



**Final Preliminary Assessment/Site Inspection Report**

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

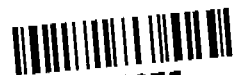
**June 2003**

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

**VOLUME IX**

**Section 21**

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**ACRONYM LIST**  
**Crab Orchard AUS OU PA/SI Report**

ACRONYM	DEFINITION
3S <sub>b</sub>	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-hygroscopic 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 <sub>ow</sub>	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**  
**Crab Orchard AUS OU PA/SI Report**

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 Reovery 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 13, the former Illinois Ordnance Plant (IOP) Finished Ammunition Igloos (FAI) Area, is west of Areas 10 and 11, and south of Crab Orchard Lake. Figure 21-1 is a map of Area 13.

### **AUS Original Site Designations**

AUS-0059, located in Area 13, was one 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). AUS-0059 has been incorporated into the current Area 13 site AUS-0A13.

## **21.1 HISTORIC SEARCH INFORMATION**

### **21.1.1 Site Description**

AUS-0A13 is located at the end of Ogden Road, approximately 2.5 miles west of Highway 148. The site is mostly grass-covered with woodlands bounding the site on all sides.

The area was constructed and operated by Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department), as part of the IOP. It is a large area containing storage igloos that have been used by industrial tenants since World War II, primarily for explosive storage.

Area 13 activities, the operator/lessees and the igloos they occupied are identified in Table 21-1.

### **21.1.2 Operational History and Waste Characteristics**

#### **21.1.2.1 IOP Operations**

The plan drawing for the IOP FAI Area showed 100 storage igloos in seven rows, each with a truck loading dock.<sup>1</sup> The igloos are all alike and are spaced at regular intervals. Twelve of the igloos shown were never actually constructed: FAI-1-6, FAI-1-10, FAI-2-4, FAI-3-12, FAI-5-9, FAI-5-10, FAI-5-11, FAI-6-4, FAI-7-6, FAI-7-7, FAI-7-10 and FAI-7-11. A rail line passed through the center of the facility, and there were two railroad loading docks, one at each end, that were used to load 500-lb bombs. The center row of igloos, FAI-4-1 through FAI-4-17, had both truck loading docks and railroad loading docks. The railway has been dismantled. Figure 21-2 shows site features.

#### **21.1.2.2 Industrial Lessees**

As shown in Table 21-1, there were two principal post-World War II industrial tenants identified in this area: Olin/Primex/General Dynamics Ordnance and Tactical Systems, Inc., and Commercial Solvents Corporation (CSC)/International Minerals and Chemical Corporation (IMC)/Trojan Corporation/Ensign Bickford Industries, Inc.

<sup>1</sup> U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant, Carbondale, Illinois, Plan No. 6544-101.24, Part 1, Section 5, Page 13.



Olin Corporation (formerly Olin Mathieson Chemical Company) began leasing igloos in the southern half of Area 13 in 1956. It continued to lease igloos in Area 13, including some in the southern half, until the end of 1996 when its ordnance manufacturing business was spun off to Primex Technologies, Inc. (Primex). Primex took over Olin's leases. In January 2001, General Dynamics Corporation acquired Primex. Primex then became a wholly owned subsidiary of General Dynamics and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS).<sup>2,3</sup>

Early lease and corporate information is incomplete, but it appears that CSC took over some of Olin's igloos in the northern portion of Area 13 when it purchased a portion of the Olin business on the Refuge in 1963. CSC later changed its name to International Minerals and Chemical Corporation (IMC). IMC sold a portion of its explosives business to Trojan Corporation in 1982. Trojan was acquired by Ensign Bickford in 1986. For a time, Trojan leased the igloos in the southern portion of Area 13 in its own name; Ensign Bickford later took over the leases.

GDO&TS and Ensign Bickford currently lease all the igloos in Area 13. These igloos, in the southern and northern half of the area, respectively, have been used historically for explosives storage. Available information on materials stored in Area 13 igloos is summarized in both Tables 21-1 and 21-2.

### **21.1.2.3 Miscellaneous Area 13 Information**

According to former Olin chemist and manager, George Wisely, nitroglycerin was stored and detonated (tested) in Area 13.<sup>4,5</sup> Mr. John Miller, a former Olin chemist and manager, said that nitroglycerin was burned in an open area in Area 13.<sup>6</sup> Mr. Robert Myers, a former Olin truck driver and laborer, stated that Olin burned dynamite in Area 13 in 1959 "right on the road...right in front of the igloos,"<sup>7</sup> using straw and diesel fuel.<sup>8</sup>

In 1998, an explosion occurred in Igloo FAI-6-11 which was leased by Primex at that time. Unstable propellant stored in this igloo was noted as the cause.<sup>9</sup>

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

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<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> Deposition of George T. Wisely, July 15, 1999, Page 130.

<sup>5</sup> Deposition of George T. Wisely, July 15, 1999, Pages 130 and 132. George Wisely indicated that what he heard regarding the burning of nitroglycerin was "indirect[ly]" and "piecemeal."

<sup>6</sup> Deposition of John Miller, April 9, 1998, Pages 163-166.

<sup>7</sup> Deposition of Robert Myers, April 10, 1998, Pages 73-79.

<sup>8</sup> Deposition of Robert Myers, April 10, 1998, Page 77.

<sup>9</sup> DPRA Document No. 00017658. Letter to Primex regarding the explosion/fire of Igloo FAI-13-6-11, dated October 7, 1998.

“*Shut-Down and Decontamination Procedures for F.D.A.P Facilities.*”<sup>10</sup> This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.<sup>11</sup> 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.).

Because Area 13 was used by the IOP as a storage area for finished ammunition, it may not have required decontamination, unlike load lines and other production areas. 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.

### 21.1.3 Area 13 Previous Sampling Results

#### O'Brien & Gere, 1988

O'Brien & Gere investigated two sites in Area 13: Site 18, (Area 13 Loading Platform [north end of Area 13]) and Site 19 (Area 13 Bunker 1-3 [Building FAI-1-3]).<sup>12</sup> Some results reported by O'Brien and Gere are not included here because they were determined to be not useable.<sup>13</sup> All results reported here are estimated. Soil results are reported in dry weight except where noted.

Four composite soil samples (0-1 foot (ft)) were collected around the perimeter of the loading dock<sup>14</sup>. Sample 18-4 was re-sampled for full priority pollutant analysis. Acetone (0.38 milligrams per kilogram (mg/kg) wet weight (wt)) and methylene chloride (0.025 mg/kg wet wt) exceeded United States Environmental Protection Agency (USEPA) Soil Screening Levels (SSLs). The following semi-volatile organic compounds (SVOCs) were detected above USEPA SSLs and/or Canadian Soil Quality Guidelines (CSOQGs): chrysene (0.137J mg/kg wet wt), fluoranthene (0.284 mg/kg wet wt), phenanthrene (0.096 mg/kg wet wt), and pyrene (0.205 mg/kg wet wt). Antimony (9.3 mg/kg) exceeded USEPA SSL and Refuge background level.<sup>15</sup>

Five composite soil samples were collected at Site 19.<sup>16</sup> One soil sample was resampled in Phase II. Acetone (0.35 mg/kg wet wt) and methylene chloride (0.028 mg/kg wet wt) exceeded USEPA SSLs. Arochlor 1254 (1.1 mg/kg wet wt) exceeded New Dutchlist Soil Optimum Levels (DSOLs). Antimony (11 mg/kg) was detected above USEPA SSL and Refuge background

<sup>10</sup> ACO 005047 - ACO 005109. Office of Field Director of Ammunition Plants, Shut-Down and Decontamination Procedures for F.D.A.P. Facilities.

<sup>11</sup> ACO 004979 - ACO 004980. CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.

<sup>12</sup> O'Brien & Gere, August 1988, Remedial Investigation Report, Volume I: Report, Crab Orchard National Wildlife Refuge, Page 25-1 through 25-4.

<sup>13</sup> 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.

<sup>14</sup> O'Brien & Gere, August 1988, Remedial Investigation Report, Volume I: Report, Crab Orchard National Wildlife Refuge, Page 25-1.

<sup>15</sup> See Table 1-11 of this report for Refuge background soil values used for the PA.

<sup>16</sup> O'Brien & Gere, August 1988, Remedial Investigation Report, Volume I: Report, Crab Orchard National Wildlife Refuge, Page 26-1 through 26-8.

level.<sup>17</sup> The O'Brien & Gere RI recommended further investigation of Site 19 (Area 13, Bunker 1-3). This site was later investigated as a part of the EMMA OU RI.

#### **Environmental Science & Engineering, Inc. Remedial Investigation/Baseline Risk Assessment, 1994**

As part of the EMMA OU RI, ESE re-investigated Site 19.<sup>18</sup> No detectable contaminants or metal detections above background were found in the soil or groundwater.

#### **Woodward Clyde Consultants, 1996**

Site 18 was included in the preliminary ecological risk assessment (PERA) for the MISCA OU Phase I RI. The 1996 RI states that the PERA concluded there is little likelihood of potential ecological risk at Site 18 and recommended no further assessment for the site. The 1996 RI report also stated that Site 18 is planned to be "part of the Uncharacterized Sites OU at the Refuge."<sup>19</sup>

#### **Parsons Engineering, 1997**

In the Parsons report, former O'Brien & Gere Site 18 was designated as EMMA OU Site COP-7. It was included with the rest of Area 13 when Parsons conducted a visual inspection of Area 13 as a part of the Engineering Evaluation and Cost Analysis (EE/CA) for the EMMA OU.<sup>20</sup> They found no indication of the presence of unexploded ordnance (UXO) found in Area 13.

#### **USEPA Sampling, 1998**

In 1998, USEPA collected one sample (AUS 59-1) from AUS-0059 for both SVOC and metals analyses. According to USEPA field notes, this site was the old Loading Dock. The location is not shown on the figures because its not known whether the sample was taken at the north loading dock or the south loading dock. Survey data were not available. The results for all detected constituents are listed in Table 21-2A. There were no SVOC target compounds detected in this sample, but reporting limits were slightly elevated for this sample. None of the metals exceeded Refuge background values.<sup>21</sup>

#### **21.1.4 Observations During Site Visit**

All of the explosives storage igloos and their associated loading docks are still on site. Staining was visible on many of the loading docks. There were also floor drains in the igloos that drained outside of the igloos onto the soil. Some ponding occurs in front of many of the igloo truck loading docks, because in many cases the driveway to the igloo slopes downward as it approaches the loading dock.

<sup>17</sup> See Table 1-11 of this report for Refuge background soil values used for the PA.

<sup>18</sup> Environmental Science & Engineering, Inc., 1994, Draft Final Remedial Investigation/Baseline Risk Assessment Report, Explosives/ Munitons Manufacturing Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, Volume I, Page 1-5.

<sup>19</sup> Woodward Clyde, 1996, Remedial Investigation, Miscellaneous Area Operable Unit, Volume I, Page 2-39.

<sup>20</sup> Parsons Engineering Science, Inc., October 1997, Engineering Evaluation and Cost Analysis, Final Report, Former Illinois Ordnance Plant Marion, Illinois, Pages 2-48 through 2-50.

<sup>21</sup> See Table 1-11 of this report for Refuge background soil values used for the PA.

Both of the former railroad loading docks are also still on site, although the railroad lines have been removed. There is a depressed area along the former railroad lines, that ponds.

It was also noted during the site reconnaissance (spring 1999), that there were numerous soil mounds located just to the north of the southern railroad loading dock.

### **21.1.5 Recommendations Based on Preliminary Assessment**

AUS-0A13 was included in the Site Investigation (SI) because the area has been used for industrial storage since World War II, and only isolated parts of it have been investigated.

## **21.2 SITE INVESTIGATION INFORMATION**

URS conducted a Site Investigation at AUS-0A13 from April 5 through April 7, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)<sup>22</sup> for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 21.1) 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 21-2 and 21-3. Survey coordinates for all sample locations in Area 13 are listed in Table 21-3. Table 21-4 lists the sample locations and the matrix sampled at that location. All samples were soil samples.

### **21.2.1 Field Investigation**

There was very little information about uses of the Area 13 igloos at the time the FSP was developed, beyond the fact that they were used mostly for explosives storage.<sup>23</sup> There was no evidence to show that any particular igloo was more likely to be contaminated than any other. Because of that, igloos were randomly selected for sampling. The igloo loading docks were numbered from 1 to 102 (including the east and west railroad loading docks) and 31 random numbers were chosen using a random number generator (30% sampling rate). All samples were collected from directly beneath the loading areas, in front of the igloo doorways where spillage of materials would be most likely. Refer to Figures 21-2 and 21-3 for sample locations.

### **21.2.2 Field Results**

#### **21.2.2.1 Site Conditions**

##### **21.2.2.1.1 *Geologic Conditions***

No borings or test pits were installed within this area. The soil from the hand auger borings (depth 6 inches below ground surface) was described as either fill or loess (silty clay).

<sup>22</sup> 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.

<sup>23</sup> Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 21.1) has been updated to include that information.

**21.2.2.1.2 Hydrogeologic Conditions**

Since no monitoring wells were installed in this area there is no available hydrogeologic information.

**21.2.2.1.3 Hydrologic Conditions**

The site has low relief and there are several ponded areas (Figure 21-1). Some temporary ponding occurs in front of many of the igloo truck loading docks, because in many cases the driveway leading from the road to the igloo slopes downward as it approaches the loading dock. Temporary ponding occurs along the former railroad lines, which were left as depressed areas after the railroad lines were removed.

There are ditches along the roadways in Area 13.

**21.2.2.2 Chemical Results**

The soil sample analytical results are summarized in Table 21-5. For this site, soil was the only matrix sampled. Table 21-5 lists all the chemicals detected in Area 13 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 21-2 – organic results for soil samples, and
- Figure 21-3 – inorganic results for soil samples.

The organic results at this site include semi-volatile organic compounds and explosives compounds plus nitroglycerin. The inorganic results at this site include TAL metals analysis plus boron.

**21.3 SCREENING RISK ASSESSMENT**

Results of the screening are presented in Tables 21-6 and 21-7 as follows:

- Table 21-6—human health risk screening for soils, and
- Table 21-7—ecological risk screening for soils.

Each table lists the maximum detected concentration for each constituent analyzed at Area 13. 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 21-2 and 21-3, 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 21-8 (human health risk) and 21-9 (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 21-8) and COPECs (Table 21-9) are shaded in the tables.

### **21.3.1 Human Health Risk**

#### **21.3.1.1 Soil**

Human health screening results for soil samples are presented in Table 21-6. For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil 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  $1 \times 10^{-6}$ . 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.

### **21.3.2 Ecological Risk**

#### **21.3.2.1 Soil**

Ecological screening results for soil samples are presented in Table 21-7. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)<sup>24</sup>
- Environment Canada (1995)<sup>25</sup>
- Talmage *et al.* (1999)<sup>26</sup>

<sup>24</sup> USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.

<sup>25</sup> 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.

- Efroymsen *et al.* (1997a, 1997b)<sup>27</sup>
- CCME (1999)<sup>28</sup>
- MHSPE (1994)<sup>29</sup>
- 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)<sup>30</sup> 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.

#### 21.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A13, 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 21-8; and on the COPEC list, Table 21-9. COPCs in this category include arsenic and nickel in soil. COPECs coded with "D" on Table 21-9 include arsenic and 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 RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

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<sup>26</sup> 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.

<sup>27</sup> Efroymsen, 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.

Efroymsen, 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.

<sup>28</sup> Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

<sup>29</sup> 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.

<sup>30</sup> USEPA 1991. *Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft)*. US Environmental Protection Agency Office of Research and Development, Washington, D.C.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 21-10.

Note that a number of the human health 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. 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.



TABLE 21-1  
AREA 13 OPERATORS/LESSEES

Operator/Lessee	Date of Occupancy	Igloo No. Occupied	Use of Igloos
SWDC/War Department	1942 through 1945	All	Storage of finished ammunition
Olin Corporation <sup>31,32,33,34/</sup> Primex <sup>35,36/</sup> GDO&TS <sup>37</sup>	1956 through 1997 <sup>38</sup>	FAI-1-(8, 9,11,12,13,14) FAI-2-(8,9,10,11,12,13,14) FAI-3-(9,10,11,13,14,15) FAI-4-(8,9,10,11,12,13,14,15,16) FAI-5-(12,13,14,15) FAI-6-(8,9,10,11,12,13,14) FAI-7-(9,12)	Storage of explosives ("...related to the manufacture or production of explosives and related products and chemicals, acids, ammonium nitrates, nitrocellulose, strontium nitrates and/or other materials necessary or useful in the manufacture or production of explosives or related products.") <sup>39</sup>
Olin Corporation <sup>40,41,42,43</sup>	1958 through 1963	FAI-1-(1,2,3,4,5,7) FAI-2-(6,7)	Storage of explosives
	1959-1963	FAI-2-(1,2,5) FAI-3-(3,6,7) FAI-6-(1,2,3,5,6,7) FAI-7-(3,4,5)	Storage of explosives
	1960-1963	FAI-2-3 FAI-3-(1,2,4,5,8) FAI-4-(1,2,3,4,5,6,7) FAI-5-(1,2,3,4,5,6,7,8) FAI-7-(1,2,8)	Storage of explosives
	1977	FAI-1-13 FAI-1-14	Storage of barium peroxide (stored in badly rusted drums) <sup>44</sup> Storage of mixed fuels and oxidizers <sup>45</sup>

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<sup>31</sup> DOI 001317 – DOI 001318. Lease Contract No. 14-18-008-2675, dated January 1, 1956, Pages 1-2; and, DPRA Document No. 00007881. Amendment of Lease, Olin Mathieson Chemical Corporation, dated March 1, 1956, Page 2.

<sup>32</sup> DOI 001399 – DOI 001402, Seventh Amendment and Codification of Lease, dated August 1, 1960, Pages 1-4.

<sup>33</sup> PRI-00554. Amendment No. 17 to Lease Contract No. 14-19-0008-2675, Olin Corporation, dated January 12, 1981.

<sup>34</sup> CRO 001495 - CRO 001506. Special Use Permits from 1958 to 1960.

<sup>35</sup> 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, 8820 Route 148, Marion, Illinois 62959, Pages 1, 8, 9, and 10.

<sup>36</sup> Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

<sup>37</sup> Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

<sup>38</sup> Olin ordnance division was spun off to Primex in 1997. Primex assumed all Olin leases at the Refuge.

<sup>39</sup> DOI 001321. Lease Contract No. 14-18-008-2675, dated January 1, 1956, Page 5.

<sup>40</sup> DOI 001317 – DOI 001318. Lease Contract No. 14-18-008-2675, dated January 1, 1956, Pages 1-2; and, DPRA Document No. 00007881. Amendment of Lease, Olin Mathieson Chemical Corporation, dated March 1, 1956, Page 2.

<sup>41</sup> DOI 001399 – DOI 001402, Seventh Amendment and Codification of Lease, dated August 1, 1960, Pages 1-4.

<sup>42</sup> PRI-00554. Amendment No. 17 to Lease Contract No. 14-19-0008-2675, Olin Corporation, dated January 12, 1981.

<sup>43</sup> CRO 001495 - CRO 001506. Special Use Permits from 1958 to 1960.

<sup>44</sup> PRI-006755. Olin inter office memo entitled "Safety Survey of Warehouses and Magazines," dated March 9, 1977, Page 2.

<sup>45</sup> PRI-006755. Olin inter office memo entitled "Safety Survey of Warehouses and Magazines," dated March 9, 1977, Page 2.

TABLE 21-1  
AREA 13 OPERATORS/LESSEES

Operator/Lessee	Date of Occupancy	Igloo No. Occupied	Use of Igloos
Olin Corporation <sup>46,47,48,49</sup>	1981	FAI-1-14 FAI-2-14 FAI-6-14	Storage of hazardous waste <sup>50</sup>
	1985	FAI-1-13	Storage of LUU-10/B casting powder <sup>51</sup>
		FAI-7-9	Storage of TEDGN, sodium picrate, and black powder <sup>52</sup>
	Previous to 1988	FAI-3-9, FAI-3-10, FAI-3-13	Storage of hazardous waste <sup>53</sup>
Southern Illinois University <sup>54</sup>	At least 1975	FAI-3-5, FAI-1-12	Used in deer research
Commercial Solvents Corporation	1963 through 1981 <sup>55</sup>	Northern Half of Area 13 - assumed to include: FAI-1-(1,2,3,4,5,7) FAI-2-(1,2,3,5,6,7) FAI-3-(1,2,3,4,5,6,7,8) FAI-4-(1,2,3,4,5,6,7) FAI-5-(1,2,3,4,5,6,7,8) FAI-6-(1,2,3,5,6,7) FAI-7-(1,2,3,4,5,8)	Possible storage of explosives since CSC manufactured explosives in Areas 11 and 12.
International Minerals and Chemical Corporation /Trojan Corporation/Ensign Bickford (current tenant) <sup>56,57</sup>	1981 through Present	46 Igloos in Northern Half of Area 13 (assumed to be same igloos as CSC listed above)	Possibly stored: PETN, TNT, cast boosters/primers, cyclotol, HBX, octol, PBX, RDX, RDX wax, TEI Cord, nitramon, composition B, composition H-6, composition A-5 and HMX. <sup>58</sup>

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<sup>46</sup> DOI 001317 – DOI 001318. Lease Contract No. 14-18-008-2675, dated January 1, 1956, Pages 1-2; and, DPRA Document No. 00007881. Amendment of Lease, Olin Mathieson Chemical Corporation, dated March 1, 1956, Page 2.

<sup>47</sup> DOI 001399 – DOI 001402, Seventh Amendment and Codification of Lease, dated August 1, 1960, Pages 1-4.

<sup>48</sup> PRI-00554. Amendment No. 17 to Lease Contract No. 14-19-0008-2675, Olin Corporation, dated January 12, 1981.

<sup>49</sup> CRO 001495 - CRO 001506. Special Use Permits from 1958 to 1960.

<sup>50</sup> CRO 001833. Olin, Letter to CONWR regarding storage of hazardous waste on the Refuge, dated June 24, 1981.

<sup>51</sup> PRI-003615. Attachment to an Olin inter office memo, attachment entitled "Chemicals/Assemblies Evaluation for I-1-1 Storage.

<sup>52</sup> PRI-003615. Attachment to an Olin inter office memo, attachment entitled "Chemicals/Assemblies Evaluation for I-1-1 Storage.

<sup>53</sup> DOI 002596. Olin, Hazardous Waste Facility Closure Plan, Ordill Industrial Area, S.O.P. 90,356 REV. K 9/88, Page 19.

<sup>54</sup> DPRA Document Number 00006449. CONWR, Annual Cost CY 1975, Fire Control – 200 and Water Plant –300-1, dated 4/20/76.

<sup>55</sup> DPRA Document No. 00007321. Lease between USFWS and Commercial Solvents Corporation, Contract Number 14-16-0003-6137, dated September 12, 1963.

<sup>56</sup> CRO 001270 – CRO 001272. Building & Igloo Lease Contract No. 14-16-0003-81-507, dated January 1, 1981, Page 1 and Pages 1-2 of 1A.

<sup>57</sup> Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

<sup>58</sup> DOI 001137. Trojan Corporation's response to 104(e) request, dated August 28, 1989, Page 2.

TABLE 21-2  
 SPECIFIC AREA 13 IGLOO USES BY OLIN<sup>59,60,61,62</sup>

Building No.	Year	Lessee	Materials Stored
FAI-1-1	March, 1963	Olin	Ordill explosives and dynamites
FAI-1-3	March, 1963	Olin	Orlite 9, dynoil, OMX-44 and OMX-42
FAI-1-4	March, 1963	Olin	Gelatins
FAI-1-5	March, 1963	Olin	Slurry
FAI-1-7	March, 1963	Olin	OMX-40, 75% sp. gel and seismograph
FAI-1-8	March, 1963	Olin	Composition B (approximately 60% RDX and 40% TNT) <sup>63</sup> and cyclotol (70% RDX and 30% TNT) <sup>64</sup>
FAI-1-9	March, 1963	Olin	Composition B
FAI-1-11	March, 1963	Olin	Composition B, casting powder, and methyl acrylate
FAI-1-13	March, 1963	Olin	S.P.O. (Solid Propellant Operations). Apparently materials from Olin's S.P.O. were stored here
FAI-1-14	March, 1963	Olin	Grained DNT
FAI-1-14	Nov. 1981 through 1988	Olin	Barium carbonate, lead thiocyanate, toluene, acetone, trichloroethylene, potassium dichromate, ethyl alcohol, xylene, toluene diisocyanate, red lead, methyl ethyl ketone, epichlorohydrin mixture
FAI-2-1	March, 1963	Olin	S.P.O.
FAI-2-2	March, 1963	Olin	S.P.O.
FAI-2-3	March, 1963	Olin	S.P.O.
FAI-2-5	March, 1963	Olin	S.P.O.
FAI-2-6	March, 1963	Olin	Composition B
FAI-2-7	March, 1963	Olin	Composition B
FAI-2-8	March, 1963	Olin	Cyclotol
FAI-2-9	March, 1963	Olin	Cyclotol
FAI-2-10	March, 1963	Olin	Compositions A, B and C, and cyclotol
FAI-2-11	March, 1963	Olin	S.P.O.
FAI-2-12	March, 1963	Olin	S.P.O.
FAI-2-13	March, 1963	Olin	S.P.O.
FAI-2-14	March 1963 and in August 1982	Olin	S.P.O., hazardous waste
FAI-3-1	March, 1963	Olin	TNT
FAI-3-2	March, 1963	Olin	TNT
FAI-3-3	March, 1963	Olin	S.P.O.
FAI-3-4	March, 1963	Olin	S.P.O.
FAI-3-7	March, 1963	Olin	S.P.O.

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<sup>59</sup> PRI-00504, PRI-00507, and PRI-00508. Olin Mathieson Chemical Corporation, Olin Mathieson Chemical Corporation, Ordill Works, Marion, Illinois, Plant Building Directory, Dated March 1963, Pages 3, 6, and 7.

<sup>60</sup> PRI-00513. Olin inter office memo entitled "Igloos," dated February 23, 1965, Page 1.

<sup>61</sup> DOI 002583. Olin, Hazardous Waste Facility Closure Plan, Ordill Industrial Area, S.O.P. 90,356 REV. K 9/88, Page 6.

<sup>62</sup> DPRA Document No. 00012606. Letter from Mr. Eugene Crawford (project manager at CONWR) to Mr. Norl Hamilton of Olin Mathieson Chemical Company, dated February 24, 1956.

<sup>63</sup> Department of the Army, September 1984, Department of the Army Technical Manual TM 9-1300-214, Military Explosives, Page 8-103.

<sup>64</sup> Department of the Army, September 1984, Department of the Army Technical Manual TM 9-1300-214, Military Explosives, Page 8-103. Cyclotol compositions range from a mix of 75% RDX and 25% TNT to a mix of 60% RDX and 40% TNT. Cyclotol Type IIB contains approximately 0.5% calcium silicate, 69.6% RDX, and 29.9% TNT.

TABLE 21-2  
 SPECIFIC AREA 13 IGLOO USES BY OLIN<sup>59,60,61,62</sup>

Building No.	Year	Lessee	Materials Stored
FAI-3-8	March, 1963	Olin	S.P.O.
FAI-3-9	March, 1963 and August 1982	Olin	Composition A (composed of a series of RDX formulations including various amounts of desensitizing wax, stearic acid, and polyethylene) and B [60% RDX and 40% TNT], <sup>65</sup> and hazardous waste
FAI-3-10	March, 1963 and August 1982	Olin (Marion and East Alton)	Composition B
FAI-3-11	March, 1963	Olin (Marion and East Alton)	Composition A, composition B, and ball powder
FAI-3-13	March, 1963 and November 1981 through 1988	Olin	Composition A, composition B, hazardous waste, lead, asbestos
FAI-3-13	Nov. 1981 through 1988	Olin	MOCA, toluenediamine, and lead beta resorcyate, asbestos
FAI-3-14	March, 1963	Olin	Composition A and composition B
FAI-3-15	March, 1963	Olin	Composition A and composition B
FAI-4-7	March, 1963	Olin	Composition B
FAI-4-8	March, 1963	Olin	Composition B
FAI-4-9	March, 1963	Olin	Dynamite control laboratory
FAI-4-10	March, 1963	Olin (Marion and East Alton)	Composition B
FAI-4-12	March, 1963	Olin	Composition B
FAI-4-13	March, 1963	Olin (Marion and East Alton)	Composition B
FAI-4-15	March, 1963	Olin	Composition B
FAI-5-1	March, 1963	Olin	S.P.O.
FAI-5-3	March, 1963	Olin	Explosives R and D
FAI-5-7	March, 1963	Olin	Rework dynamite, cruciforms rocket powder, and orlite rework
FAI-6-1	March, 1963	Olin	Explosives R and D
FAI-6-2	March, 1963	Olin	Nitrocotton storage
FAI-6-5	March, 1963	Olin	OMX-51A slurry, seismograph F. C., dynamite
FAI-6-6	March, 1963	Olin	TNT
FAI-6-7	March, 1963	Olin	TNT
FAI-6-8	1956	Olin	Explosives storage
FAI-6-9	1956	Olin	Explosives storage
FAI-6-12	March, 1963	Olin	Empty
FAI-6-13	March, 1963	Olin	Sales magazine (caps and fuses)
FAI-6-14	March, 1963	Olin	Sales magazine (super prime and primacord), hazardous waste
FAI-7-2	March, 1963	Olin	Composition B
FAI-7-3	March, 1963	Olin	Composition B

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FAI-7-4	March, 1963	Olin	Composition B
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<sup>65</sup> Department of the Army, September 1984, Department of the Army Technical Manual TM 9-1300-214, Military Explosives, Page 8-100.

**TABLE 21-2**  
**SPECIFIC AREA 13 IGLOO USES BY OLIN<sup>59,60,61,62</sup>**

<b>Building No.</b>	<b>Year</b>	<b>Lessee</b>	<b>Materials Stored</b>
FAI-7-5	March, 1963	Olin	Composition B
FAI-7-8	March, 1963	Olin	Composition B
FAI-7-9	March, 1963	Olin	Sales magazine (salable dynamite)
FAI-8-1	1963	Olin	Magazine area office (former IOP guard house at easternmost entrance to Area 13)

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Note, this table was developed from Olin documentation that shows only some of what Olin stored in Area 13 igloos for some specific dates. No other information was found regarding any other Olin uses of these and other Area 13 igloos.

TABLE 21-2A  
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
59-01	Aluminum	12,000
	Barium	140
	Beryllium	0.7
	Calcium	7,500
	Chromium	14
	Cobalt	9.8
	Copper	7
	Iron	17,000
	Magnesium	5,000
	Manganese	1,300
	Mercury	0.05
	Nickel	13
	Potassium	870
	Silver	1.5
	Vanadium	33
Zinc	38	

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mg/kg = milligrams per kilogram

TABLE 21-3  
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A13

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A13-001	369967.2	773770.3	422.91	NA	
0A13-002	368489.0	774717.3	426.12	NA	
0A13-003	367761.4	775179.2	432.00	NA	
0A13-004	371306.8	772336.0	430.57	NA	
0A13-005	370952.1	772559.4	432.59	NA	
0A13-006	370238.2	773046.9	430.18	NA	
0A13-007				NA	No survey data for this location.
0A13-008	369043.9	773180.8	430.92	NA	
0A13-009	367965.6	773878.7	425.75	NA	
0A13-010	367604.2	774106.8	431.04	NA	
0A13-011	366862.5	774564.9	429.97	NA	
0A13-012	366145.3	775019.9	434.84	NA	
0A13-013	364849.9	775816.9	438.85	NA	
0A13-014	370427.2	771710.1	432.71	NA	
0A13-015	366831.2	774006.9	433.12	NA	
0A13-016	366104.9	774467.7	432.73	NA	
0A13-017	365388.1	774923.3	436.79	NA	
0A13-018	369955.6	771417.4	441.67	NA	
0A13-019	368862.1	772105.0	437.83	NA	
0A13-020				NA	No survey data for this location.
0A13-021	367412.2	773029.8	432.47	NA	
0A13-022	367047.2	773260.4	425.40	NA	
0A13-023				NA	No survey data for this location.
0A13-024	368050.8	772027.2	434.36	NA	
0A13-025	367690.8	772268.2	428.89	NA	
0A13-026	366616.2	772939.0	427.87	NA	
0A13-027	366249.7	773174.4	434.27	NA	
0A13-028	365521.4	773629.0	440.40	NA	
0A13-029	369791.4	770326.0	441.02	NA	
0A13-030	367613.5	771717.0	424.87	NA	
0A13-031				NA	No survey data for this location.

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NA = Not Applicable

**TABLE 21-4  
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A13**

Soil		
AUS-0A13-001	AUS-0A13-012	AUS-0A13-023
AUS-0A13-002	AUS-0A13-013	AUS-0A13-024
AUS-0A13-003	AUS-0A13-014	AUS-0A13-025
AUS-0A13-004	AUS-0A13-015	AUS-0A13-026
AUS-0A13-005	AUS-0A13-016	AUS-0A13-027
AUS-0A13-006	AUS-0A13-017	AUS-0A13-028
AUS-0A13-007	AUS-0A13-018	AUS-0A13-029
AUS-0A13-008	AUS-0A13-019	AUS-0A13-030
AUS-0A13-009	AUS-0A13-020	AUS-0A13-031
AUS-0A13-010	AUS-0A13-021	
AUS-0A13-011	AUS-0A13-022	

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TABLE 21-5  
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituent	Number of Detections	Range of Detections
<b>Semivolatile Organic Compounds</b>		
2-Methylnaphthalene	5/31	42 ug/kg to 130 ug/kg
4-Chloro-3-Methylphenol	1/31	160 ug/kg
Acenaphthene	5/31	55 ug/kg to 580 ug/kg
Acenaphthylene	1/31	120 ug/kg
Anthracene	10/31	53 ug/kg to 1,600 ug/kg
Benzo(a)anthracene	18/31	52 ug/kg to 5,500 ug/kg
Benzo(a)pyrene	18/31	58 ug/kg to 5,300 ug/kg
Benzo(b)fluoranthene	19/31	47 ug/kg to 6,700 ug/kg
Benzo(g,h,i)perylene	13/31	76 ug/kg to 4,300 ug/kg
Benzo(k)fluoranthene	18/31	55 ug/kg to 5,900 ug/kg
bis(2-Ethylhexyl) phthalate	12/31	48 ug/kg to 11,000 ug/kg
Benzyl butyl phthalate	2/31	47 ug/kg to 390 ug/kg
Carbazole	7/31	57 ug/kg to 960 ug/kg
Chrysene	19/31	45 ug/kg to 7,800 ug/kg
Di-n-butyl phthalate	10/31	47 ug/kg to 230,000 ug/kg
Di-n-octyl phthalate	2/31	59 ug/kg to 85 ug/kg
Dibenz(a,h)Anthracene	6/31	140 ug/kg to 1,900 ug/kg
Dibenzofuran	8/31	45 ug/kg to 440 ug/kg
Dimethyl Phthalate	1/31	68 ug/kg
Fluoranthene	20/31	47 ug/kg to 11,000 ug/kg
Fluorene	4/31	79 ug/kg to 550 ug/kg
Indeno(1,2,3-c,d)Pyrene	13/31	72 ug/kg to 3,800 ug/kg
N-Nitrosodiphenylamine	7/31	67 ug/kg to 52,000 ug/kg
Naphthalene	1/31	110 ug/kg
Phenanthrene	18/31	67 ug/kg to 7,600 ug/kg
Phenol	1/31	55 ug/kg
Pyrene	19/31	43 ug/kg to 9,500 ug/kg
<b>Explosives</b>		
2,4-Dinitrotoluene	4/31	170 ug/kg to 64,000 ug/kg
2,6-Dinitrotoluene	2/31	70 ug/kg to 2,900 ug/kg
Nitroglycerin	3/31	2,300 ug/kg to 300,000 ug/kg
<b>Other Inorganics</b>		
Total Organic Carbon	1/31	35300 mg/kg
<b>Metals</b>		
Aluminum	31/31	1,830 mg/kg to 8,170 mg/kg
Antimony	11/31	0.27 mg/kg to 1.6 mg/kg
Arsenic	31/31	2.1 mg/kg to 9.9 mg/kg
Barium	31/31	21.4 mg/kg to 245 mg/kg
Boron	23/31	1.6 mg/kg to 5.8 mg/kg
Cadmium	9/31	0.12 mg/kg to 0.54 mg/kg
Calcium	31/31	890 mg/kg to 359,000 mg/kg
Chromium, Total	31/31	3.7 mg/kg to 155 mg/kg
Cobalt	27/31	1.4 mg/kg to 18.2 mg/kg
Copper	31/31	4 mg/kg to 117 mg/kg
Iron	31/31	4,740 mg/kg to 25,200 mg/kg

Sheet 1 of 2

TABLE 21-5  
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituent	Number of Detections	Range of Detections
Lead	31/31	6 mg/kg to 73 mg/kg
Magnesium	31/31	605 mg/kg to 42,900 mg/kg
Manganese	31/31	124 mg/kg to 1,500 mg/kg
Mercury	8/31	0.06 mg/kg to 0.83 mg/kg
Nickel	31/31	3.6 mg/kg to 18 mg/kg
Potassium	31/31	213 mg/kg to 5790 mg/kg
Selenium	27/31	0.17 mg/kg to 4.2 mg/kg
Silver	2/31	0.37 mg/kg to 0.55 mg/kg
Sodium	6/31	1070 mg/kg to 3230 mg/kg
Thallium	1/31	0.24 mg/kg
Vanadium	31/31	3.6 mg/kg to 26.5 mg/kg
Zinc	31/31	15.4 mg/kg to 236 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: MMF 7/23/01

**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**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)
<b>Semivolatile Organic Compounds</b>								
120-82-1	1,2,4-Trichlorobenzene	520	U	UG/KG			6.83E-05	1.73E+00
95-50-1	1,2-Dichlorobenzene	520	U	UG/KG			1.57E-04	5.78E-01
541-73-1	1,3-Dichlorobenzene	520	U	UG/KG			1.00E-02	
106-46-7	1,4-Dichlorobenzene	520	U	UG/KG		6.40E-08	2.71E-04	5.20E+00
95-95-4	2,4,5-Trichlorophenol	2600	U	UG/KG			2.95E-05	2.60E-01
88-06-2	2,4,6-Trichlorophenol	520	U	UG/KG		2.32E-09		6.50E+01
120-83-2	2,4-Dichlorophenol	520	U	UG/KG			1.97E-04	1.04E+01
105-67-9	2,4-Dimethylphenol	520	U	UG/KG			2.95E-05	1.30E+00
51-28-5	2,4-Dinitrophenol	2600	U	UG/KG			1.48E-03	2.60E+02
91-58-7	2-Chloronaphthalene	520	U	UG/KG			1.91E-05	
95-57-8	2-Chlorophenol	520	U	UG/KG			2.15E-03	2.60E+00
91-57-6	2-Methylnaphthalene	130	J	UG/KG			2.40E-06	6.50E-04
95-48-7	2-Methylphenol	520	U	UG/KG			1.18E-05	6.50E-01
88-74-4	2-Nitroaniline	2600	U	UG/KG			5.17E-02	
88-75-5	2-Nitrophenol	520	U	UG/KG			7.38E-05	
91-94-1	3,3'-Dichlorobenzidine	520	U	UG/KG		9.49E-08		1.73E+03
99-09-2	3-Nitroaniline	2600	U	UG/KG			5.17E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2600	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	520	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	160	J	UG/KG			3.63E-06	
106-47-8	4-Chloroaniline	1000	U	UG/KG			2.84E-04	3.33E+01
7005-72-3	4-Chlorophenyl phenyl ether	520	U	UG/KG				
106-44-5	4-Methylphenol	520	U	UG/KG			1.18E-04	
100-01-6	4-Nitroaniline	2600	U	UG/KG			5.17E-02	

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

**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU  
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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)
100-02-7	4-Nitrophenol	2600	U	UG/KG			3.69E-04	
83-32-9	Acenaphthene	580		UG/KG			1.51E-05	1.93E-02
208-96-8	Acenaphthylene	120	J	UG/KG			2.21E-06	6.00E-04
120-12-7	Anthracene	1600		UG/KG			4.11E-06	2.67E-03
56-55-3	Benzo(a)anthracene	5500		UG/KG		1.91E-06		6.88E+01
50-32-8	Benzo(a)pyrene	5300		UG/KG		1.84E-05		1.33E+01
205-99-2	Benzo(b)fluoranthene	6700		UG/KG		2.32E-06		3.35E+01
191-24-2	Benzo(g,h,i)perylene	4300		UG/KG			7.93E-05	2.15E-02
207-08-9	Benzo(k)fluoranthene	5900		UG/KG		2.04E-07		2.95E+00
111-91-1	bis(2-Chloroethoxy)methane	520	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	520	U	UG/KG		8.39E-07		2.60E+04
108-60-1	bis(2-Chloroisopropyl) ether	520	U	UG/KG		6.44E-08	1.22E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	11000		UG/KG		6.24E-08	6.24E-04	
85-68-7	Butyl benzyl phthalate	390	J	UG/KG			2.21E-06	4.88E-04
86-74-8	Carbazole	960		UG/KG		7.78E-09		3.20E+01
218-01-9	Chrysene	7800		UG/KG		2.70E-08		9.75E-01
84-74-2	Di-n-butyl phthalate	230000		UG/KG			2.61E-03	7.67E-01
117-84-0	Di-n-octyl phthalate	85	J	UG/KG			4.82E-06	8.50E-06
53-70-3	Dibenz(a,h)anthracene	1900		UG/KG		6.58E-06		2.38E+01
132-64-9	Dibenzofuran	440		UG/KG			8.69E-05	
84-66-2	Diethyl phthalate	520	U	UG/KG			7.38E-07	
131-11-3	Dimethyl phthalate	68	J	UG/KG			7.72E-09	
206-44-0	Fluoranthene	11000		UG/KG			3.65E-04	5.50E-02
86-73-7	Fluorene	550		UG/KG			1.66E-05	1.83E-02
118-74-1	Hexachlorobenzene	520	U	UG/KG		3.37E-07	7.38E-04	5.20E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect  
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**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

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87-68-3	Hexachlorobutadiene	520	U	UG/KG		1.64E-08	2.95E-03	5.20E+00
77-47-4	Hexachlorocyclopentadiene	520	U	UG/KG			8.82E-05	2.60E-02
67-72-1	Hexachloroethane	520	U	UG/KG		2.95E-09	5.90E-04	2.60E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	3800		UG/KG		1.32E-06		5.43E+00
78-59-1	Isophorone	520	U	UG/KG		2.00E-10	2.95E-06	1.73E+01
621-64-7	N-Nitroso-di-n-propylamine	520	U	UG/KG		1.48E-06		2.60E+05
86-30-6	N-Nitrosodiphenylamine	52000		UG/KG		1.03E-07		8.67E+02
91-20-3	Naphthalene	110	J	UG/KG			5.83E-04	2.75E-02
87-86-5	Pentachlorophenol	2600	U	UG/KG		2.34E-07	1.82E-04	2.60E+03
85-01-8	Phenanthrene	7600		UG/KG			1.40E-04	3.80E-02
108-95-2	Phenol	55	J	UG/KG			1.04E-07	1.10E-02
129-00-0	Pyrene	9500		UG/KG			1.75E-04	4.75E-02
<b>Semivolatile Organic Compounds</b>								
99-35-4	1,3,5-Trinitrobenzene	390	U	UG/KG			1.48E-05	
99-65-0	1,3-Dinitrobenzene	390	U	UG/KG			4.43E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	780	U	UG/KG		9.49E-09	1.77E-03	
121-14-2	2,4-Dinitrotoluene	64000		UG/KG			3.63E-02	1.60E+06
606-20-2	2,6-Dinitrotoluene	2900		UG/KG			3.29E-03	9.67E+04
	Dinitrotoluene Mixture	66900		UG/KG		1.86E-05		1.67E+06
35572-78-2	2-Amino-4,6-Dinitrotoluene	780	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	780	U	UG/KG				
99-08-1	3-Nitrotoluene	780	U	UG/KG			3.84E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	780	U	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	780	U	UG/KG			3.84E-04	
2691-41-0	HMX	780	U	UG/KG			1.77E-05	

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**TABLE 21-6  
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CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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98-95-3	Nitrobenzene	390	U	UG/KG			3.41E-03	
55-63-0	Nitroglycerin	300000		UG/KG		1.70E-06		
78-11-5	Pentaerythritol tetranitrate (PETN)	3100	U	UG/KG				
121-82-4	RDX	780	U	UG/KG		3.48E-08	2.95E-04	
479-45-8	Tetryl	1200	UJ	UG/KG			1.36E-04	
<b>Metals</b>								
7429-90-5	Aluminum	8170		MG/KG	2.84E-01		4.87E-03	
7440-36-0	Antimony	1.6		MG/KG	1.93E+00		1.96E-03	5.33E+00
7440-38-2	Arsenic	9.9		MG/KG	7.33E-01	3.63E-06	2.25E-02	9.90E+00
7440-39-3	Barium	245		MG/KG	1.26E+00		1.97E-03	3.06E+00
7440-41-7	Beryllium	0.78	U	MG/KG	1.03E+00	3.48E-10	2.11E-04	2.60E-01
7440-42-8	Boron	5.8		MG/KG	1.09E+00		7.33E-05	
7440-43-9	Cadmium	0.54	J	MG/KG	2.84E+00	1.81E-10	6.67E-04	1.35E+00
7440-70-2	Calcium	359000		MG/KG	1.44E+02			
7440-47-3	Chromium	155		MG/KG	6.15E+00	3.46E-07		7.75E+01
7440-48-4	Cobalt	18.2		MG/KG	8.39E-01		1.48E-04	
7440-50-8	Copper	117		MG/KG	1.04E+01		1.54E-03	
7439-89-6	Iron	25200		MG/KG	1.31E+00		4.11E-02	
7439-92-1	Lead	73		MG/KG	3.12E+00			
7439-95-4	Magnesium	42900		MG/KG	2.76E+01			
7439-96-5	Manganese	1500		MG/KG	4.12E-01		4.65E-02	
7439-97-6	Mercury	0.83		MG/KG	1.38E+01			
7440-02-0	Nickel	18		MG/KG	9.52E-01		4.40E-04	2.57E+00
2023695	Potassium	5790		MG/KG	9.26E+00			
7782-49-2	Selenium	4.2		MG/KG	1.79E+00		4.11E-04	1.40E+01

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**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**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)
7440-22-4	Silver	0.55	J	MG/KG	9.48E-01		5.38E-05	2.75E-01
7440-23-5	Sodium	3230	U	MG/KG	1.90E+01			
7440-28-0	Thallium	0.24	J	MG/KG	5.85E-01		1.68E-06	
7440-62-2	Vanadium	26.5		MG/KG	5.61E-01		1.85E-03	8.83E-02
7440-66-6	Zinc	236		MG/KG	4.59E+00		3.85E-04	3.93E-01
<b>Other Parameters</b>								
TOC	TOC	35300		MG/KG	1.12E+00			

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HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**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
<b>Semivolatile Organic Compounds</b>							
120-82-1	1,2,4-Trichlorobenzene	520	U	UG/KG	2.60E-05	2.60E-04	1.04E-01
95-50-1	1,2-Dichlorobenzene	520	U	UG/KG	2.89E-06	2.89E-05	3.06E-02
541-73-1	1,3-Dichlorobenzene	520	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	520	U	UG/KG			2.60E-01
95-95-4	2,4,5-Trichlorophenol	2600	U	UG/KG	1.30E-05	1.30E-05	9.63E-03
88-06-2	2,4,6-Trichlorophenol	520	U	UG/KG	1.00E-03	4.73E-05	2.60E+00
120-83-2	2,4-Dichlorophenol	520	U	UG/KG	8.52E-05	8.52E-04	5.20E-01
105-67-9	2,4-Dimethylphenol	520	U	UG/KG	1.27E-05	1.27E-05	5.78E-02
51-28-5	2,4-Dinitrophenol	2600	U	UG/KG	6.34E-04	6.34E-03	1.30E+01
91-58-7	2-Chloronaphthalene	520	U	UG/KG			
95-57-8	2-Chlorophenol	520	U	UG/KG	5.20E-05	5.20E-05	1.30E-01
91-57-6	2-Methylnaphthalene	130	J	UG/KG	2.13E-06	2.13E-06	3.10E-05
95-48-7	2-Methylphenol	520	U	UG/KG	5.20E-06	5.20E-06	3.47E-02
88-74-4	2-Nitroaniline	2600	U	UG/KG			
88-75-5	2-Nitrophenol	520	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	520	U	UG/KG	4.00E-02	1.86E-03	7.43E+01
99-09-2	3-Nitroaniline	2600	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2600	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	520	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	160	J	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	520	U	UG/KG			
106-44-5	4-Methylphenol	520	U	UG/KG			
100-01-6	4-Nitroaniline	2600	U	UG/KG			

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HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

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100-02-7	4-Nitrophenol	2600	U	UG/KG			
83-32-9	Acenaphthene	580		UG/KG	4.83E-06	4.83E-06	1.02E-03
208-96-8	Acenaphthylene	120	J	UG/KG	1.97E-06	1.97E-06	2.86E-05
120-12-7	Anthracene	1600		UG/KG	2.62E-06	2.62E-06	1.33E-04
56-55-3	Benzo(a)anthracene	5500		UG/KG	6.88E-01	3.24E-02	2.75E+00
50-32-8	Benzo(a)pyrene	5300		UG/KG	6.63E+00	3.12E-01	6.63E-01
205-99-2	Benzo(b)fluoranthene	6700		UG/KG	8.38E-01	3.94E-02	1.34E+00
191-24-2	Benzo(g,h,i)perylene	4300		UG/KG	7.05E-05	7.05E-05	1.02E-03
207-08-9	Benzo(k)fluoranthene	5900		UG/KG	7.56E-02	3.47E-03	1.20E-01
111-91-1	bis(2-Chloroethoxy)methane	520	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	520	U	UG/KG	1.04E-01	6.93E-03	1.30E+03
108-60-1	bis(2-Chloroisopropyl) ether	520	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	390	J	UG/KG	9.51E-07	9.51E-07	4.19E-04
86-74-8	Carbazole	960		UG/KG	3.31E-03	1.55E-04	1.60E+00
218-01-9	Chrysene	7800		UG/KG	1.00E-02	4.59E-04	4.88E-02
84-74-2	Di-n-butyl phthalate	230000		UG/KG	1.15E-03	1.15E-03	1.00E-01
117-84-0	Di-n-octyl phthalate	85	J	UG/KG	2.07E-06	2.07E-05	8.50E-06
53-70-3	Dibenz(a,h)anthracene	1900		UG/KG	2.38E+00	1.12E-01	9.50E-01
132-64-9	Dibenzofuran	440		UG/KG			
84-66-2	Diethyl phthalate	520	U	UG/KG	5.20E-07	5.20E-07	1.11E-03
131-11-3	Dimethyl phthalate	68	J	UG/KG			
206-44-0	Fluoranthene	11000		UG/KG	1.34E-04	1.34E-04	2.56E-03
86-73-7	Fluorene	550		UG/KG	6.71E-06	6.71E-06	9.82E-04
118-74-1	Hexachlorobenzene	520	U	UG/KG	1.30E-01	6.67E-03	2.60E-01

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

**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**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
87-68-3	Hexachlorobutadiene	520	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	520	U	UG/KG	3.71E-05	3.71E-05	1.30E-03
67-72-1	Hexachloroethane	520	U	UG/KG	2.60E-04	2.60E-04	1.04E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	3800		UG/KG	4.75E-01	2.24E-02	2.71E-01
78-59-1	Isophorone	520	U	UG/KG	1.27E-06	1.27E-06	6.50E-02
621-64-7	N-Nitroso-di-n-propylamine	520	U	UG/KG	6.50E-01	2.89E-02	1.04E+04
86-30-6	N-Nitrosodiphenylamine	52000		UG/KG	4.33E-02	2.08E-03	5.20E+01
91-20-3	Naphthalene	110	J	UG/KG	1.34E-06	1.34E-05	1.31E-03
87-86-5	Pentachlorophenol	2600	U	UG/KG	1.08E-01	5.00E-03	8.67E+01
85-01-8	Phenanthrene	7600		UG/KG	1.25E-04	1.25E-04	1.81E-03
108-95-2	Phenol	55	J	UG/KG	5.50E-08	4.58E-07	5.50E-04
129-00-0	Pyrene	9500		UG/KG	1.56E-04	1.56E-04	2.26E-03
<b>Semivolatile Organic Compounds</b>							
99-35-4	1,3,5-Trinitrobenzene	390	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	390	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	780	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	64000		UG/KG	7.62E+00	3.56E-01	8.00E+04
606-20-2	2,6-Dinitrotoluene	2900		UG/KG	3.45E-01	1.61E-02	4.14E+03
	Dinitrotoluene Mixture	66900		UG/KG			
35572-78-2	2-Amino-4,6-Dinitrotoluene	780	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	780	U	UG/KG			
99-08-1	3-Nitrotoluene	780	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	780	U	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	780	U	UG/KG			
2691-41-0	HMX	780	U	UG/KG			

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

**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**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
98-95-3	Nitrobenzene	390	U	UG/KG	3.90E-04	3.90E-04	3.90E+00
55-63-0	Nitroglycerin	300000		UG/KG			
78-11-5	Pentaerythritol tetranitrate (PETN)	3100	U	UG/KG			
121-82-4	RDX	780	U	UG/KG			
479-45-8	Tetryl	1200	UJ	UG/KG			
<b>Metals</b>							
7429-90-5	Aluminum	8170		MG/KG			
7440-36-0	Antimony	1.6		MG/KG	1.95E-03	1.95E-02	3.20E-01
7440-38-2	Arsenic	9.9		MG/KG	3.30E+00	1.62E-01	3.54E-01
7440-39-3	Barium	245		MG/KG	1.75E-03	1.75E-02	2.04E-01
7440-41-7	Beryllium	0.78	U	MG/KG	7.80E-01	2.69E-02	1.18E-01
7440-42-8	Boron	5.8		MG/KG	3.22E-05	3.22E-04	
7440-43-9	Cadmium	0.54	J	MG/KG	2.70E-04	2.70E-03	1.46E-01
7440-70-2	Calcium	359000		MG/KG			
7440-47-3	Chromium	155		MG/KG	1.55E-02	3.78E-02	5.54E+00
7440-48-4	Cobalt	18.2		MG/KG	1.52E-04	1.52E-03	
7440-50-8	Copper	117		MG/KG	1.43E-03	1.43E-02	1.06E-02
7439-89-6	Iron	25200		MG/KG			
7439-92-1	Lead	73		MG/KG	1.83E-01	1.83E-01	
7439-95-4	Magnesium	42900		MG/KG			
7439-96-5	Manganese	1500		MG/KG	1.56E-02	1.56E-01	
7439-97-6	Mercury	0.83		MG/KG	1.36E-03	1.36E-02	5.53E+00
7440-02-0	Nickel	18		MG/KG	4.39E-04	4.39E-03	2.37E-01
2023695	Potassium	5790		MG/KG			
7782-49-2	Selenium	4.2		MG/KG	4.20E-04	4.20E-03	1.75E+00

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

**TABLE 21-6  
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-OA13)**

**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
7440-22-4	Silver	0.55	J	MG/KG	5.50E-05	5.50E-04	3.67E-01
7440-23-5	Sodium	3230	U	MG/KG			
7440-28-0	Thallium	0.24	J	MG/KG	1.50E-03	1.50E-03	1.00E-01
7440-62-2	Vanadium	26.5		MG/KG	1.89E-03	1.89E-02	2.70E-02
7440-66-6	Zinc	236		MG/KG	3.87E-04	3.87E-03	6.56E-02
<b>Other Parameters</b>							
TOC	TOC	35300		MG/KG			

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

TABLE 21-7  
 ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-0A13)

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
<b>Semivolatile Organic Compounds</b>							
120-82-1	1,2,4-Trichlorobenzene		520	U	UG/KG	2.60E-02	
95-50-1	1,2-Dichlorobenzene		520	U	UG/KG	1.76E-01	
541-73-1	1,3-Dichlorobenzene		520	U	UG/KG	1.38E-02	
106-46-7	1,4-Dichlorobenzene		520	U	UG/KG	2.60E-02	
95-95-4	2,4,5-Trichlorophenol		2600	U	UG/KG	6.50E-01	
88-06-2	2,4,6-Trichlorophenol		520	U	UG/KG	5.20E-02	
120-83-2	2,4-Dichlorophenol		520	U	UG/KG	5.94E-03	
105-67-9	2,4-Dimethylphenol		520	U	UG/KG	5.20E+01	
51-28-5	2,4-Dinitrophenol		2600	U	UG/KG	1.30E-01	
91-58-7	2-Chloronaphthalene		520	U	UG/KG	4.27E+01	
95-57-8	2-Chlorophenol		520	U	UG/KG	2.14E+00	
91-57-6	2-Methylnaphthalene		130	J	UG/KG	4.01E-02	YES
95-48-7	2-Methylphenol		520	U	UG/KG	1.29E-02	
88-74-4	2-Nitroaniline		2600	U	UG/KG	3.51E-02	
88-75-5	2-Nitrophenol		520	U	UG/KG	3.25E-01	
91-94-1	3,3'-Dichlorobenzidine		520	U	UG/KG	8.05E-01	
99-09-2	3-Nitroaniline		2600	U	UG/KG	8.23E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2600	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		520	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		160	J	UG/KG	2.01E-02	
106-47-8	4-Chloroaniline		1000	U	UG/KG	9.09E-01	
7005-72-3	4-Chlorophenyl phenyl ether		520	U	UG/KG		
106-44-5	4-Methylphenol		520	U	UG/KG	3.19E-03	
100-01-6	4-Nitroaniline		2600	U	UG/KG	1.19E-01	
100-02-7	4-Nitrophenol		2600	U	UG/KG	3.71E-01	
83-32-9	Acenaphthene		580		UG/KG	8.50E-04	YES
208-96-8	Acenaphthylene		120	J	UG/KG	1.76E-04	
120-12-7	Anthracene		1600		UG/KG	1.08E-03	YES
56-55-3	Benzo(a)anthracene		5500		UG/KG	1.06E+00	YES
50-32-8	Benzo(a)pyrene		5300		UG/KG	1.20E-03	YES
205-99-2	Benzo(b)fluoranthene		6700		UG/KG	1.12E-01	YES
191-24-2	Benzo(g,h,i)perylene		4300		UG/KG	3.61E-02	YES
207-08-9	Benzo(k)fluoranthene		5900		UG/KG	9.87E-02	YES
111-91-1	bis(2-Chloroethoxy)methane		520	U	UG/KG	1.72E+00	
111-44-4	bis(2-Chloroethyl) ether		520	U	UG/KG	2.19E-02	
108-60-1	bis(2-Chloroisopropyl) ether		520	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		11000		UG/KG	1.19E+01	YES
85-68-7	Butyl benzyl phthalate		390	J	UG/KG	1.63E+00	YES
86-74-8	Carbazole		960		UG/KG		YES
218-01-9	Chrysene		7800		UG/KG	1.65E+00	YES
84-74-2	Di-n-butyl phthalate		230000		UG/KG	1.15E+00	YES

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

**TABLE 21-7  
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-0A13)**

**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
117-84-0	Di-n-octyl phthalate		85	J	UG/KG	1.20E-04	YES
53-70-3	Dibenz(a,h)anthracene		1900		UG/KG	1.03E-01	YES
132-64-9	Dibenzofuran		440		UG/KG		YES
84-66-2	Diethyl phthalate		520	U	UG/KG	5.20E-03	
131-11-3	Dimethyl phthalate		68	J	UG/KG	3.40E-04	
206-44-0	Fluoranthene		11000		UG/KG	9.02E-02	YES
86-73-7	Fluorene		550		UG/KG	1.83E-02	YES
118-74-1	Hexachlorobenzene		520	U	UG/KG	5.20E-04	
87-68-3	Hexachlorobutadiene		520	U	UG/KG	1.31E+01	
77-47-4	Hexachlorocyclopentadiene		520	U	UG/KG	5.20E-02	
67-72-1	Hexachloroethane		520	U	UG/KG	8.72E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		3800		UG/KG	3.49E-02	YES
78-59-1	Isophorone		520	U	UG/KG	3.74E-03	
621-64-7	N-Nitroso-di-n-propylamine		520	U	UG/KG	9.56E-01	
86-30-6	N-Nitrosodiphenylamine		52000		UG/KG	2.60E+00	
91-20-3	Naphthalene		110	J	UG/KG	4.42E-04	
87-86-5	Pentachlorophenol		2600	U	UG/KG	4.33E-01	
85-01-8	Phenanthrene		7600		UG/KG	1.66E-01	YES
108-95-2	Phenol		55	J	UG/KG	1.38E-03	
129-00-0	Pyrene		9500		UG/KG	1.21E-01	YES
<b>Explosives</b>							
99-35-4	1,3,5-Trinitrobenzene		390	U	UG/KG	1.04E+00	
99-65-0	1,3-Dinitrobenzene		390	U	UG/KG	5.96E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		780	U	UG/KG	2.60E-02	
121-14-2	2,4-Dinitrotoluene		64000		UG/KG	5.00E+01	
606-20-2	2,6-Dinitrotoluene		2900		UG/KG	8.83E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		780	U	UG/KG	9.75E-03	
88-72-2	2-Nitrotoluene (ONT)		780	U	UG/KG		
99-08-1	3-Nitrotoluene		780	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		780	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		780	U	UG/KG		
2691-41-0	HMX		780	U	UG/KG	3.12E-02	
98-95-3	Nitrobenzene		390	U	UG/KG	9.75E-03	
55-63-0	Nitroglycerin		300000		UG/KG		
78-11-5	Pentaerythritol tetranitrate (PETN)		3100	U	UG/KG		
121-82-4	RDX		780	U	UG/KG	7.80E-03	
479-45-8	Tetryl		1200	UJ	UG/KG		
<b>Metals</b>							
7429-90-5	Aluminum	28800	8170		MG/KG		
7440-36-0	Antimony	0.83	1.6		MG/KG	3.20E-01	
7440-38-2	Arsenic	13.5	9.9		MG/KG	1.10E+00	
7440-39-3	Barium	195	245		MG/KG	4.90E-01	

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

TABLE 21-7  
 ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 13 (AUS-0A13)

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
7440-41-7	Beryllium	0.76	0.78	U	MG/KG	7.80E-02	
7440-42-8	Boron	5.3	5.8		MG/KG	1.16E+01	
7440-43-9	Cadmium	0.19	0.54	J	MG/KG	1.86E-02	
7440-70-2	Calcium	2497	359000		MG/KG		
7440-47-3	Chromium	25.2	155		MG/KG	3.10E+01	
7440-48-4	Cobalt	21.7	18.2		MG/KG	9.10E-01	
7440-50-8	Copper	11.3	117		MG/KG	3.77E+00	
7439-89-6	Iron	19306	25200		MG/KG	1.26E+02	
7439-92-1	Lead	23.4	73		MG/KG	1.69E-01	
7439-95-4	Magnesium	1552	42900		MG/KG		
7439-96-5	Manganese	3640	1500		MG/KG	1.50E+01	
7439-97-6	Mercury	0.06	0.83		MG/KG	1.19E-01	YES
7440-02-0	Nickel	18.9	18		MG/KG	6.00E-01	
2023695	Potassium	625	5790		MG/KG		
7782-49-2	Selenium	2.34	4.2		MG/KG	4.20E+00	YES
7440-22-4	Silver	0.58	0.55	J	MG/KG	2.75E-01	
7440-23-5	Sodium	170	3230	U	MG/KG		
7440-28-0	Thallium	0.41	0.24	J	MG/KG	2.40E-01	
7440-62-2	Vanadium	47.2	26.5		MG/KG	5.76E-01	
7440-66-6	Zinc	51.4	236		MG/KG	1.97E+00	
<b>Other Parameters</b>							
TOC	TOC	31393	35300		MG/KG		

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

TABLE 21-8, AUS-0A13  
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
<b>Volatile Organic Compounds</b>								
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	NA	NA	NA	NA	NA	NA	NA	NA
N-Hexane	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene (PCE)	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA
total Xylenes	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene (TCE)	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	NA	NA	NA	NA	NA	NA	NA	NA
<b>Semivolatile Organic Compounds</b>								
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	No	A



TABLE 21-8, AUS-0A13  
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	NA	NA	NA	NA	Uncertainty	B
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	No	A
2-Chlorophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	No	F
2-Methylphenol	NA	NA	NA	NA	NA	NA	No	A
2-Nitroaniline	NA	NA	NA	NA	NA	NA	No	A
2-Nitrophenol	NA	NA	NA	NA	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	Uncertainty	B
3-Nitroaniline	NA	NA	NA	NA	NA	NA	No	A
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	NA	NA	NA	NA	No	C
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	No	F
4-Chloroaniline	NA	NA	NA	NA	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	No	C
4-Methylphenol	NA	NA	NA	NA	NA	NA	No	A
4-Nitroaniline	NA	NA	NA	NA	NA	NA	No	A
4-Nitrophenol	NA	NA	NA	NA	NA	NA	No	A
Acenaphthene	NA	NA	NA	NA	NA	NA	No	F
Acenaphthylene	NA	NA	NA	NA	NA	NA	No	F
Anthracene	NA	NA	NA	NA	NA	NA	No	F
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	Yes	E
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	Yes	E
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	Yes	E
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	No	F
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	No	C
bis(2-Chloroethyl) ether	NA	NA	NA	NA	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	NA	NA	NA	NA	NA	NA	No	A
bis(2-Ethylhexyl) phthalate	NA	NA	NA	NA	NA	NA	No	F
Butyl benzyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Carbazole	NA	NA	NA	NA	NA	NA	Yes	E
Chrysene	NA	NA	NA	NA	NA	NA	No	F
Di-n-butyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Di-n-octyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	Yes	E
Dibenzofuran	NA	NA	NA	NA	NA	NA	No	F
Diethyl phthalate	NA	NA	NA	NA	NA	NA	No	A
Dimethyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Fluoranthene	NA	NA	NA	NA	NA	NA	No	F

TABLE 21-8, AUS-0A13  
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	NA	NA	NA	NA	No	F
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	No	A
Hexachloroethane	NA	NA	NA	NA	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	NA	NA	NA	Yes	E
Isophorone	NA	NA	NA	NA	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	NA	NA	NA	NA	NA	NA	Uncertainty	B
N-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	Yes	E
Naphthalene	NA	NA	NA	NA	NA	NA	No	F
Pentachlorophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
Phenanthrene	NA	NA	NA	NA	NA	NA	No	F
Phenol	NA	NA	NA	NA	NA	NA	No	F
Pyrene	NA	NA	NA	NA	NA	NA	No	F
<b>Metals and Inorganics</b>								
Aluminum	NA	NA	NA	NA	NA	NA	No	F
Antimony	NA	NA	NA	NA	NA	NA	Yes	E
Arsenic	NA	NA	NA	NA	NA	NA	Yes	D
Barium	NA	NA	NA	NA	NA	NA	Yes	E
Beryllium	NA	NA	NA	NA	NA	NA	No	A
Boron	NA	NA	NA	NA	NA	NA	No	F
Cadmium	NA	NA	NA	NA	NA	NA	Yes	E
Calcium	NA	NA	NA	NA	NA	NA	No	H
Chromium	NA	NA	NA	NA	NA	NA	Yes	E
Cobalt	NA	NA	NA	NA	NA	NA	No	F
Copper	NA	NA	NA	NA	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	No	F
Lead	NA	NA	NA	NA	NA	NA	No	F
Magnesium	NA	NA	NA	NA	NA	NA	No	H
Manganese	NA	NA	NA	NA	NA	NA	No	F
Mercury	NA	NA	NA	NA	NA	NA	Yes	E
Nickel	NA	NA	NA	NA	NA	NA	Yes	D
Potassium	NA	NA	NA	NA	NA	NA	No	H
Selenium	NA	NA	NA	NA	NA	NA	Yes	E
Silver	NA	NA	NA	NA	NA	NA	No	F
Sodium	NA	NA	NA	NA	NA	NA	No	C
Thallium	NA	NA	NA	NA	NA	NA	No	F
Vanadium	NA	NA	NA	NA	NA	NA	No	F
Zinc	NA	NA	NA	NA	NA	NA	No	F
<b>Explosives</b>								
1,3,5-Trinitrobenzene	NA	NA	NA	NA	NA	NA	No	A
1,3-Dinitrobenzene	NA	NA	NA	NA	NA	NA	No	A

**TABLE 21-8, AUS-0A13  
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)	NA	NA	NA	NA	NA	NA	No	A
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	Yes	E
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	Yes	E
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	No	C
2-Nitrotoluene (ONT)	NA	NA	NA	NA	NA	NA	No	C
3-Nitrotoluene	NA	NA	NA	NA	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	No	C
4-Nitrotoluene (PNT)	NA	NA	NA	NA	NA	NA	No	A
HMX	NA	NA	NA	NA	NA	NA	No	A
Nitrobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
Nitroglycerin	NA	NA	NA	NA	NA	NA	Yes	E
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA	No	A
Tetryl	NA	NA	NA	NA	NA	NA	No	A
<b>Other Parameters</b>								
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 exceeded 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 21-9, AUS-0A13  
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
<b>Volatile Organic Compounds</b>						
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA
Methylene chloride	NA	NA	NA	NA	NA	NA
N-Hexane	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA
Tetrachloroethylene (PCE)	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA
total Xylenes	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA
Trichloroethylene (TCE)	NA	NA	NA	NA	NA	NA
Vinyl chloride	NA	NA	NA	NA	NA	NA
<b>Semivolatile Organic Compounds</b>						
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 21-9, AUS-0A13  
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	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	F
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	Yes	E
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	Yes	E
Butyl benzyl phthalate	NA	NA	NA	NA	Yes	E
Carbazole	NA	NA	NA	NA	Yes	E
Chrysene	NA	NA	NA	NA	Yes	E
Di-n-butyl phthalate	NA	NA	NA	NA	Yes	E
Di-n-octyl phthalate	NA	NA	NA	NA	Yes	E
Dibenz(a,h)anthracene	NA	NA	NA	NA	Yes	E
Dibenzofuran	NA	NA	NA	NA	Yes	E
Diethyl phthalate	NA	NA	NA	NA	No	A
Dimethyl phthalate	NA	NA	NA	NA	No	F
Fluoranthene	NA	NA	NA	NA	Yes	E

TABLE 21-9, AUS-0A13  
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	Yes	E
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	F
Pyrene	NA	NA	NA	NA	Yes	E
<b>Metals and Inorganics</b>						
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	A
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	E
Cobalt	NA	NA	NA	NA	No	F
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	E
Nickel	NA	NA	NA	NA	No	F
Potassium	NA	NA	NA	NA	Uncertainty	G,H
Selenium	NA	NA	NA	NA	Yes	E
Silver	NA	NA	NA	NA	No	F
Sodium	NA	NA	NA	NA	No	C
Thallium	NA	NA	NA	NA	No	F
Vanadium	NA	NA	NA	NA	No	F
Zinc	NA	NA	NA	NA	Yes	E
<b>Explosives</b>						
1,3,5-Trinitrobenzene	NA	NA	NA	NA	Uncertainty	B
1,3-Dinitrobenzene	NA	NA	NA	NA	No	A

TABLE 21-9, AUS-0A13  
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	No	A
2,4-Dinitrotoluene	NA	NA	NA	NA	Yes	E
2,6-Dinitrotoluene	NA	NA	NA	NA	Yes	E
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	No	A
2-Nitrotoluene (ONT)	NA	NA	NA	NA	No	C
3-Nitrotoluene	NA	NA	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	No	C
4-Nitrotoluene (PNT)	NA	NA	NA	NA	No	C
HMX	NA	NA	NA	NA	No	A
Nitrobenzene	NA	NA	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	NA	NA	NA	NA	No	A
Tetryl	NA	NA	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 exceeded 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 21-10**  
**AUS-0A13 - IOP FINISHED AMMUNITION IGLOOS AREA**  
**CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND**  
**(WHERE APPLICABLE)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU SI**

Chemical	Drum <sup>1</sup>	Soil	Sediment	Ground Water	Surface Water
<b>SVOCs</b>					
2-Methylnaphthalene		E	NA	NA	NA
Acenaphthene		E	NA	NA	NA
Anthracene		E	NA	NA	NA
Benzo(a)anthracene		H,E	NA	NA	NA
Benzo(a)pyrene		H,E	NA	NA	NA
Benzo(b)fluoranthene		H,E	NA	NA	NA
Benzo(g,h,i)perylene		E	NA	NA	NA
Benzo(k)fluoranthene		H,E	NA	NA	NA
bis(2-Ethylhexyl)phthalate		E	NA	NA	NA
Butyl benzyl phthalate		E	NA	NA	NA
Carbazole		H,E	NA	NA	NA
Chrysene		E	NA	NA	NA
Di-n-butyl phthalate		E	NA	NA	NA
Di-n-octyl phthalate		E	NA	NA	NA
Dibenz(a,h)anthracene		H,E	NA	NA	NA
Dibenzofuran		E	NA	NA	NA
Fluoranthene		E	NA	NA	NA
Fluorene		E	NA	NA	NA
Indeno(1,2,3-c,d)pyrene		H,E	NA	NA	NA
N-Nitrosodiphenylamine		H,E	NA	NA	NA
Phenanthrene		E	NA	NA	NA
Pyrene		E	NA	NA	NA
<b>Metals</b>					
Antimony		H	NA	NA	NA
Barium		H	NA	NA	NA
Boron		E	NA	NA	NA
Cadmium		H	NA	NA	NA
Chromium		H,E	NA	NA	NA
Copper		E	NA	NA	NA
Iron		E	NA	NA	NA
Mercury		H,E	NA	NA	NA
Selenium		H,E	NA	NA	NA
Zinc		E	NA	NA	NA
<b>Explosives</b>					
2,4-Dinitrotoluene		H,E	NA	NA	NA
2,6-Dinitrotoluene		H,E	NA	NA	NA
Nitroglycerin		H	NA	NA	NA

Key:

<sup>1</sup> Drums were not present at this site.

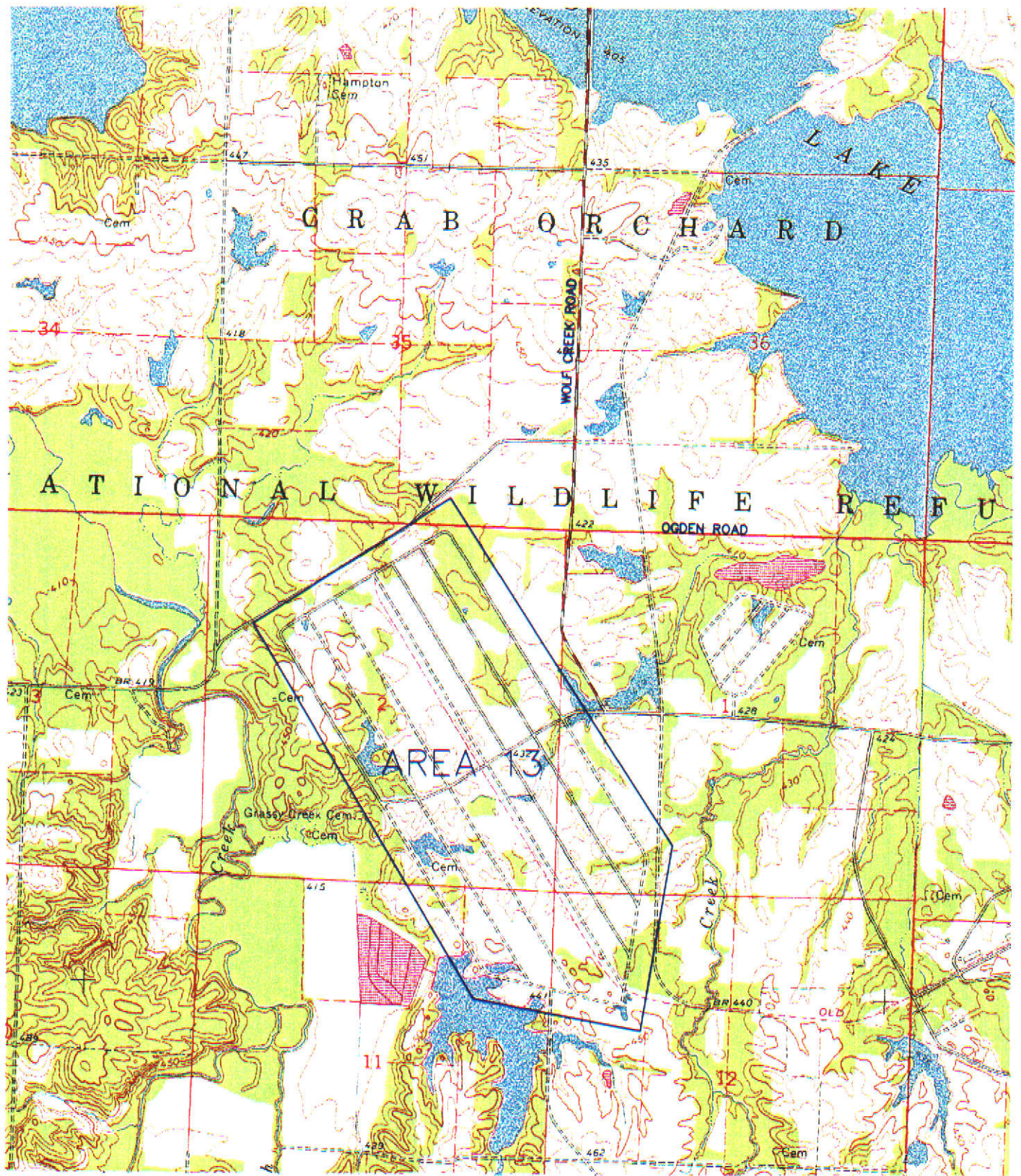
NA = not analyzed

H = human health screening criteria exceeded

E = ecological screening criteria exceeded



File: E:\45FOM9602N\FIG 21-1.DWG Last edited: 06/28/01 @ 4:59 p.m. © WCC-ST. LOUIS



PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS		PROJECT NO. 2320000026.00
<b>URS</b>		FIG. NO. 21-1
DRN. BY: djd 9/7/99 DSGN. BY: mch CHKD. BY: cmw	Area 13 Site Location Map	

LEGEND  
⊕ HAND AUGER LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	h1
Little Crany Background Sediment UTL	h2
Ecological Direct Exposure Surface Water UTL	h3
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 (non-carcinogenic)	e5
USEPA Region IX Industrial Soil PFO - carcinogenic	h1
USEPA Region IX Industrial Soil PFO - non-carcinogenic	h2
USEPA Region IX Tap Water PFO - carcinogenic	h3
USEPA Region IX Tap Water PFO - non-carcinogenic	h4
USEPA Region IX Migration in Groundwater PFO (DAP-1)	h5
USEPA MCL Drinking Water Standards	h6
IEPA TACO Industrial/Commercial Soil Legislation	h7
IEPA TACO Construction Worker Soil Legislation	h8
IEPA TACO Class II Soil Component of Groundwater	h9
IEPA General Use Surface Water Quality Human Health	h10

AUS-0A13-004	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	38	
Acetophenone	UGKGD	46	
Acrylonitrile	UGKGD	65	
Benzene	UGKGD	65	
Benzonitrile	UGKGD	30	
Benzophenone	UGKGD	30	
Benzothiazole	UGKGD	60	
Benzotrifluoride	UGKGD	70	
Benzyl alcohol	UGKGD	2500	
Benzyl acetate	UGKGD	60	
Benzyl benzoate	UGKGD	70	
Benzyl bromide	UGKGD	60	
Benzyl chloride	UGKGD	60	
Benzyl cyanide	UGKGD	60	
Benzyl ether	UGKGD	60	
Benzyl fluoride	UGKGD	60	
Benzyl iodide	UGKGD	60	
Benzyl isocyanide	UGKGD	60	
Benzyl mercaptan	UGKGD	60	
Benzyl nitrate	UGKGD	60	
Benzyl peroxide	UGKGD	60	
Benzyl sulfide	UGKGD	60	
Benzyl sulfone	UGKGD	60	
Benzyl thioether	UGKGD	60	
Benzylamine	UGKGD	60	
Benzylamine hydrochloride	UGKGD	60	
Benzylamine sulfate	UGKGD	60	
Benzylamine tartrate	UGKGD	60	
Benzylamine trifluoromethanesulfonate	UGKGD	60	
Benzylamine hydrochloride	UGKGD	60	
Benzylamine sulfate	UGKGD	60	
Benzylamine tartrate	UGKGD	60	
Benzylamine trifluoromethanesulfonate	UGKGD	60	
Benzylamine hydrochloride	UGKGD	60	
Benzylamine sulfate	UGKGD	60	
Benzylamine tartrate	UGKGD	60	
Benzylamine trifluoromethanesulfonate	UGKGD	60	
All Explosives	UGKGD	ND	NC

AUS-0A13-005	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	83	
Acetophenone	UGKGD	290	
Acrylonitrile	UGKGD	70	
Benzene	UGKGD	84	
Benzonitrile	UGKGD	74	
Benzophenone	UGKGD	40	
Benzotrifluoride	UGKGD	40	
Benzothiazole	UGKGD	74	
Benzotrifluoride	UGKGD	110	
Benzyl alcohol	UGKGD	100	
Benzyl acetate	UGKGD	100	
Benzyl benzoate	UGKGD	100	
Benzyl bromide	UGKGD	100	
Benzyl chloride	UGKGD	100	
Benzyl cyanide	UGKGD	100	
Benzyl ether	UGKGD	100	
Benzyl fluoride	UGKGD	100	
Benzyl iodide	UGKGD	100	
Benzyl isocyanide	UGKGD	100	
Benzyl mercaptan	UGKGD	100	
Benzyl nitrate	UGKGD	100	
Benzyl peroxide	UGKGD	100	
Benzyl sulfide	UGKGD	100	
Benzyl sulfone	UGKGD	100	
Benzyl thioether	UGKGD	100	
Benzylamine	UGKGD	100	
Benzylamine hydrochloride	UGKGD	100	
Benzylamine sulfate	UGKGD	100	
Benzylamine tartrate	UGKGD	100	
Benzylamine trifluoromethanesulfonate	UGKGD	100	
All Explosives	UGKGD	ND	NC

AUS-0A13-008	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	170	
Acetophenone	UGKGD	86	
Acrylonitrile	UGKGD	86	
Benzene	UGKGD	440	
Benzonitrile	UGKGD	440	
Benzophenone	UGKGD	440	
Benzotrifluoride	UGKGD	440	
Benzothiazole	UGKGD	440	
Benzotrifluoride	UGKGD	440	
Benzyl alcohol	UGKGD	250	
Benzyl acetate	UGKGD	250	
Benzyl benzoate	UGKGD	250	
Benzyl bromide	UGKGD	250	
Benzyl chloride	UGKGD	250	
Benzyl cyanide	UGKGD	250	
Benzyl ether	UGKGD	250	
Benzyl fluoride	UGKGD	250	
Benzyl iodide	UGKGD	250	
Benzyl isocyanide	UGKGD	250	
Benzyl mercaptan	UGKGD	250	
Benzyl nitrate	UGKGD	250	
Benzyl peroxide	UGKGD	250	
Benzyl sulfide	UGKGD	250	
Benzyl sulfone	UGKGD	250	
Benzyl thioether	UGKGD	250	
Benzylamine	UGKGD	250	
Benzylamine hydrochloride	UGKGD	250	
Benzylamine sulfate	UGKGD	250	
Benzylamine tartrate	UGKGD	250	
Benzylamine trifluoromethanesulfonate	UGKGD	250	
All Explosives	UGKGD	ND	NC

AUS-0A13-002	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	67	
Acetophenone	UGKGD	67	
Acrylonitrile	UGKGD	67	
Benzene	UGKGD	67	
Benzonitrile	UGKGD	67	
Benzophenone	UGKGD	67	
Benzotrifluoride	UGKGD	67	
Benzothiazole	UGKGD	67	
Benzotrifluoride	UGKGD	67	
Benzyl alcohol	UGKGD	67	
Benzyl acetate	UGKGD	67	
Benzyl benzoate	UGKGD	67	
Benzyl bromide	UGKGD	67	
Benzyl chloride	UGKGD	67	
Benzyl cyanide	UGKGD	67	
Benzyl ether	UGKGD	67	
Benzyl fluoride	UGKGD	67	
Benzyl iodide	UGKGD	67	
Benzyl isocyanide	UGKGD	67	
Benzyl mercaptan	UGKGD	67	
Benzyl nitrate	UGKGD	67	
Benzyl peroxide	UGKGD	67	
Benzyl sulfide	UGKGD	67	
Benzyl sulfone	UGKGD	67	
Benzyl thioether	UGKGD	67	
Benzylamine	UGKGD	67	
Benzylamine hydrochloride	UGKGD	67	
Benzylamine sulfate	UGKGD	67	
Benzylamine tartrate	UGKGD	67	
Benzylamine trifluoromethanesulfonate	UGKGD	67	
All Explosives	UGKGD	ND	NC

AUS-0A13-009	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	150	
Acetophenone	UGKGD	150	
Acrylonitrile	UGKGD	150	
Benzene	UGKGD	150	
Benzonitrile	UGKGD	150	
Benzophenone	UGKGD	150	
Benzotrifluoride	UGKGD	150	
Benzothiazole	UGKGD	150	
Benzotrifluoride	UGKGD	150	
Benzyl alcohol	UGKGD	150	
Benzyl acetate	UGKGD	150	
Benzyl benzoate	UGKGD	150	
Benzyl bromide	UGKGD	150	
Benzyl chloride	UGKGD	150	
Benzyl cyanide	UGKGD	150	
Benzyl ether	UGKGD	150	
Benzyl fluoride	UGKGD	150	
Benzyl iodide	UGKGD	150	
Benzyl isocyanide	UGKGD	150	
Benzyl mercaptan	UGKGD	150	
Benzyl nitrate	UGKGD	150	
Benzyl peroxide	UGKGD	150	
Benzyl sulfide	UGKGD	150	
Benzyl sulfone	UGKGD	150	
Benzyl thioether	UGKGD	150	
Benzylamine	UGKGD	150	
Benzylamine hydrochloride	UGKGD	150	
Benzylamine sulfate	UGKGD	150	
Benzylamine tartrate	UGKGD	150	
Benzylamine trifluoromethanesulfonate	UGKGD	150	
All Explosives	UGKGD	ND	NC

AUS-0A13-003	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	500	
Acetophenone	UGKGD	130	
Acrylonitrile	UGKGD	130	
Benzene	UGKGD	130	
Benzonitrile	UGKGD	130	
Benzophenone	UGKGD	130	
Benzotrifluoride	UGKGD	130	
Benzothiazole	UGKGD	130	
Benzotrifluoride	UGKGD	130	
Benzyl alcohol	UGKGD	130	
Benzyl acetate	UGKGD	130	
Benzyl benzoate	UGKGD	130	
Benzyl bromide	UGKGD	130	
Benzyl chloride	UGKGD	130	
Benzyl cyanide	UGKGD	130	
Benzyl ether	UGKGD	130	
Benzyl fluoride	UGKGD	130	
Benzyl iodide	UGKGD	130	
Benzyl isocyanide	UGKGD	130	
Benzyl mercaptan	UGKGD	130	
Benzyl nitrate	UGKGD	130	
Benzyl peroxide	UGKGD	130	
Benzyl sulfide	UGKGD	130	
Benzyl sulfone	UGKGD	130	
Benzyl thioether	UGKGD	130	
Benzylamine	UGKGD	130	
Benzylamine hydrochloride	UGKGD	130	
Benzylamine sulfate	UGKGD	130	
Benzylamine tartrate	UGKGD	130	
Benzylamine trifluoromethanesulfonate	UGKGD	130	
All Explosives	UGKGD	ND	NC

AUS-0A13-007	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	71	
Acetophenone	UGKGD	100	
Acrylonitrile	UGKGD	100	
Benzene	UGKGD	400	
Benzonitrile	UGKGD	400	
Benzophenone	UGKGD	400	
Benzotrifluoride	UGKGD	400	
Benzothiazole	UGKGD	400	
Benzotrifluoride	UGKGD	400	
Benzyl alcohol	UGKGD	400	
Benzyl acetate	UGKGD	400	
Benzyl benzoate	UGKGD	400	
Benzyl bromide	UGKGD	400	
Benzyl chloride	UGKGD	400	
Benzyl cyanide	UGKGD	400	
Benzyl ether	UGKGD	400	
Benzyl fluoride	UGKGD	400	
Benzyl iodide	UGKGD	400	
Benzyl isocyanide	UGKGD	400	
Benzyl mercaptan	UGKGD	400	
Benzyl nitrate	UGKGD	400	
Benzyl peroxide	UGKGD	400	
Benzyl sulfide	UGKGD	400	
Benzyl sulfone	UGKGD	400	
Benzyl thioether	UGKGD	400	
Benzylamine	UGKGD	400	
Benzylamine hydrochloride	UGKGD	400	
Benzylamine sulfate	UGKGD	400	
Benzylamine tartrate	UGKGD	400	
Benzylamine trifluoromethanesulfonate	UGKGD	400	
All Explosives	UGKGD	ND	NC

AUS-0A13-010	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	1000	
Acetophenone	UGKGD	70	
Acrylonitrile	UGKGD	70	
Benzene	UGKGD	50	
Benzonitrile	UGKGD	50	
Benzophenone	UGKGD	50	
Benzotrifluoride	UGKGD	50	
Benzothiazole	UGKGD	50	
Benzotrifluoride	UGKGD	50	
Benzyl alcohol	UGKGD	50	
Benzyl acetate	UGKGD	50	
Benzyl benzoate	UGKGD	50	
Benzyl bromide	UGKGD	50	
Benzyl chloride	UGKGD	50	
Benzyl cyanide	UGKGD	50	
Benzyl ether	UGKGD	50	
Benzyl fluoride	UGKGD	50	
Benzyl iodide	UGKGD	50	
Benzyl isocyanide	UGKGD	50	
Benzyl mercaptan	UGKGD	50	
Benzyl nitrate	UGKGD	50	
Benzyl peroxide	UGKGD	50	
Benzyl sulfide	UGKGD	50	
Benzyl sulfone	UGKGD	50	
Benzyl thioether	UGKGD	50	
Benzylamine	UGKGD	50	
Benzylamine hydrochloride	UGKGD	50	
Benzylamine sulfate	UGKGD	50	
Benzylamine tartrate	UGKGD	50	
Benzylamine trifluoromethanesulfonate	UGKGD	50	
All Explosives	UGKGD	ND	NC

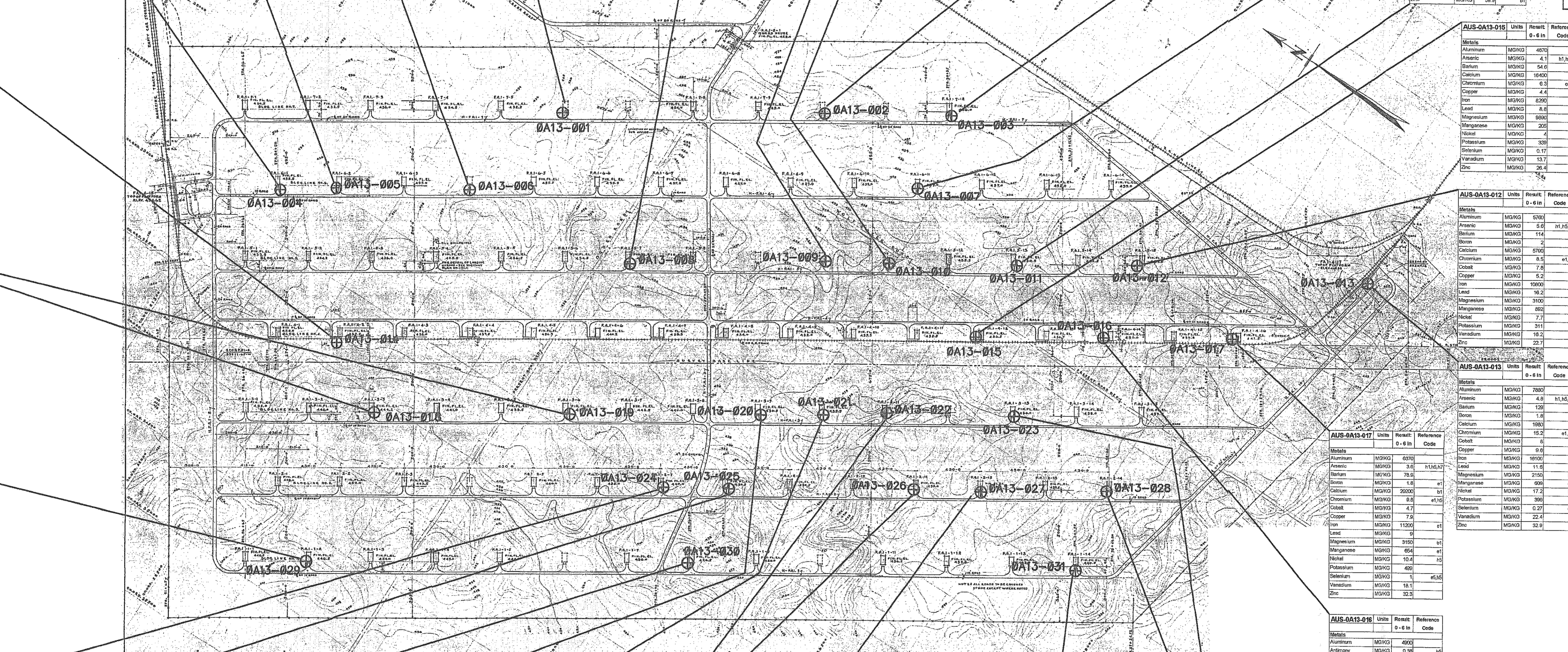
AUS-0A13-011	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	20	
Acetophenone	UGKGD	20	
Acrylonitrile	UGKGD	20	
Benzene	UGKGD	240	
Benzonitrile	UGKGD	240	
Benzophenone	UGKGD	240	
Benzotrifluoride	UGKGD	240	
Benzothiazole	UGKGD	240	
Benzotrifluoride	UGKGD	240	
Benzyl alcohol	UGKGD	240	
Benzyl acetate	UGKGD	240	
Benzyl benzoate	UGKGD	240	
Benzyl bromide	UGKGD	240	
Benzyl chloride	UGKGD	240	
Benzyl cyanide	UGKGD	240	
Benzyl ether	UGKGD	240	
Benzyl fluoride	UGKGD	240	
Benzyl iodide	UGKGD	240	
Benzyl isocyanide	UGKGD	240	
Benzyl mercaptan	UGKGD	240	
Benzyl nitrate	UGKGD	240	
Benzyl peroxide	UGKGD	240	
Benzyl sulfide	UGKGD	240	
Benzyl sulfone	UGKGD	240	
Benzyl thioether	UGKGD	240	
Benzylamine	UGKGD	240	
Benzylamine hydrochloride	UGKGD	240	
Benzylamine sulfate	UGKGD	240	
Benzylamine tartrate	UGKGD	240	
Benzylamine trifluoromethanesulfonate	UGKGD	240	
All Explosives	UGKGD	ND	NC

AUS-0A13-016	Units	Result	Reference
0-6 in			Code
Semivolatile Organic Compounds	UGKGD	ND	NC
Acetone	UGKGD	70	
Acetophenone	UGKGD	70	
Acrylonitrile	UGKGD	70	
Benzene	UGKGD	70	
Benzonitrile	UGKGD	70	
Benzophenone	UGKGD	70	
Benzotrifluoride	UGKGD	70	
Benzothiazole	UGKGD	70	
Benzotrifluoride	UGKGD	70	
Benzyl alcohol	UGKGD	70	
Benzyl acetate	UGKGD</		

LEGEND  
⊕ HAND AUGER LOCATION

Screening Reference	Reference Code
AIS Background Soil UTL	b1
Little Crassy Background Surface UTL	b2
Little Crassy Background Sediment UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	a1
Ecological Direct Exposure Pathway TRV - Sediment	a2
Ecological Direct Exposure Pathway TRV - Surface Water	a3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	a4
Superfund Chemical Data Matrix Kow values (potential bioaccumulators)	a5
USEPA Regional Industrial Soil PRG - carcinous	b1
USEPA Region IX Top Water PRG - noncarcinous	b2
USEPA Region IX Tap Water PRG - carcinous	b3
USEPA Region IX Tap Water PRG - noncarcinous	b4
USEPA Region IX Groundwater PRG (DAP-1)	b5
USEPA MCL Drinking Water Standards	b6
IEPA TACO Industrial/Commercial Soil Ingestion	b7
IEPA TACO Construction Worker Soil Ingestion	b8
IEPA TACO Class I Soil Component of Groundwater	b9
IEPA General Use Surface Water Quality Human Health	b10

AUS-0A13-004	Units	Result	Reference
0 - 6 in Code			
Metals			
Aluminum	MG/KG	7700	
Antimony	MG/KG	1.3	H1, H5, H7
Arsenic	MG/KG	4.2	H1, H5, H7
Barium	MG/KG	146	H5
Boron	MG/KG	4.3	e1
Cadmium	MG/KG	0.53	e1, H5
Calcium	MG/KG	2492	
Chromium	MG/KG	12.1	e1, H5
Cobalt	MG/KG	4.7	
Copper	MG/KG	106	e1, H5
Iron	MG/KG	13000	
Lead	MG/KG	72.8	b1
Magnesium	MG/KG	17800	
Manganese	MG/KG	528	e1
Nickel	MG/KG	0.83	e1, H5
Potassium	MG/KG	13.3	H5
Selenium	MG/KG	889	b1
Silver	MG/KG	0.36	e1, H5
Sodium	MG/KG	6.8	e1, H5
Vanadium	MG/KG	207	
Zinc	MG/KG	102	



AUS-0A13-011	Units	Result	Reference
0 - 6 in Code			
Metals			
Aluminum	MG/KG	6520	
Antimony	MG/KG	0.5	H1, H5, H7
Arsenic	MG/KG	1.42	H5
Barium	MG/KG	142	H5
Boron	MG/KG	3	H5
Cadmium	MG/KG	0.28	H5
Calcium	MG/KG	21000	b1
Chromium	MG/KG	11.5	e1, H5
Cobalt	MG/KG	4.8	
Copper	MG/KG	11.9	b1
Iron	MG/KG	13400	e1
Lead	MG/KG	260	b1
Magnesium	MG/KG	1400	b1
Manganese	MG/KG	608	e1
Nickel	MG/KG	10.3	H5
Potassium	MG/KG	507	H5
Selenium	MG/KG	1.1	e1, H5
Silver	MG/KG	0.55	e1, H5
Sodium	MG/KG	24	
Vanadium	MG/KG	17.1	
Zinc	MG/KG	58.9	b1

AUS-0A13-012	Units	Result	Reference
0 - 6 in Code			
Metals			
Aluminum	MG/KG	6780	
Antimony	MG/KG	0.6	H1, H5, H7
Arsenic	MG/KG	1.54	H5
Barium	MG/KG	154	H5
Boron	MG/KG	2	H5
Calcium	MG/KG	2700	b1
Chromium	MG/KG	8.6	e1, H5
Cobalt	MG/KG	7.8	
Copper	MG/KG	5.2	
Iron	MG/KG	10800	e1
Lead	MG/KG	19.2	b1
Magnesium	MG/KG	3100	b1
Manganese	MG/KG	892	e1
Nickel	MG/KG	2.92	H5
Potassium	MG/KG	339	
Selenium	MG/KG	0.17	e1, H5
Silver	MG/KG	0.37	
Vanadium	MG/KG	13.7	
Zinc	MG/KG	27.7	

Revision No.	Description	Date	By	App.

REVISIONS

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

AUS-0A13 Sample Locations and Detections of  
Inorganic Compounds in Soils

Date:	11/14/00	Project Number:	232000026.00	Figure Number:	21-3
Drawn by:	DJD	Design by:	MAM	Checked by:	CMW

URS

FILE: E:\232000026.00\PA-SI REPORT-AUS OU\TAB 21-3.DWG Last edited: AUS\_05\_01 @ 11:36 a.m. URS Corp.

BASE MAP SOURCE: ILLINOIS ORDNANCE PLANT, CARBONDALE, ILLINOIS, 1942, FINISHED AMMUNITION IGLOOS (88), AREA FAI, PLAN NO. 6544-101-24

NOTE:  
1. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.