nitroglycerin	1500	U	UG/KG			
78-11-5	Pentaerythritol tetranitrate (PETN)	3000	U	UG/KG			
121-82-4	RDX	760	U	UG/KG			
479-45-8	Tetryl	1100	U	UG/KG			
Metals							
7429-90-5	Aluminum	12000		MG/KG			
7440-36-0	Antimony	1.6	J	MG/KG	1.95E-03	1.95E-02	3.20E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect

J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-38-2	Arsenic	87.5		MG/KG	2.92E+01	1.43E+00	3.13E+00
7440-39-3	Barium	139		MG/KG	9.93E-04	9.93E-03	1.16E-01
7440-41-7	Beryllium	0.73	J	MG/KG	7.30E-01	2.52E-02	1.11E-01
7440-42-8	Boron	7.3	J	MG/KG	4.06E-05	4.06E-04	
7440-43-9	Cadmium	1.3		MG/KG	6.50E-04	6.50E-03	3.51E-01
7440-70-2	Calcium	113000		MG/KG			
7440-47-3	Chromium	28.6		MG/KG	2.86E-03	6.98E-03	1.02E+00
7440-48-4	Cobalt	15.1		MG/KG	1.26E-04	1.26E-03	
7440-50-8	Copper	186		MG/KG	2.27E-03	2.27E-02	1.69E-02
7439-89-6	Iron	25700		MG/KG			
7439-92-1	Lead	60.5		MG/KG	1.51E-01	1.51E-01	
7439-95-4	Magnesium	57200		MG/KG			
7439-96-5	Manganese	1680	J	MG/KG	1.75E-02	1.75E-01	
7439-97-6	Mercury	0.32		MG/KG	5.25E-04	5.25E-03	2.13E+00
7440-02-0	Nickel	22.7		MG/KG	5.54E-04	5.54E-03	2.99E-01
2023695	Potassium	886		MG/KG			
7782-49-2	Selenium	3.7		MG/KG	3.70E-04	3.70E-03	1.54E+00
7440-22-4	Silver	237		MG/KG	2.37E-02	2.37E-01	1.58E+02
7440-23-5	Sodium	1590		MG/KG			
7440-28-0	Thallium	0.21	J	MG/KG	1.31E-03	1.31E-03	8.75E-02
7440-62-2	Vanadium	31.8		MG/KG	2.27E-03	2.27E-02	3.24E-02
7440-66-6	Zinc	612		MG/KG	1.00E-03	1.00E-02	1.70E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-8
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Other Parameters							
TOC	TOC	20200		MG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-9

HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	7	J	UG/L		8.84E-03	3.50E-02
79-34-5	1,1,2,2-Tetrachloroethane	5000	U	UG/L	9.04E-02	1.37E+01	
79-00-5	1,1,2-Trichloroethane	14	J	UG/L	7.02E-05	5.75E-01	2.80E+00
75-34-3	1,1-Dichloroethane	5000	U	UG/L		6.16E+00	
75-35-4	1,1-Dichloroethene	5	J	UG/L	1.10E-04	9.13E-02	7.14E-01
107-06-2	1,2-Dichloroethane (EDC)	2	J	UG/L	1.62E-05	1.98E-01	4.00E-01
78-87-5	1,2-Dichloropropane	5000	U	UG/L	3.03E-02	7.24E+02	1.00E+03
78-93-3	2-Butanone (MEK)	25000	U	UG/L		1.31E+01	
591-78-6	2-Hexanone	25000	U	UG/L			
108-10-1	4-Methyl-2-pentanone (MIBK)	25000	U	UG/L		1.58E+02	
67-64-1	Acetone	25000	U	UG/L		4.11E+01	
71-43-2	Benzene	5000	U	UG/L	1.22E-02	4.46E+02	1.00E+03
75-27-4	Bromodichloromethane	5000	U	UG/L	2.77E-02	4.11E+01	
75-25-2	Bromoform	5000	U	UG/L	5.88E-04	6.85E+00	
74-83-9	Bromomethane	5000	U	UG/L		5.77E+02	
75-15-0	Carbon disulfide	5000	U	UG/L		4.79E+00	
56-23-5	Carbon tetrachloride	5000	U	UG/L	2.92E-02	1.17E+03	1.00E+03
108-90-7	Chlorobenzene	5000	U	UG/L		4.71E+01	5.00E+01
75-00-3	Chloroethane	5000	U	UG/L	1.08E-03	5.82E-01	
67-66-3	Chloroform	0.6	J	UG/L	3.65E-06	9.57E-01	
74-87-3	Chloromethane	5000	U	UG/L	3.31E-03		
156-59-2	cis-1,2-Dichloroethene	40		UG/L		6.58E-01	5.71E-01
10061-01-5	cis-1,3-Dichloropropene	5000	U	UG/L	6.17E-02	5.76E+02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect

J = Estimated U = Nondetect

TABLE 6-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
124-48-1	Dibromochloromethane	5000	U	UG/L	3.75E-02	4.11E+01	
100-41-4	Ethylbenzene	5000	U	UG/L		3.73E+00	7.14E+00
75-09-2	Methylene chloride	5000	U	UG/L	1.17E-03	3.08E+00	1.00E+03
110-54-3	N-Hexane	5000	U	UG/L		1.43E+01	
100-42-5	Styrene	5000	U	UG/L		3.05E+00	5.00E+01
127-18-4	Tetrachloroethylene (PCE)	230	J	UG/L	2.13E-04	9.07E-01	4.60E+01
108-88-3	Toluene	1	J	UG/L		1.38E-03	1.00E-03
1330-20-7	total Xylenes	5000	U	UG/L		3.49E+00	5.00E-01
156-60-5	trans-1,2-Dichloroethene	1		UG/L		8.22E-03	1.00E-02
10061-02-6	trans-1,3-Dichloropropene	5000	U	UG/L	6.17E-02	5.76E+02	
79-01-6	Trichloroethylene (TCE)	120000		UG/L	7.32E-02	3.29E+03	2.40E+04
75-01-4	Vinyl chloride	0.7	J	UG/L	3.54E-05		3.50E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		5.14E-02	1.43E-01
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		2.70E-02	1.67E-02
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		1.83E+00	
106-46-7	1,4-Dichlorobenzene	10	U	UG/L	1.99E-05	5.48E-02	1.33E-01
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		1.37E-02	
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L	1.64E-06		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		9.13E-02	
105-67-9	2,4-Dimethylphenol	10	U	UG/L		1.37E-02	
51-28-5	2,4-Dinitrophenol	50	U	UG/L		6.85E-01	
91-58-7	2-Chloronaphthalene	10	U	UG/L		2.05E-02	
95-57-8	2-Chlorophenol	10	U	UG/L		3.29E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
91-57-6	2-Methylnaphthalene	10	U	UG/L		5.48E-02	
95-48-7	2-Methylphenol	10	U	UG/L		5.48E-03	
88-74-4	2-Nitroaniline	50	U	UG/L		2.40E+01	
88-75-5	2-Nitrophenol	10	U	UG/L		3.42E-02	
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L	1.34E-04		
99-09-2	3-Nitroaniline	50	U	UG/L		2.40E+01	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L			
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L			
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		5.48E-03	
106-47-8	4-Chloroaniline	20	U	UG/L		1.37E-01	
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L			
106-44-5	4-Methylphenol	10	U	UG/L		5.48E-02	
100-01-6	4-Nitroaniline	50	U	UG/L		2.40E+01	
100-02-7	4-Nitrophenol	50	U	UG/L		1.71E-01	
83-32-9	Acenaphthene	10	U	UG/L		2.74E-02	
208-96-8	Acenaphthylene	10	U	UG/L		5.48E-02	
120-12-7	Anthracene	10	U	UG/L		5.48E-03	
56-55-3	Benzo(a)anthracene	10	U	UG/L	1.09E-04		
50-32-8	Benzo(a)pyrene	10	U	UG/L	1.09E-03		5.00E+01
205-99-2	Benzo(b)fluoranthene	10	U	UG/L	1.09E-04		
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		5.48E-02	
207-08-9	Benzo(k)fluoranthene	10	U	UG/L	1.09E-05		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L			
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L	1.02E-03		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L	3.64E-05	4.11E-02	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L	2.08E-06	1.37E-02	
85-68-7	Butyl benzyl phthalate	10	U	UG/L		1.37E-03	
86-74-8	Carbazole	10	U	UG/L	2.97E-06		
218-01-9	Chrysene	10	U	UG/L	1.09E-06		
84-74-2	Di-n-butyl phthalate	10	U	UG/L		2.74E-03	
117-84-0	Di-n-octyl phthalate	10	U	UG/L		1.37E-02	
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L	1.09E-03		
132-64-9	Dibenzofuran	10	U	UG/L		4.11E-01	
84-66-2	Diethyl phthalate	10	U	UG/L		3.42E-04	
131-11-3	Dimethyl phthalate	10	U	UG/L		2.74E-05	
206-44-0	Fluoranthene	10	U	UG/L		6.85E-03	
86-73-7	Fluorene	10	U	UG/L		4.11E-02	
118-74-1	Hexachlorobenzene	10	U	UG/L	2.38E-04	3.42E-01	1.00E+01
87-68-3	Hexachlorobutadiene	10	U	UG/L	1.16E-05	1.37E+00	
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		3.91E-02	2.00E-01
67-72-1	Hexachloroethane	10	U	UG/L	2.08E-06	2.74E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L	1.09E-04		
78-59-1	Isophorone	10	U	UG/L	1.41E-07	1.37E-03	
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L	1.04E-03		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L	7.29E-07		
91-20-3	Naphthalene	10	U	UG/L		1.61E+00	
87-86-5	Pentachlorophenol	50	U	UG/L	8.92E-05	4.57E-02	5.00E+01
85-01-8	Phenanthrene	10	U	UG/L		5.48E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
108-95-2	Phenol	10	U	UG/L		4.57E-04	1.00E-01
129-00-0	Pyrene	10	U	UG/L		5.48E-02	
Explosives							
99-35-4	1,3,5-Trinitrobenzene	0.25	U	UG/L		2.28E-04	
99-65-0	1,3-Dinitrobenzene	0.25	U	UG/L		6.85E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L	2.23E-07	2.74E-02	
121-14-2	2,4-Dinitrotoluene	0.25	U	UG/L		3.42E-03	
606-20-2	2,6-Dinitrotoluene	0.5	U	UG/L		1.37E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L			
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L			
99-08-1	3-Nitrotoluene	0.5	U	UG/L		8.22E-03	
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L			
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		8.22E-03	
2691-41-0	HMX	0.5	U	UG/L		2.74E-04	
98-95-3	Nitrobenzene	0.25	U	UG/L		7.36E-02	
55-63-0	Nitroglycerin	1	U	UG/L	2.08E-07.		
78-11-5	Pentaerythritol tetranitrate (PETN)	2	UJ	UG/L			
121-82-4	RDX	0.5	U	UG/L	8.18E-07	4.57E-03	
479-45-8	Tetryl	0.75	U	UG/L		2.05E-03	
Metals							
7429-90-5	Aluminum	1220		UG/L		3.34E-02	
7440-36-0	Antimony	6	U	UG/L		4.11E-01	1.00E+00
7440-38-2	Arsenic	10	U	UG/L	2.23E-04	9.13E-01	2.00E-01
7440-39-3	Barium	61.7	J	UG/L		2.41E-02	3.09E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-9
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
7440-41-7	Beryllium	5	U	UG/L		6.85E-02	1.25E+00
7440-42-8	Boron	119		UG/L		3.62E-02	5.95E-02
7440-43-9	Cadmium	5	U	UG/L		2.74E-01	1.00E+00
7440-70-2	Calcium	68900		UG/L			
7440-47-3	Chromium	10	U	UG/L			1.00E-01
7440-48-4	Cobalt	50	U	UG/L		2.28E-02	5.00E-02
7440-50-8	Copper	1.2	J	UG/L		8.85E-04	1.85E-03
7439-89-6	Iron	996		UG/L		9.10E-02	1.99E-01
7439-92-1	Lead	3	U	UG/L			4.00E-01
7439-95-4	Magnesium	30700		UG/L			
7439-96-5	Manganese	24.6		UG/L		2.81E-02	1.64E-01
7439-97-6	Mercury	0.2	U	UG/L			1.00E-01
7440-02-0	Nickel	1.7	J	UG/L		2.33E-03	1.70E-02
2023695	Potassium	725	J	UG/L			
7782-49-2	Selenium	6.2		UG/L		3.40E-02	1.24E-01
7440-22-4	Silver	10	U	UG/L		5.48E-02	2.00E-01
7440-23-5	Sodium	89700		UG/L			
7440-28-0	Thallium	10	U	UG/L		3.91E+00	5.00E+00
7440-62-2	Vanadium	50	U	UG/L		1.96E-01	
7440-66-6	Zinc	20	U	UG/L		1.83E-03	4.00E-03
Other Parameters							
ALK	Alkalinity, Total (as CaCO3)	346		MG/L			
7664-41-7	Nitrogen, Ammonia (as N)	0.31		MG/L			
Nitrate+Nitrite	Nitrogen, Nitrate-Nitrite	4.6	J	MG/L		4.60E+00	4.60E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-9

HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
7601-90-3	Perchlorate	1200		UG/L		6.58E+01	
7723-14-0	Phosphorus, Total (as P)	0.062		MG/L		8.49E+01	
TDS	TDS	548		MG/L			4.57E-01
TSS	TSS	34.5		MG/L			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
Volatile Organic Compounds						
71-55-6	1,1,1-Trichloroethane	1	U	UG/L		
79-34-5	1,1,2,2-Tetrachloroethane	1	U	UG/L		
79-00-5	1,1,2-Trichloroethane	1	U	UG/L		
75-34-3	1,1-Dichloroethane	1	U	UG/L		
75-35-4	1,1-Dichloroethene	1	U	UG/L		
107-06-2	1,2-Dichloroethane (EDC)	1	U	UG/L		
78-87-5	1,2-Dichloropropane	1	U	UG/L		
78-93-3	2-Butanone (MEK)	2	U	UG/L		
591-78-6	2-Hexanone	2	U	UG/L		
108-10-1	4-Methyl-2-pentanone (MIBK)	2	U	UG/L		
67-64-1	Acetone	2	U	UG/L		
71-43-2	Benzene	1	U	UG/L		4.76E-02
75-27-4	Bromodichloromethane	1	U	UG/L		
75-25-2	Bromoform	1	U	UG/L		
74-83-9	Bromomethane	1	U	UG/L		
75-15-0	Carbon disulfide	1	U	UG/L		
56-23-5	Carbon tetrachloride	1	U	UG/L		
108-90-7	Chlorobenzene	1	U	UG/L		
75-00-3	Chloroethane	1	U	UG/L		
67-66-3	Chloroform	1	U	UG/L		
74-87-3	Chloromethane	1	U	UG/L		
156-59-2	cis-1,2-Dichloroethene	1	U	UG/L		
10061-01-5	cis-1,3-Dichloropropene	1	U	UG/L		
124-48-1	Dibromochloromethane	1	U	UG/L		
100-41-4	Ethylbenzene	1	U	UG/L		1.08E-04
75-09-2	Methylene chloride	1	U	UG/L		2.94E-03
110-54-3	N-Hexane	1	U	UG/L		
100-42-5	Styrene	1	U	UG/L		
127-18-4	Tetrachloroethylene (PCE)	1	U	UG/L		
108-88-3	Toluene	1	U	UG/L		1.61E-05
1330-20-7	total Xylenes	1	U	UG/L		1.61E-05
156-60-5	trans-1,2-Dichloroethene	1	U	UG/L		
10061-02-6	trans-1,3-Dichloropropene	1	U	UG/L		
79-01-6	Trichloroethylene (TCE)	1	U	UG/L		
75-01-4	Vinyl chloride	1	U	UG/L		
Semivolatile Organic Compounds						
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-10

HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
106-46-7	1,4-Dichlorobenzene	10	U	UG/L		
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		
105-67-9	2,4-Dimethylphenol	10	U	UG/L		
51-28-5	2,4-Dinitrophenol	50	U	UG/L		
91-58-7	2-Chloronaphthalene	10	U	UG/L		
95-57-8	2-Chlorophenol	10	U	UG/L		
91-57-6	2-Methylnaphthalene	10	U	UG/L		2.86E-03
95-48-7	2-Methylphenol	10	U	UG/L		
88-74-4	2-Nitroaniline	50	U	UG/L		
88-75-5	2-Nitrophenol	10	U	UG/L		
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L		
99-09-2	3-Nitroaniline	50	U	UG/L		
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L		
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L		
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		
106-47-8	4-Chloroaniline	20	U	UG/L		
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L		
106-44-5	4-Methylphenol	10	U	UG/L		
100-01-6	4-Nitroaniline	50	U	UG/L		
100-02-7	4-Nitrophenol	50	U	UG/L		
83-32-9	Acenaphthene	10	U	UG/L		
208-96-8	Acenaphthylene	10	U	UG/L		2.86E-03
120-12-7	Anthracene	10	U	UG/L		2.86E-04
56-55-3	Benzo(a)anthracene	10	U	UG/L		1.00E+02
50-32-8	Benzo(a)pyrene	10	U	UG/L		1.00E+03
205-99-2	Benzo(b)fluoranthene	10	U	UG/L		1.00E+02
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		2.86E-03
207-08-9	Benzo(k)fluoranthene	10	U	UG/L		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L		
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L		
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L		
85-68-7	Butyl benzyl phthalate	10	U	UG/L		
86-74-8	Carbazole	10	U	UG/L		
218-01-9	Chrysene	10	U	UG/L		1.00E+00
84-74-2	Di-n-butyl phthalate	10	U	UG/L		
117-84-0	Di-n-octyl phthalate	10	U	UG/L		
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect

J = Estimated U = Nondetect

TABLE 6-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
132-64-9	Dibenzofuran	10	U	UG/L		
84-66-2	Diethyl phthalate	10	U	UG/L		
131-11-3	Dimethyl phthalate	10	U	UG/L		
206-44-0	Fluoranthene	10	U	UG/L		8.33E-02
86-73-7	Fluorene	10	U	UG/L		2.22E-03
118-74-1	Hexachlorobenzene	10	U	UG/L		
87-68-3	Hexachlorobutadiene	10	U	UG/L		
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		
67-72-1	Hexachloroethane	10	U	UG/L		
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L		1.00E+02
78-59-1	Isophorone	10	U	UG/L		
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L		
91-20-3	Naphthalene	10	U	UG/L		
87-86-5	Pentachlorophenol	50	U	UG/L		
85-01-8	Phenanthrene	10	U	UG/L		2.86E-03
108-95-2	Phenol	10	U	UG/L	1.00E+00	1.00E-01
129-00-0	Pyrene	10	U	UG/L		2.86E-03
Explosives						
99-35-4	1,3,5-Trinitrobenzene	0.25	U	UG/L		
99-65-0	1,3-Dinitrobenzene	0.25	U	UG/L		
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L		
121-14-2	2,4-Dinitrotoluene	0.25	U	UG/L		
606-20-2	2,6-Dinitrotoluene	0.5	U	UG/L		
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L		
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L		
99-08-1	3-Nitrotoluene	0.5	U	UG/L		
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L		
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		
2691-41-0	HMX	0.5	U	UG/L		
98-95-3	Nitrobenzene	0.25	U	UG/L		
55-63-0	Nitroglycerin	1	U	UG/L		
78-11-5	Pentaerythritol tetranitrate (PETN)	2	U	UG/L		
121-82-4	RDX	0.5	U	UG/L		
479-45-8	Tetryl	0.75	U	UG/L		
Metals						
7429-90-5	Aluminum	1320	J	UG/L	6.60E+00	
7440-36-0	Antimony	6	U	UG/L	1.00E+00	
7440-38-2	Arsenic	2.1	J	UG/L	2.10E-01	
7440-39-3	Barium	52.5	J	UG/L	2.31E+00	1.05E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-10
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
7440-41-7	Beryllium	5	U	UG/L	1.00E+00	
7440-42-8	Boron	100	U	UG/L		1.00E-01
7440-43-9	Cadmium	5	U	UG/L	1.00E+00	
7440-70-2	Calcium	63400		UG/L	8.81E+00	
7440-47-3	Chromium	10	U	UG/L	1.00E+00	
7440-48-4	Cobalt	50	U	UG/L	1.00E+00	
7440-50-8	Copper	10	U	UG/L	1.00E+00	
7439-89-6	Iron	1260		UG/L	1.26E+01	1.26E+00
7439-92-1	Lead	3	U	UG/L	1.50E+00	
7439-95-4	Magnesium	17200		UG/L	6.79E+00	
7439-96-5	Manganese	20	U	UG/L	3.44E-02	2.00E-02
7439-97-6	Mercury	0.2	U	UG/L	1.00E+00	1.67E+01
7440-02-0	Nickel	10	U	UG/L	1.00E+00	1.00E-02
2023695	Potassium	1970		UG/L	1.22E+00	
7782-49-2	Selenium	5	U	UG/L	1.85E+00	5.00E-03
7440-22-4	Silver	10	U	UG/L	1.00E+00	2.00E+00
7440-23-5	Sodium	26700		UG/L	8.43E+00	
7440-28-0	Thallium	10	U	UG/L	1.00E+00	
7440-62-2	Vanadium	50	U	UG/L	1.00E+00	
7440-66-6	Zinc	36.9		UG/L	1.85E+00	3.69E-02
Other Parameters						
7601-90-3	Perchlorate	500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 6-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		9	U	UG/KG	3.02E-04	
79-34-5	1,1,2,2-Tetrachloroethane		9	U	UG/KG	7.07E-02	
79-00-5	1,1,2-Trichloroethane		9	U	UG/KG	3.15E-04	
75-34-3	1,1-Dichloroethane		9	U	UG/KG	4.48E-04	
75-35-4	1,1-Dichloroethene		9	U	UG/KG	1.09E-03	
107-06-2	1,2-Dichloroethane (EDC)		9	U	UG/KG	4.25E-04	
540-59-0	1,2-Dichloroethene (total)		9	U	UG/KG	1.14E-02	
78-87-5	1,2-Dichloropropane		9	U	UG/KG	1.29E-05	
78-93-3	2-Butanone (MEK)		18	U	UG/KG	2.01E-04	
591-78-6	2-Hexanone		18	U	UG/KG	1.43E-03	
108-10-1	4-Methyl-2-pentanone (MIBK)		18	U	UG/KG	4.06E-05	
67-64-1	Acetone		18	U	UG/KG	7.20E-03	
71-43-2	Benzene		9	U	UG/KG	5.63E-04	
75-27-4	Bromodichloromethane		9	U	UG/KG	1.67E-02	
75-25-2	Bromoform		9	U	UG/KG	5.66E-04	
74-83-9	Bromomethane		9	U	UG/KG	3.83E-02	
75-15-0	Carbon disulfide		9	U	UG/KG	9.56E-02	
56-23-5	Carbon tetrachloride		9	U	UG/KG	9.00E-06	
108-90-7	Chlorobenzene		9	U	UG/KG	2.25E-04	
75-00-3	Chloroethane		9	U	UG/KG		
67-66-3	Chloroform		9	U	UG/KG	7.56E-03	
74-87-3	Chloromethane		9	U	UG/KG	8.65E-04	
156-59-2	cis-1,2-Dichloroethene		8		UG/KG	1.02E-02	
10061-01-5	cis-1,3-Dichloropropene		9	U	UG/KG	2.26E-02	
124-48-1	Dibromochloromethane		9	U	UG/KG	4.39E-03	
100-41-4	Ethylbenzene		9	U	UG/KG	1.80E-03	
75-09-2	Methylene chloride		9	U	UG/KG	2.22E-03	
110-54-3	N-Hexane		9	U	UG/KG		
100-42-5	Styrene		9	U	UG/KG	3.00E-05	
127-18-4	Tetrachloroethylene (PCE)		15		UG/KG	1.15E-03	
108-88-3	Toluene		9	U	UG/KG	3.00E-03	
1330-20-7	total Xylenes		9	U	UG/KG	1.50E-02	
156-60-5	trans-1,2-Dichloroethene		9	U	UG/KG	1.14E-02	
10061-02-6	trans-1,3-Dichloropropene		9	U	UG/KG	2.26E-02	
79-01-6	Trichloroethylene (TCE)		240	J	UG/KG	2.67E-02	
75-01-4	Vinyl chloride		9	U	UG/KG	1.39E-02	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		500	U	UG/KG	2.50E-02	
95-50-1	1,2-Dichlorobenzene		500	U	UG/KG	1.69E-01	
541-73-1	1,3-Dichlorobenzene		500	U	UG/KG	1.33E-02	
106-46-7	1,4-Dichlorobenzene		500	U	UG/KG	2.50E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
95-95-4	2,4,5-Trichlorophenol		2500	U	UG/KG	6.25E-01	
88-06-2	2,4,6-Trichlorophenol		500	U	UG/KG	5.00E-02	
120-83-2	2,4-Dichlorophenol		500	U	UG/KG	5.71E-03	
105-67-9	2,4-Dimethylphenol		500	U	UG/KG	5.00E+01	
51-28-5	2,4-Dinitrophenol		2500	U	UG/KG	1.25E-01	
91-58-7	2-Chloronaphthalene		500	U	UG/KG	4.11E+01	
95-57-8	2-Chlorophenol		500	U	UG/KG	2.06E+00	
90-12-0	1-Methylnaphthalene		2200		UG/KG		
91-57-6	2-Methylnaphthalene		6700		UG/KG	2.07E+00	YES
95-48-7	2-Methylphenol		500	U	UG/KG	1.24E-02	
88-74-4	2-Nitroaniline		2500	U	UG/KG	3.37E-02	
88-75-5	2-Nitrophenol		500	U	UG/KG	3.13E-01	
91-94-1	3,3'-Dichlorobenzidine		500	U	UG/KG	7.74E-01	
99-09-2	3-Nitroaniline		2500	U	UG/KG	7.91E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2500	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		500	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		500	U	UG/KG	6.29E-02	
106-47-8	4-Chloroaniline		1000	U	UG/KG	9.09E-01	
7005-72-3	4-Chlorophenyl phenyl ether		500	U	UG/KG		
106-44-5	4-Methylphenol		500	U	UG/KG	3.07E-03	
100-01-6	4-Nitroaniline		2500	U	UG/KG	1.14E-01	
100-02-7	4-Nitrophenol		2500	U	UG/KG	3.57E-01	
83-32-9	Acenaphthene		95	J	UG/KG	1.39E-04	YES
208-96-8	Acenaphthylene		3700		UG/KG	5.42E-03	
120-12-7	Anthracene		100	J	UG/KG	6.76E-05	YES
56-55-3	Benzo(a)anthracene		500		UG/KG	9.60E-02	YES
50-32-8	Benzo(a)pyrene		480		UG/KG	1.09E-04	YES
205-99-2	Benzo(b)fluoranthene		510		UG/KG	8.53E-03	YES
191-24-2	Benzo(g,h,i)perylene		330		UG/KG	2.77E-03	YES
207-08-9	Benzo(k)fluoranthene		490		UG/KG	8.19E-03	YES
111-91-1	bis(2-Chloroethoxy)methane		500	U	UG/KG	1.65E+00	
111-44-4	bis(2-Chloroethyl) ether		500	U	UG/KG	2.11E-02	
108-60-1	bis(2-Chloroisopropyl) ether		500	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		190	J	UG/KG	2.05E-01	YES
85-68-7	Butyl benzyl phthalate		6300		UG/KG	2.64E+01	YES
86-74-8	Carbazole		66	J	UG/KG		YES
218-01-9	Chrysene		630		UG/KG	1.33E-01	YES
84-74-2	Di-n-butyl phthalate		500	U	UG/KG	2.50E-03	
117-84-0	Di-n-octyl phthalate		500	U	UG/KG	7.05E-04	
53-70-3	Dibenz(a,h)anthracene		130	J	UG/KG	7.07E-03	YES
132-64-9	Dibenzofuran		58	J	UG/KG		YES
84-66-2	Diethyl phthalate		140	J	UG/KG	1.40E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
131-11-3	Dimethyl phthalate		500	U	UG/KG	2.50E-03	
206-44-0	Fluoranthene		1200		UG/KG	9.84E-03	YES
86-73-7	Fluorene		44	J	UG/KG	1.47E-03	YES
118-74-1	Hexachlorobenzene		500	U	UG/KG	5.00E-04	
87-68-3	Hexachlorobutadiene		500	U	UG/KG	1.26E+01	
77-47-4	Hexachlorocyclopentadiene		500	U	UG/KG	5.00E-02	
67-72-1	Hexachloroethane		500	U	UG/KG	8.38E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		310	J	UG/KG	2.84E-03	YES
78-59-1	Isophorone		500	U	UG/KG	3.60E-03	
621-64-7	N-Nitroso-di-n-propylamine		500	U	UG/KG	9.20E-01	
86-30-6	N-Nitrosodiphenylamine		500	U	UG/KG	2.50E-02	
91-20-3	Naphthalene		1600		UG/KG	6.43E-03	
87-86-5	Pentachlorophenol		2500	U	UG/KG	4.17E-01	
85-01-8	Phenanthrene		1200		UG/KG	2.63E-02	YES
108-95-2	Phenol		500	U	UG/KG	1.25E-02	
129-00-0	Pyrene		980		UG/KG	1.25E-02	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		380	U	UG/KG	1.01E+00	
99-65-0	1,3-Dinitrobenzene		380	U	UG/KG	5.80E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		760	U	UG/KG	2.53E-02	
121-14-2	2,4-Dinitrotoluene		380	U	UG/KG	2.97E-01	
606-20-2	2,6-Dinitrotoluene		760	U	UG/KG	2.31E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		760	U	UG/KG	9.50E-03	
88-72-2	2-Nitrotoluene (ONT)		760	U	UG/KG		
99-08-1	3-Nitrotoluene		760	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		760	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		760	U	UG/KG		
2691-41-0	HMX		760	U	UG/KG	3.04E-02	
98-95-3	Nitrobenzene		380	U	UG/KG	9.50E-03	
55-63-0	Nitroglycerin		1500	U	UG/KG		
78-11-5	Pentaerythritol tetranitrate (PETN)		3000	U	UG/KG		
121-82-4	RDX		760	U	UG/KG	7.60E-03	
479-45-8	Tetryl		1100	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	12000		MG/KG		
7440-36-0	Antimony	0.83	1.6	J	MG/KG	3.20E-01	
7440-38-2	Arsenic	13.5	87.5		MG/KG	9.72E+00	
7440-39-3	Barium	195	139		MG/KG	2.78E-01	
7440-41-7	Beryllium	0.76	0.73	J	MG/KG	7.30E-02	
7440-42-8	Boron	5.3	7.3	J	MG/KG	1.46E+01	
7440-43-9	Cadmium	0.19	1.3		MG/KG	4.48E-02	
7440-70-2	Calcium	2497	113000		MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-11
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-47-3	Chromium	25.2	28.6		MG/KG	5.72E+00	
7440-48-4	Cobalt	21.7	15.1		MG/KG	7.55E-01	
7440-50-8	Copper	11.3	186		MG/KG	6.00E+00	
7439-89-6	Iron	19306	25700		MG/KG	1.29E+02	
7439-92-1	Lead	23.4	60.5		MG/KG	1.40E-01	
7439-95-4	Magnesium	1552	57200		MG/KG		
7439-96-5	Manganese	3640	1680	J	MG/KG	1.68E+01	
7439-97-6	Mercury	0.06	0.32		MG/KG	4.57E-02	YES
7440-02-0	Nickel	18.9	22.7		MG/KG	7.57E-01	
2023695	Potassium	625	886		MG/KG		
7782-49-2	Selenium	2.34	3.7		MG/KG	3.70E+00	YES
7440-22-4	Silver	0.58	237		MG/KG	1.19E+02	
7440-23-5	Sodium	170	1590		MG/KG		
7440-28-0	Thallium	0.41	0.21	J	MG/KG	2.10E-01	
7440-62-2	Vanadium	47.2	31.8		MG/KG	6.91E-01	
7440-66-6	Zinc	51.4	612		MG/KG	5.10E+00	
Other Parameters							
TOC	TOC	31393	20200		MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		1	U	UG/L	9.09E-02	
79-34-5	1,1,2,2-Tetrachloroethane		1	U	UG/L	4.17E-03	
79-00-5	1,1,2-Trichloroethane		1	U	UG/L	1.06E-03	
75-34-3	1,1-Dichloroethane		1	U	UG/L	2.13E-02	
75-35-4	1,1-Dichloroethene		1	U	UG/L	4.00E-02	
107-06-2	1,2-Dichloroethane (EDC)		1	U	UG/L	1.10E-03	
78-87-5	1,2-Dichloropropane		1	U	UG/L	1.90E-03	
78-93-3	2-Butanone (MEK)		2	U	UG/L	1.43E-04	
591-78-6	2-Hexanone		2	U	UG/L	2.02E-02	
108-10-1	4-Methyl-2-pentanone (MIBK)		2	U	UG/L	1.18E-02	
67-64-1	Acetone		2	U	UG/L	3.94E-03	
71-43-2	Benzene		1	U	UG/L	2.17E-02	
75-27-4	Bromodichloromethane		1	U	UG/L	6.57E-05	
75-25-2	Bromoform		1	U	UG/L	3.41E-03	
74-83-9	Bromomethane		1	U	UG/L	1.48E-05	
75-15-0	Carbon disulfide		1	U	UG/L	1.09E+00	
56-23-5	Carbon tetrachloride		1	U	UG/L	1.02E-01	
108-90-7	Chlorobenzene		1	U	UG/L	1.56E-02	
75-00-3	Chloroethane		1	U	UG/L	4.75E-05	
67-66-3	Chloroform		1	U	UG/L	3.57E-02	
74-87-3	Chloromethane		1	U	UG/L	1.48E-05	
156-59-2	cis-1,2-Dichloroethene		1	U	UG/L	1.69E-03	
10061-01-5	cis-1,3-Dichloropropene		1	U	UG/L	1.82E+01	
124-48-1	Dibromochloromethane		1	U	UG/L	6.85E-05	
100-41-4	Ethylbenzene		1	U	UG/L	1.37E-01	
75-09-2	Methylene chloride		1	U	UG/L	5.18E-04	
110-54-3	N-Hexane		1	U	UG/L		
100-42-5	Styrene		1	U	UG/L	2.49E-04	
127-18-4	Tetrachloroethylene (PCE)		1	U	UG/L	1.19E-02	
108-88-3	Toluene		1	U	UG/L	1.02E-01	
1330-20-7	total Xylenes		1	U	UG/L	5.56E-01	
156-60-5	trans-1,2-Dichloroethene		1	U	UG/L	1.69E-03	
10061-02-6	trans-1,3-Dichloropropene		1	U	UG/L	4.10E-02	
79-01-6	Trichloroethylene (TCE)		1	U	UG/L	2.13E-02	
75-01-4	Vinyl chloride		1	U	UG/L	5.48E-05	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		10	U	UG/L	2.23E-01	
95-50-1	1,2-Dichlorobenzene		10	U	UG/L	7.14E-01	
541-73-1	1,3-Dichlorobenzene		10	U	UG/L	1.99E-01	
106-46-7	1,4-Dichlorobenzene		10	U	UG/L	8.93E-01	
95-95-4	2,4,5-Trichlorophenol		50	U	UG/L	7.94E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
88-06-2	2,4,6-Trichlorophenol		10	U	UG/L	3.13E+00	
120-83-2	2,4-Dichlorophenol		10	U	UG/L	2.74E-01	
105-67-9	2,4-Dimethylphenol		10	U	UG/L	4.72E-01	
51-28-5	2,4-Dinitrophenol		50	U	UG/L	8.06E+00	
91-58-7	2-Chloronaphthalene		10	U	UG/L	3.23E-02	
95-57-8	2-Chlorophenol		10	U	UG/L	2.28E-01	
91-57-6	2-Methylnaphthalene		10	U	UG/L	2.40E-02	
95-48-7	2-Methylphenol		10	U	UG/L	7.69E-01	
88-74-4	2-Nitroaniline		50	U	UG/L	2.16E-03	
88-75-5	2-Nitrophenol		10	U	UG/L	2.90E-03	
91-94-1	3,3'-Dichlorobenzidine		20	U	UG/L	1.90E-01	
99-09-2	3-Nitroaniline		50	U	UG/L	7.32E-04	
534-52-1	4,6-Dinitro-2-methylphenol		50	U	UG/L	2.17E+01	
101-55-3	4-Bromophenyl phenyl ether		10	U	UG/L	6.67E+00	
59-50-7	4-Chloro-3-methylphenol		10	U	UG/L	3.33E+01	
106-47-8	4-Chloroaniline		20	U	UG/L	8.89E-03	
7005-72-3	4-Chlorophenyl phenyl ether		10	U	UG/L	2.17E-01	
106-44-5	4-Methylphenol		10	U	UG/L	4.44E-03	
100-01-6	4-Nitroaniline		50	U	UG/L	1.08E-03	
100-02-7	4-Nitrophenol		50	U	UG/L	6.04E-01	
83-32-9	Acenaphthene		10	U	UG/L	5.88E-01	
208-96-8	Acenaphthylene		10	U	UG/L	1.50E-02	
120-12-7	Anthracene		10	U	UG/L	1.67E+00	
56-55-3	Benzo(a)anthracene		10	U	UG/L	3.70E+02	
50-32-8	Benzo(a)pyrene		10	U	UG/L	7.14E+02	
205-99-2	Benzo(b)fluoranthene		10	U	UG/L	1.79E+03	
191-24-2	Benzo(g,h,i)perylene		10	U	UG/L	1.31E+00	
207-08-9	Benzo(k)fluoranthene		10	U	UG/L	1.79E+03	
111-91-1	bis(2-Chloroethoxy)methane		10	U	UG/L	1.56E-03	
111-44-4	bis(2-Chloroethyl) ether		10	U	UG/L	4.20E-03	
108-60-1	bis(2-Chloroisopropyl) ether		10	U	UG/L		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		10	U	UG/L	3.33E+00	
85-68-7	Butyl benzyl phthalate		10	U	UG/L	5.26E-01	
86-74-8	Carbazole		10	U	UG/L	1.12E-02	
218-01-9	Chrysene		10	U	UG/L	6.25E-01	
84-74-2	Di-n-butyl phthalate		10	U	UG/L	1.06E+00	
117-84-0	Di-n-octyl phthalate		10	U	UG/L	1.41E-02	
53-70-3	Dibenz(a,h)anthracene		10	U	UG/L	6.25E+03	
132-64-9	Dibenzofuran		10	U	UG/L	2.70E+00	
84-66-2	Diethyl phthalate		10	U	UG/L	4.76E-02	
131-11-3	Dimethyl phthalate		10	U	UG/L	3.03E-02	
206-44-0	Fluoranthene		10	U	UG/L	1.23E+00	

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J = Estimated U = Nondetect

TABLE 6-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
86-73-7	Fluorene		10	U	UG/L	2.56E+00	
118-74-1	Hexachlorobenzene		10	U	UG/L	2.72E+00	
87-68-3	Hexachlorobutadiene		10	U	UG/L	1.08E+01	
77-47-4	Hexachlorocyclopentadiene		10	U	UG/L	1.43E+02	
67-72-1	Hexachloroethane		10	U	UG/L	1.02E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		10	U	UG/L	2.32E+00	
78-59-1	Isophorone		10	U	UG/L	8.55E-03	
621-64-7	N-Nitroso-di-n-propylamine		10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine		10	U	UG/L	1.71E-01	
91-20-3	Naphthalene		10	U	UG/L	8.33E-01	
87-86-5	Pentachlorophenol		50	U	UG/L	3.33E+00	
85-01-8	Phenanthrene		10	U	UG/L	1.59E+00	
108-95-2	Phenol	10	10	U	UG/L	1.00E-01	
129-00-0	Pyrene		10	U	UG/L	1.64E-01	
Explosives							
99-35-4	1,3,5-Trinitrobenzene		0.25	U	UG/L	8.33E-03	
99-65-0	1,3-Dinitrobenzene		0.25	U	UG/L	1.25E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)		0.5	U	UG/L	1.25E-02	
121-14-2	2,4-Dinitrotoluene		0.25	U	UG/L	1.09E-03	
606-20-2	2,6-Dinitrotoluene		0.5	U	UG/L	1.19E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene		0.5	U	UG/L	2.50E-02	
88-72-2	2-Nitrotoluene (ONT)		0.5	U	UG/L	6.85E-05	
99-08-1	3-Nitrotoluene		0.5	U	UG/L	6.02E-05	
19406-51-0	4-Amino-2,6-Dinitrotoluene		0.5	U	UG/L	9.26E-04	
99-99-0	4-Nitrotoluene (PNT)		0.5	U	UG/L	7.14E-05	
2691-41-0	HMX		0.5	U	UG/L	1.52E-03	
98-95-3	Nitrobenzene		0.25	U	UG/L	9.26E-04	
55-63-0	Nitroglycerin		1	U	UG/L	5.00E-03	
78-11-5	Pentaerythritol tetranitrate (PETN)		2	U	UG/L	2.35E-05	
121-82-4	RDX		0.5	U	UG/L	2.63E-03	
479-45-8	Tetryl		0.75	U	UG/L		
Metals							
7429-90-5	Aluminum	200	1320	J	UG/L	1.52E+01	
7440-36-0	Antimony	6	6	U	UG/L	2.00E-01	
7440-38-2	Arsenic	10	2.1	J	UG/L	1.11E-02	
7440-39-3	Barium	22.7	52.5	J	UG/L	1.05E-02	
7440-41-7	Beryllium	5	5	U	UG/L	9.43E+00	
7440-42-8	Boron		100	U	UG/L	1.00E-01	
7440-43-9	Cadmium	5	5	U	UG/L	4.55E+00	
7440-70-2	Calcium	7197	63400		UG/L	5.47E-01	
7440-47-3	Chromium	10	10	U	UG/L	4.83E-02	
7440-48-4	Cobalt	50	50	U	UG/L	2.17E+01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-12
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 2P (AUS-0A2P)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
7440-50-8	Copper	10	10	U	UG/L	8.47E-01	
7439-89-6	Iron	100	1260		UG/L	1.26E+00	
7439-92-1	Lead	2	3	U	UG/L	1.49E-01	
7439-95-4	Magnesium	2534	17200		UG/L	2.10E-01	
7439-96-5	Manganese	582	20	U	UG/L	2.00E-02	
7439-97-6	Mercury	0.2	0.2	U	UG/L	1.54E-01	
7440-02-0	Nickel	10	10	U	UG/L	1.00E-02	
2023695	Potassium	1613	1970		UG/L	3.72E-02	
7782-49-2	Selenium	2.7	5	U	UG/L	5.00E-03	
7440-22-4	Silver	10	10	U	UG/L	2.00E+00	
7440-23-5	Sodium	3169	26700		UG/L	3.93E-02	
7440-28-0	Thallium	10	10	U	UG/L	2.50E+00	
7440-62-2	Vanadium	50	50	U	UG/L	2.63E+00	
7440-66-6	Zinc	20	36.9		UG/L	3.69E-02	
Other Parameters							
7601-90-3	Perchlorate		500	U	UG/L		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 6-13, AUS-0A2P
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Volatile Organic Compounds								
1,1,1-Trichloroethane	No	C	No	F	NA	NA	No	A
1,1,2,2-Tetrachloroethane	No	C	Uncertainty	B	NA	NA	Uncertainty	B
1,1,2-Trichloroethane	No	C	Yes	E	NA	NA	Uncertainty	B
1,1-Dichloroethane	No	C	Uncertainty	B	NA	NA	No	A
1,1-Dichloroethene	No	C	Yes	E	NA	NA	Uncertainty	B
1,2-Dichloroethane (EDC)	No	C	Yes	E	NA	NA	Uncertainty	B
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	No	A
1,2-Dichloropropane	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2-Butanone (MEK)	No	C	Uncertainty	B	NA	NA	No	A
2-Hexanone	No	C	No	C	NA	NA	No	C
4-Methyl-2-pentanone (MIBK)	No	C	Uncertainty	B	NA	NA	No	A
Acetone	No	C	Uncertainty	B	NA	NA	No	A
Benzene	No	A	Uncertainty	B	NA	NA	Uncertainty	B
Bromodichloromethane	No	C	Uncertainty	B	NA	NA	No	A
Bromoform	No	C	Uncertainty	B	NA	NA	No	A
Bromomethane	No	C	Uncertainty	B	NA	NA	No	A
Carbon disulfide	No	C	Uncertainty	B	NA	NA	No	A
Carbon tetrachloride	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Chlorobenzene	No	C	Uncertainty	B	NA	NA	No	A
Chloroethane	No	C	Uncertainty	B	NA	NA	No	A
Chloroform	No	C	Yes	E	NA	NA	No	A
Chloromethane	No	C	Uncertainty	B	NA	NA	No	A
cis-1,2-Dichloroethene	No	C	No	F	NA	NA	No	F
cis-1,3-Dichloropropene	No	C	Uncertainty	B	NA	NA	No	A
Dibromochloromethane	No	C	Uncertainty	B	NA	NA	No	A
Ethylbenzene	No	A	Uncertainty	B	NA	NA	No	A
Methylene chloride	No	A	Uncertainty	B	NA	NA	Uncertainty	B
N-Hexane	No	C	Uncertainty	B	NA	NA	No	A
Styrene	No	C	Uncertainty	B	NA	NA	No	A
Tetrachloroethylene (PCE)	No	C	Yes	E	NA	NA	Yes	E
Toluene	No	A	No	F	NA	NA	No	A
total Xylenes	No	A	Uncertainty	B	NA	NA	No	A
trans-1,2-Dichloroethene	No	C	No	F	NA	NA	No	A
trans-1,3-Dichloropropene	No	C	Uncertainty	B	NA	NA	No	A
Trichloroethylene (TCE)	No	C	Yes	E	NA	NA	Yes	E
Vinyl chloride	No	C	Yes	E	NA	NA	Uncertainty	B
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	No	C	No	A	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	No	C	No	A	NA	NA	No	A
1,3-Dichlorobenzene	No	C	Uncertainty	B	NA	NA	No	A
1,4-Dichlorobenzene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	No	C	No	A	NA	NA	No	A

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trichlorophenol	No	C	Uncertainty	B	NA	NA	Uncertainty	B
2,4-Dichlorophenol	No	C	No	A	NA	NA	Uncertainty	B
2,4-Dimethylphenol	No	C	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	No	C	No	A	NA	NA	Uncertainty	B
2-Chloronaphthalene	No	C	No	A	NA	NA	No	A
2-Chlorophenol	No	C	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	No	F
2-Methylnaphthalene	No	A	No	A	NA	NA	No	F
2-Methylphenol	No	C	No	A	NA	NA	No	A
2-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
2-Nitrophenol	No	C	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	No	C	Uncertainty	B	NA	NA	Uncertainty	B
3-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
4,6-Dinitro-2-methylphenol	No	C	No	C	NA	NA	No	C
4-Bromophenyl phenyl ether	No	C	No	C	NA	NA	No	C
4-Chloro-3-methylphenol	No	C	No	A	NA	NA	No	A
4-Chloroaniline	No	C	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	No	C	No	C	NA	NA	No	C
4-Methylphenol	No	C	No	A	NA	NA	No	A
4-Nitroaniline	No	C	Uncertainty	B	NA	NA	No	A
4-Nitrophenol	No	C	No	A	NA	NA	No	A
Acenaphthene	No	C	No	A	NA	NA	No	F
Acenaphthylene	No	A	No	A	NA	NA	No	F
Anthracene	No	A	No	A	NA	NA	No	F
Benzo(a)anthracene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(b)fluoranthene	Uncertainty	B	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	No	A	No	A	NA	NA	No	F
Benzo(k)fluoranthene	No	C	Uncertainty	B	NA	NA	No	F
bis(2-Chloroethoxy)methane	No	C	No	C	NA	NA	No	C
bis(2-Chloroethyl) ether	No	C	Uncertainty	B	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	No	C	Uncertainty	B	NA	NA	No	A
bis(2-Ethylhexyl) phthalate	No	C	Uncertainty	B	NA	NA	No	F
Butyl benzyl phthalate	No	C	No	A	NA	NA	No	F
Carbazole	No	C	Uncertainty	B	NA	NA	Yes	E
Chrysene	Uncertainty	B	Uncertainty	B	NA	NA	No	F
Di-n-butyl phthalate	No	C	No	A	NA	NA	No	A
Di-n-octyl phthalate	No	C	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	No	C	Uncertainty	B	NA	NA	Yes	E
Dibenzofuran	No	C	No	A	NA	NA	No	F
Diethyl phthalate	No	C	No	A	NA	NA	No	F
Dimethyl phthalate	No	C	No	A	NA	NA	No	A
Fluoranthene	No	A	No	A	NA	NA	No	F

TABLE 6-13, AUS-0A2P
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Fluorene	No	A	No	A	NA	NA	No	F
Hexachlorobenzene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorobutadiene	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	No	C	No	A	NA	NA	No	A
Hexachloroethane	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	Uncertainty	B	Uncertainty	B	NA	NA	No	F
Isophorone	No	C	No	A	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	No	C	Uncertainty	B	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	No	C	No	A	NA	NA	Uncertainty	B
Naphthalene	No	C	Uncertainty	B	NA	NA	No	F
Pentachlorophenol	No	C	Uncertainty	B	NA	NA	Uncertainty	B
Phenanthrene	No	A	No	A	NA	NA	No	F
Phenol	No	A	No	A	NA	NA	No	A
Pyrene	No	A	No	A	NA	NA	No	F
Metals and Inorganics								
Aluminum	Uncertainty	G	No	F	NA	NA	No	F
Antimony	No	C	Uncertainty	B	NA	NA	Yes	E
Arsenic	Uncertainty	G	Uncertainty	B	NA	NA	Yes	E
Barium	No	F	No	F	NA	NA	Yes	D
Beryllium	No	C	Uncertainty	B	NA	NA	No	F
Boron	No	A	No	F	NA	NA	No	F
Cadmium	No	C	Uncertainty	B	NA	NA	Yes	E
Calcium	No	H	No	H	NA	NA	No	H
Chromium	No	C	No	A	NA	NA	Yes	E
Cobalt	No	C	No	A	NA	NA	No	F
Copper	No	C	No	F	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Yes	E	No	F	NA	NA	No	F
Lead	No	C	No	A	NA	NA	No	F
Magnesium	No	H	No	H	NA	NA	No	H
Manganese	No	A	No	F	NA	NA	No	F
Mercury	Uncertainty	B	No	A	NA	NA	Yes	E
Nickel	No	A	No	F	NA	NA	Yes	E
Potassium	No	H	No	H	NA	NA	No	H
Selenium	No	A	No	F	NA	NA	Yes	E
Silver	Uncertainty	B	No	A	NA	NA	Yes	E
Sodium	No	H	No	H	NA	NA	No	H
Thallium	No	C	Uncertainty	B	NA	NA	No	F
Vanadium	No	C	No	A	NA	NA	No	F
Zinc	No	F	No	A	NA	NA	Yes	E
Explosives								
1,3,5-Trinitrobenzene	No	C	No	A	NA	NA	No	A
1,3-Dinitrobenzene	No	C	No	A	NA	NA	No	A

TABLE 6-13, AUS-0A2P
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	C	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	No	C	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
2-Nitrotoluene (ONT)	No	C	No	C	NA	NA	No	C
3-Nitrotoluene	No	C	No	A	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	No	C	No	C	NA	NA	No	C
4-Nitrotoluene (PNT)	No	C	No	A	NA	NA	No	A
HMX	No	C	No	A	NA	NA	No	A
Nitrobenzene	No	C	No	A	NA	NA	Uncertainty	B
Nitroglycerin	No	C	No	A	NA	NA	No	A
Pentaerythritol tetranitrate (PETN)	No	C	No	C	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	No	C	No	A	NA	NA	No	A
Tetryl	No	C	No	A	NA	NA	No	A
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	Yes	E	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	Yes	E	NA	NA	NA	NA

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 6-14, AUS-0A2P
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	No	A	NA	NA	No	A
1,1,2,2-Tetrachloroethane	No	A	NA	NA	No	A
1,1,2-Trichloroethane	No	A	NA	NA	No	A
1,1-Dichloroethane	No	A	NA	NA	No	A
1,1-Dichloroethene	No	A	NA	NA	No	A
1,2-Dichloroethane (EDC)	No	A	NA	NA	No	A
1,2-Dichloroethene (total)	NA	NA	NA	NA	No	A
1,2-Dichloropropane	No	A	NA	NA	No	A
2-Butanone (MEK)	No	A	NA	NA	No	A
2-Hexanone	No	A	NA	NA	No	A
4-Methyl-2-pentanone (MIBK)	No	A	NA	NA	No	A
Acetone	No	A	NA	NA	No	A
Benzene	No	A	NA	NA	No	A
Bromodichloromethane	No	A	NA	NA	No	A
Bromoform	No	A	NA	NA	No	A
Bromomethane	No	A	NA	NA	No	A
Carbon disulfide	Uncertainty	B	NA	NA	No	A
Carbon tetrachloride	No	A	NA	NA	No	A
Chlorobenzene	No	A	NA	NA	No	A
Chloroethane	No	A	NA	NA	No	C
Chloroform	No	A	NA	NA	No	A
Chloromethane	No	A	NA	NA	No	A
cis-1,2-Dichloroethene	No	A	NA	NA	No	F
cis-1,3-Dichloropropene	Uncertainty	B	NA	NA	No	A
Dibromochloromethane	No	A	NA	NA	No	A
Ethylbenzene	No	A	NA	NA	No	A
Methylene chloride	No	A	NA	NA	No	A
N-Hexane	No	C	NA	NA	No	C
Styrene	No	A	NA	NA	No	A
Tetrachloroethylene (PCE)	No	A	NA	NA	No	F
Toluene	No	A	NA	NA	No	A
total Xylenes	No	A	NA	NA	No	A
trans-1,2-Dichloroethene	No	A	NA	NA	No	A
trans-1,3-Dichloropropene	No	A	NA	NA	No	A
Trichloroethylene (TCE)	No	A	NA	NA	No	F
Vinyl chloride	No	A	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	No	A	NA	NA	No	A
1,2-Dichlorobenzene	No	A	NA	NA	No	A
1,3-Dichlorobenzene	No	A	NA	NA	No	A
1,4-Dichlorobenzene	No	A	NA	NA	No	A
2,4,5-Trichlorophenol	No	A	NA	NA	No	A

TABLE 6-14, AUS-0A2P
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trichlorophenol	Uncertainty	B	NA	NA	No	A
2,4-Dichlorophenol	No	A	NA	NA	No	A
2,4-Dimethylphenol	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	Uncertainty	B	NA	NA	No	A
2-Chloronaphthalene	No	A	NA	NA	Uncertainty	B
2-Chlorophenol	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	Uncertainty	G
2-Methylnaphthalene	No	A	NA	NA	Yes	E
2-Methylphenol	No	A	NA	NA	No	A
2-Nitroaniline	No	A	NA	NA	No	A
2-Nitrophenol	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	No	A	NA	NA	No	A
3-Nitroaniline	No	A	NA	NA	No	A
4,6-Dinitro-2-methylphenol	Uncertainty	B	NA	NA	No	C
4-Bromophenyl phenyl ether	Uncertainty	B	NA	NA	No	C
4-Chloro-3-methylphenol	Uncertainty	B	NA	NA	No	A
4-Chloroaniline	No	A	NA	NA	No	A
4-Chlorophenyl phenyl ether	No	A	NA	NA	No	C
4-Methylphenol	No	A	NA	NA	No	A
4-Nitroaniline	No	A	NA	NA	No	A
4-Nitrophenol	No	A	NA	NA	No	A
Acenaphthene	No	A	NA	NA	Yes	E
Acenaphthylene	No	A	NA	NA	No	F
Anthracene	Uncertainty	B	NA	NA	Yes	E
Benzo(a)anthracene	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	Uncertainty	B	NA	NA	Yes	E
Benzo(b)fluoranthene	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	Uncertainty	B	NA	NA	Yes	E
Benzo(k)fluoranthene	Uncertainty	B	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	No	A	NA	NA	Uncertainty	B
bis(2-Chloroethyl) ether	No	A	NA	NA	No	A
bis(2-Chloroisopropyl) ether	No	C	NA	NA	No	C
bis(2-Ethylhexyl) phthalate	Uncertainty	B	NA	NA	Yes	E
Butyl benzyl phthalate	No	A	NA	NA	Yes	E
Carbazole	No	A	NA	NA	Yes	E
Chrysene	No	A	NA	NA	Yes	E
Di-n-butyl phthalate	Uncertainty	B	NA	NA	No	A
Di-n-octyl phthalate	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	Uncertainty	B	NA	NA	Yes	E
Dibenzofuran	Uncertainty	B	NA	NA	Yes	E
Diethyl phthalate	No	A	NA	NA	No	F
Dimethyl phthalate	No	A	NA	NA	No	A
Fluoranthene	Uncertainty	B	NA	NA	Yes	E

TABLE 6-14, AUS-0A2P
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Fluorene	Uncertainty	B	NA	NA	Yes	E
Hexachlorobenzene	Uncertainty	B	NA	NA	No	A
Hexachlorobutadiene	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	Uncertainty	B	NA	NA	No	A
Hexachloroethane	Uncertainty	B	NA	NA	No	A
Indeno(1,2,3-c,d)pyrene	Uncertainty	B	NA	NA	Yes	E
Isophorone	No	A	NA	NA	No	A
N-Nitroso-di-n-propylamine	No	C	NA	NA	No	A
N-Nitrosodiphenylamine	No	A	NA	NA	No	A
Naphthalene	No	A	NA	NA	No	F
Pentachlorophenol	Uncertainty	B	NA	NA	No	A
Phenanthrene	Uncertainty	B	NA	NA	Yes	E
Phenol	No	A	NA	NA	No	A
Pyrene	No	A	NA	NA	Yes	E
Metals and Inorganics						
Aluminum	Yes	E	NA	NA	Uncertainty	I
Antimony	No	A	NA	NA	No	F
Arsenic	No	F	NA	NA	Yes	E
Barium	No	F	NA	NA	No	F
Beryllium	Uncertainty	B	NA	NA	No	F
Boron	No	A	NA	NA	Yes	E
Cadmium	Uncertainty	B	NA	NA	No	F
Calcium	No	F,H	NA	NA	Uncertainty	G,H
Chromium	No	A	NA	NA	Yes	E
Cobalt	Uncertainty	B	NA	NA	No	F
Copper	No	A	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	NA	NA
Iron	Yes	E	NA	NA	Yes	E
Lead	No	A	NA	NA	No	F
Magnesium	No	F,H	NA	NA	Uncertainty	G,H
Manganese	No	A	NA	NA	Yes	D
Mercury	No	A	NA	NA	Yes	E
Nickel	No	A	NA	NA	No	F
Potassium	No	F,H	NA	NA	Uncertainty	G,H
Selenium	No	A	NA	NA	Yes	E
Silver	Uncertainty	B	NA	NA	Yes	E
Sodium	No	F,H	NA	NA	Uncertainty	G,H
Thallium	Uncertainty	B	NA	NA	No	F
Vanadium	Uncertainty	B	NA	NA	No	F
Zinc	No	F	NA	NA	Yes	E
Explosives						
1,3,5-Trinitrobenzene	No	A	NA	NA	Uncertainty	B
1,3-Dinitrobenzene	No	A	NA	NA	No	A

TABLE 6-14, AUS-0A2P
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	A	NA	NA	No	A
2,6-Dinitrotoluene	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	A	NA	NA	No	A
2-Nitrotoluene (ONT)	No	A	NA	NA	No	C
3-Nitrotoluene	No	A	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	No	A	NA	NA	No	C
4-Nitrotoluene (PNT)	No	A	NA	NA	No	C
HMX	No	A	NA	NA	No	A
Nitrobenzene	No	A	NA	NA	No	A
Nitroglycerin	No	A	NA	NA	No	C
Pentaerythritol tetranitrate (PETN)	No	A	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	No	A	NA	NA	No	A
Tetryl	No	C	NA	NA	No	C

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.

J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 6-15

AUS-0A2P - IOP ARTILLERY PRIMER LOADING LINE

CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND (WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum[1]	Soil	Sediment	Ground Water	Surface Water
VOCs					
1,1,2-Trichloroethane			NA	H	
1,1-Dichloroethene			NA	H	
1,2-Dichloroethane (EDC)			NA	H	
Chloroform			NA	H	
Tetrachloroethylene (PCE)		H	NA	H	
Trichloroethylene (TCE)		H	NA	H	
Vinyl chloride			NA	H	
SVOCs					
2-Methylnaphthalene		E	NA		
Acenaphthene		E	NA		
Anthracene		E	NA		
Benzo(a)anthracene		H,E	NA		
Benzo(a)pyrene		H,E	NA		
Benzo(b)fluoranthene		H,E	NA		
Benzo(g,h,i)perylene		E	NA		
Benzo(k)fluoranthene		E	NA		
bis(2-Ethylhexyl)phthalate		E	NA		
Butyl benzyl phthalate		E	NA		
Carbazole		H,E	NA		
Chrysene		E	NA		
Dibenz(a,h)anthracene		H,E	NA		
Dibenzofuran		E	NA		
Fluoranthene		E	NA		
Fluorene		E	NA		
Indeno(1,2,3-c,d)pyrene		E	NA		
Phenanthrene		E	NA		
Pyrene		E	NA		
Metals					
Aluminum			NA		E
Antimony		H	NA		
Arsenic		H,E	NA		
Boron		E	NA		
Cadmium		H	NA		
Chromium		H,E	NA		
Copper		E	NA		
Iron		E	NA		H,E
Mercury		H,E	NA		
Nickel		H	NA		
Selenium		H,E	NA		
Silver		H,E	NA		
Zinc		H,E	NA		

TABLE 6-15

AUS-0A2P - IOP ARTILLERY PRIMER LOADING LINE

CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND (WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum[1]	Soil	Sediment	Ground Water	Surface Water
Other Parameters					
Nitrogen, Nitrate-Nitrite		NA	NA	**H**	NA
Phosphorus, Total (as P)		NA	NA	**H**	NA

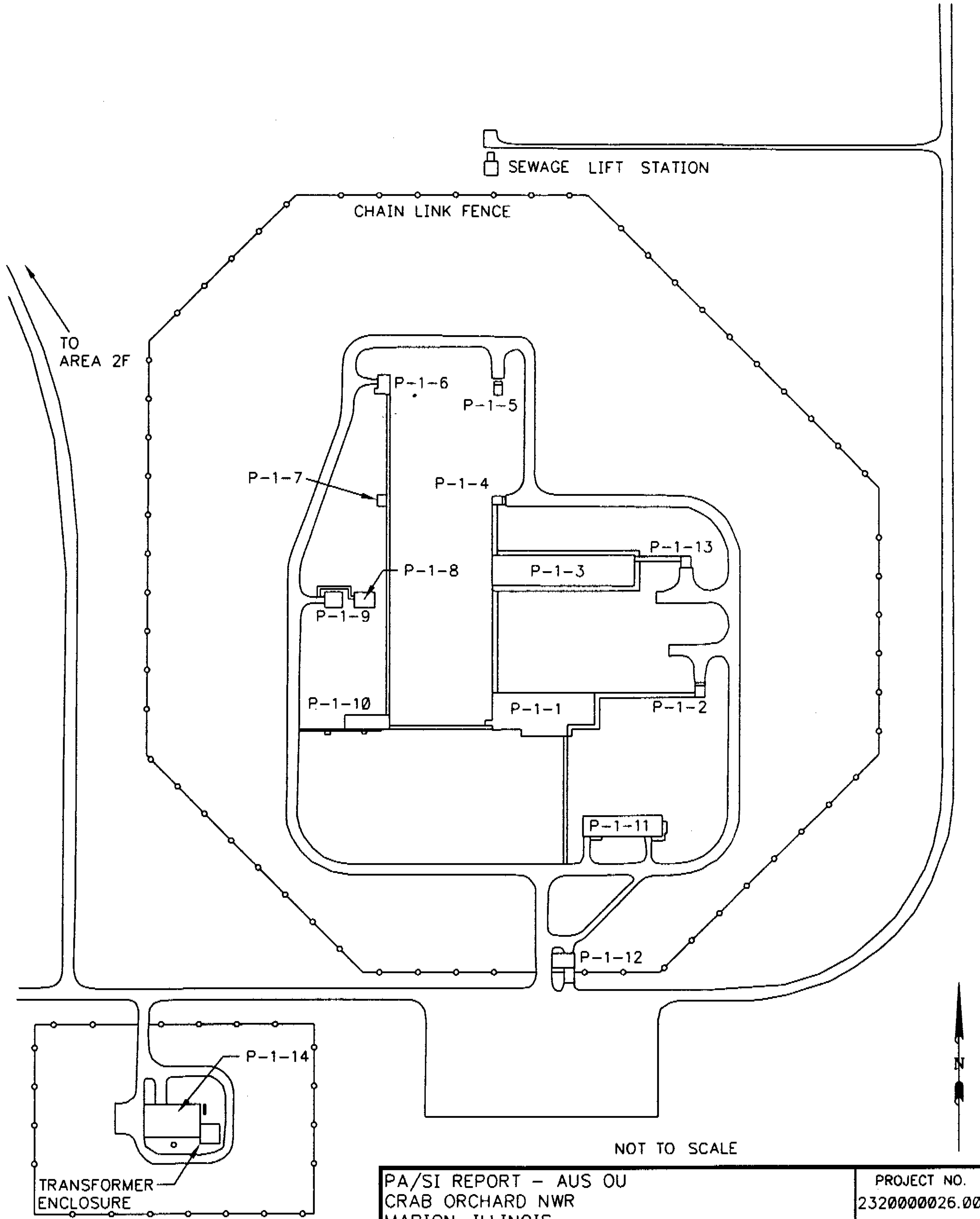
Key:

[1] Drums were not present at this site.

NA = not analyzed

H = human health screening criteria exceeded

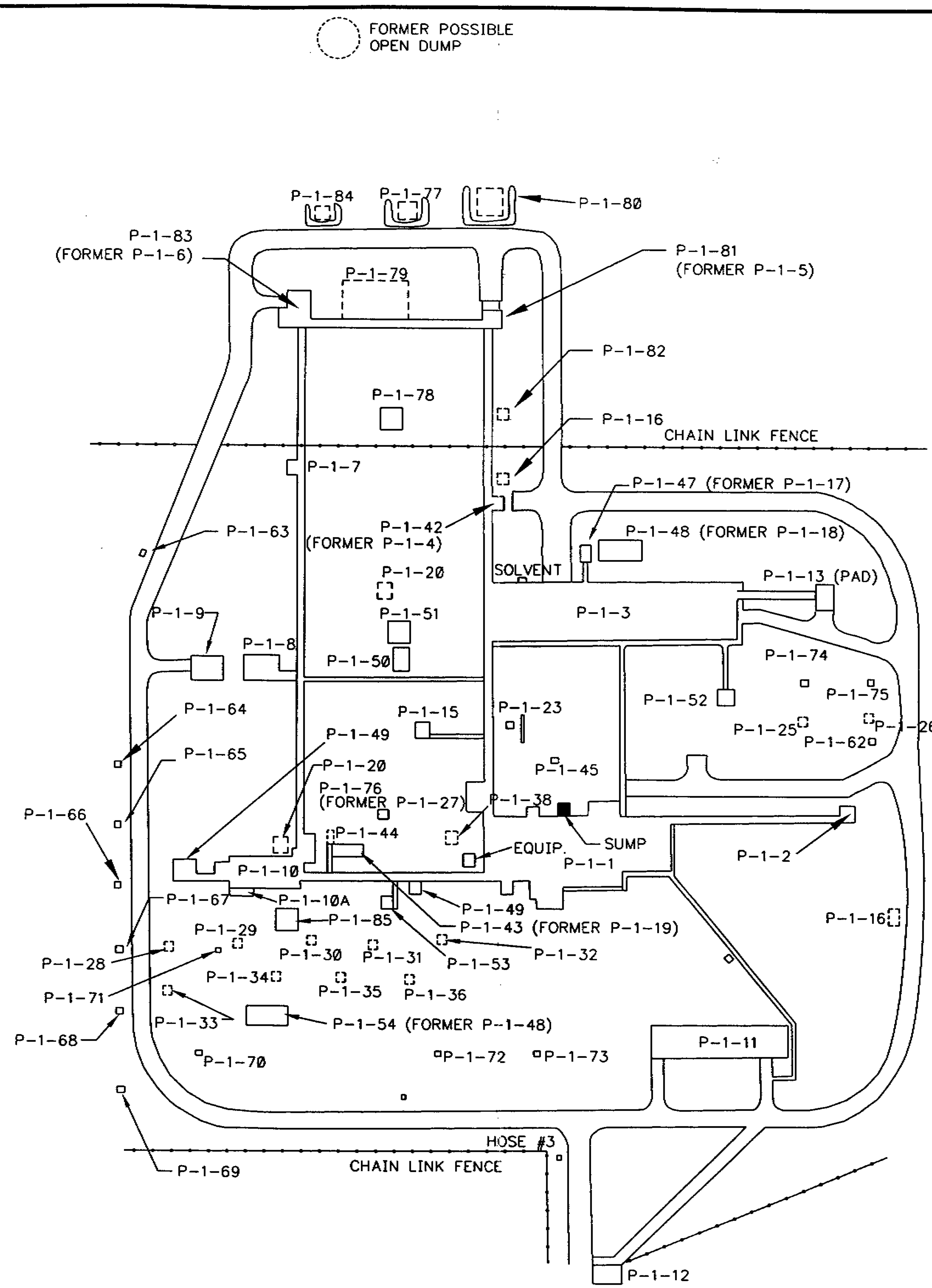
E = ecological screening criteria exceeded



SOURCE: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT
PART I SEC 1.5 PAGE 6
(PLAN NO. 6544-101.12)

PA/SI REPORT - AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 8/15/99 DSGN. BY: mh CHKD. BY: cmw	Original IOP Configuration of Area 2P
FIG. NO.	6-1

File: E:\2320000026.00\PA-SI REPORT-AUS OU\CRABFIG6-1LS.DWG Last edited: 09/18/01 @ 11:13 a.m. WC-ST.LOUIS, MO



SOURCES:

1. PRI – Ø16821
2. PRI – ØØ6639
3. PRI – Ø16721
4. PRI – ØØ2633
5. SITE RECONNAISSANCE PERFORMED ON APRIL 2Ø, 1999.
6. ENTECH, INC. 1999. SITE SPECIFIC REPORT ON AREA 2 AT THE FORMER ILLINOIS ORDNANCE PLANT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS, FIGURE 12.
7. ORIGINAL IOP PLAN NO. 6544-1Ø1.12, LAST REVISION JUNE 3Ø, 1942 WITH LATER NOTATIONS ADDED BY REFUGE PERSONNEL. THE NOTATIONS RECORDED SOME INFORMATION ABOUT LEASES, BUILDING USES, AND BUILDINGS THAT WERE REMOVED OR DESTROYED.

N

NOT TO SCALE

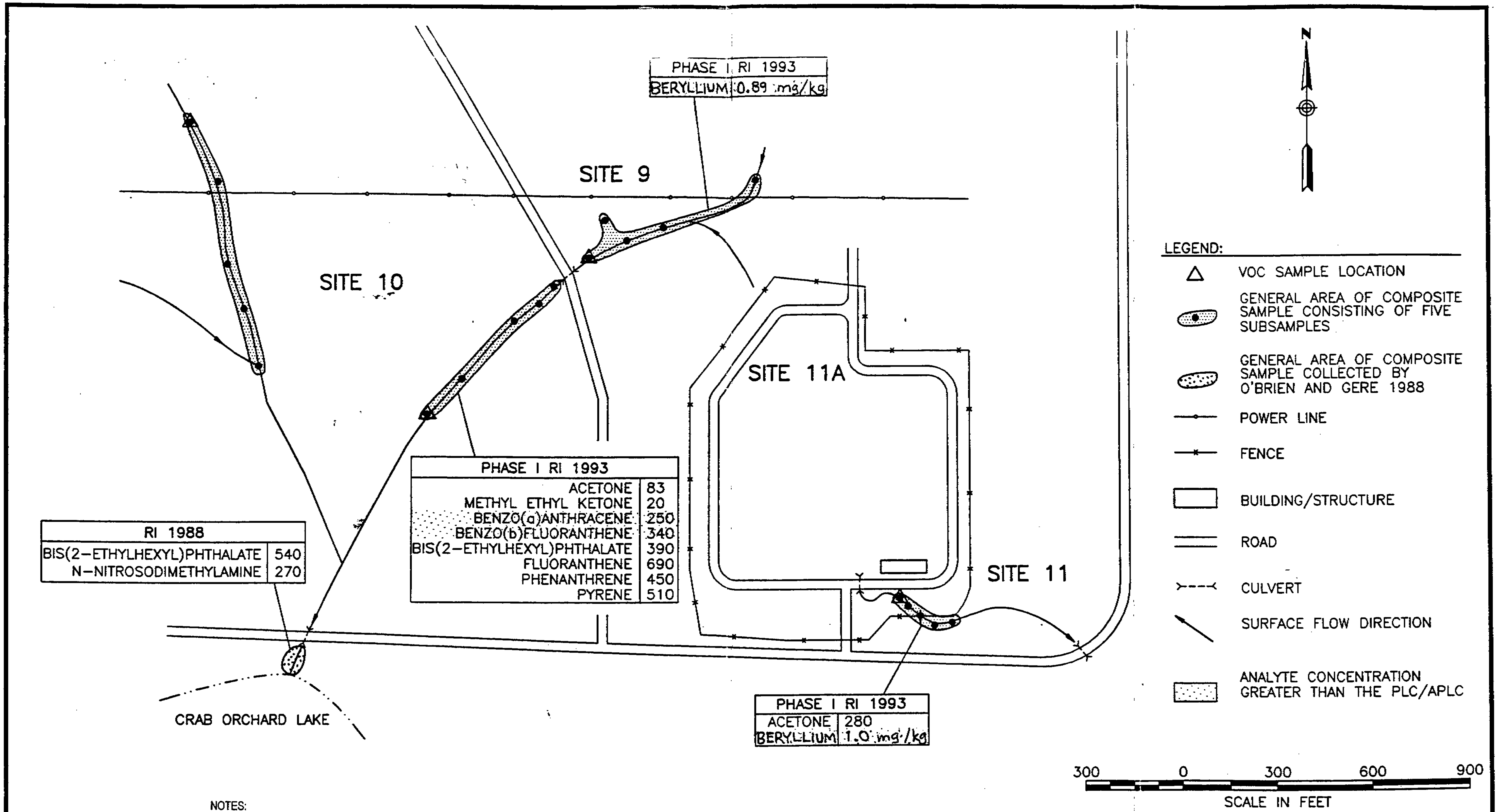
NOTE:

1. DASHED OUTLINES INDICATE FORMER BUILDINGS.

PA/SI REPORT – AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY:djd 8/8/99 DSGN. BY:mh CHKD. BY:mch/cmw	Current Area 2P Configuration	FIG. NO. 6-2



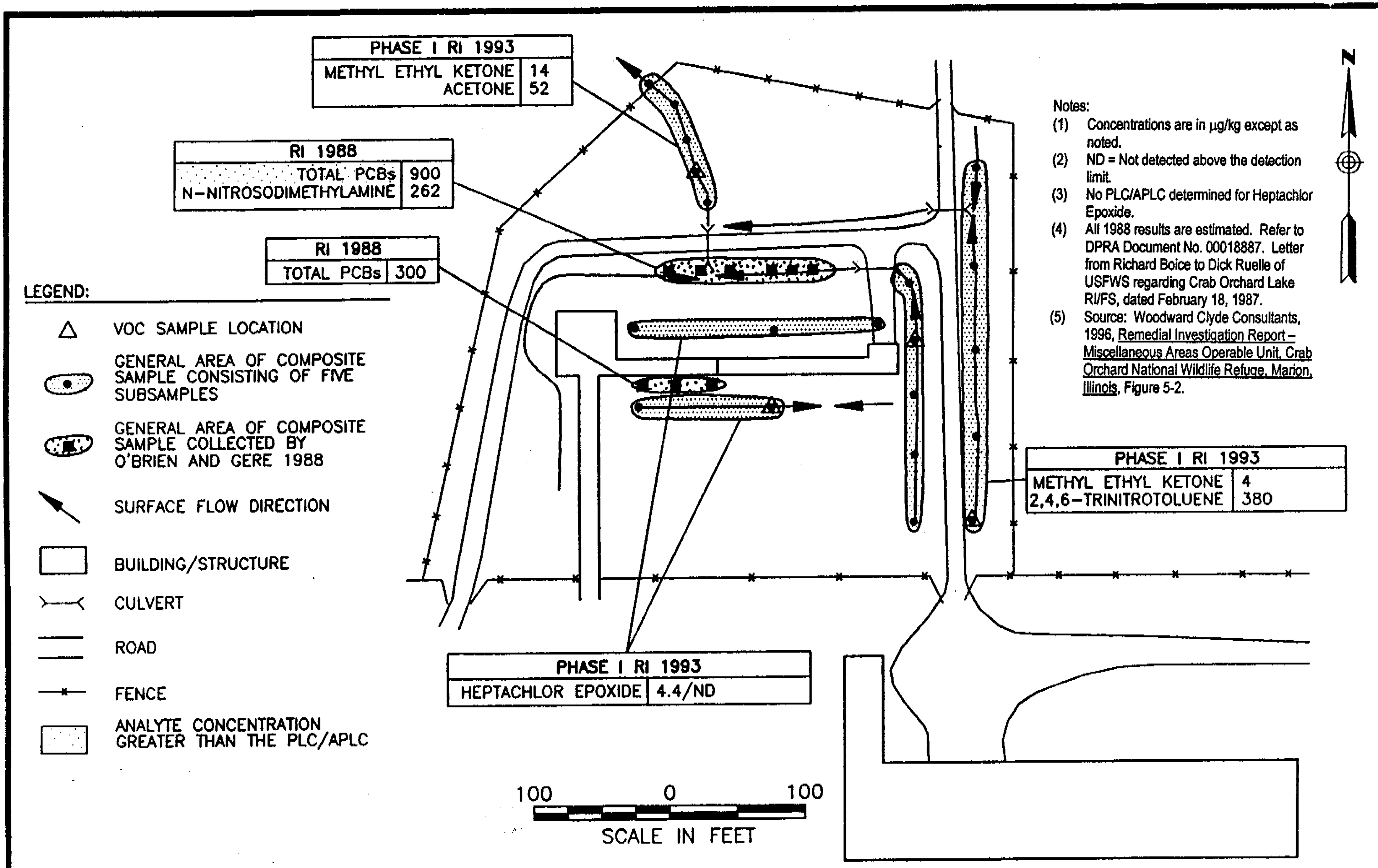
NOTES:

(1) CONCENTRATIONS ARE IN µg/kg EXCEPT AS NOTED.

(2) ALL 1988 RESULTS ARE ESTIMATED. REFER TO DPRA DOCUMENT NO. 00018887. LETTER FROM RICHARD BOICE TO DICK RUELLE OF USFWS REGARDING CRAB ORCHARD LAKE RI/FS, DATED FEBRUARY 18, 1987.

(3) SOURCE: WOODWARD CLYDE CONSULTANTS, 1996, REMEDIAL INVESTIGATION REPORT – MISCELLANEOUS AREAS OPERABLE UNIT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS, FIGURE 5-1.

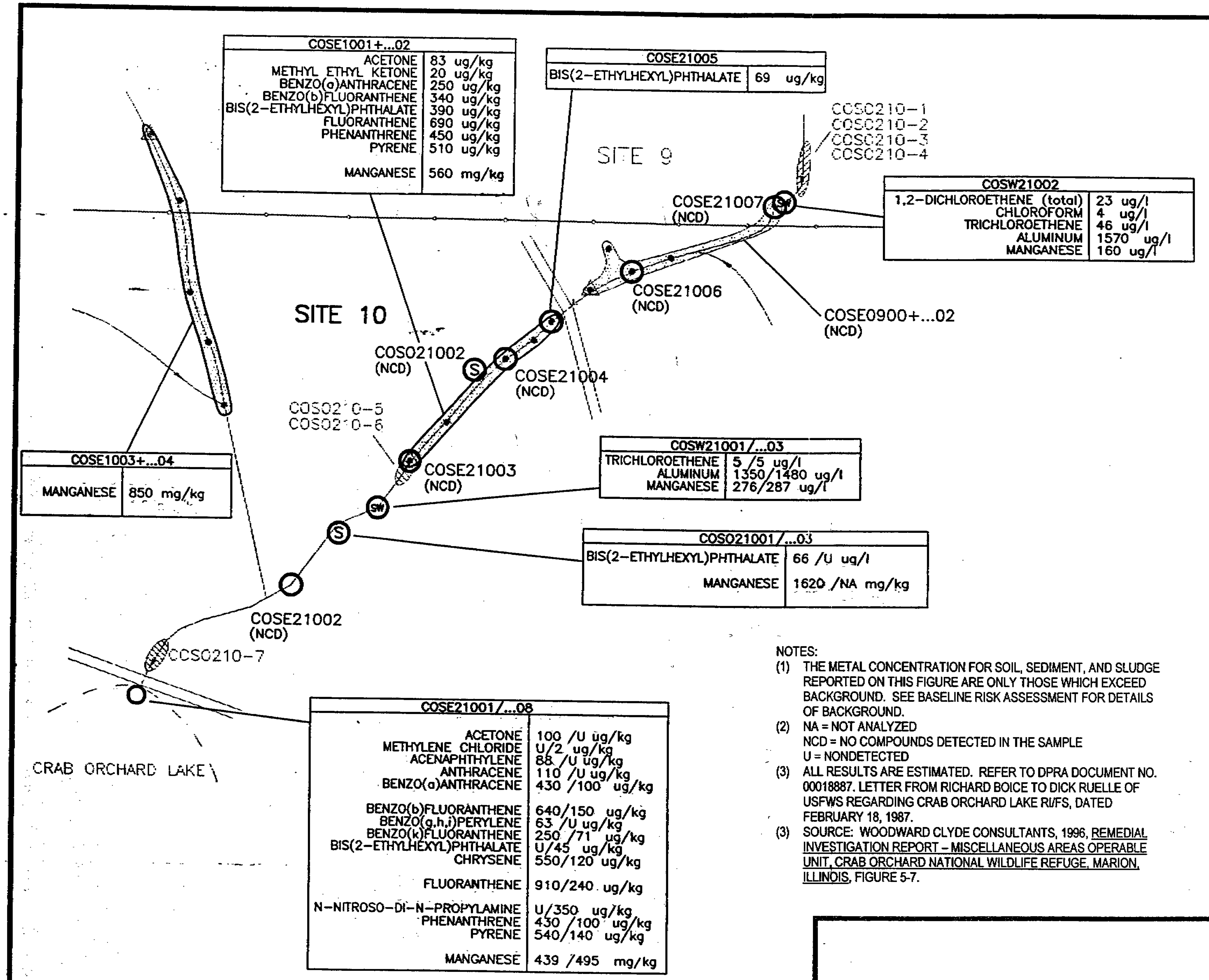
CLIENT/PROJECT: W-C/CRAB ORCHARD RI/IL	TITLE: SITES 9, 10, AND 11 SUMMARY OF PHASE I ANALYTICAL RESULTS		
	DRAWN: DMC	DATE: 2-28-95	JOB NO. 933-8168
	CHECKED: [illegible]	SCALE: AS SHOWN	DWG. NO.
	REVIEWED: [illegible]	FILE NAME: 8168163	FIGURE NO. 6-2a



CLIENT/PROJECT: W-C/CRAB ORCHARD RI/IL

TITLE: SITE 11A SUMMARY OF PHASE I ANALYTICAL RESULTS

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NAME	JOB NO.	DWG NO.	FIGURE
DMC	WGB	WGB	2-28-95	AS SHOWN	8168164	933-8168		6-2b



LEGEND:

PHASE I SAMPLING LOCATIONS

- VOC SAMPLE LOCATION
- GENERAL AREA OF COMPOSITE SAMPLE CONSISTING OF FIVE GRAB SAMPLES

PHASE II SAMPLING LOCATIONS

- DISCRETE SEDIMENT SAMPLE LOCATION
- DISCRETE SOIL SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION
- GENERAL LOCATION OF SOLID PHASE TOXICITY SAMPLING AREA

OTHER FEATURES

- POWER LINE
- ROAD
- CULVERT
- SURFACE FLOW DIRECTION

NOTES:

(1) THE METAL CONCENTRATION FOR SOIL, SEDIMENT, AND SLUDGE REPORTED ON THIS FIGURE ARE ONLY THOSE WHICH EXCEED BACKGROUND. SEE BASELINE RISK ASSESSMENT FOR DETAILS OF BACKGROUND.

(2) NA = NOT ANALYZED
NCD = NO COMPOUNDS DETECTED IN THE SAMPLE
U = NONDETECTED

(3) ALL RESULTS ARE ESTIMATED. REFER TO DPRA DOCUMENT NO. 00018887. LETTER FROM RICHARD BOICE TO DICK RUELLE OF USFWS REGARDING CRAB ORCHARD LAKE RI/FS, DATED FEBRUARY 18, 1987.

(3) SOURCE: WOODWARD CLYDE CONSULTANTS, 1996, REMEDIAL INVESTIGATION REPORT – MISCELLANEOUS AREAS OPERABLE UNIT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS, FIGURE 5-7.

CLIENT/PROJECT: W-C/CRAB ORCHARD RI/IL	TITLE: SITE 10 DETECTED CONCENTRATIONS		
	DRAWN: TPK	DATE: 2-28-95	JOB NO. 933-8168
	CHECKED: WGB	SCALE: AS SHOWN	DWG. NO.
	REVIEWED: WGB	FILE NAME: 8168138	FIGURE NO. 6-2c

LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

AUS-0A2P-023	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-W01	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 17 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2P-002	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-001	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-003	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-005	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-011	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	72	e5		
Butyl benzyl phthalate	UG/KG	100	e5		
Chrysene	UG/KG	63	e5		
Pyrene	UG/KG	49	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-020	Units	Result: 0 - 6 in	Reference Code
Explosives			
All Explosives	UG/KG	ND	

AUS-0A2P-012	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-015	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Anthracene	UG/KG	72	e5		
Benzo(a)anthracene	UG/KG	280	e5,h5		
Benzo(a)pyrene	UG/KG	280	e5		
Benzo(b)fluoranthene	UG/KG	320	e5,h5		
Benzo(g,h,i)perylene	UG/KG	180	e5		
Benzo(k)fluoranthene	UG/KG	230	e5		
Chrysene	UG/KG	350	e5		
Fluoranthene	UG/KG	550	e5		
Indeno(1,2,3-c,d)pyrene	UG/KG	170	e5		
Phenanthrene	UG/KG	380	e5		
Pyrene	UG/KG	730	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-013	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-W05	Units	Result: 1.5 ft	Reference Code	Result: 2 ft	Reference Code	Result: 5 ft	Reference Code	Result: 16 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2P-014	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-010	Units	Result: 0 - 6 in	Reference Code
Explosives			
All Explosives	UG/KG	ND	

AUS-0A2P-016	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-004	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-W02	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 15 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND			
cis-1,2-Dichloroethene	UG/KG							3	
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2P-006	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-007	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-W03	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 18 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA							
cis-1,2-Dichloroethene	UG/KG			ND		8		2	
Tetrachloroethylene (PCE)	UG/KG			ND		ND		15	h5
Trichloroethylene (TCE)	UG/KG			4	h5	190	h5,h9	240	h5,h9
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2P-008	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Butyl benzyl phthalate	UG/KG	6300	e1,e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-009	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Butyl benzyl phthalate	UG/KG	60	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-W04	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 20 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Semivolatile Organic Compounds									
All SVOCs	UG/KG			NA		NA		NA	
Benzo(b)fluoranthene	UG/KG	54	e5						
Butyl benzyl phthalate	UG/KG	840	e1,e5						
Diethyl phthalate (duplicate)	UG/KG	140							
Fluoranthene	UG/KG	42	e5						
Pyrene	UG/KG	61	e5						
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2P-W06	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code	Result: 5 ft	Reference Code	Result: 10 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Semivolatile Organic Compounds									
All SVOCs	UG/KG			NA		NA		NA	
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	180	e5						
Butyl benzyl phthalate	UG/KG	430	e1,e5						
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A2P-021	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Trichloroethylene (TCE)	UG/KG			4	h5
Polynuclear Aromatic Hydrocarbons (PAHs)					
All PAHs	UG/KG			NA	
1-Methylnaphthalene	UG/KG	2200			
2-Methylnaphthalene	UG/KG	6700	e1,e5		
Acenaphthene	UG/KG	95	e5		
Acenaphthylene	UG/KG	3700			
Benzo(a)anthracene	UG/KG	150	e5,h5		
Benzo(a)pyrene	UG/KG	75	e5		
Benzo(b)fluoranthene	UG/KG	28	e5		
Benzo(g,h,i)perylene	UG/KG	330	e5		
Benzo(k)fluoranthene	UG/KG	21	e5		
Chrysene	UG/KG	470	e5		
Fluoranthene	UG/KG	570	e5		
Fluorene	UG/KG	44	e5		
Naphthalene	UG/KG	1600			
Phenanthrene	UG/KG	1200	e5		
Pyrene	UG/KG	120	e5		

AUS-0A2P-022	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)					
All PAHs	UG/KG			NA	
1-Methylnaphthalene	UG/KG	130			
2-Methylnaphthalene	UG/KG	170	e5		
Acenaphthylene	UG/KG	160			
Benzo(a)anthracene	UG/KG	12	e5		
Benzo(a)pyrene	UG/KG	13	e5		
Benzo(b)fluoranthene	UG/KG	14	e5		
Benzo(g,h,i)perylene	UG/KG	18	e5		
Benzo(k)fluoranthene	UG/KG	7.8	e5		
Chrysene	UG/KG	36	e5		
Fluoranthene	UG/KG	45	e5		
Naphthalene	UG/KG	59			
Phenanthrene	UG/KG	76	e5		
Pyrene	UG/KG	26	e5		

AUS-0A2P-017	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Anthracene	UG/KG	100	e5		
Benzo(a)anthracene	UG/KG	500	e5,h5		
Benzo(a)pyrene	UG/KG	480	e5,h1,h5		
Benzo(b)fluoranthene	UG/KG	510	e5,h5		
Benzo(g,h,i)perylene	UG/KG	320	e5		
Benzo(k)fluoranthene	UG/KG	490	e5		
bis(2-Ethylhexyl) phthalate (DEHP)	UG/KG	190	e5		
Carbazole	UG/KG	63	e5,h5		
Chrysene	UG/KG	630	e5		
Dibenz(a,h)anthracene	UG/KG	130	e5,h5		
Fluoranthene	UG/KG	1200	e5		
Indeno(1,2,3-c,d)pyrene	UG/KG	310	e5		
Phenanthrene	UG/KG	550	e5		
Pyrene	UG/KG	960	e5		
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-018	Units	Result: 0 - 6 in	Reference Code	Result: 1 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A2P-019	Units	Result: 0 - 6 in	Reference Code
Semivolatile Organic Compounds			
Anthracene	UG/KG	89	e5
Benzo(a)anthracene	UG/KG	410	e5,h5
Benzo(a)pyrene	UG/KG	390	e5,h1
Benzo(b)fluoranthene	UG/KG	410	e5,h5
Benzo(g,h,i)perylene	UG/KG	240	e5
Benzo(k)fluoranthene	UG/KG	400	e5
Butyl benzyl phthalate	UG/KG	250	e1,e5
Carbazole	UG/KG	66	e5,h5
Chrysene	UG/KG	500	e5
Dibenzofuran	UG/KG	58	e5
Fluoranthene	UG/KG	760	e5
Indeno(1,2,3-c,d)pyrene	UG/KG	230	e5
Phenanthrene	UG/KG	490	e5
Pyrene	UG/KG	980	e5
Explosives			
All Explosives	UG/KG	ND	

N

100 0 100

SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.
4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

File: E:\AUS-SAMPLE LOCATION2\AUS-0A2P.DWG Last edited: NOV. 17, 00 @ 1:43 p.m. URS Corp.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS-ØA2P Sample Locations and Detections of Organic Compounds in Soils

Date: 6/28/00	Project Number: 2320000026.00	Figure Number: 6-3
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

AUS-0A2P-003	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6690	
Arsenic	MG/KG	7.7	h1,h5,h7
Barium	MG/KG	87.4	h5
Calcium	MG/KG	2090	
Chromium	MG/KG	10.3	e1,h5
Cobalt	MG/KG	6.9	
Copper	MG/KG	8.5	
Iron	MG/KG	18100	e1
Lead	MG/KG	18.4	
Magnesium	MG/KG	1510	
Manganese	MG/KG	979	e1
Nickel	MG/KG	10.6	h5
Potassium	MG/KG	482	
Selenium	MG/KG	1.2	e1,e5,h5
Silver (duplicate)	MG/KG	0.55	
Vanadium	MG/KG	22.3	
Zinc	MG/KG	34.1	

AUS-0A2P-001	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	11700	
Arsenic	MG/KG	13.9	b1,e1,h1,h5,h7
Barium	MG/KG	71.2	
Calcium	MG/KG	1580	
Chromium	MG/KG	15.4	e1,h5
Copper	MG/KG	14.4	b1
Iron	MG/KG	25200	b1,e1
Lead	MG/KG	15.4	
Magnesium	MG/KG	2700	b1
Manganese	MG/KG	246	e1
Nickel	MG/KG	10.7	h5
Potassium	MG/KG	637	b1
Selenium	MG/KG	0.97	e5,h5
Thallium	MG/KG	0.21	
Vanadium	MG/KG	31.7	
Zinc	MG/KG	43.3	
Other Parameters			
TOC	MG/KG	16100	

AUS-0A2P-002	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4620	
Antimony	MG/KG	0.38	h5
Arsenic	MG/KG	9.6	e1,h1,h5,h7
Barium	MG/KG	56.4	
Cadmium	MG/KG	0.32	b1
Calcium	MG/KG	17800	b1
Chromium	MG/KG	8.3	e1,h5
Copper	MG/KG	6.7	
Iron	MG/KG	13400	e1
Lead	MG/KG	14.8	
Magnesium	MG/KG	10600	b1
Manganese	MG/KG	581	e1
Nickel	MG/KG	7.6	h5
Potassium	MG/KG	517	
Selenium	MG/KG	0.86	e5,h5
Vanadium	MG/KG	16.6	
Zinc	MG/KG	192	b1,e1

AUS-0A2P-023	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7300	
Arsenic	MG/KG	3.9	h1,h5,h7
Barium	MG/KG	75.1	
Beryllium	MG/KG	0.42	
Cadmium	MG/KG	0.72	b1,h5
Calcium	MG/KG	2310	
Chromium	MG/KG	9.5	e1,h5
Cobalt	MG/KG	5.3	
Copper	MG/KG	6.8	
Iron	MG/KG	10100	e1
Lead	MG/KG	12.8	
Magnesium	MG/KG	1430	
Manganese	MG/KG	986	e1
Mercury	MG/KG	0.024	e5
Nickel	MG/KG	8.9	h5
Potassium	MG/KG	549	
Sodium	MG/KG	118	
Vanadium	MG/KG	17.9	
Zinc	MG/KG	119	b1

AUS-0A2P-W01	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8200	
Arsenic	MG/KG	9.9	e1,h1,h5,h7
Barium	MG/KG	89.1	h5
Cadmium	MG/KG	0.21	b1
Calcium	MG/KG	16400	b1
Chromium	MG/KG	13	e1,h5
Cobalt	MG/KG	8.1	
Copper	MG/KG	13	b1
Iron	MG/KG	17900	e1
Lead	MG/KG	16.8	
Magnesium	MG/KG	4730	b1
Manganese	MG/KG	472	e1
Mercury	MG/KG	0.15	b1,e5
Nickel	MG/KG	13.6	h5
Potassium	MG/KG	540	
Vanadium	MG/KG	20.6	
Zinc	MG/KG	50.8	

AUS-0A2P-004	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8270	
Antimony	MG/KG	0.43	h5
Arsenic	MG/KG	21.4	b1,e1,h1,h5,h7
Barium	MG/KG	84	h5
Calcium	MG/KG	3310	b1
Chromium	MG/KG	12	e1,h5
Copper	MG/KG	11.8	b1
Iron	MG/KG	18600	e1
Lead	MG/KG	19.6	
Magnesium	MG/KG	2270	b1
Manganese	MG/KG	561	e1
Mercury	MG/KG	0.06	e5
Nickel	MG/KG	11.3	h5
Potassium	MG/KG	622	
Selenium	MG/KG	1.2	e1,e5,h5
Silver	MG/KG	1	b1
Thallium	MG/KG	0.21	
Vanadium	MG/KG	24.8	
Zinc	MG/KG	104	b1

AUS-0A2P-011	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6140	
Antimony	MG/KG	0.76	h5
Arsenic	MG/KG	15.7	b1,e1,h1,h5,h7
Barium	MG/KG	83	h5
Cadmium	MG/KG	0.96	b1,h5
Calcium	MG/KG	13500	b1
Chromium	MG/KG	14.5	e1,h5
Cobalt	MG/KG	15.1	
Copper	MG/KG	186	b1,e1
Iron	MG/KG	21600	b1,e1
Lead	MG/KG	60.5	b1
Magnesium	MG/KG	6240	b1
Manganese	MG/KG	200	e1
Mercury	MG/KG	0.019	e5
Nickel	MG/KG	16	h5
Potassium	MG/KG	534	
Selenium	MG/KG	0.91	e5,h5
Silver	MG/KG	20.6	b1,e1,h5,h9
Vanadium	MG/KG	17	
Zinc	MG/KG	612	b1,e1,h5

AUS-0A2P-005	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7710	
Arsenic	MG/KG	8.4	h1,h5,h7
Barium	MG/KG	81.7	h5
Calcium	MG/KG	3290	b1
Chromium	MG/KG	11.7	e1,h5
Copper	MG/KG	10.1	
Iron	MG/KG	14800	e1
Lead	MG/KG	17.9	
Magnesium	MG/KG	2770	b1
Manganese	MG/KG	242	e1
Nickel	MG/KG	9.9	h5
Potassium	MG/KG	819	b1
Selenium	MG/KG	0.7	e5,h5
Thallium	MG/KG	0.17	
Vanadium	MG/KG	21.3	
Zinc	MG/KG	40.7	

AUS-0A2P-020	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7890	
Arsenic	MG/KG	10.3	e1,h1,h5,h7
Barium	MG/KG	73.7	
Boron	MG/KG	2.5	e1
Calcium	MG/KG	2650	b1
Chromium	MG/KG	11.3	e1,h5
Cobalt	MG/KG	5.9	
Copper	MG/KG	10.8	
Iron	MG/KG	18400	e1
Lead	MG/KG	16.5	
Magnesium	MG/KG	1920	b1
Manganese	MG/KG	503	e1
Nickel	MG/KG	9.1	h5
Potassium	MG/KG	521	
Vanadium	MG/KG	26.3	
Zinc	MG/KG	57.1	b1

AUS-0A2P-012	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	9530	
Arsenic	MG/KG	32	b1,e1,h1,h5,h7,h9
Barium	MG/KG	139	h5
Boron	MG/KG	4	e1
Calcium	MG/KG	1960	
Chromium	MG/KG	16	e1,h5
Cobalt	MG/KG	10.2	
Copper	MG/KG	22.7	b1
Iron	MG/KG	20300	b1,e1
Lead	MG/KG	39.9	b1
Magnesium	MG/KG	2380	b1
Manganese	MG/KG	417	e1
Nickel	MG/KG	18.6	h5
Potassium	MG/KG	534	
Silver	MG/KG	22.9	b1,e1,h5,h9
Vanadium	MG/KG	29	
Zinc	MG/KG	86.1	b1

AUS-0A2P-015	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5670	
Arsenic	MG/KG	10.9	e1,h1,h5,h7
Barium	MG/KG	73.9	
Calcium	MG/KG	45300	b1
Chromium	MG/KG	12.6	e1,h5
Cobalt	MG/KG	6.4	
Copper	MG/KG	10.1	
Iron	MG/KG	15800	e1
Lead	MG/KG	12.7	
Magnesium	MG/KG	28300	b1
Manganese	MG/KG	873	e1
Nickel	MG/KG	10	h5
Potassium	MG/KG	609	
Selenium	MG/KG	0.57	e5,h5
Vanadium	MG/KG	18.6	
Zinc	MG/KG	35.5	

AUS-0A2P-008	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6990	
Arsenic	MG/KG	26.1	b1,e1,h1,h5,h7
Barium	MG/KG	90.7	h5
Calcium	MG/KG	2100	
Chromium	MG/KG	11.5	e1,h5
Cobalt	MG/KG	6.3	
Copper	MG/KG	13	b1
Iron	MG/KG	15600	e1
Lead	MG/KG	23.5	b1
Magnesium	MG/KG	1870	b1
Manganese	MG/KG	289	e1
Mercury	MG/KG	0.09	b1,e5
Nickel	MG/KG	9.1	h5
Potassium	MG/KG	647	b1
Selenium	MG/KG	1.2	e1,e5,h5
Silver	MG/KG	1.1	b1
Vanadium	MG/KG	20.9	
Zinc	MG/KG	52.2	b1

AUS-0A2P-013	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6510	
Arsenic	MG/KG	8.7	h1,h5,h7
Barium	MG/KG	105	h5
Boron	MG/KG	4.3	e1
Cadmium	MG/KG	0.03	
Calcium	MG/KG	10700	b1
Chromium	MG/KG	12.5	e1,h5
Cobalt	MG/KG	6.6	
Copper	MG/KG	17.9	b1
Iron	MG/KG	2400	e1
Lead	MG/KG	19.5	
Magnesium	MG/KG	2710	b1
Manganese	MG/KG	295	e1
Nickel	MG/KG	14.3	h5
Potassium	MG/KG	573	
Vanadium	MG/KG	21.7	
Zinc	MG/KG	73.3	b1

AUS-0A2P-W04	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5300	
Arsenic	MG/KG	7.1	h1,h5,h7
Barium	MG/KG	62.7	
Calcium	MG/KG	13000	b1
Chromium	MG/KG	9.8	e1,h5
Cobalt (duplicate)	MG/KG	8.4	
Copper	MG/KG	6.5	
Iron	MG/KG	13400	e1
Lead	MG/KG	14.9	
Magnesium	MG/KG	5540	b1
Manganese	MG/KG	627	e1
Mercury	MG/KG	0.084	b1,e5
Nickel	MG/KG	7.4	h5
Potassium	MG/KG	378	
Selenium	MG/KG	1	e5,h5
Vanadium	MG/KG	18.6	
Zinc	MG/KG	33.3	

AUS-0A2P-W05	Units	Result: 1.5 ft	Reference Code
Metals			
Aluminum	MG/KG	7900	
Arsenic	MG/KG	8.5	h1,h5,h7
Barium	MG/KG	122	h5
Boron	MG/KG	3.3	e1
Calcium	MG/KG	2790	b1
Chromium	MG/KG	16.2	e1,h5
Cobalt	MG/KG	8.5	
Copper	MG/KG	15.1	b1
Iron	MG/KG	20700	b1,e1
Lead	MG/KG	9.8	
Magnesium	MG/KG	2210	b1
Manganese	MG/KG	421	e1
Nickel	MG/KG	22.7	b1,h5
Potassium	MG/KG	395	
Selenium	MG/KG	1.1	e1,e5,h5
Vanadium	MG/KG	29.2	
Zinc	MG/KG	40.7	

AUS-0A2P-010	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6710	
Arsenic	MG/KG	87.5	b1,e1,h1,h5,h7,h8,h9
Barium	MG/KG	119	h5
Boron	MG/KG	3.2	e1
Calcium	MG/KG	4520	b1
Chromium	MG/KG	10.8	e1,h5
Cobalt	MG/KG	6.5	
Copper	MG/KG	20.6	b1
Iron	MG/KG	16400	e1
Lead	MG/KG	22.8	
Magnesium	MG/KG	1770	b1
Manganese	MG/KG	532	e1
Nickel	MG/KG	8.8	h5
Potassium	MG/KG	405	
Vanadium	MG/KG	24.1	
Zinc	MG/KG	71.8	b1

AUS-0A2P-021	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	12000	
Arsenic	MG/KG	9.2	e1,h1,h5,h7
Barium	MG/KG	135	h5
Beryllium	MG/KG	0.52	
Boron	MG/KG	1.7	e1
Calcium	MG/KG	12000	b1
Chromium	MG/KG	15.1	e1,h5
Cobalt	MG/KG	7.2	
Copper	MG/KG	12	b1
Iron	MG/KG	18800	e1
Lead	MG/KG	11.6	
Magnesium	MG/KG	7820	b1
Manganese	MG/KG	802	e1
Mercury	MG/KG	0.045	e5
Nickel	MG/KG	11.6	h5
Potassium	MG/KG	836	b1
Sodium	MG/KG	61.4	
Vanadium	MG/KG	31.8	
Zinc	MG/KG	53.5	b1

AUS-0A2P-022	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6400	
Antimony	MG/KG	0.53	h5
Arsenic	MG/KG	23.2	b1,e1,h1,h5,h7
Barium	MG/KG	49.3	
Beryllium	MG/KG	0.37	
Boron	MG/KG	7.3	b1,e1
Calcium	MG/KG	113000	b1
Chromium	MG/KG	10.8	e1,h5
Cobalt	MG/KG	5.1	
Copper	MG/KG	19.5	b1
Iron	MG/KG	12700	e1
Lead	MG/KG	23	
Magnesium	MG/KG	57200	b1
Manganese	MG/KG	373	e1
Mercury	MG/KG	0.15	b1,e5
Nickel	MG/KG	11.6	h5
Potassium	MG/KG	770	b1
Silver	MG/KG	0.29	
Sodium	MG/KG	150	
Vanadium	MG/KG	18.2	
Zinc	MG/KG	101	b1

AUS-0A2P-016	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8500	
Arsenic	MG/KG	11.2	e1,h1,h5,h7
Barium	MG/KG	80.2	h5
Boron	MG/KG	4.1	e1
Calcium	MG/KG	6400	b1
Chromium	MG/KG	12.7	e1,h5
Cobalt	MG/KG	5.8	
Copper	MG/KG	11.9	b1
Iron	MG/KG	18400	e1
Lead	MG/KG	15.3	
Magnesium	MG/KG	2210	b1
Manganese	MG/KG	306	e1
Nickel	MG/KG	11.4	h5
Potassium	MG/KG	886	b1
Sodium	MG/KG	1550	b1
Vanadium	MG/KG	26.1	
Zinc	MG/KG	52.6	b1

AUS-0A2P-014	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7680	
Antimony	MG/KG	0.29	
Arsenic	MG/KG	75.9	b1,e1,h1,h5,h7,h8,h9
Barium	MG/KG	99.2	h5
Boron	MG/KG	3.4	e1
Calcium	MG/KG	3040	b1
Chromium	MG/KG	13.2	e1,h5
Cobalt	MG/KG	5.3	
Copper	MG/KG	32.1	b1,e1
Iron	MG/KG	18100	e1
Lead	MG/KG	38	b1
Magnesium	MG/KG	1810	b1
Manganese	MG/KG	373	e1
Mercury	MG/KG	0.08	b1,e5
Nickel	MG/KG	10.3	h5
Potassium	MG/KG	445	
Selenium	MG/KG	1.1	e1,e5,h5
Silver	MG/KG	2.2	b1,e1,h5,h9
Vanadium	MG/KG	22.8	
Zinc	MG/KG	213	b1,e1

AUS-0A2P-W06	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5900	
Arsenic	MG/KG	16.4	b1,e1,h1,h5,h7
Barium	MG/KG	95.4	h5
Cadmium	MG/KG	1	b1,h5
Calcium	MG/KG	4800	b1
Chromium	MG/KG	9.9	e1,h5
Cobalt	MG/KG	6.6	
Copper	MG/KG	23.9	b1
Iron	MG/KG	11100	e1
Lead	MG/KG	56	b1
Magnesium	MG/KG	2070	b1
Manganese	MG/KG	1090	e1
Mercury	MG/KG	0.32	b1,e5,h9
Nickel	MG/KG	10.1	h5
Potassium	MG/KG	230	
Selenium	MG/KG	1.1	e1,e5,h5
Vanadium	MG/KG	18.8	
Zinc	MG/KG	162	b1,e1

AUS-0A2P-017	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	10100	
Arsenic	MG/KG	10.9	e1,h1,h5,h7
Barium	MG/KG	68.9	
Beryllium	MG/KG	0.44	
Calcium	MG/KG	2540	b1
Chromium	MG/KG	15.3	e1,h5
Copper	MG/KG	36.8	b1,e1
Iron	MG/KG	13300	e1
Lead	MG/KG	25.6	b1
Magnesium	MG/KG	1710	b1
Manganese	MG/KG	202	e1
Mercury	MG/KG	0.13	b1,e5
Nickel	MG/KG	10.9	h5
Potassium	MG/KG	505	
Selenium	MG/KG	1.4	e1,e5,h5
Vanadium	MG/KG	26.9	
Zinc	MG/KG	124	b1,e1

AUS-0A2P-018	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4150	
Arsenic	MG/KG	4.9	h1,h5,h7
Barium	MG/KG	54.2	
Beryllium	MG/KG	0.27	
Calcium	MG/KG	29500	b1
Chromium	MG/KG	5.7	e1,h5
Copper	MG/KG	4.3	
Iron	MG/KG	7210	e1
Lead	MG/KG	8.3	
Magnesium	MG/KG	2720	b1
Manganese	MG/KG	242	e1
Mercury	MG/KG	0.06	e5
Nickel	MG/KG	4.4	
Potassium	MG/KG	231	
Silver	MG/KG	3.1	b1,e1,h5,h9
Vanadium	MG/KG	13.7	
Zinc	MG/KG	34.5	
Other Parameters			
TOC	MG/KG	20200	

AUS-0A2P-019	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6840	
Arsenic	MG/KG	19.7	b1,e1,h1,h5,h7
Barium	MG/KG	81.6	h5
Beryllium	MG/KG	0.73	
Calcium	MG/KG	42800	b1
Chromium	MG/KG	12.8	e1,h5
Cobalt	MG/KG	10.7	
Copper	MG/KG	9.2	
Iron	MG/KG	20300	b1,e1
Lead	MG/KG	18.1	
Magnesium	MG/KG	12700	b1
Manganese	MG/KG	806	e1
Mercury	MG/KG	0.06	e5
Nickel	MG/KG	10.5	h5
Potassium	MG/KG	498	
Selenium	MG/KG	3.7	b1,e1,e5,h5,h9
Silver	MG/KG	3.5	b1,e1,h5,h9
Vanadium	MG/KG	30.7	
Zinc	MG/KG	91.7	b1

AUS-0A2P-009	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4070	
Arsenic	MG/KG	7.5	h1,h5,h7
Barium	MG/KG	82.1	h5
Calcium	MG/KG	13900	b1
Chromium	MG/KG	7.5	e1,h5
Copper	MG/KG	4	
Iron	MG/KG	14200	e1
Lead	MG/KG	11.7	
Magnesium	MG/KG	2020	b1
Manganese	MG/KG	834	e1
Nickel	MG/KG	6.9	
Potassium	MG/KG	263	
Selenium	MG/KG	1.1	e1,e5,h5
Vanadium	MG/KG	21.5	
Zinc	MG/KG	59.8	b1

AUS-0A2P-W03	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6570	
Antimony	MG/KG	0.37	h5
Arsenic	MG/KG	13.7	b1,e1,h1,h5,h7
Barium	MG/KG	111	h5
Boron	MG/KG	2.5	e1
Calcium	MG/KG	2550	b1
Chromium	MG/KG	12.4	e1,h5
Cobalt	MG/KG	7.2	
Copper	MG/KG	9.1	
Iron	MG/KG	17000	e1
Lead	MG/KG	22.3	
Magnesium	MG/KG	2260	b1
Manganese	MG/KG	785	e1
Mercury	MG/KG	0.07	b1,e5
Nickel	MG/KG	9.2	h5
Potassium	MG/KG	311	
Selenium	MG/KG	0.68	e5,h5
Vanadium	MG/KG	26.3	
Zinc	MG/KG	31.2	

AUS-0A2P-007	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7600	
Antimony	MG/KG	1.6	b1,h5
Arsenic	MG/KG	13	e1,h1,h5,h7
Barium	MG/KG	82	h5
Cadmium	MG/KG	1.3	b1,h5
Calcium	MG/KG	10500	b1
Chromium	MG/KG	28.6	b1,e1,h5,h9
Copper	MG/KG	13	b1
Iron	MG/KG	14400	e1
Lead	MG/KG	22.2	
Magnesium	MG/KG	3150	b1
Manganese	MG/KG	327	e1
Mercury	MG/KG	0.26	b1,e5,h9
Nickel	MG/KG	14.1	h5
Potassium	MG/KG	665	b1
Selenium	MG/KG	1.1	e1,e5,h5
Silver	MG/KG	0.99	b1
Vanadium	MG/KG	18.4	
Zinc	MG/KG	122	b1,e1

AUS-0A2P-006	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	11800	
Arsenic	MG/KG	18	b1,e1,h1,h5,h7
Barium	MG/KG	105	h5
Calcium	MG/KG	2600	b1
Chromium	MG/KG	15.9	e1,h5
Copper	MG/KG	12.1	b1
Iron	MG/KG	25700	b1,e1
Lead	MG/KG	13.4	
Magnesium	MG/KG	1850	b1
Manganese	MG/KG	189	e1
Mercury	MG/KG	0.09	b1,e5
Nickel	MG/KG	10.8	h5
Potassium	MG/KG	519	
Selenium	MG/KG	1.2	e1,e5,h5
Silver	MG/KG	29.3	b1,e1,h5,h9
Thallium	MG/KG	0.18	
Vanadium	MG/KG	29.8	
Zinc	MG/KG	47.6	

AUS-0A2P-W02	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5380	
Antimony	MG/KG	0.33	h5
Arsenic	MG/KG	10	e1,h1,h5,h7
Barium	MG/KG	62.5	
Calcium	MG/KG	7790	b1
Chromium	MG/KG	12.6	e1,h5
Copper	MG/KG	7.7	
Iron	MG/KG	11600	e1
Lead	MG/KG	17.7	
Magnesium	MG/KG	2250	b1
Manganese	MG/KG	397	e1
Mercury	MG/KG	0.1	b1,e5
Nickel	MG/KG	7.5	h5
Potassium	MG/KG	280	
Selenium	MG/KG	0.65	e5,h5
Silver	MG/KG	237	b1,e1,h5,h9
Vanadium	MG/KG	16.6	
Zinc	MG/KG	30.4	

LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.

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SCALE FEET

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–ØA2P Sample Locations and Detections of Inorganic Compounds in Soils

Date: 6/28/00	Project Number: 2320000026.00	Figure Number: 6-4
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

File: E:\AUS-SAMPLE LOCATION2\AUS-0A2P.DWG Last edited: NOV. 17, 00 @ 1:43 p.m. URS Corp.

AUS-0A2P-W01-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
Trichloroethylene (TCE)	UG/L	5	h6
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	1220	
Barium	UG/L	54.4	
Calcium	UG/L	66500	
Copper	UG/L	1.2	
Iron	UG/L	996	
Magnesium	UG/L	30700	
Manganese	UG/L	22.7	
Nickel	UG/L	1.7	
Potassium	UG/L	725	
Sodium	UG/L	89700	
Other Parameters			
Alkalinity, Total (as CaCO3)	MG/L	346	
Nitrogen, Ammonia (as N)	MG/L	ND	
Nitrogen, Nitrate-Nitrite	MG/L	1.6	h4,h6
Perchlorate	UG/L	ND	
Phosphorus, Total (as P)	MG/L	0.062	h4
TDS	MG/L	548	
TSS	MG/L	34.5	

LEGEND

MONITORING WELL LOCATION

HAND AUGER LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

AUS-0A2P-W03-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
1,1,1-Trichloroethane	UG/L	7	
1,1,2-Trichloroethane	UG/L	14	h3,h6
1,1-Dichloroethene	UG/L	5	h3
1,2-Dichloroethane (EDC)	UG/L	2	h3
Chloroform (duplicate)	UG/L	0.6	h3
cis-1,2-Dichloroethene	UG/L	23	
Tetrachloroethylene (PCE)	UG/L	230	h3,h6
Toluene	UG/L	1	
Trichloroethylene (TCE)	UG/L	110000	h3,h4,h6
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	49.9	
Barium	UG/L	49.9	
Boron	UG/L	13.1	
Calcium	UG/L	67200	
Iron	UG/L	59	
Magnesium	UG/L	23700	
Manganese	UG/L	15.5	
Selenium (duplicate)	UG/L	3.2	
Sodium	UG/L	33800	
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2P-W02-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
cis-1,2-Dichloroethene	UG/L	40	
trans-1,2-Dichloroethene	UG/L	1	
Trichloroethylene (TCE)	UG/L	6	h3,h6
Vinyl chloride	UG/L	0.7	h3
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	63.3	
Barium	UG/L	31.6	
Boron	UG/L	11.7	
Calcium	UG/L	49900	
Copper	UG/L	1	
Iron	UG/L	93.7	
Magnesium	UG/L	19300	
Manganese	UG/L	24.6	
Sodium	UG/L	86200	
Other Parameters			
Nitrogen, Ammonia (as N)	MG/L	0.31	
Nitrogen, Nitrate-Nitrite	MG/L	0.27	
Perchlorate	UG/L	ND	

AUS-0A2P-W04-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	579	
Barium	UG/L	34.6	
Calcium	UG/L	38200	
Iron	UG/L	758	
Magnesium	UG/L	20500	
Manganese	UG/L	7.6	
Selenium	UG/L	3.8	
Sodium	UG/L	84000	
Other Parameters			
Nitrogen, Ammonia (as N)	MG/L	0.11	
Nitrogen, Nitrate-Nitrite	MG/L	0.72	
Perchlorate	UG/L	1200	h4

AUS-0A2P-W05-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
Trichloroethylene (TCE)	UG/L	0.9	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	74.3	
Barium	UG/L	39.7	
Boron	UG/L	30.6	
Calcium	UG/L	32900	
Iron	UG/L	70	
Magnesium	UG/L	15900	
Manganese	UG/L	15.2	
Selenium	UG/L	6.2	
Sodium	UG/L	22700	
Other Parameters			
Nitrogen, Ammonia (as N)	MG/L	ND	
Nitrogen, Nitrate-Nitrite	MG/L	1.1	h4,h6
Perchlorate	UG/L	ND	

AUS-0A2P-019-SW-0X	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	1320	b3,e3
Arsenic	UG/L	2.1	
Barium	UG/L	52.5	b3
Calcium	UG/L	63400	b3
Iron	UG/L	1260	b3,e3,e4,h10
Magnesium	UG/L	17200	b3
Potassium	UG/L	1970	b3
Sodium	UG/L	26700	b3
Zinc	UG/L	36.9	b3
Other Parameters			
Perchlorate	UG/L	ND	

AUS-0A2P-W06-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	133	
Barium	UG/L	61.7	
Boron	UG/L	119	
Calcium	UG/L	64500	
Iron	UG/L	148	
Magnesium	UG/L	22900	
Manganese	UG/L	8.8	
Sodium	UG/L	18500	
Other Parameters			
Alkalinity, Total (as CaCO3)	MG/L	223	
Nitrogen, Ammonia (as N)	MG/L	ND	
Nitrogen, Nitrate-Nitrite	MG/L	4.6	h4,h6
Perchlorate	UG/L	ND	
TDS	MG/L	370	
TSS	MG/L	2.5	

N

100 0 100

SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES, FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
2. DASHED OUTLINES SHOW APPROXIMATE LOCATIONS OF FORMER STRUCTURES.
3. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO QCSR FOR DATA QUALIFIERS.
4. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

REVISIONS

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

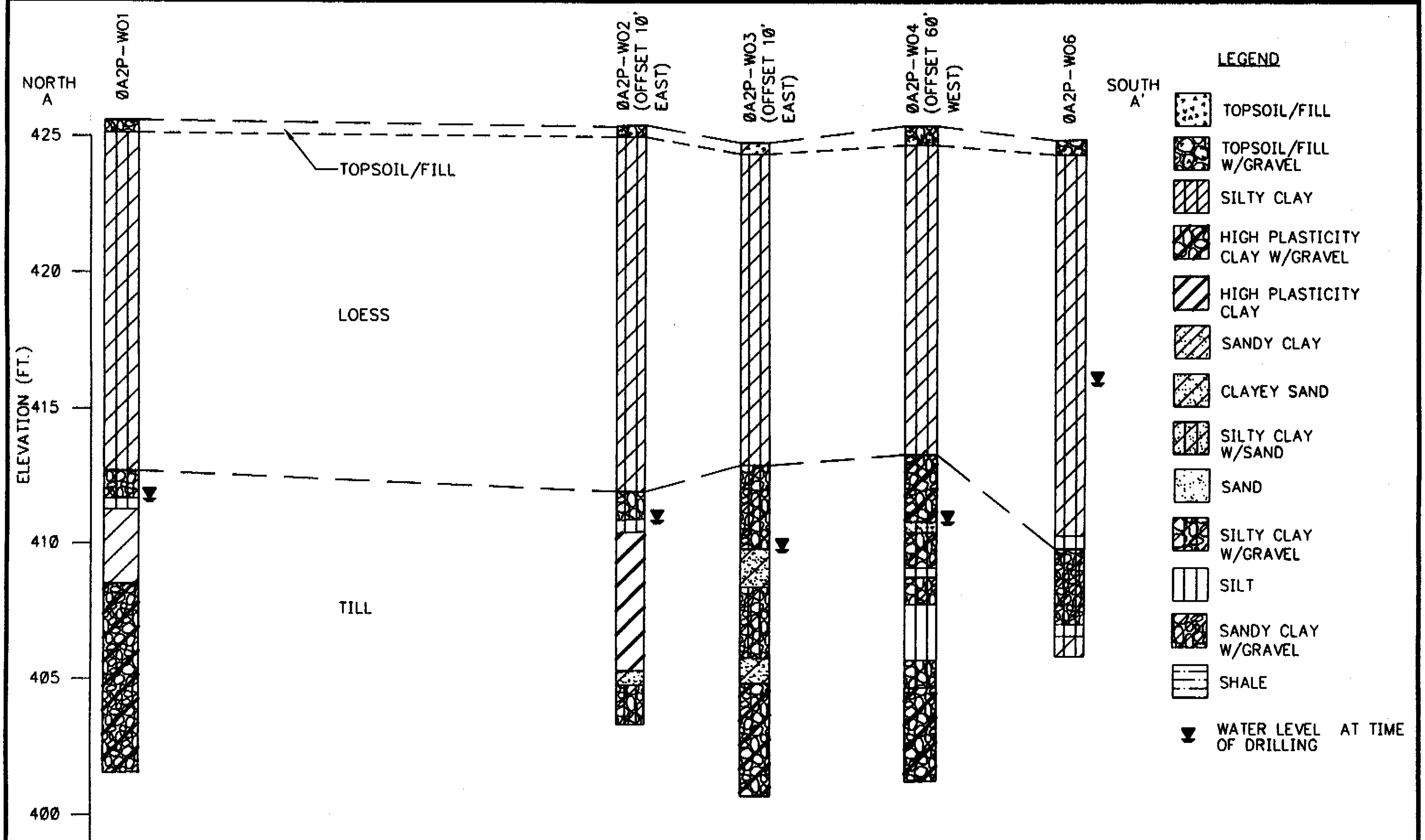
AUS-ØA2P Sample Locations and Detections in Surface Water and Groundwater

Date: 6/28/00	Project Number: 2320000026.00	Figure Number: 6-5
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

File: E:\23200000026.00\PA-SI REPORT-AUS OU\AUS-SAMPLE LOCATION 2\AUS-0A2P.DWG Last edited: SEP. 21, 01 @ 10:35 a.m. URS Corp.

File: E:\2320000026.00\PA-SI REPORT-AUS OU\FIG6-6.DWG Last edited: JUN. 21, 01 @ 3:01 p.m. URS Corp.



PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO. 2320000026.00

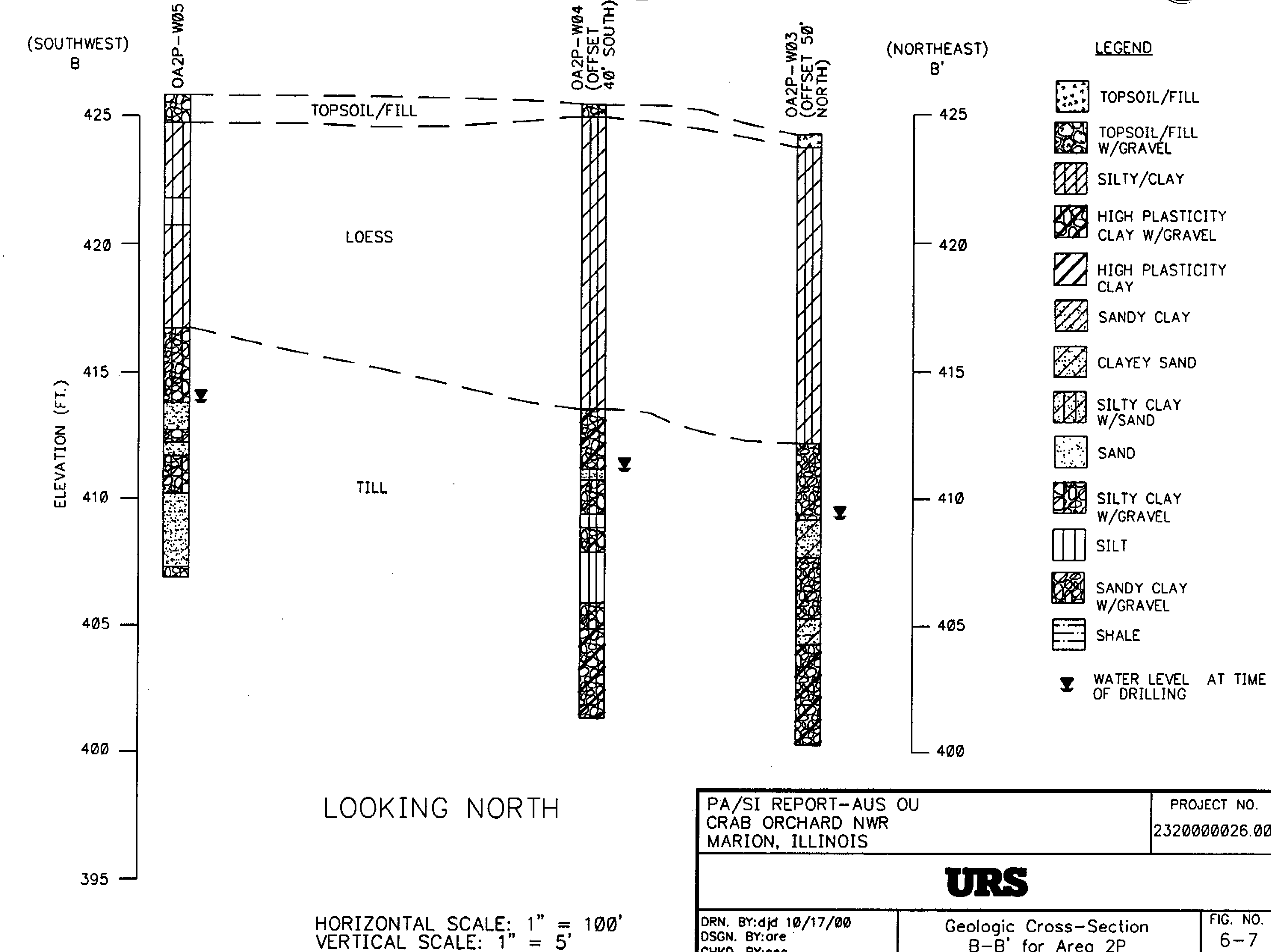
URS

DRN. BY: djd 10/17/00
DSGN. BY: are
CHKD. BY: sea

Geologic Cross-Section A-A' for Area 2P

FIG. NO. 6-6

File: E:\2320[illegible]026.00\PA-SI REPORT-AUS OU\FIG6-7.DWG Last edited: AUG. [illegible]1 @ 10:33 a.m. URS Corp.



PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

URS

DRN. BY:djd 10/17/00 DSGN. BY:are CHKD. BY:sea	Geologic Cross-Section B-B' for Area 2P	FIG. NO. 6-7

Area 2R is a railroad spur that was part of the Illinois Ordnance Plant (IOP) and has been used by later industrial tenants. The site is located approximately 0.5 miles south of Old Highway 13 and 0.9 miles east of Wolf Creek Road. The location of Area 2R (AUS-0A2R) is shown in Figure 3-1, along with the other sites in Area 2. Area 2R is located just northeast of the rest of Area 2 but is considered a part of Area 2 for this report. Unlike the designations for the other Area 2 sites, which were derived from IOP usage and are currently in use by industrial tenants, the “Area 2R” designation was made for this Additional and Uncharacterized Sites Operable Unit (AUS OU) investigation.

AUS Original Site Designations

AUS-0A2R is Site AUS-0083 on the 1997-1999 United States Fish & Wildlife Service (USFWS) AUS OU list. It was renamed to be consistent with current Area 2 AUS OU site designations.

7.1 HISTORIC SEARCH INFORMATION

7.1.1 Site Description

Area 2R currently consists of two storage areas, a railroad spur and a loading dock. The railroad enters the site from the north (across Old Route 13) and dead ends north of Post Oak Road. There were originally two rail spurs (both located on the west side of the main line) and one main line constructed in this area as a part of the IOP. Both spurs were located west of the main line (Figure 7-1). The main line and the east spur are no longer present. The west spur is still on site.

7.1.2 Operational History and Waste Characteristics

This area was originally built and used by the Sherwin Williams Defense Corporation under contract with the War Department, (SWDC/War Department), as part of the IOP, which operated from 1942 to 1945. The USFWS too over operation of the railroads when the Refuge was established; the Refuge terminated railroad operations in 1976.[1] Lease documents indicate Olin began using this railroad spur in 1995;[2] however, a 1992 Refuge narrative report[3] indicates Olin began renovating the railroad spur in 1992 without prior approval from the Refuge. Olin initiated vegetation control and the staging of rail cars. This work resulted in adverse effects on Killdeer nesting and on the Loggerhead shrike perching habitat. Olin ceased renovation until after the nesting season when they were issued a Special Use Permit allowing them to use the area. Olin's ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end

[1] DPRA Document No. 00009433. National Wildlife Refuge System, Fish and Wildlife Service, U.S. Department of the Interior, Crab Orchard National Wildlife Refuge, Carterville, Illinois, Annual Narrative Report, Calendar Year 1976, Page 5.

[2] DPRA Document No. 00007505. Attachment No. 1 to “Special Amendment No. 13 to Building Lease Contract No. 14-16-0003-81-528, Olin Corporation, dated December 31, 1995.

[3] DPRA Document No. 00016084. U.S. Department of the Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge Annual Narrative Report, Calendar Year 1992, Page 54.

of 1996.[4] In January 2001, General Dynamics Corporation acquired Primex. Primex became a wholly owned subsidiary of General Dynamics and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (hereafter referred to as GDO&TS).[5,6] GDO&TS, the Area 2 tenant, currently uses the railroad spur. It is assumed that any of the tenants in Area 2 may have used the rail lines and loading docks in Area 2R. Table 7-1 is a list of Area 2 operators/lessees.

Historical aerial photographs revealed nine buildings, several sheds, two rail spurs and one main line, and open storage of coal and crates/containers in Area 2R in 1943.[7] In the southwest corner of the site (south of Post Oak Road and west of Stringtown Road), a linear excavation with an access road leading to it was also observed in the 1943 aerial photograph.[8] The excavation appeared to contain liquid, and there also appeared to be a horizontal tank just to the south of the excavation.[9] Two buildings and an open storage area of dark-toned waste materials were along the main line in 1943.[10] These materials and buildings were removed by 1951.[11] The remainder of this rail yard was also dismantled by 1951; however, the linear excavation was still present on site.[12] This excavation was gone and the area had re-vegetated by 1960.[13]

[4] DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579 by and between U.S. Fish and Wildlife Service and PRIMEX Technologies, Inc., 8820 Route 148, Marion, Illinois 62959, Page 10.
[5] General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.
[6] Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.
[7] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7, and Volume II: MAPS, Page B. The Entech reports analyze historic aerial overflight photographs of industrial areas at the Refuge, from 1943 to 1993 (except in Area 2, which was analyzed from 1960-1993). The photos were obtained from the National Archives and Records Administration (NARA) and the U.S. Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS).
[8] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[9] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[10] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[11] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[12] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[13] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.

It appears that the Straitline Freight Co. may have occupied Area 2R in at least 1950, for trucking.[14] A Refuge map places them in the vicinity of Area 2R at that time.[15]

Also in 1960, there were several piles of earthen material on this site.[16] By 1965, various stored materials covered the portion of the site between the easternmost and westernmost rail spurs.[17] These materials were still present in 1971, along with a new building on the southern portion of the site.[18] In 1976, E. T. Simonds occupied AUS-0A2R for storage.[19,20] The stored materials were removed from the site by 1980 and a string of rail cars were visible on the westernmost spur at this time.[21]

A possible disposal area containing various materials, including light-toned earthen materials, was noted in northernmost part of the area in the 1980 aerial photograph just south of the convergence of the center and western rail lines. These materials were removed by 1993.

7.1.3 Area 2R Previous Sampling Results

USEPA Sampling, 1998

In 1998, the United States Environmental Protection Agency (USEPA) collected two soil samples (83-01 and 83-02) from the original site AUS-0083. Sample locations are shown in Figures 7-1, 7-2, and 7-3. The samples were tested for semivolatile organic compounds and metals. The results for all detected constituents are listed in Table 7-1A. The following semi-volatile organic compounds (SVOCs) were detected at the site above either USEPA Soil Screening Levels (SSLs) and/or Canadian Soil Quality Guidelines (CSOQGs): benzo[a]anthracene (2.9 milligrams per kilogram (mg/kg)), benzo[a]pyrene (3.4 mg/kg), benzo[b]fluoranthene (6.5 mg/kg), indeno[1,2,3-cd]pyrene (2.5 mg/kg), dibenz[a,h]anthracene (1.5 mg/kg), naphthalene (2.0 mg/kg), and benzo[k]fluoranthene (6.5 mg/kg). Mercury (0.11

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[14] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[15] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[16] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[17] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.
[18] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7, and Volume II: MAPS, Page B.
[19] DPRA Document No. 00006406. Attachment "C", Land, Dated November 8, 1976. Identifies several companies at CONWR.
[20] DPRA Document No. 00006409. Special Area Designations Map associated with Attachment "C", Land, Dated November 8, 1976. Identifies several companies at CONWR.
[21] Entech, Inc., 1999, Historical Aerial Photographic Analysis – Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge (CONWR) Marion, Illinois, Volume I: TEXT, Page 3-7.

mg/kg) exceeded USEPA SSL and Refuge background level.[22] Zinc (170 mg/kg) exceeded New Dutchlist Soil Optimum Levels (DSOLs) and Refuge background level.

7.1.4 Observations During Site Visit

The concrete loading dock and the west rail spur were present at the time of the site visit in the spring of 1999. Part of the site was grass-covered and part was covered with gravel. To the south of the loading dock was a fenced, open storage area that was used by Primex, the Area 2 tenant at the time of the site visit. According to USFWS personnel, Primex stored ordnance scrap on the concrete within this fenced area.[23] There was also an equipment storage area north of the loading dock.

7.1.5 Recommendations Based On Preliminary Assessment

Site AUS-0A2R was included in the Site Investigation (SI) based on exceedances of the Preliminary Assessment (PA) screening criteria in the USEPA 1998 samples.

7.2 SITE INVESTIGATION INFORMATION

URS conducted an SI at AUS-0A2R on April 18 and May 2, 2000. The rationale for sample locations, media, and analytes was not included in the FSP for the AUS OU PA/SI, since sample locations at this site were added after the FSP had been completed. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 7.1) includes that information.

AUS OU SI sample locations are shown on Figures 7-1, 7-2, and 7-3. Survey coordinates for all sample locations in Area 2R are found in Table 7-2. Matrices sampled at each location are shown in Table 7-3. All samples were soil except for one water sample taken from a test pit (trench water).

7.2.1 Field Investigation

The following areas of concern were investigated during the SI.

Existing and Former Rail Lines

Sample 0A2R-004 was located along the existing (west) rail spur, next to the loading dock. Samples 0A2R-002 and 0A2R-003 were located along the former (east) rail spur. Sample 0A2R-005 was located just to the west of the former main line, in the area of dark-toned waste materials observed in the 1943 aerial photograph. Because there are no present-day features associated with this area of dark-toned waste materials, this sample was located using coordinates obtained from historical aerial photographs.[24]

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[22] See Table 1-11 of this report for Refuge background soil values used for the PA.
[23] Elaine L. Moore, USFWS, September 19, 2001.
[24] At the beginning of the project, a test was conducted to estimate the accuracy of locating features from historic aerial photos. Using conventional methods, survey coordinates were obtained of a number of existing features at the Refuge that also appeared on a series of historic photos (for example, the corners of IOP buildings that are still

Former Linear Excavation in Area 2R

In 1943, a linear excavation with an access road leading up to it was observed in Area 2R. There was a possible horizontal tank located to the south of this excavation. Test pit 0A2R-001 was located in the area of this former linear excavation. Because there are no present-day features associated with this linear excavation, this sample was located using coordinates obtained from historical aerial photographs.

7.2.2 Field Results

7.2.2.1 Site Conditions

7.2.2.1.1 Geologic Conditions

One test pit was excavated in Area 2R at the location shown in Figure 7-1. This test pit log indicates that loess (silt with trace clay) was encountered from the ground surface to the bottom of the test pit at 10 feet (ft) below ground surface (bgs).

7.2.2.1.2 Hydrogeologic Conditions

No monitoring wells were installed in Area 2R. Groundwater was encountered at approximately 1.5 ft bgs in the one test pit installed at the site.

7.2.2.1.3 Hydrologic Conditions

There do not appear to be any drainage ditches located in the area of the former rail spurs, and no ponded areas were noted during the site reconnaissance.

7.2.2.2 Chemical Results

The sample analytical results are summarized in the following tables:

- Table 7-4 -- soil samples results, and
- Table 7-5 -- trench water results.

These tables list all the chemicals detected in Area 2R during this investigation, along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report (QCSR).

Sample results are presented on the following figures:

- Figure 7-1 -- organic results for soil samples,
- Figure 7-2 -- inorganic results for soil samples, and
- Figure 7-3 -- results for trench water samples.

existing). Entech independently obtained coordinates from the aerial photos. The coordinates obtained from the aerial photos were found to be in agreement with the coordinates obtained by conventional methods, within a few ft.

7.3 SCREENING RISK ASSESSMENT

Results of the risk screening are presented in Tables 7-6 through 7-8 as follows:

- Table 7-6--human health risk screening for soils,
- Table 7-7--human health risk screening for trench water, and
- Table 7-8--ecological risk screening for soils.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A2R. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

Chemicals that are shaded in the tables are those that exceeded the screening criteria, and are identified as chemicals of potential concern (COPCs) for human health risk, and chemicals of potential ecological concern (COPECs) for ecological risk. The only COPCs/COPECs not shaded in the table are those inorganic constituents that exceeded the screening criteria but were detected at levels below Refuge background.

In cases where the chemical was analyzed but not detected, the HQ is the ratio between the maximum reporting limit and the screening concentration. Chemicals not detected are identified with a "U" qualifier in the qualifier column. When these HQ values exceed one, they are not shaded. These constituents are not identified as COPCs/COPECs, but rather as uncertainties.

In Figures 7-1 through 7-3, the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 7-9 (human health risk) and 7-10 (ecological risk) list all the analytes and corresponding media sampled and indicate whether each is a COPC (or COPEC), not a COPC (or COPEC), or an uncertainty. The codes in the tables indicate the rationale for each classification. All COPCs (Table 7-9) and COPECs (Table 7-10) are shaded in the tables.

7.3.1 Human Health Risk

7.3.1.1 Soil

Human health screening results for soil and drum samples are presented in Table 7-6.

For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil Preliminary Remediation Goals (PRGs) as screening values. Calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values derived the cancer risk. These ratios were then multiplied by 1×10^{-6}. In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (Dilution Attenuation Factor (DAF)=1), the Illinois Tiered Approach to Corrective Action Objectives (TACO) Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

7.3.1.2 Trench Water

Human health screening results for water from the test pit (trench water) are presented in Table 7-7. The maximum groundwater concentrations from AUS-0A2R were screened against maximum contaminant levels (MCLs) and Illinois Class I groundwater standards. These values are very conservative since the trench water sample has a high suspended solids content compared to groundwater.

7.3.2 Ecological Risk

7.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 7-8. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[25]
- Environment Canada (1995)[26]
- Talmage *et al.* (1999)[27]
- Efroymson *et al.* (1997a, 1997b)[28]
- CCME (1999)[29]
- MHSPE (1994)[30]
- Other sources

A detailed discussion of the screening concentration selection is presented in Appendix G.

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[25] USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.
[26] Environment Canada. 1995. Toxicity Testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Guidelines Division, Evaluation and interpretation Branch, Environmental Conservation Directorate, Environment Canada. Hull, Quebec.
[27] Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E Welsh, F. M. Cretella, P.H. Reno, and F. B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev Environ. Contam. Toxicol 161:1-156.
[28] Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-85/R3.
Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-126/R2.
[29] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.
[30] Ministry of Housing, Spatial Planning, and the Environment (MHSPE). 1994. *Intervention Values and Target Values – Soil Quality Standards.* Directorate General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

The screening approach for ingestion pathway exposures was based on the potential for a chemical to bioaccumulate. The potential for a chemical to bioaccumulate was based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. The document *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991)[31] used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

7.4 SCIENTIFIC MANAGEMENT DECISION POINT

A Remedial Investigation (RI) is recommended for Site AUS-0A2R, based on exceedances of the SI screening criteria.

This report recommends that inorganic constituents that exceeded project screening criteria but were within Refuge background levels not be retained as COPCs/COPECs for further evaluation. These are the constituents coded with "D" on the COPC list, Table 7-9; and on the COPEC list, Table 7-10. COPCs in this category include arsenic, chromium, and selenium in soil. COPECs coded with "D" on Table 7-10 include arsenic, chromium, manganese and selenium in soil. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method, if new information on site usage suggests they should be evaluated, or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 7-11.

Note that a number of the human heath COPCs exceed migration to groundwater screening criteria. Groundwater has not been investigated at this site, and based on these data, should be considered in the RI. Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. These issues will be addressed in the work plan for the RI.

[31] USEPA 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

TABLE 7-1
AREA 2 OPERATORS/LESSEES

Operator/Lessee	Area	Years of Operation	Operations
Central Technologies, Inc.	Area 2B	1963-1970	Manufacturing of pyrotechnics and explosives
E-Bee Business Systems Co.	Area 2B	1949-1953	Manufacturing office supplies
E.T. Simonds	Area 2R	1976	Unspecified storage
Job Corps	Area 2F	Unknown	Auto mechanic work; gymnasium
Olin/Primex/GDO&TS	Areas 2B, 2D, 2F, 2P and 2R (not in all locations at all times)	1957-Present	Research, development and manufacturing of explosives
Ordill Foundry & Mfg. Co. (sold to Wood Corporation in 1953)	Area 2F	1947-1953	Manufacturing iron castings
Sherwin Williams Defense Corporation/War Department	Areas 2B, 2D, 2F, 2P and 2R	1942-1945	Booster, detonator, fuse and artillery primer loading lines
Straitline Freight Co.	Area 2R?	1950	Trucking
Universal Match Corporation	Areas 2B, 2D and 2F	2B: 1952-1963 2D: 1953-1962 2F: 1959-1961	Testing and manufacturing of primary and secondary explosives
U.S. Fish and Wildlife Service	Area 2B	1948-1956	Refuge division office/storage of grain

Sheet 1 of 1

References for this information is found in the associated text in Sections 3 through 7.

TABLE 7-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
83-01	2-Methylnaphthalene	2.0J
	Benzo[a]anthracene	0.53J
	Benzo[b]fluoranthene	0.85J
	Chrysene	0.75J
	Dibenzofuran	1.2J
	Fluoranthene	0.83J
	Naphthalene	0.79J
	Phenanthrene	2.4
	Pyrene	0.64J
	Aluminum	3,000
	Barium	36
	Beryllium	0.7
	Calcium	54,000
	Chromium	13
	Cobalt	5.2
	Copper	11
	Iron	8,400
	Lead	29
	Magnesium	8,600
	Manganese	160
	Mercury	0.04
	Nickel	15
	Potassium	880
	Silver	1.5
	Sodium	730
	Vanadium	14
	Zinc	97
83-02	2-Methylnaphthalene	3.8
	Acenaphthene	0.8J
	Acenaphthylene	1.1J
	Anthracene	0.74J, 1.4J
	Benzo[a]anthracene	2.9, 1.2J
	Benzo[a]pyrene	3.4, 1.8J
	Benzo[b]fluoranthene	6.5, 6.5J
	Benzo[g,h,i]perylene	0.78J, 1.0J
	Benzo[k]fluoranthene	2.0J, 6.5J
	Chrysene	3.6, 1.5J
	Dibenz[a,h]anthracene	1.5J
	Dibenzofuran	1.7J
	Fluoranthene	4.1, 1.8J
	Indeno[1,2,3-c,d]pyrene	1.1J, 2.5J
	Naphthalene	2.0J
	Phenanthrene	4.3, 1.0J
	Pyrene	3.6, 2.3J
	Aluminum	2,100
	Barium	38
	Beryllium	0.5
	Calcium	71,000

Sheet 1 of 2

TABLE 7-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
83-02	Chromium	13
	Cobalt	4.2
	Copper	9.8
	Iron	13,000
	Lead	62
	Magnesium	23,000
	Manganese	230
	Mercury	0.11
	Nickel	8.5
	Potassium	560
	Silver	1.6
	Sodium	630
	Vanadium	12
	Zinc	170

Sheet 2 of 2

mg/kg = milligrams per kilogram
J = Estimated
Note: When two results are shown for one constituent, the first result is the semivolatile organics analysis data, and the second result is the polyaromatic hydrocarbons analysis data.

TABLE 7-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A2R

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A2R-001	388118.5	778225.3	436.72	NA	
0A2R-002	389089.0	778838.1	436.08	NA	
0A2R-003	388702.7	778803.2	438.56	NA	
0A2R-004	389360.9	778586.3	440.35	NA	
0A2R-005	388573.1	779028.2	431.12	NA	

Sheet 1 of 1

NA = Not Applicable

TABLE 7-3
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A2R

Soil	Trench Water
AUS-0A2R-001	AUS-0A2R-001[1]
AUS-0A2R-002	
AUS-0A2R-003	
AUS-0A2R-004	
AUS-0A2R-005	

Sheet 1 of 1

[1] This sample was originally designated as groundwater ("GW"), but is actually a trench water sample.

TABLE 7-4
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Semivolatile Organic Compounds		
1-Methylnaphthalene	4/4	240 ug/kg to 2,400 ug/kg
2-Methylnaphthalene	4/4	830 ug/kg to 7,200 ug/kg
Acenaphthylene	4/4	130 ug/kg to 4,500 ug/kg
Anthracene	3/4	130 ug/kg to 340 ug/kg
Benzo(a)anthracene	4/4	86 ug/kg to 1,900 ug/kg
Benzo(a)pyrene	4/4	100 ug/kg to 2,600 ug/kg
Benzo(b)fluoranthene	4/4	180 ug/kg to 3,500 ug/kg
Benzo(g,h,i)perylene	4/4	110 ug/kg to 1,400 ug/kg
Benzo(k)fluoranthene	4/4	75 ug/kg to 1,600 ug/kg
Chrysene	4/4	220 ug/kg to 3,200 mg/kg
Dibenz(a,h)anthracene	4/4	12 ug/kg to 320 ug/kg
Fluoranthene	4/4	270 ug/kg to 3,500 ug/kg
Fluorene	2/4	17 ug/kg to 110 ug/kg
Indeno(1,2,3-c,d)pyrene	4/4	53 ug/kg to 1,700 ug/kg
Naphthalene	4/4	230 ug/kg to 3,600 ug/kg
Phenanthrene	4/4	230 ug/kg to 1,400 ug/kg
Pyrene	4/4	190 ug/kg to 3,500 ug/kg
Metals		
Aluminum	6/6	3,450 mg/kg to 10,700 mg/kg
Antimony	4/6	0.47 mg/kg to 1.1 mg/kg
Arsenic	6/6	5.3 mg/kg to 12.8 mg/kg
Barium	6/6	53.4 mg/kg to 337 mg/kg
Beryllium	6/6	0.28 mg/kg to 0.97mg/kg
Boron	5/6	1.9 mg/kg to 59.6 mg/kg
Cadmium	6/6	0.62 mg/kg to 1.6 mg/kg
Calcium	6/6	2,080 mg/kg to 76,400 ug/kg
Chromium, Total	6/6	11.3 mg/kg to 19 mg/kg
Cobalt	5/6	6 mg/kg to 29.5 mg/kg
Copper	6/6	13.1 mg/kg to 156 mg/kg
Iron	6/6	17,900 mg/kg to 33,900 mg/kg
Lead	6/6	12.1 mg/kg to 101 mg/kg
Magnesium	6/6	1,360 mg/kg to 36,800 mg/kg
Manganese	6/6	261 mg/kg to 747 mg/kg
Mercury	4/6	0.028 mg/kg to 0.055 mg/kg
Nickel	6/6	14.2 mg/kg to 30.7 mg/kg
Potassium	6/6	295 mg/kg to 705 mg/kg
Selenium	1/6	0.49 mg/kg
Silver	1/6	0.73 mg/kg
Sodium	6/6	75.8 mg/kg to 543 mg/kg

Sheet 1 of 2

TABLE 7-4
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Thallium	1/6	0.76 mg/kg
Vanadium	6/6	12.7 mg/kg to 34.5 mg/kg
Zinc	6/6	22.3 mg/kg to 634 mg/kg

Sheet 2 of 2

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/20/01

TABLE 7-5
TRENCH WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Aluminum	1/1	111,000 ug/L
Arsenic	1/1	18.4 ug/L
Barium	1/1	2,510 ug/L
Beryllium	1/1	10.9 ug/L
Cadmium	1/1	4.9 ug/L
Calcium	1/1	283,000 ug/L
Chromium, Total	1/1	111 ug/L
Cobalt	1/1	68.8 ug/L
Copper	1/1	80.5 ug/L
Iron	1/1	84,200 ug/L
Lead	1/1	99.4 ug/L
Magnesium	1/1	61,700 ug/L
Manganese	1/1	4,180 ug/L
Mercury	1/1	1 ug/L
Nickel	1/1	142 ug/L
Potassium	1/1	8,630 ug/L
Selenium	1/1	3.6 ug/L
Sodium	1/1	45,000 ug/L
Vanadium	1/1	169 ug/L
Zinc	1/1	432 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Volatile Organic Compounds								
71-55-6	1,1,1-Trichloroethane	5	U	UG/KG			1.50E-06	5.00E-02
79-34-5	1,1,2,2-Tetrachloroethane	5	U	UG/KG		5.57E-09	1.28E-06	2.50E+01
79-00-5	1,1,2-Trichloroethane	5	U	UG/KG		2.63E-09	3.29E-05	5.56E+00
75-34-3	1,1-Dichloroethane	5	U	UG/KG			2.43E-06	5.00E-03
75-35-4	1,1-Dichloroethene	5	U	UG/KG		4.21E-08	7.42E-05	1.67E+00
107-06-2	1,2-Dichloroethane (EDC)	5	U	UG/KG		6.54E-09	1.42E-04	5.00E+00
540-59-0	1,2-Dichloroethene (total)	5	U	UG/KG			3.39E-05	2.50E-01
78-87-5	1,2-Dichloropropane	5	U	UG/KG		6.51E-09	2.35E-04	5.00E+00
78-93-3	2-Butanone (MEK)	11	U	UG/KG			3.97E-07	
591-78-6	2-Hexanone	11	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	11	U	UG/KG			3.81E-06	
67-64-1	Acetone	11	U	UG/KG			1.77E-06	1.38E-02
71-43-2	Benzene	5	U	UG/KG		3.41E-09	2.06E-04	2.50E+00
75-27-4	Bromodichloromethane	5	U	UG/KG		2.12E-09	4.79E-06	1.67E-01
75-25-2	Bromoform	5	U	UG/KG		1.60E-11	2.84E-07	1.25E-01
74-83-9	Bromomethane	5	U	UG/KG			3.81E-04	5.00E-01
75-15-0	Carbon disulfide	5	U	UG/KG			4.14E-06	2.50E-03
56-23-5	Carbon tetrachloride	5	U	UG/KG		9.45E-09	7.15E-04	1.67E+00
108-90-7	Chlorobenzene	5	U	UG/KG			9.21E-06	7.14E-02
75-00-3	Chloroethane	5	U	UG/KG		7.68E-10	2.65E-07	
67-66-3	Chloroform	5	U	UG/KG		9.60E-09	3.88E-03	1.67E-01
74-87-3	Chloromethane	5	U	UG/KG		1.88E-09		
156-59-2	cis-1,2-Dichloroethene	5	U	UG/KG			3.39E-05	2.50E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

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10061-01-5	cis-1,3-Dichloropropene	5	U	UG/KG		2.81E-08	1.14E-04	
124-48-1	Dibromochloromethane	5	U	UG/KG		1.88E-09	3.14E-06	2.50E-01
100-41-4	Ethylbenzene	5	U	UG/KG			8.37E-07	7.14E-03
75-09-2	Methylene chloride	5	U	UG/KG		2.44E-10	5.11E-07	5.00E+00
110-54-3	N-Hexane	5	U	UG/KG			1.24E-05	
100-42-5	Styrene	5	U	UG/KG			2.45E-07	2.50E-02
127-18-4	Tetrachloroethylene (PCE)	5	U	UG/KG		2.68E-10	2.94E-06	1.67E+00
108-88-3	Toluene	5	U	UG/KG			2.52E-06	8.33E-03
1330-20-7	total Xylenes	5	U	UG/KG			1.12E-06	5.00E-04
156-60-5	trans-1,2-Dichloroethene	5	U	UG/KG			2.33E-05	1.67E-01
10061-02-6	trans-1,3-Dichloropropene	5	U	UG/KG		2.81E-08	1.14E-04	
79-01-6	Trichloroethylene (TCE)	5	U	UG/KG		8.17E-10	6.32E-05	1.67E+00
75-01-4	Vinyl chloride	5	U	UG/KG		1.03E-07		7.14E+00
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	420	U	UG/KG			5.51E-05	1.40E+00
95-50-1	1,2-Dichlorobenzene	420	U	UG/KG			1.27E-04	4.67E-01
541-73-1	1,3-Dichlorobenzene	420	U	UG/KG			8.12E-03	
106-46-7	1,4-Dichlorobenzene	420	U	UG/KG		5.17E-08	2.19E-04	4.20E+00
95-95-4	2,4,5-Trichlorophenol	2100	U	UG/KG			2.38E-05	2.10E-01
88-06-2	2,4,6-Trichlorophenol	420	U	UG/KG		1.87E-09		5.25E+01
120-83-2	2,4-Dichlorophenol	420	U	UG/KG			1.59E-04	8.40E+00
105-67-9	2,4-Dimethylphenol	420	U	UG/KG			2.38E-05	1.05E+00
51-28-5	2,4-Dinitrophenol	2100	U	UG/KG			1.19E-03	2.10E+02
91-58-7	2-Chloronaphthalene	420	U	UG/KG			1.54E-05	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

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CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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95-57-8	2-Chlorophenol	420	U	UG/KG			1.74E-03	2.10E+00
90-12-0	1-Methylnaphthalene	2400	J	UG/KG			1.27E-02	6.00E-01
91-57-6	2-Methylnaphthalene	7200	J	UG/KG			1.33E-04	3.60E-02
95-48-7	2-Methylphenol	420	U	UG/KG			9.54E-06	5.25E-01
88-74-4	2-Nitroaniline	2100	U	UG/KG			4.17E-02	
88-75-5	2-Nitrophenol	420	U	UG/KG			5.96E-05	
91-94-1	3,3'-Dichlorobenzidine	420	U	UG/KG		7.66E-08		1.40E+03
99-09-2	3-Nitroaniline	2100	U	UG/KG			4.17E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2100	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	420	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	420	U	UG/KG			9.54E-06	
106-47-8	4-Chloroaniline	830	U	UG/KG			2.36E-04	2.77E+01
7005-72-3	4-Chlorophenyl phenyl ether	420	U	UG/KG				
106-44-5	4-Methylphenol	420	U	UG/KG			9.54E-05	
100-01-6	4-Nitroaniline	2100	U	UG/KG			4.17E-02	
100-02-7	4-Nitrophenol	2100	U	UG/KG			2.98E-04	
83-32-9	Acenaphthene	420	U	UG/KG			1.09E-05	1.40E-02
208-96-8	Acenaphthylene	4500	J	UG/KG			8.30E-05	2.25E-02
120-12-7	Anthracene	340	J	UG/KG			8.72E-07	5.67E-04
56-55-3	Benzo(a)anthracene	1900	J	UG/KG		6.58E-07		2.38E+01
50-32-8	Benzo(a)pyrene	2600	J	UG/KG		9.01E-06		6.50E+00
205-99-2	Benzo(b)fluoranthene	3500	J	UG/KG		1.21E-06		1.75E+01
191-24-2	Benzo(g,h,i)perylene	1400	J	UG/KG			2.58E-05	7.00E-03
207-08-9	Benzo(k)fluoranthene	1600	J	UG/KG		5.54E-08		8.00E-01

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TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

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111-91-1	bis(2-Chloroethoxy)methane	420	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	420	U	UG/KG		6.78E-07		2.10E+04
108-60-1	bis(2-Chloroisopropyl) ether	420	U	UG/KG		5.20E-08	9.88E-05	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	420	U	UG/KG		2.38E-09	2.38E-05	
85-68-7	Butyl benzyl phthalate	420	U	UG/KG			2.38E-06	5.25E-04
86-74-8	Carbazole	420	U	UG/KG		3.41E-09		1.40E+01
218-01-9	Chrysene	3200	J	UG/KG		1.11E-08		4.00E-01
84-74-2	Di-n-butyl phthalate	420	U	UG/KG			4.77E-06	1.40E-03
117-84-0	Di-n-octyl phthalate	420	U	UG/KG			2.38E-05	4.20E-05
53-70-3	Dibenz(a,h)anthracene	320	J	UG/KG		1.11E-06		4.00E+00
132-64-9	Dibenzofuran	420	U	UG/KG			8.30E-05	
84-66-2	Diethyl phthalate	420	U	UG/KG			5.96E-07	
131-11-3	Dimethyl phthalate	420	U	UG/KG			4.77E-08	
206-44-0	Fluoranthene	3500	J	UG/KG			1.16E-04	1.75E-02
86-73-7	Fluorene	110	J	UG/KG			3.32E-06	3.67E-03
118-74-1	Hexachlorobenzene	420	U	UG/KG		2.72E-07	5.96E-04	4.20E+00
87-68-3	Hexachlorobutadiene	420	U	UG/KG		1.33E-08	2.38E-03	4.20E+00
77-47-4	Hexachlorocyclopentadiene	420	U	UG/KG			7.12E-05	2.10E-02
67-72-1	Hexachloroethane	420	U	UG/KG		2.38E-09	4.77E-04	2.10E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	1700	J	UG/KG		5.89E-07		2.43E+00
78-59-1	Isophorone	420	U	UG/KG		1.62E-10	2.38E-06	1.40E+01
621-64-7	N-Nitroso-di-n-propylamine	420	U	UG/KG		1.19E-06		2.10E+05
86-30-6	N-Nitrosodiphenylamine	420	U	UG/KG		8.34E-10		7.00E+00
91-20-3	Naphthalene	3600	J	UG/KG			1.91E-02	9.00E-01

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87-86-5	Pentachlorophenol	2100	U	UG/KG		1.89E-07	1.47E-04	2.10E+03
85-01-8	Phenanthrene	1400	J	UG/KG			2.58E-05	7.00E-03
108-95-2	Phenol	420	U	UG/KG			7.95E-07	8.40E-02
129-00-0	Pyrene	3500	J	UG/KG			6.45E-05	1.75E-02
Explosives								
121-14-2	2,4-Dinitrotoluene	420	U	UG/KG			2.38E-04	1.05E+04
606-20-2	2,6-Dinitrotoluene	420	U	UG/KG			4.77E-04	1.40E+04
98-95-3	Nitrobenzene	420	U	UG/KG			3.67E-03	
Metals								
7429-90-5	Aluminum	10700		MG/KG	3.72E-01		6.38E-03	
7440-36-0	Antimony	1.1		MG/KG	1.33E+00		1.35E-03	3.67E+00
7440-38-2	Arsenic	12.8		MG/KG	9.48E-01	4.69E-06	2.91E-02	1.28E+01
7440-39-3	Barium	337		MG/KG	1.73E+00		2.71E-03	4.21E+00
7440-41-7	Beryllium	0.97		MG/KG	1.28E+00	4.33E-10	2.63E-04	3.23E-01
7440-42-8	Boron	59.6		MG/KG	1.12E+01		7.53E-04	
7440-43-9	Cadmium	1.6		MG/KG	8.42E+00	5.35E-10	1.98E-03	4.00E+00
7440-70-2	Calcium	76400		MG/KG	3.06E+01			
7440-47-3	Chromium	19		MG/KG	7.54E-01	4.24E-08		9.50E+00
7440-48-4	Cobalt	29.5		MG/KG	1.36E+00		2.41E-04	
7440-50-8	Copper	156		MG/KG	1.38E+01		2.06E-03	
7439-89-6	Iron	33900	J	MG/KG	1.76E+00		5.54E-02	
7439-92-1	Lead	101		MG/KG	4.32E+00			
7439-95-4	Magnesium	36800		MG/KG	2.37E+01			
7439-96-5	Manganese	747		MG/KG	2.05E-01		2.32E-02	

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J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7439-97-6	Mercury	0.055	J	MG/KG	9.17E-01			
7440-02-0	Nickel	30.7		MG/KG	1.62E+00		7.51E-04	4.39E+00
2023695	Potassium	705		MG/KG	1.13E+00			
7782-49-2	Selenium	0.49	J	MG/KG	2.09E-01		4.79E-05	1.63E+00
7440-22-4	Silver	0.73	J	MG/KG	1.26E+00		7.14E-05	3.65E-01
7440-23-5	Sodium	543		MG/KG	3.19E+00			
7440-28-0	Thallium	0.76	J	MG/KG	1.85E+00		5.31E-06	
7440-62-2	Vanadium	34.5		MG/KG	7.31E-01		2.41E-03	1.15E-01
7440-66-6	Zinc	634	J	MG/KG	1.23E+01		1.04E-03	1.06E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	5	U	UG/KG			2.50E-03
79-34-5	1,1,2,2-Tetrachloroethane	5	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	5	U	UG/KG	6.10E-07	6.10E-07	2.50E-01
75-34-3	1,1-Dichloroethane	5	U	UG/KG	2.50E-08	2.50E-08	2.17E-04
75-35-4	1,1-Dichloroethene	5	U	UG/KG	2.78E-07	2.78E-06	8.33E-02
107-06-2	1,2-Dichloroethane (EDC)	5	U	UG/KG	7.94E-05	3.57E-06	2.50E-01
540-59-0	1,2-Dichloroethene (total)	5	U	UG/KG	2.50E-07	2.50E-07	1.25E-02
78-87-5	1,2-Dichloropropane	5	U	UG/KG	5.95E-05	2.78E-06	1.67E-01
78-93-3	2-Butanone (MEK)	11	U	UG/KG			
591-78-6	2-Hexanone	11	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	11	U	UG/KG			
67-64-1	Acetone	11	U	UG/KG	5.50E-08	5.50E-08	6.88E-04
71-43-2	Benzene	5	U	UG/KG	2.50E-05	1.16E-06	1.67E-01
75-27-4	Bromodichloromethane	5	U	UG/KG	5.43E-05	2.50E-06	8.33E-03
75-25-2	Bromoform	5	U	UG/KG	6.94E-06	3.13E-07	6.25E-03
74-83-9	Bromomethane	5	U	UG/KG	1.72E-06	5.00E-06	2.50E-02
75-15-0	Carbon disulfide	5	U	UG/KG	2.50E-08	2.50E-07	1.56E-04
56-23-5	Carbon tetrachloride	5	U	UG/KG	1.14E-04	1.22E-05	7.14E-02
108-90-7	Chlorobenzene	5	U	UG/KG	1.22E-07	1.22E-06	5.00E-03
75-00-3	Chloroethane	5	U	UG/KG			
67-66-3	Chloroform	5	U	UG/KG	5.32E-06	2.50E-06	8.33E-03
74-87-3	Chloromethane	5	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	5	U	UG/KG	2.50E-07	2.50E-07	1.25E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
10061-01-5	cis-1,3-Dichloropropene	5	U	UG/KG			
124-48-1	Dibromochloromethane	5	U	UG/KG	1.22E-07	1.22E-07	1.25E-02
100-41-4	Ethylbenzene	5	U	UG/KG	2.50E-08	2.50E-07	3.85E-04
75-09-2	Methylene chloride	5	U	UG/KG	6.58E-06	4.17E-07	2.50E-01
110-54-3	N-Hexane	5	U	UG/KG			
100-42-5	Styrene	5	U	UG/KG	1.22E-08	1.22E-07	1.25E-03
127-18-4	Tetrachloroethylene (PCE)	5	U	UG/KG	4.55E-05	2.08E-06	8.33E-02
108-88-3	Toluene	5	U	UG/KG	1.22E-08	1.22E-08	4.17E-04
1330-20-7	total Xylenes	5	U	UG/KG	5.00E-09	1.22E-08	3.33E-05
156-60-5	trans-1,2-Dichloroethene	5	U	UG/KG	1.22E-07	1.22E-07	7.14E-03
10061-02-6	trans-1,3-Dichloropropene	5	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	5	U	UG/KG	9.62E-06	4.17E-06	8.33E-02
75-01-4	Vinyl chloride	5	U	UG/KG	1.67E-03	7.69E-05	5.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	420	U	UG/KG	2.10E-05	2.10E-04	8.40E-02
95-50-1	1,2-Dichlorobenzene	420	U	UG/KG	2.33E-06	2.33E-05	2.47E-02
541-73-1	1,3-Dichlorobenzene	420	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	420	U	UG/KG			2.10E-01
95-95-4	2,4,5-Trichlorophenol	2100	U	UG/KG	1.05E-05	1.05E-05	7.78E-03
88-06-2	2,4,6-Trichlorophenol	420	U	UG/KG	8.08E-04	3.82E-05	2.10E+00
120-83-2	2,4-Dichlorophenol	420	U	UG/KG	6.89E-05	6.89E-04	4.20E-01
105-67-9	2,4-Dimethylphenol	420	U	UG/KG	1.02E-05	1.02E-05	4.67E-02
51-28-5	2,4-Dinitrophenol	2100	U	UG/KG	5.12E-04	5.12E-03	1.05E+01
91-58-7	2-Chloronaphthalene	420	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	420	U	UG/KG	4.20E-05	4.20E-05	1.05E-01
90-12-0	1-Methylnaphthalene	2400	J	UG/KG	2.93E-05	2.93E-04	2.86E-02
91-57-6	2-Methylnaphthalene	7200	J	UG/KG	1.18E-04	1.18E-04	1.71E-03
95-48-7	2-Methylphenol	420	U	UG/KG	4.20E-06	4.20E-06	2.80E-02
88-74-4	2-Nitroaniline	2100	U	UG/KG			
88-75-5	2-Nitrophenol	420	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	420	U	UG/KG	3.23E-02	1.50E-03	6.00E+01
99-09-2	3-Nitroaniline	2100	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2100	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	420	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	420	U	UG/KG			
106-47-8	4-Chloroaniline	830	U	UG/KG	1.01E-04	1.01E-03	1.19E+00
7005-72-3	4-Chlorophenyl phenyl ether	420	U	UG/KG			
106-44-5	4-Methylphenol	420	U	UG/KG			
100-01-6	4-Nitroaniline	2100	U	UG/KG			
100-02-7	4-Nitrophenol	2100	U	UG/KG			
83-32-9	Acenaphthene	420	U	UG/KG	3.50E-06	3.50E-06	7.37E-04
208-96-8	Acenaphthylene	4500	J	UG/KG	7.38E-05	7.38E-05	1.07E-03
120-12-7	Anthracene	340	J	UG/KG	5.57E-07	5.57E-07	2.83E-05
56-55-3	Benzo(a)anthracene	1900	J	UG/KG	2.38E-01	1.12E-02	9.50E-01
50-32-8	Benzo(a)pyrene	2600	J	UG/KG	3.25E+00	1.53E-01	3.25E-01
205-99-2	Benzo(b)fluoranthene	3500	J	UG/KG	4.38E-01	2.06E-02	7.00E-01
191-24-2	Benzo(g,h,i)perylene	1400	J	UG/KG	2.30E-05	2.30E-05	3.33E-04
207-08-9	Benzo(k)fluoranthene	1600	J	UG/KG	2.05E-02	9.41E-04	3.27E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-91-1	bis(2-Chloroethoxy)methane	420	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	420	U	UG/KG	8.40E-02	5.60E-03	1.05E+03
108-60-1	bis(2-Chloroisopropyl) ether	420	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	420	U	UG/KG	1.02E-03	1.02E-04	1.17E-04
85-68-7	Butyl benzyl phthalate	420	U	UG/KG	1.02E-06	1.02E-06	4.52E-04
86-74-8	Carbazole	420	U	UG/KG	1.45E-03	6.77E-05	7.00E-01
218-01-9	Chrysene	3200	J	UG/KG	4.10E-03	1.88E-04	2.00E-02
84-74-2	Di-n-butyl phthalate	420	U	UG/KG	2.10E-06	2.10E-06	1.83E-04
117-84-0	Di-n-octyl phthalate	420	U	UG/KG	1.02E-05	1.02E-04	4.20E-05
53-70-3	Dibenz(a,h)anthracene	320	J	UG/KG	4.00E-01	1.88E-02	1.60E-01
132-64-9	Dibenzofuran	420	U	UG/KG			
84-66-2	Diethyl phthalate	420	U	UG/KG	4.20E-07	4.20E-07	8.94E-04
131-11-3	Dimethyl phthalate	420	U	UG/KG			
206-44-0	Fluoranthene	3500	J	UG/KG	4.27E-05	4.27E-05	8.14E-04
86-73-7	Fluorene	110	J	UG/KG	1.34E-06	1.34E-06	1.96E-04
118-74-1	Hexachlorobenzene	420	U	UG/KG	1.05E-01	5.38E-03	2.10E-01
87-68-3	Hexachlorobutadiene	420	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	420	U	UG/KG	3.00E-05	3.00E-05	1.05E-03
67-72-1	Hexachloroethane	420	U	UG/KG	2.10E-04	2.10E-04	8.40E-01
193-39-5	Indeno(1,2,3-c,d)pyrene	1700	J	UG/KG	2.13E-01	1.00E-02	1.21E-01
78-59-1	Isophorone	420	U	UG/KG	1.02E-06	1.02E-06	5.25E-02
621-64-7	N-Nitroso-di-n-propylamine	420	U	UG/KG	5.25E-01	2.33E-02	8.40E+03
86-30-6	N-Nitrosodiphenylamine	420	U	UG/KG	3.50E-04	1.68E-05	4.20E-01
91-20-3	Naphthalene	3600	J	UG/KG	4.39E-05	4.39E-04	4.29E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
87-86-5	Pentachlorophenol	2100	U	UG/KG	8.75E-02	4.04E-03	7.00E+01
85-01-8	Phenanthrene	1400	J	UG/KG	2.30E-05	2.30E-05	3.33E-04
108-95-2	Phenol	420	U	UG/KG	4.20E-07	3.50E-06	4.20E-03
129-00-0	Pyrene	3500	J	UG/KG	5.74E-05	5.74E-05	8.33E-04
Explosives							
121-14-2	2,4-Dinitrotoluene	420	U	UG/KG	5.00E-02	2.33E-03	5.25E+02
606-20-2	2,6-Dinitrotoluene	420	U	UG/KG	5.00E-02	2.33E-03	6.00E+02
98-95-3	Nitrobenzene	420	U	UG/KG	4.20E-04	4.20E-04	4.20E+00
Metals							
7429-90-5	Aluminum	10700		MG/KG			
7440-36-0	Antimony	1.1		MG/KG	1.34E-03	1.34E-02	2.20E-01
7440-38-2	Arsenic	12.8		MG/KG	4.27E+00	2.10E-01	4.57E-01
7440-39-3	Barium	337		MG/KG	2.41E-03	2.41E-02	2.81E-01
7440-41-7	Beryllium	0.97		MG/KG	9.70E-01	3.34E-02	1.47E-01
7440-42-8	Boron	59.6		MG/KG	3.31E-04	3.31E-03	
7440-43-9	Cadmium	1.6		MG/KG	8.00E-04	8.00E-03	4.32E-01
7440-70-2	Calcium	76400		MG/KG			
7440-47-3	Chromium	19		MG/KG	1.90E-03	4.63E-03	6.79E-01
7440-48-4	Cobalt	29.5		MG/KG	2.46E-04	2.46E-03	
7440-50-8	Copper	156		MG/KG	1.90E-03	1.90E-02	1.42E-02
7439-89-6	Iron	33900	J	MG/KG			
7439-92-1	Lead	101		MG/KG	2.53E-01	2.53E-01	
7439-95-4	Magnesium	36800		MG/KG			
7439-96-5	Manganese	747		MG/KG	7.78E-03	7.78E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-6
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7439-97-6	Mercury	0.055	J	MG/KG	9.02E-05	9.02E-04	3.67E-01
7440-02-0	Nickel	30.7		MG/KG	7.49E-04	7.49E-03	4.04E-01
2023695	Potassium	705		MG/KG			
7782-49-2	Selenium	0.49	J	MG/KG	4.90E-05	4.90E-04	2.04E-01
7440-22-4	Silver	0.73	J	MG/KG	7.30E-05	7.30E-04	4.87E-01
7440-23-5	Sodium	543		MG/KG			
7440-28-0	Thallium	0.76	J	MG/KG	4.75E-03	4.75E-03	3.17E-01
7440-62-2	Vanadium	34.5		MG/KG	2.46E-03	2.46E-02	3.52E-02
7440-66-6	Zinc	634	J	MG/KG	1.04E-03	1.04E-02	1.76E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-7
HUMAN HEALTH SCREENING OF TRENCH WATER RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	1	U	UG/L		1.26E-03	5.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	1	U	UG/L	1.81E-05	2.74E-03	
79-00-5	1,1,2-Trichloroethane	1	U	UG/L	5.01E-06	4.11E-02	2.00E-01
75-34-3	1,1-Dichloroethane	1	U	UG/L		1.23E-03	
75-35-4	1,1-Dichloroethene	1	U	UG/L	2.19E-05	1.83E-02	1.43E-01
107-06-2	1,2-Dichloroethane (EDC)	1	U	UG/L	8.12E-06	9.88E-02	2.00E-01
78-87-5	1,2-Dichloropropane	1	U	UG/L	6.07E-06	1.45E-01	2.00E-01
78-93-3	2-Butanone (MEK)	5	U	UG/L		2.63E-03	
591-78-6	2-Hexanone	5	U	UG/L			
108-10-1	4-Methyl-2-pentanone (MIBK)	1	U	UG/L		6.34E-03	
67-64-1	Acetone	5	U	UG/L		8.22E-03	
71-43-2	Benzene	1	U	UG/L	2.44E-06	8.92E-02	2.00E-01
75-27-4	Bromodichloromethane	1	U	UG/L	5.53E-06	8.22E-03	
75-25-2	Bromoform	1	U	UG/L	1.18E-07	1.37E-03	
74-83-9	Bromomethane	1	U	UG/L		1.15E-01	
75-15-0	Carbon disulfide	1	U	UG/L		9.59E-04	
56-23-5	Carbon tetrachloride	1	U	UG/L	5.84E-06	2.35E-01	2.00E-01
108-90-7	Chlorobenzene	1	U	UG/L		9.43E-03	1.00E-02
75-00-3	Chloroethane	1	U	UG/L	2.16E-07	1.16E-04	
67-66-3	Chloroform	1	U	UG/L	6.08E-06	1.60E+00	
74-87-3	Chloromethane	1	U	UG/L	6.62E-07		
156-59-2	cis-1,2-Dichloroethene	1	U	UG/L		1.64E-02	1.43E-02
10061-01-5	cis-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-7

HUMAN HEALTH SCREENING OF TRENCH WATER RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
124-48-1	Dibromochloromethane	1	U	UG/L	7.50E-06	8.22E-03	
100-41-4	Ethylbenzene	1	U	UG/L		7.46E-04	1.43E-03
75-09-2	Methylene chloride	1	U	UG/L	2.34E-07	6.16E-04	2.00E-01
110-54-3	N-Hexane	5	U	UG/L		1.43E-02	
100-42-5	Styrene	1	U	UG/L		6.09E-04	1.00E-02
127-18-4	Tetrachloroethylene (PCE)	1	U	UG/L	9.24E-07	3.94E-03	2.00E-01
108-88-3	Toluene	1	U	UG/L		1.38E-03	1.00E-03
1330-20-7	total Xylenes	1	U	UG/L		6.99E-04	1.00E-04
156-60-5	trans-1,2-Dichloroethene	1	U	UG/L		8.22E-03	1.00E-02
10061-02-6	trans-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	
79-01-6	Trichloroethylene (TCE)	1	U	UG/L	6.10E-07	2.74E-02	2.00E-01
75-01-4	Vinyl chloride	1	U	UG/L	5.06E-05		5.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	10	U	UG/L		5.14E-02	1.43E-01
95-50-1	1,2-Dichlorobenzene	10	U	UG/L		2.70E-02	1.67E-02
541-73-1	1,3-Dichlorobenzene	10	U	UG/L		1.83E+00	
106-46-7	1,4-Dichlorobenzene	10	U	UG/L	1.99E-05	5.48E-02	1.33E-01
95-95-4	2,4,5-Trichlorophenol	50	U	UG/L		1.37E-02	
88-06-2	2,4,6-Trichlorophenol	10	U	UG/L	1.64E-06		
120-83-2	2,4-Dichlorophenol	10	U	UG/L		9.13E-02	
105-67-9	2,4-Dimethylphenol	10	U	UG/L		1.37E-02	
51-28-5	2,4-Dinitrophenol	50	U	UG/L		6.85E-01	
91-58-7	2-Chloronaphthalene	10	U	UG/L		2.05E-02	
95-57-8	2-Chlorophenol	10	U	UG/L		3.29E-01	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect

J = Estimated U = Nondetect

TABLE 7-7

HUMAN HEALTH SCREENING OF TRENCH WATER RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
91-57-6	2-Methylnaphthalene	10	U	UG/L		5.48E-02	
95-48-7	2-Methylphenol	10	U	UG/L		5.48E-03	
88-74-4	2-Nitroaniline	50	U	UG/L		2.40E+01	
88-75-5	2-Nitrophenol	10	U	UG/L		3.42E-02	
91-94-1	3,3'-Dichlorobenzidine	20	U	UG/L	1.34E-04		
99-09-2	3-Nitroaniline	50	U	UG/L		2.40E+01	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	UG/L			
101-55-3	4-Bromophenyl phenyl ether	10	U	UG/L			
59-50-7	4-Chloro-3-methylphenol	10	U	UG/L		5.48E-03	
106-47-8	4-Chloroaniline	20	U	UG/L		1.37E-01	
7005-72-3	4-Chlorophenyl phenyl ether	10	U	UG/L			
106-44-5	4-Methylphenol	10	U	UG/L		5.48E-02	
100-01-6	4-Nitroaniline	50	U	UG/L		2.40E+01	
100-02-7	4-Nitrophenol	50	U	UG/L		1.71E-01	
83-32-9	Acenaphthene	10	U	UG/L		2.74E-02	
208-96-8	Acenaphthylene	10	U	UG/L		5.48E-02	
120-12-7	Anthracene	10	U	UG/L		5.48E-03	
56-55-3	Benzo(a)anthracene	10	U	UG/L	1.09E-04		
50-32-8	Benzo(a)pyrene	10	U	UG/L	1.09E-03		5.00E+01
205-99-2	Benzo(b)fluoranthene	10	U	UG/L	1.09E-04		
191-24-2	Benzo(g,h,i)perylene	10	U	UG/L		5.48E-02	
207-08-9	Benzo(k)fluoranthene	10	U	UG/L	1.09E-05		
111-91-1	bis(2-Chloroethoxy)methane	10	U	UG/L			
111-44-4	bis(2-Chloroethyl) ether	10	U	UG/L	1.02E-03		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect

J = Estimated U = Nondetect

TABLE 7-7
HUMAN HEALTH SCREENING OF TRENCH WATER RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
108-60-1	bis(2-Chloroisopropyl) ether	10	U	UG/L	3.64E-05	4.11E-02	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	10	U	UG/L	2.08E-06	1.37E-02	
85-68-7	Butyl benzyl phthalate	10	U	UG/L		1.37E-03	
86-74-8	Carbazole	10	U	UG/L	2.97E-06		
218-01-9	Chrysene	10	U	UG/L	1.09E-06		
84-74-2	Di-n-butyl phthalate	10	U	UG/L		2.74E-03	
117-84-0	Di-n-octyl phthalate	10	U	UG/L		1.37E-02	
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L	1.09E-03		
132-64-9	Dibenzofuran	10	U	UG/L		4.11E-01	
84-66-2	Diethyl phthalate	10	U	UG/L		3.42E-04	
131-11-3	Dimethyl phthalate	10	U	UG/L		2.74E-05	
206-44-0	Fluoranthene	10	U	UG/L		6.85E-03	
86-73-7	Fluorene	10	U	UG/L		4.11E-02	
118-74-1	Hexachlorobenzene	10	U	UG/L	2.38E-04	3.42E-01	1.00E+01
87-68-3	Hexachlorobutadiene	10	U	UG/L	1.16E-05	1.37E+00	
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		3.91E-02	2.00E-01
67-72-1	Hexachloroethane	10	U	UG/L	2.08E-06	2.74E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L	1.09E-04		
78-59-1	Isophorone	10	U	UG/L	1.41E-07	1.37E-03	
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L	1.04E-03		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L	7.29E-07		
91-20-3	Naphthalene	10	U	UG/L		1.61E+00	
87-86-5	Pentachlorophenol	50	U	UG/L	8.92E-05	4.57E-02	5.00E+01
85-01-8	Phenanthrene	10	U	UG/L		5.48E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-7
HUMAN HEALTH SCREENING OF TRENCH WATER RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
108-95-2	Phenol	10	U	UG/L		4.57E-04	1.00E-01
129-00-0	Pyrene	10	U	UG/L		5.48E-02	
Explosives							
121-14-2	2,4-Dinitrotoluene	10	U	UG/L		1.37E-01	
606-20-2	2,6-Dinitrotoluene	10	U	UG/L		2.74E-01	
98-95-3	Nitrobenzene	10	U	UG/L		2.95E+00	
Metals							
7429-90-5	Aluminum	111000		UG/L		3.04E+00	
7440-36-0	Antimony	6	U	UG/L		4.11E-01	1.00E+00
7440-38-2	Arsenic	18.4		UG/L	4.11E-04	1.68E+00	3.68E-01
7440-39-3	Barium	2510		UG/L		9.82E-01	1.26E+00
7440-41-7	Beryllium	10.9		UG/L		1.49E-01	2.73E+00
7440-42-8	Boron	100	U	UG/L		3.04E-02	5.00E-02
7440-43-9	Cadmium	4.9	J	UG/L		2.68E-01	9.80E-01
7440-70-2	Calcium	283000		UG/L			
7440-47-3	Chromium	111		UG/L			1.11E+00
7440-48-4	Cobalt	68.8		UG/L		3.14E-02	6.88E-02
7440-50-8	Copper	80.5		UG/L		5.94E-02	1.24E-01
7439-89-6	Iron	84200		UG/L		7.69E+00	1.68E+01
7439-92-1	Lead	99.4		UG/L			1.33E+01
7439-95-4	Magnesium	61700		UG/L			
7439-96-5	Manganese	4180		UG/L		4.77E+00	2.79E+01
7439-97-6	Mercury	1		UG/L			5.00E-01
7440-02-0	Nickel	142		UG/L		1.95E-01	1.42E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 7-7
HUMAN HEALTH SCREENING OF TRENCH WATER RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
2023695	Potassium	8630		UG/L			
7782-49-2	Selenium	3.6	J	UG/L		1.97E-02	7.20E-02
7440-22-4	Silver	10	U	UG/L		5.48E-02	2.00E-01
7440-23-5	Sodium	45000		UG/L			
7440-28-0	Thallium	10	U	UG/L		3.91E+00	5.00E+00
7440-62-2	Vanadium	169		UG/L		6.61E-01	
7440-66-6	Zinc	432		UG/L		3.95E-02	8.64E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-8
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		5	U	UG/KG	1.68E-04	
79-34-5	1,1,2,2-Tetrachloroethane		5	U	UG/KG	3.93E-02	
79-00-5	1,1,2-Trichloroethane		5	U	UG/KG	1.75E-04	
75-34-3	1,1-Dichloroethane		5	U	UG/KG	2.49E-04	
75-35-4	1,1-Dichloroethene		5	U	UG/KG	6.04E-04	
107-06-2	1,2-Dichloroethane (EDC)		5	U	UG/KG	2.36E-04	
540-59-0	1,2-Dichloroethene (total)		5	U	UG/KG	6.35E-03	
78-87-5	1,2-Dichloropropane		5	U	UG/KG	7.14E-06	
78-93-3	2-Butanone (MEK)		11	U	UG/KG	1.23E-04	
591-78-6	2-Hexanone		11	U	UG/KG	8.73E-04	
108-10-1	4-Methyl-2-pentanone (MIBK)		11	U	UG/KG	2.48E-05	
67-64-1	Acetone		11	U	UG/KG	4.40E-03	
71-43-2	Benzene		5	U	UG/KG	3.13E-04	
75-27-4	Bromodichloromethane		5	U	UG/KG	9.26E-03	
75-25-2	Bromoform		5	U	UG/KG	3.14E-04	
74-83-9	Bromomethane		5	U	UG/KG	2.13E-02	
75-15-0	Carbon disulfide		5	U	UG/KG	5.31E-02	
56-23-5	Carbon tetrachloride		5	U	UG/KG	5.00E-06	
108-90-7	Chlorobenzene		5	U	UG/KG	1.25E-04	
75-00-3	Chloroethane		5	U	UG/KG		
67-66-3	Chloroform		5	U	UG/KG	4.20E-03	
74-87-3	Chloromethane		5	U	UG/KG	4.81E-04	
156-59-2	cis-1,2-Dichloroethene		5	U	UG/KG	6.35E-03	
10061-01-5	cis-1,3-Dichloropropene		5	U	UG/KG	1.26E-02	
124-48-1	Dibromochloromethane		5	U	UG/KG	2.44E-03	
100-41-4	Ethylbenzene		5	U	UG/KG	1.00E-03	
75-09-2	Methylene chloride		5	U	UG/KG	1.23E-03	
110-54-3	N-Hexane		5	U	UG/KG		
100-42-5	Styrene		5	U	UG/KG	1.67E-05	
127-18-4	Tetrachloroethylene (PCE)		5	U	UG/KG	3.85E-04	
108-88-3	Toluene		5	U	UG/KG	1.67E-03	
1330-20-7	total Xylenes		5	U	UG/KG	8.33E-03	
156-60-5	trans-1,2-Dichloroethene		5	U	UG/KG	6.35E-03	
10061-02-6	trans-1,3-Dichloropropene		5	U	UG/KG	1.26E-02	
79-01-6	Trichloroethylene (TCE)		5	U	UG/KG	5.56E-04	
75-01-4	Vinyl chloride		5	U	UG/KG	7.74E-03	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		420	U	UG/KG	2.10E-02	
95-50-1	1,2-Dichlorobenzene		420	U	UG/KG	1.42E-01	
541-73-1	1,3-Dichlorobenzene		420	U	UG/KG	1.11E-02	
106-46-7	1,4-Dichlorobenzene		420	U	UG/KG	2.10E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-8
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
95-95-4	2,4,5-Trichlorophenol		2100	U	UG/KG	5.25E-01	
88-06-2	2,4,6-Trichlorophenol		420	U	UG/KG	4.20E-02	
120-83-2	2,4-Dichlorophenol		420	U	UG/KG	4.80E-03	
105-67-9	2,4-Dimethylphenol		420	U	UG/KG	4.20E+01	
51-28-5	2,4-Dinitrophenol		2100	U	UG/KG	1.05E-01	
91-58-7	2-Chloronaphthalene		420	U	UG/KG	3.45E+01	
95-57-8	2-Chlorophenol		420	U	UG/KG	1.73E+00	
90-12-0	1-Methylnaphthalene		2400	J	UG/KG		
91-57-6	2-Methylnaphthalene		7200	J	UG/KG	2.22E+00	YES
95-48-7	2-Methylphenol		420	U	UG/KG	1.04E-02	
88-74-4	2-Nitroaniline		2100	U	UG/KG	2.83E-02	
88-75-5	2-Nitrophenol		420	U	UG/KG	2.63E-01	
91-94-1	3,3'-Dichlorobenzidine		420	U	UG/KG	6.50E-01	
99-09-2	3-Nitroaniline		2100	U	UG/KG	6.65E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2100	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		420	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		420	U	UG/KG	5.28E-02	
106-47-8	4-Chloroaniline		830	U	UG/KG	7.55E-01	
7005-72-3	4-Chlorophenyl phenyl ether		420	U	UG/KG		
106-44-5	4-Methylphenol		420	U	UG/KG	2.58E-03	
100-01-6	4-Nitroaniline		2100	U	UG/KG	9.59E-02	
100-02-7	4-Nitrophenol		2100	U	UG/KG	3.00E-01	
83-32-9	Acenaphthene		420	U	UG/KG	6.15E-04	
208-96-8	Acenaphthylene		4500	J	UG/KG	6.59E-03	
120-12-7	Anthracene		340	J	UG/KG	2.30E-04	YES
56-55-3	Benzo(a)anthracene		1900	J	UG/KG	3.65E-01	YES
50-32-8	Benzo(a)pyrene		2600	J	UG/KG	5.91E-04	YES
205-99-2	Benzo(b)fluoranthene		3500	J	UG/KG	5.85E-02	YES
191-24-2	Benzo(g,h,i)perylene		1400	J	UG/KG	1.18E-02	YES
207-08-9	Benzo(k)fluoranthene		1600	J	UG/KG	2.68E-02	YES
111-91-1	bis(2-Chloroethoxy)methane		420	U	UG/KG	1.39E+00	
111-44-4	bis(2-Chloroethyl) ether		420	U	UG/KG	1.77E-02	
108-60-1	bis(2-Chloroisopropyl) ether		420	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		420	U	UG/KG	4.54E-01	
85-68-7	Butyl benzyl phthalate		420	U	UG/KG	1.76E+00	
86-74-8	Carbazole		420	U	UG/KG		
218-01-9	Chrysene		3200	J	UG/KG	6.77E-01	YES
84-74-2	Di-n-butyl phthalate		420	U	UG/KG	2.10E-03	
117-84-0	Di-n-octyl phthalate		420	U	UG/KG	5.92E-04	
53-70-3	Dibenz(a,h)anthracene		320	J	UG/KG	1.74E-02	YES
132-64-9	Dibenzofuran		420	U	UG/KG		
84-66-2	Diethyl phthalate		420	U	UG/KG	4.20E-03	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-8
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
131-11-3	Dimethyl phthalate		420	U	UG/KG	2.10E-03	
206-44-0	Fluoranthene		3500	J	UG/KG	2.87E-02	YES
86-73-7	Fluorene		110	J	UG/KG	3.67E-03	YES
118-74-1	Hexachlorobenzene		420	U	UG/KG	4.20E-04	
87-68-3	Hexachlorobutadiene		420	U	UG/KG	1.06E+01	
77-47-4	Hexachlorocyclopentadiene		420	U	UG/KG	4.20E-02	
67-72-1	Hexachloroethane		420	U	UG/KG	7.04E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		1700	J	UG/KG	1.56E-02	YES
78-59-1	Isophorone		420	U	UG/KG	3.02E-03	
621-64-7	N-Nitroso-di-n-propylamine		420	U	UG/KG	7.73E-01	
86-30-6	N-Nitrosodiphenylamine		420	U	UG/KG	2.10E-02	
91-20-3	Naphthalene		3600	J	UG/KG	1.45E-02	
87-86-5	Pentachlorophenol		2100	U	UG/KG	3.50E-01	
85-01-8	Phenanthrene		1400	J	UG/KG	3.06E-02	YES
108-95-2	Phenol		420	U	UG/KG	1.05E-02	
129-00-0	Pyrene		3500	J	UG/KG	4.46E-02	YES
Explosives							
121-14-2	2,4-Dinitrotoluene		420	U	UG/KG	3.28E-01	
606-20-2	2,6-Dinitrotoluene		420	U	UG/KG	1.28E+01	
98-95-3	Nitrobenzene		420	U	UG/KG	1.05E-02	
Metals							
7429-90-5	Aluminum	28800	10700		MG/KG		
7440-36-0	Antimony	0.83	1.1		MG/KG	2.20E-01	
7440-38-2	Arsenic	13.5	12.8		MG/KG	1.42E+00	
7440-39-3	Barium	195	337		MG/KG	6.74E-01	
7440-41-7	Beryllium	0.76	0.97		MG/KG	9.70E-02	
7440-42-8	Boron	5.3	59.6		MG/KG	1.19E+02	
7440-43-9	Cadmium	0.19	1.6		MG/KG	5.52E-02	
7440-70-2	Calcium	2497	76400		MG/KG		
7440-47-3	Chromium	25.2	19		MG/KG	3.80E+00	
7440-48-4	Cobalt	21.7	29.5		MG/KG	1.48E+00	
7440-50-8	Copper	11.3	156		MG/KG	5.03E+00	
7439-89-6	Iron	19306	33900	J	MG/KG	1.70E+02	
7439-92-1	Lead	23.4	101		MG/KG	2.33E-01	
7439-95-4	Magnesium	1552	36800		MG/KG		
7439-96-5	Manganese	3640	747		MG/KG	7.47E+00	
7439-97-6	Mercury	0.06	0.055	J	MG/KG	7.86E-03	YES
7440-02-0	Nickel	18.9	30.7		MG/KG	1.02E+00	
2023695	Potassium	625	705		MG/KG		
7782-49-2	Selenium	2.34	0.49	J	MG/KG	4.90E-01	YES
7440-22-4	Silver	0.58	0.73	J	MG/KG	3.65E-01	
7440-23-5	Sodium	170	543		MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-8
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 2R (AUS-0A2R)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-28-0	Thallium	0.41	0.76	J	MG/KG	7.60E-01	
7440-62-2	Vanadium	47.2	34.5		MG/KG	7.50E-01	
7440-66-6	Zinc	51.4	634	J	MG/KG	5.28E+00	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

TABLE 7-9, AUS-0A2R
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Trench Water		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Volatile Organic Compounds								
1,1,1-Trichloroethane	NA	NA	No	A	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1,2-Trichloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,1-Dichloroethane	NA	NA	No	A	NA	NA	No	A
1,1-Dichloroethene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,2-Dichloroethane (EDC)	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2-Butanone (MEK)	NA	NA	No	A	NA	NA	No	A
2-Hexanone	NA	NA	No	C	NA	NA	No	C
4-Methyl-2-pentanone (MIBK)	NA	NA	No	A	NA	NA	No	A
Acetone	NA	NA	No	A	NA	NA	No	A
Benzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Bromodichloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Bromoform	NA	NA	No	A	NA	NA	No	A
Bromomethane	NA	NA	No	A	NA	NA	No	A
Carbon disulfide	NA	NA	No	A	NA	NA	No	A
Carbon tetrachloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Chlorobenzene	NA	NA	No	A	NA	NA	No	A
Chloroethane	NA	NA	No	A	NA	NA	No	A
Chloroform	NA	NA	Uncertainty	B	NA	NA	No	A
Chloromethane	NA	NA	No	A	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	No	A	NA	NA	No	A
cis-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Dibromochloromethane	NA	NA	Uncertainty	B	NA	NA	No	A
Ethylbenzene	NA	NA	No	A	NA	NA	No	A
Methylene chloride	NA	NA	No	A	NA	NA	Uncertainty	B
N-Hexane	NA	NA	No	A	NA	NA	No	A
Styrene	NA	NA	No	A	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	No	A	NA	NA	Uncertainty	B
Toluene	NA	NA	No	A	NA	NA	No	A
total Xylenes	NA	NA	No	A	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	No	A	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	Uncertainty	B	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	No	A	NA	NA	Uncertainty	B
Vinyl chloride	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	NA	NA	No	A	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	NA	NA	No	A	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	Uncertainty	B	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	NA	NA	No	A	NA	NA	No	A

TABLE 7-9, AUS-0A2R
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Trench Water		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trichlorophenol	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
2,4-Dichlorophenol	NA	NA	No	A	NA	NA	Uncertainty	B
2,4-Dimethylphenol	NA	NA	No	A	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	No	A	NA	NA	Uncertainty	B
2-Chloronaphthalene	NA	NA	No	A	NA	NA	No	A
2-Chlorophenol	NA	NA	No	A	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	No	F
2-Methylnaphthalene	NA	NA	No	A	NA	NA	No	F
2-Methylphenol	NA	NA	No	A	NA	NA	No	A
2-Nitroaniline	NA	NA	Uncertainty	B	NA	NA	No	A
2-Nitrophenol	NA	NA	No	A	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
3-Nitroaniline	NA	NA	Uncertainty	B	NA	NA	No	A
4,6-Dinitro-2-methylphenol	NA	NA	No	C	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	No	C	NA	NA	No	C
4-Chloro-3-methylphenol	NA	NA	No	A	NA	NA	No	A
4-Chloroaniline	NA	NA	No	A	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	NA	NA	No	C	NA	NA	No	C
4-Methylphenol	NA	NA	No	A	NA	NA	No	A
4-Nitroaniline	NA	NA	Uncertainty	B	NA	NA	No	A
4-Nitrophenol	NA	NA	No	A	NA	NA	No	A
Acenaphthene	NA	NA	No	A	NA	NA	No	A
Acenaphthylene	NA	NA	No	A	NA	NA	No	F
Anthracene	NA	NA	No	A	NA	NA	No	F
Benzo(a)anthracene	NA	NA	Uncertainty	B	NA	NA	Yes	E
Benzo(a)pyrene	NA	NA	Uncertainty	B	NA	NA	Yes	E
Benzo(b)fluoranthene	NA	NA	Uncertainty	B	NA	NA	Yes	E
Benzo(g,h,i)perylene	NA	NA	No	A	NA	NA	No	F
Benzo(k)fluoranthene	NA	NA	Uncertainty	B	NA	NA	Yes	J
bis(2-Chloroethoxy)methane	NA	NA	No	C	NA	NA	No	C
bis(2-Chloroethyl) ether	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	NA	NA	Uncertainty	B	NA	NA	No	A
bis(2-Ethylhexyl) phthalate	NA	NA	Uncertainty	B	NA	NA	No	A
Butyl benzyl phthalate	NA	NA	No	A	NA	NA	No	A
Carbazole	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Chrysene	NA	NA	Uncertainty	B	NA	NA	No	F
Di-n-butyl phthalate	NA	NA	No	A	NA	NA	No	A
Di-n-octyl phthalate	NA	NA	No	A	NA	NA	No	A
Dibenz(a,h)anthracene	NA	NA	Uncertainty	B	NA	NA	Yes	E
Dibenzofuran	NA	NA	No	A	NA	NA	No	A
Diethyl phthalate	NA	NA	No	A	NA	NA	No	A
Dimethyl phthalate	NA	NA	No	A	NA	NA	No	A
Fluoranthene	NA	NA	No	A	NA	NA	No	F

TABLE 7-9, AUS-0A2R
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Trench Water		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Fluorene	NA	NA	No	A	NA	NA	No	F
Hexachlorobenzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorobutadiene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	No	A	NA	NA	No	A
Hexachloroethane	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	NA	NA	Uncertainty	B	NA	NA	Yes	E
Isophorone	NA	NA	No	A	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	NA	NA	No	A	NA	NA	Uncertainty	B
Naphthalene	NA	NA	Uncertainty	B	NA	NA	No	F
Pentachlorophenol	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Phenanthrene	NA	NA	No	A	NA	NA	No	F
Phenol	NA	NA	No	A	NA	NA	No	A
Pyrene	NA	NA	No	A	NA	NA	No	F
Metals and Inorganics								
Aluminum	NA	NA	Yes	E	NA	NA	No	F
Antimony	NA	NA	Uncertainty	B	NA	NA	Yes	E
Arsenic	NA	NA	Yes	E	NA	NA	Yes	D
Barium	NA	NA	Yes	E	NA	NA	Yes	E
Beryllium	NA	NA	Yes	E	NA	NA	No	F
Boron	NA	NA	No	A	NA	NA	No	F
Cadmium	NA	NA	No	F	NA	NA	Yes	E
Calcium	NA	NA	No	H	NA	NA	No	H
Chromium	NA	NA	Yes	E	NA	NA	Yes	D
Cobalt	NA	NA	No	F	NA	NA	No	F
Copper	NA	NA	No	F	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	Yes	E	NA	NA	No	F
Lead	NA	NA	Yes	E	NA	NA	No	F
Magnesium	NA	NA	No	H	NA	NA	No	H
Manganese	NA	NA	Yes	E	NA	NA	No	F
Mercury	NA	NA	No	F	NA	NA	No	F
Nickel	NA	NA	Yes	E	NA	NA	Yes	E
Potassium	NA	NA	No	H	NA	NA	No	H
Selenium	NA	NA	No	F	NA	NA	Yes	D
Silver	NA	NA	No	A	NA	NA	No	F
Sodium	NA	NA	No	H	NA	NA	No	H
Thallium	NA	NA	Uncertainty	B	NA	NA	No	F
Vanadium	NA	NA	No	F	NA	NA	No	F
Zinc	NA	NA	No	F	NA	NA	Yes	E
Explosives								
1,3,5-Trinitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-9, AUS-0A2R
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Trench Water		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	No	A	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	NA	NA	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrotoluene (ONT)	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrotoluene (PNT)	NA	NA	NA	NA	NA	NA	NA	NA
HMX	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	NA	NA	Uncertainty	B	NA	NA	Uncertainty	B
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	NA	NA
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA	NA	NA
Tetryl	NA	NA	NA	NA	NA	NA	NA	NA
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	NA	NA	NA	NA	NA	NA

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 7-10, AUS-0A2R
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	NA	NA	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	No	A
1,1,2-Trichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethene	NA	NA	NA	NA	No	A
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	No	A
1,2-Dichloroethene (total)	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	NA	NA	No	A
2-Butanone (MEK)	NA	NA	NA	NA	No	A
2-Hexanone	NA	NA	NA	NA	No	A
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	No	A
Acetone	NA	NA	NA	NA	No	A
Benzene	NA	NA	NA	NA	No	A
Bromodichloromethane	NA	NA	NA	NA	No	A
Bromoform	NA	NA	NA	NA	No	A
Bromomethane	NA	NA	NA	NA	No	A
Carbon disulfide	NA	NA	NA	NA	No	A
Carbon tetrachloride	NA	NA	NA	NA	No	A
Chlorobenzene	NA	NA	NA	NA	No	A
Chloroethane	NA	NA	NA	NA	No	C
Chloroform	NA	NA	NA	NA	No	A
Chloromethane	NA	NA	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	NA	NA	No	A
cis-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Dibromochloromethane	NA	NA	NA	NA	No	A
Ethylbenzene	NA	NA	NA	NA	No	A
Methylene chloride	NA	NA	NA	NA	No	A
N-Hexane	NA	NA	NA	NA	No	C
Styrene	NA	NA	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	NA	NA	No	A
Toluene	NA	NA	NA	NA	No	A
total Xylenes	NA	NA	NA	NA	No	A
trans-1,2-Dichloroethene	NA	NA	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	NA	NA	No	A
Trichloroethylene (TCE)	NA	NA	NA	NA	No	A
Vinyl chloride	NA	NA	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	NA	NA	NA	NA	No	A
1,2-Dichlorobenzene	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	No	A
2,4,5-Trichlorophenol	NA	NA	NA	NA	No	A

TABLE 7-10, AUS-0A2R
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trichlorophenol	NA	NA	NA	NA	No	A
2,4-Dichlorophenol	NA	NA	NA	NA	No	A
2,4-Dimethylphenol	NA	NA	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	NA	NA	No	A
2-Chloronaphthalene	NA	NA	NA	NA	Uncertainty	B
2-Chlorophenol	NA	NA	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	Uncertainty	G
2-Methylnaphthalene	NA	NA	NA	NA	Yes	E
2-Methylphenol	NA	NA	NA	NA	No	A
2-Nitroaniline	NA	NA	NA	NA	No	A
2-Nitrophenol	NA	NA	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	NA	NA	No	A
3-Nitroaniline	NA	NA	NA	NA	No	A
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	NA	NA	No	C
4-Chloro-3-methylphenol	NA	NA	NA	NA	No	A
4-Chloroaniline	NA	NA	NA	NA	No	A
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	No	C
4-Methylphenol	NA	NA	NA	NA	No	A
4-Nitroaniline	NA	NA	NA	NA	No	A
4-Nitrophenol	NA	NA	NA	NA	No	A
Acenaphthene	NA	NA	NA	NA	No	A
Acenaphthylene	NA	NA	NA	NA	No	F
Anthracene	NA	NA	NA	NA	Yes	E
Benzo(a)anthracene	NA	NA	NA	NA	Yes	E
Benzo(a)pyrene	NA	NA	NA	NA	Yes	E
Benzo(b)fluoranthene	NA	NA	NA	NA	Yes	E
Benzo(g,h,i)perylene	NA	NA	NA	NA	Yes	E
Benzo(k)fluoranthene	NA	NA	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	Uncertainty	B
bis(2-Chloroethyl) ether	NA	NA	NA	NA	No	A
bis(2-Chloroisopropyl) ether	NA	NA	NA	NA	No	C
bis(2-Ethylhexyl) phthalate	NA	NA	NA	NA	No	A
Butyl benzyl phthalate	NA	NA	NA	NA	Uncertainty	B
Carbazole	NA	NA	NA	NA	No	C
Chrysene	NA	NA	NA	NA	Yes	E
Di-n-butyl phthalate	NA	NA	NA	NA	No	A
Di-n-octyl phthalate	NA	NA	NA	NA	No	A
Dibenz(a,h)anthracene	NA	NA	NA	NA	Yes	E
Dibenzofuran	NA	NA	NA	NA	No	C
Diethyl phthalate	NA	NA	NA	NA	No	A
Dimethyl phthalate	NA	NA	NA	NA	No	A
Fluoranthene	NA	NA	NA	NA	Yes	E

TABLE 7-10, AUS-0A2R
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Fluorene	NA	NA	NA	NA	Yes	E
Hexachlorobenzene	NA	NA	NA	NA	No	A
Hexachlorobutadiene	NA	NA	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	NA	NA	No	A
Hexachloroethane	NA	NA	NA	NA	No	A
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	NA	Yes	E
Isophorone	NA	NA	NA	NA	No	A
N-Nitroso-di-n-propylamine	NA	NA	NA	NA	No	A
N-Nitrosodiphenylamine	NA	NA	NA	NA	No	A
Naphthalene	NA	NA	NA	NA	No	F
Pentachlorophenol	NA	NA	NA	NA	No	A
Phenanthrene	NA	NA	NA	NA	Yes	E
Phenol	NA	NA	NA	NA	No	A
Pyrene	NA	NA	NA	NA	Yes	E
Metals and Inorganics						
Aluminum	NA	NA	NA	NA	Uncertainty	I
Antimony	NA	NA	NA	NA	No	F
Arsenic	NA	NA	NA	NA	Yes	D
Barium	NA	NA	NA	NA	No	F
Beryllium	NA	NA	NA	NA	No	F
Boron	NA	NA	NA	NA	Yes	E
Cadmium	NA	NA	NA	NA	No	F
Calcium	NA	NA	NA	NA	Uncertainty	G,H
Chromium	NA	NA	NA	NA	Yes	D
Cobalt	NA	NA	NA	NA	Yes	E
Copper	NA	NA	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	Yes	E
Lead	NA	NA	NA	NA	No	F
Magnesium	NA	NA	NA	NA	Uncertainty	G,H
Manganese	NA	NA	NA	NA	Yes	D
Mercury	NA	NA	NA	NA	Yes	J
Nickel	NA	NA	NA	NA	Yes	E
Potassium	NA	NA	NA	NA	Uncertainty	G,H
Selenium	NA	NA	NA	NA	Yes	D
Silver	NA	NA	NA	NA	No	F
Sodium	NA	NA	NA	NA	Uncertainty	G,H
Thallium	NA	NA	NA	NA	No	F
Vanadium	NA	NA	NA	NA	No	F
Zinc	NA	NA	NA	NA	Yes	E
Explosives						
1,3,5-Trinitrobenzene	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	NA	NA	NA	NA	NA	NA

TABLE 7-10, AUS-0A2R
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA	No	A
2,6-Dinitrotoluene	NA	NA	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA
2-Nitrotoluene (ONT)	NA	NA	NA	NA	NA	NA
3-Nitrotoluene	NA	NA	NA	NA	NA	NA
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA
4-Nitrotoluene (PNT)	NA	NA	NA	NA	NA	NA
HMX	NA	NA	NA	NA	NA	NA
Nitrobenzene	NA	NA	NA	NA	No	A
Nitroglycerin	NA	NA	NA	NA	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA
Tetryl	NA	NA	NA	NA	NA	NA

A - Chemical was not detected and the reporting limit does not exceed the screening concentration.

B - Chemical was not detected, but reporting limit was equal to or exceeeded screening concentration.

C - Chemical was not detected and there is no screening concentration.

D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.

E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.

F - Chemical was detected and did not exceed screening concentration.

G - Chemical was detected, but no screening value was available.

H - Chemical was detected, but it is an essential nutrient.

I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.

J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.

NA - Not Analyzed or not applicable.

TABLE 7-11
AUS-0A2R - RAILROAD SPUR
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum[1]	Soil	Sediment	Trench Water	Surface Water
SVOCs					
2-Methylnaphthalene		**E**	NA		NA
Anthracene		**E**	NA		NA
Benzo(a)anthracene		**H,E**	NA		NA
Benzo(a)pyrene		**H,E**	NA		NA
Benzo(b)fluoranthene		**H,E**	NA		NA
Benzo(g,h,i)perylene		**E**	NA		NA
Benzo(k)fluoranthene		**H,E**	NA		NA
Chrysene		**E**	NA		NA
Dibenz(a,h)anthracene		**H,E**	NA		NA
Fluoranthene		**E**	NA		NA
Fluorene		**E**	NA		NA
Indeno(1,2,3-c,d)pyrene		**H,E**	NA		NA
Phenanthrene		**E**	NA		NA
Pyrene		**E**	NA		NA
Metals					
Aluminum			NA	**H**	NA
Antimony		**H**	NA		NA
Arsenic			NA	**H**	NA
Barium		**H**	NA	**H**	NA
Beryllium			NA	**H**	NA
Boron		**E**	NA		NA
Cadmium		**H**	NA		NA
Chromium			NA	**H**	NA
Cobalt		**E**	NA		NA
Copper		**E**	NA		NA
Iron		**E**	NA	**H**	NA
Lead			NA	**H**	NA
Manganese			NA	**H**	NA
Mercury		**H,E**	NA		NA
Nickel		**H,E**	NA	**H**	NA
Zinc		**H,E**	NA		NA

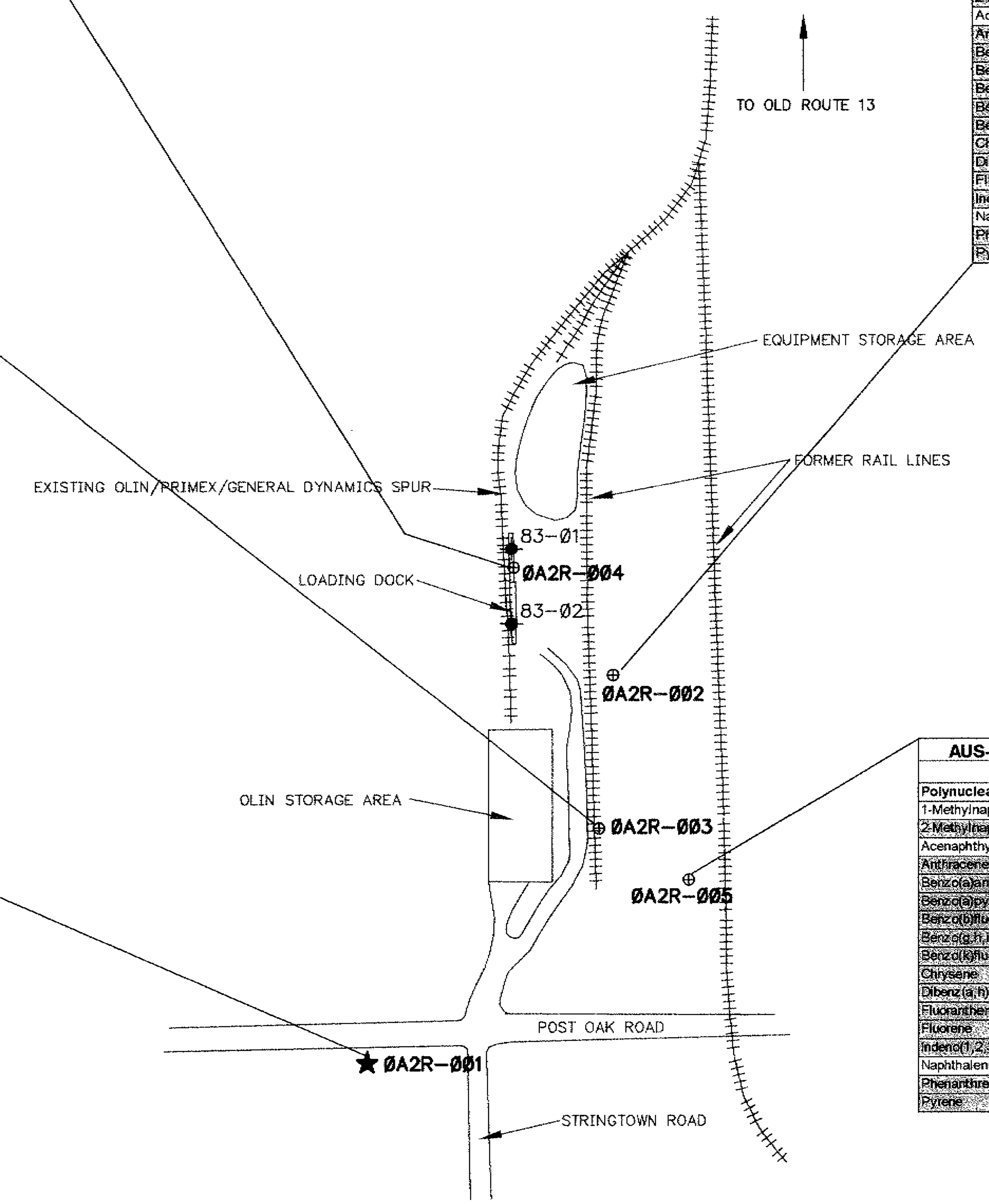
Key:
[1] Drums were not present at this site.
NA = not analyzed
H = human health screening criteria exceeded
E = ecological screening criteria exceeded

AUS-ØA2R-OLIN/PRIMEX/GENERAL DYNAMICS RAIL SPUR

AUS-0A2R-004	Units	Result: 0 - 6 in	Reference Code
Polynuclear Aromatic Hydrocarbons (PAHs)			
1-Methylnaphthalene	UG/KG	2400	
2-Methylnaphthalene	UG/KG	7200	e1,e5
Acenaphthylene	UG/KG	4500	
Anthracene	UG/KG	340	e5
Benzo(a)anthracene	UG/KG	1900	e5,h5
Benzo(a)pyrene	UG/KG	2600	e5,h1,h5,h7
Benzo(b)fluoranthene	UG/KG	3500	e5,h1,h5
Benzo(g,h,i)perylene	UG/KG	1400	e5
Benzo(k)fluoranthene	UG/KG	1600	e5
Chrysene	UG/KG	3200	e5
Dibenz(a,h)anthracene	UG/KG	320	e5,h1,h5
Fluoranthene	UG/KG	3500	e5
Indeno(1,2,3-c,d)pyrene	UG/KG	1700	e5,h5
Naphthalene	UG/KG	3600	
Phenanthrene	UG/KG	1400	e5
Pyrene	UG/KG	3500	e5

AUS-0A2R-003	Units	Result: 0 - 6 in	Reference Code
Polynuclear Aromatic Hydrocarbons (PAHs)			
1-Methylnaphthalene	UG/KG	430	
2-Methylnaphthalene	UG/KG	1000	e5
Acenaphthylene	UG/KG	390	
Benzo(a)anthracene	UG/KG	86	e5,h5
Benzo(a)pyrene	UG/KG	100	e5
Benzo(b)fluoranthene	UG/KG	180	e5
Benzo(g,h,i)perylene	UG/KG	110	e5
Benzo(k)fluoranthene	UG/KG	75	e5
Chrysene	UG/KG	220	e5
Dibenz(a,h)anthracene	UG/KG	12	e5
Fluoranthene	UG/KG	270	e5
Fluorene	UG/KG	17	e5
Indeno(1,2,3-c,d)pyrene	UG/KG	53	e5
Naphthalene	UG/KG	290	
Phenanthrene	UG/KG	230	e5
Pyrene	UG/KG	190	e5

AUS-0A2R-001	Units	Result: 5 ft	Reference Code	Result: 10 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	ND		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		ND	



AUS-0A2R-002	Units	Result: 0 - 6 in	Reference Code
Polynuclear Aromatic Hydrocarbons (PAHs)			
1-Methylnaphthalene	UG/KG	250	
2-Methylnaphthalene	UG/KG	830	e5
Acenaphthylene	UG/KG	190	
Anthracene	UG/KG	130	e5
Benzo(a)anthracene	UG/KG	430	e5,h5
Benzo(a)pyrene	UG/KG	460	e5,h1,h5
Benzo(b)fluoranthene	UG/KG	610	e5,h5
Benzo(g,h,i)perylene	UG/KG	280	e5
Benzo(k)fluoranthene	UG/KG	300	e5
Chrysene	UG/KG	700	e5
Dibenz(a,h)anthracene	UG/KG	66	e5
Fluoranthene	UG/KG	690	e5
Indeno(1,2,3-c,d)pyrene	UG/KG	270	e5
Naphthalene	UG/KG	230	
Phenanthrene	UG/KG	280	e5
Pyrene	UG/KG	660	e5

LEGEND

⊕ HAND AUGER LOCATION

★ TEST PIT LOCATION

USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

NOTES:

1. THE BASE MAP FOR THIS FIGURE WAS COMPILED FROM THREE SOURCES: (1) A HAND SKETCH PERFORMED DURING THE FIELD RECONNAISSANCE IN SPRING 1999; (2) AERIAL PHOTOGRAPHS TAKEN ON FEBRUARY 22, 2ØØØ; AND, (3) ENTECH AERIAL PHOTOGRAPHS (DATED 1943-1993) FROM THEIR 1999 REPORT ENTITLED "HISTORICAL AERIAL PHOTOGRAPHIC ANALYSIS-INVENTORY OF POTENTIAL DISPOSAL SITES: ADDITIONAL AND UNCHARACTERIZED SITES (AUS) OPERABLE UNIT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE (CONWR), MARION ILLINOIS, VOLUME II: MAPS, PAGE B."

2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.

3. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

AUS-0A2R-005	Units	Result: 0 - 6 in	Reference Code
Polynuclear Aromatic Hydrocarbons (PAHs)			
1-Methylnaphthalene	UG/KG	240	
2-Methylnaphthalene	UG/KG	1200	e5
Acenaphthylene	UG/KG	130	
Anthracene	UG/KG	180	e5
Benzo(a)anthracene	UG/KG	740	e5,h5
Benzo(a)pyrene	UG/KG	1200	e5,h1,h5,h7
Benzo(b)fluoranthene	UG/KG	1800	e5,h5
Benzo(g,h,i)perylene	UG/KG	1200	e5
Benzo(k)fluoranthene	UG/KG	890	e5
Chrysene	UG/KG	1500	e5
Dibenz(a,h)anthracene	UG/KG	210	e5,h5
Fluoranthene	UG/KG	1900	e5
Fluorene	UG/KG	110	e5
Indeno(1,2,3-c,d)pyrene	UG/KG	1200	e5,h5
Naphthalene	UG/KG	360	
Phenanthrene	UG/KG	440	e5
Pyrene	UG/KG	1700	e5

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SCALE FEET

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00

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DRN. BY:djd 10/24/00 DSGN. BY:mam CHKD. BY:cmw	AUS-ØA2R Sample Locations and Detections of Organic Compounds in Soils	FIG. NO. 7-1

AUS-ØA2R-OLIN/PRIMEX/GENERAL DYNAMICS RAIL SPUR

LEGEND

⊕ HAND AUGER LOCATION

★ TEST PIT LOCATION

USEPA 1998 SAMPLE LOCATION

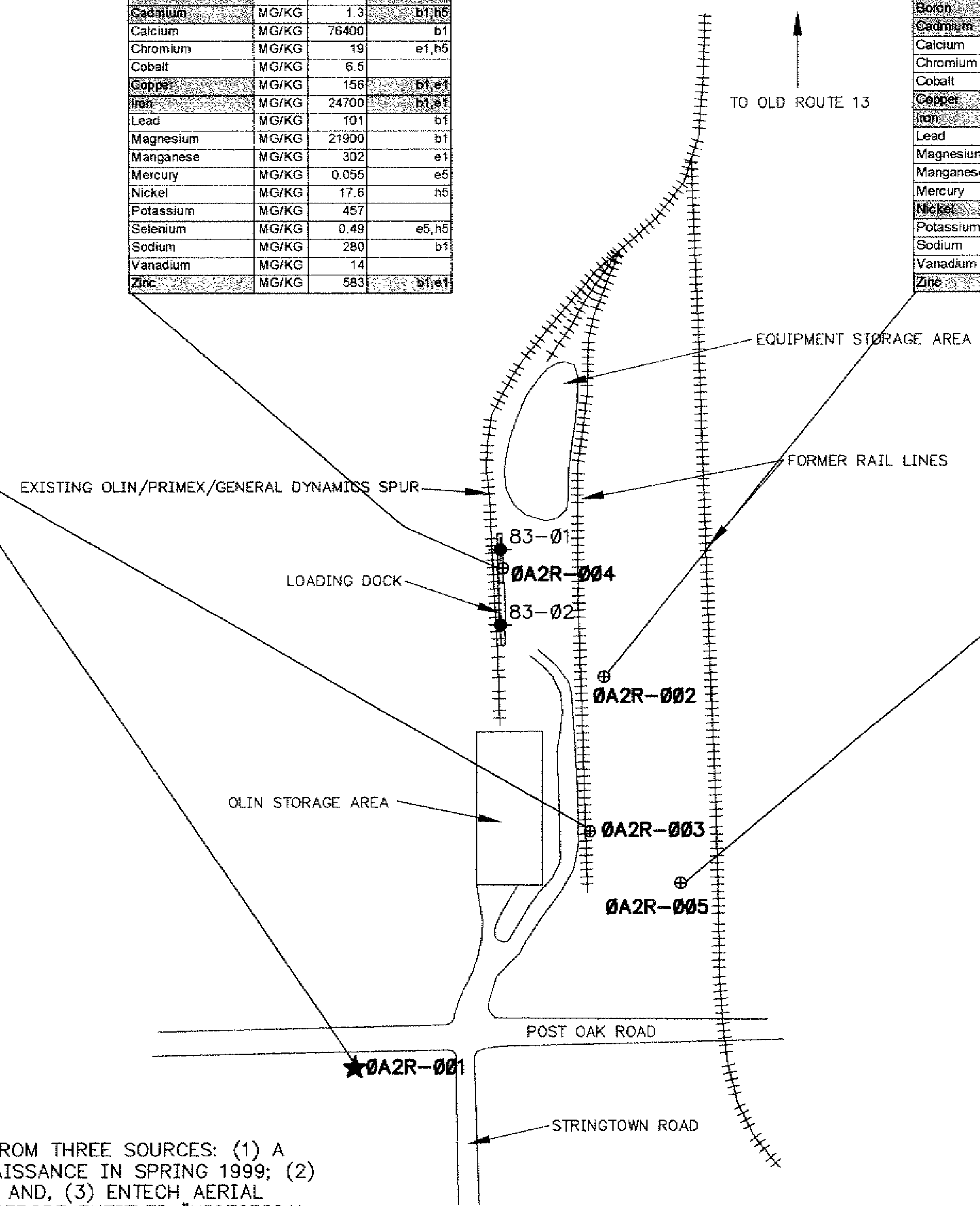
Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

AUS-0A2R-004	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	3450	
Antimony	MG/KG	0.92	b1,h5
Arsenic	MG/KG	12.8	e1,h1,h5,h7
Barium	MG/KG	53.4	
Beryllium	MG/KG	0.28	
Boron	MG/KG	13.8	b1,e1
Cadmium	MG/KG	1.3	b1,h5
Calcium	MG/KG	76400	b1
Chromium	MG/KG	19	e1,h5
Cobalt	MG/KG	6.5	
Copper	MG/KG	156	b1,e1
Iron	MG/KG	24700	b1,e1
Lead	MG/KG	101	b1
Magnesium	MG/KG	21900	b1
Manganese	MG/KG	302	e1
Mercury	MG/KG	0.055	e5
Nickel	MG/KG	17.6	h5
Potassium	MG/KG	457	
Selenium	MG/KG	0.49	e5,h5
Sodium	MG/KG	280	b1
Vanadium	MG/KG	14	
Zinc	MG/KG	583	b1,e1

AUS-0A2R-002	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4820	
Antimony	MG/KG	1.1	b1,h5
Arsenic	MG/KG	9.2	e1,h1,h5,h7
Barium	MG/KG	76.4	
Beryllium	MG/KG	0.29	
Boron	MG/KG	10.4	b1,e1
Cadmium	MG/KG	0.8	b1,h5
Calcium	MG/KG	68400	b1
Chromium	MG/KG	17.4	e1,h5
Cobalt	MG/KG	6	
Copper	MG/KG	83.2	b1,e1
Iron	MG/KG	33800	b1,e1
Lead	MG/KG	55.9	b1
Magnesium	MG/KG	36800	b1
Manganese	MG/KG	569	e1
Mercury	MG/KG	0.043	e5
Nickel	MG/KG	23.9	b1,h5
Potassium	MG/KG	606	
Sodium	MG/KG	169	
Vanadium	MG/KG	12.7	
Zinc	MG/KG	150	b1,e1

AUS-0A2R-003	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7560	
Antimony	MG/KG	0.79	h5
Arsenic	MG/KG	5.9	h1,h5,h7
Barium	MG/KG	167	h5
Beryllium	MG/KG	0.97	b1
Boron	MG/KG	59.6	b1,e1
Cadmium	MG/KG	1.6	b1,h5
Calcium	MG/KG	16300	b1
Chromium	MG/KG	15.6	e1,h5
Cobalt	MG/KG	6.3	
Copper	MG/KG	30.3	b1
Iron	MG/KG	33900	b1,e1
Lead	MG/KG	54.2	b1
Magnesium	MG/KG	4800	b1
Manganese	MG/KG	265	e1
Mercury	MG/KG	0.028	e5
Nickel	MG/KG	23.2	b1,h5
Potassium	MG/KG	613	
Sodium	MG/KG	543	b1
Vanadium	MG/KG	28.4	
Zinc	MG/KG	634	b1,e1,h5

AUS-0A2R-001	Units	Result: 5 ft	Reference Code	Result: 10 ft	Reference Code
Metals					
Aluminum	MG/KG	9010		6430	
Arsenic	MG/KG	9.7	e1,h1,h5,h7	5.3	h1,h5,h7
Barium	MG/KG	337	b1,h5	123	h5
Beryllium	MG/KG	0.83	b1	0.77	b1
Boron	MG/KG	ND		1.9	e1
Cadmium	MG/KG	0.71	b1,h5	0.62	b1,h5
Calcium	MG/KG	2950	b1	2080	
Chromium	MG/KG	15.9	e1,h5	11.3	e1,h5
Cobalt	MG/KG	ND		29.5	b1,e1
Copper	MG/KG	13.3	b1	13.1	b1
Iron	MG/KG	17900	e1	21400	b1,e1
Lead	MG/KG	12.1		15.9	
Magnesium	MG/KG	2490	b1	1360	
Manganese	MG/KG	261	e1	747	e1
Nickel	MG/KG	30.7	b1,e1,h5	14.2	h5
Potassium	MG/KG	473		295	
Silver	MG/KG	ND		0.73	b1
Sodium	MG/KG	315	b1	220	b1
Vanadium	MG/KG	27.9		34.5	
Zinc	MG/KG	54.1	b1	22.3	



AUS-0A2R-005	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	10700	
Antimony	MG/KG	0.47	h5
Arsenic	MG/KG	9	h1,h5,h7
Barium	MG/KG	83.5	h5
Beryllium	MG/KG	0.42	
Boron	MG/KG	2.6	e1
Cadmium	MG/KG	0.74	b1,h5
Calcium	MG/KG	36200	b1
Chromium	MG/KG	15.8	e1,h5
Cobalt	MG/KG	6.7	
Copper	MG/KG	20.9	b1
Iron	MG/KG	18500	e1
Lead	MG/KG	35.1	b1
Magnesium	MG/KG	14700	b1
Manganese	MG/KG	481	e1
Mercury	MG/KG	0.043	e5
Nickel	MG/KG	15.6	h5
Potassium	MG/KG	705	b1
Sodium	MG/KG	75.8	
Thallium	MG/KG	0.76	b1
Vanadium	MG/KG	25.6	
Zinc	MG/KG	115	b1

N

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SCALE FEET

NOTES:

1. THE BASE MAP FOR THIS FIGURE WAS COMPILED FROM THREE SOURCES: (1) A HAND SKETCH PERFORMED DURING THE FIELD RECONNAISSANCE IN SPRING 1999; (2) AERIAL PHOTOGRAPHS TAKEN ON FEBRUARY 22, 2ØØØ; AND, (3) ENTECH AERIAL PHOTOGRAPHS (DATED 1943-1993) FROM THEIR 1999 REPORT ENTITLED "HISTORICAL AERIAL PHOTOGRAPHIC ANALYSIS-INVENTORY OF POTENTIAL DISPOSAL SITES: ADDITIONAL AND UNCHARACTERIZED SITES (AUS) OPERABLE UNIT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE (CONWR), MARION ILLINOIS, VOLUME II: MAPS, PAGE B."

2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320ØØØØ26.ØØ
DRN. BY:djd 1/5/Ø1 DSGN. BY:mam CHKD. BY:cmw	AUS-ØA2R Sample Locations and Detections of Inorganic Compounds in Soils
FIG. NO.	7-2

AUS-ØA2R-OLIN/PRIMEX/GENERAL DYNAMICS RAIL SPUR

LEGEND

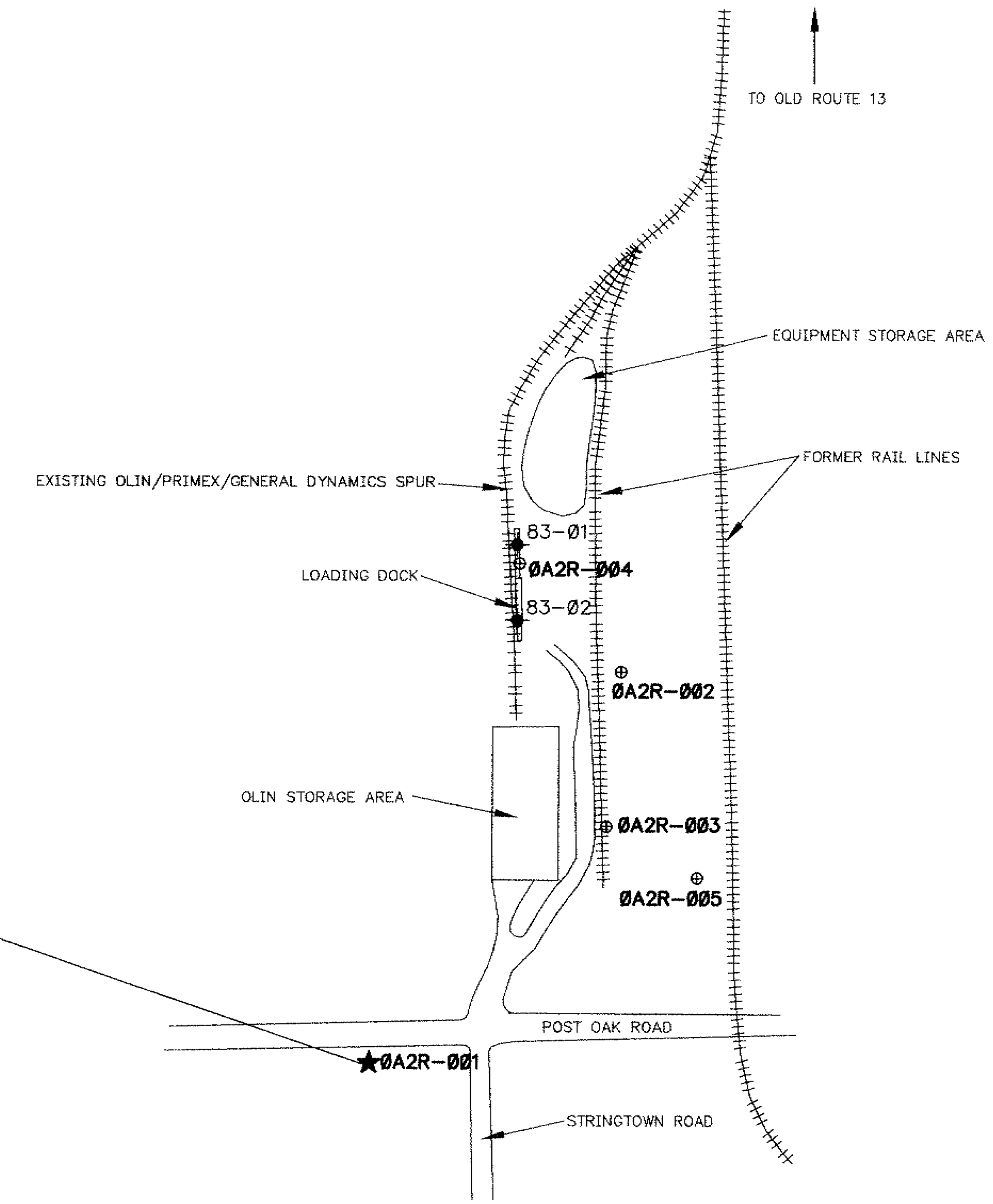
⊕ HAND AUGER LOCATION

★ TEST PIT LOCATION

⯁ USEPA 1998 SAMPLE LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Sediment UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulator)	e5
USEPA Region IX Industrial Soil PRG - cancerous	h1
USEPA Region IX Industrial Soil PRG - noncancerous	h2
USEPA Region IX Tap Water PRG - cancerous	h3
USEPA Region IX Tap Water PRG - noncancerous	h4
USEPA Region IX Migration to Groundwater PRG (DAF=1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Ingestion	h7
IEPA TACO Construction Worker Soil Ingestion	h8
IEPA TACO Class I Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

AUS-0A2R-001-GW-00 (Trench Water)	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Semivolatile Organic Compounds			
All SVOCs	UG/L	ND	
Metals			
Aluminum	UG/L	111000	h4
Arsenic	UG/L	18.4	h3,h4
Barium	UG/L	2510	h6
Beryllium	UG/L	10.9	h6
Cadmium	UG/L	4.9	
Calcium	UG/L	283000	
Chromium	UG/L	111	h6
Cobalt	UG/L	68.8	
Copper	UG/L	80.5	
Iron	UG/L	84200	h4,h6
Lead	UG/L	99.4	h6
Magnesium	UG/L	61700	
Manganese	UG/L	4180	h4,h6
Mercury	UG/L	1	
Nickel	UG/L	142	h6
Potassium	UG/L	8630	
Selenium	UG/L	3.6	
Sodium	UG/L	45000	
Vanadium	UG/L	169	
Zinc	UG/L	432	



NOTES:

1. THE BASE MAP FOR THIS FIGURE WAS COMPILED FROM THREE SOURCES: (1) A HAND SKETCH PERFORMED DURING THE FIELD RECONNAISSANCE IN SPRING 1999; (2) AERIAL PHOTOGRAPHS TAKEN ON FEBRUARY 22, 2000; AND, (3) ENTECH AERIAL PHOTOGRAPHS (DATED 1943–1993) FROM THEIR 1999 REPORT ENTITLED "HISTORICAL AERIAL PHOTOGRAPHIC ANALYSIS–INVENTORY OF POTENTIAL DISPOSAL SITES: ADDITIONAL AND UNCHARACTERIZED SITES (AUS) OPERABLE UNIT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE (CONWR), MARION ILLINOIS, VOLUME II: MAPS, PAGE B."

2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.

3. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

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SCALE FEET

PA/SI REPORT-AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO. 2320000026.00

URS

DRN. BY:djd 1/5/01
DSGN. BY:mam
CHKD. BY:cmw

AUS-ØA2R Sample Locations and Detections in Trench Water

FIG. NO. 7-3