



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 VII

Section 14

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ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

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

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

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

ACRONYM LIST
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 Recovery Act
RDX	Royal Demolition Explosive (Cyclonite)
RI	Remedial Investigation
RI/FS	Remedial Investigation / Feasibility Study
RL	Reporting Limit
ROD	Record of Decision
RR	Railroad
RRTC	Railroad Tank Car
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act (1986)
SI	Site Investigation
SIU	Southern Illinois University
SMCL	Secondary Maximum Contaminant Level
SMDP	Scientific Management Decision Point
SOP	Standard Operating Procedure
SPO	Solid Propellant Operations
SSLs	Soil Screening Levels (USEPA)
SVOC	Semi-volatile Organic Compound
SWDC	Sherwin Williams Defense Corporation
TACO	Tiered Approach to Corrective Action Objectives
TAL	Target Analyte List
TBD	To Be Determined
TCDD	Tetrachlorodibenzo-p-Dioxin
TCE	Trichloroethylene
TCL	Target Compound List
TDS	Total Dissolved Solids
TEC	Threshold Effect Concentration
TEL	Threshold Effect Level
TEQ	Toxicity Equivalent for Dioxins/Furans
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TRV	Toxicity Reference Value

ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

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

The access road to Area 10 is on the north side of Ogden Road, about 1.5 miles west of Route 148 (Figure 14-1).

AUS Original Site Designations

Two of the original sites designated in 1997-1999 by the United States Fish & Wildlife Service (USFWS) as part of the Additional and Uncharacterized Sites Operable Unit (AUS OU) were located in Area 10: AUS-0041 and AUS-0042. These have been incorporated into the larger, current site, AUS-0A10, which includes all of Area 10.

14.1 HISTORIC SEARCH INFORMATION

14.1.1 Site Description

This site was the former Illinois Ordnance Plant (IOP) Fuse and Booster Storage Magazine (FBM)¹. There were sixteen magazines which have all been removed. From 1968 to 1970, Olin used the site as a burn area for incineration of wastes from its operations in various parts of the Refuge. Sometime between 1971 and 1980, a small-arms firing range was built in this area.² Since that time the site has been used by local law enforcement personnel and the USFWS for small arms practice.

14.1.2 Operational History and Waste Characteristics

14.1.2.1 IOP Operations

Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department), operated the Fuse and Booster Storage Magazine during World War II from 1942 to 1945. The fuses and boosters stored in this area were loaded in Area 2. From the Area 10 storage magazines they were transported to the IOP Load Lines, where anti-tank mines, bombs and artillery were being produced.

The FBM area was in the shape of a polygon, with four inter-connecting roads (Figure 14-2). There were 16 storage magazines (each about 27 feet (ft) wide and 48 ft long), arranged in four rows (two rows of five magazines and two rows of three magazines).³ All building numbers start with the preface "FBM."

¹ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant, Carbondale, Illinois, Part 1, Section 5, Page 14, (Plan No. 6544-101.28).

² Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 59 and Figures 3 and 4. The Entech reports analyze historic aerial overflight photographs of industrial areas at the Refuge, from 1943 to 1993. The photos were obtained from the National Archives and Records Administration (NARA) and the U.S. Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS).

³ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant, Carbondale, Illinois, Part 1, Section 5, Page 14, (Plan No. 6544-101.28).

A 1951 aerial photograph showed that only 6 of the original 16 storage magazines remained on site (Buildings FBM-2-5, FBM-3-1, FBM-3-2, FBM-3-3, FBM-4-1 and FBM-4-2).⁴ By 1960, only Buildings FBM-3-1, FBM-3-2 and FBM-3-3 remained; by 1965 there were no buildings on site.⁵

Two ponds were also observed on site in the 1951 aerial photograph.⁶ One was located northeast of Building FBM-3-3 and the other was located north of Building FBM-2-4 and southwest of Building FBM-2-5. These ponds were present through at least 1980. By 1993, they were no longer present; it appeared that they were drained northward into a nearby low-lying area.⁷ There was some ponding observed in these areas during the 1999 site reconnaissance.

Surficial discoloration was noted in aerial photographs on the concrete pad that was the foundation for former Building FBM-4-1.⁸ The surficial discoloration was heaviest on both the north and south sides of the pad, and was lighter toned in the center of the pad.⁹ By 1965 there was no evidence of the discoloration in the photographs.¹⁰

IOP Decontamination

After the IOP operations ended at CONWR, the IOP was to be decontaminated in accordance with a manual developed by the Ordnance Field Director of Ammunition Plants (OFDAP), called "*Shut-Down and Decontamination Procedures for F.D.A.P Facilities.*"¹¹ This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.¹² 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 10 was used by the IOP as a storage area, 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, if it was adequately decontaminated, and if decontamination instructions were followed.

⁴ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 57 and Figure 1.

⁵ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 57 and Figure 2.

⁶ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 57 and Figure 1.

⁷ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 61 and Figure 5.

⁸ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 57 and Figure 2.

⁹ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 57 and Figure 2.

¹⁰ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 59.

¹¹ ACO 005047 - ACO 005109. Office of Field Director of Ammunition Plants, Shut-Down and Decontamination Procedures for F.D.A.P. Facilities.

¹² ACO 004979 – ACO 004980. CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.

14.1.2.2 U.S. Fish and Wildlife Service Operations

Three of the former storage magazines (FBM-3-1, FBM-3-2 and FBM-3-3) in Area 10 were used by the Fish and Wildlife Service for storage of grain in 1949.¹³

According to Mr. John Mahan, the firearms safety officer for the Refuge, Area 10 was being used as a firing range in 1999. The firing range is located between former Buildings FBM-2-1 and FBM-2-2 just south of the former burning grounds. Mr. Mahan reported that over the years the Marion Federal Penitentiary, local police forces, the Federal Bureau of Investigation (FBI), the Drug Enforcement Agency (DEA), and the USFWS have used the firing range.¹⁴ During his tenure, the range has been used by these agencies for small firearm practice, with occasional use for smoke or tear gas training canisters, but no live rounds. The range has been in operation since at least 1980,¹⁵ the USFWS has been the only organization to use this facility since 1997.¹⁶

An 8 to 10-ft high backstop (berm) is located on the north side of the firing range. Some spent ammunition is scattered across the ground in this area. The ammunition consists of shotgun shells, and rifle and pistol rounds.

A possible dark-toned pit at the southern end of the ground-scarred area (former burn pit area), was observed in the 1993 aerial photograph. It measured approximately 20 ft in diameter.¹⁷ Based on the burned materials observed on the ground surface during the site reconnaissance in 1999, this is presumed to be a surficial burn area.

14.1.2.3 Sangamo Operations

Sangamo Weston, Inc. (formerly Sangamo Electric Co., later Schlumberger Industries, Inc.) leased two former storage magazines (FBM-1-4 & FBM-1-5) from 1949 to 1951.^{18,19}

14.1.2.4 Olin Operations

Although it had no leases in Area 10, Olin constructed and used large pits in this area for the incineration of ignitable wastes from its production operations (Figure 14-2). John Miller, a former Olin chemist and manager, indicated that Olin moved from one burning ground to another as they outgrew the previous burn areas, and that all of Olin's manufacturing operations on the Refuge used a single burn area at the same time.^{20,21} Olin documents indicate that their

¹³ DPRA Document No. 00009059. CONWR, Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, dated April 12, 1949.

¹⁴ John Mahan, personal interview, September 2, 1999.

¹⁵ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 59 and Figure 4.

¹⁶ John Mahan, personal interview, September 2, 1999.

¹⁷ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 61 and Figure 5.

¹⁸ DPRA Document No. 00009059. CONWR, Lease Data for Industrial Unit, Crab Orchard National Wildlife Refuge, dated June 1, 1951, Page 17.

¹⁹ DPRA Document No. 00009039. CONWR, Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, dated April 12, 1949.

²⁰ Deposition of Mr. John Miller, April 9, 1998, Pages 80 and 81.

²¹ Deposition of George Wisely, June 28, 1999, Page 52.

burning grounds were moved from Area 12 to Area 2D in 1965, from Area 2D to Area 9 in 1967 and from Area 9 to Area 10 in 1968.²² The Area 10 burn area which was used only by Olin, was in operation until open burning was banned at the Refuge in July 1970.^{23, 24} According to John Miller, explosive wastes were not disposed of at Olin's off-Refuge Test Range in Energy, Illinois until 1973, when the incinerator at that location was approved.²⁵ It was not determined what Olin did with their explosive wastes between July of 1970 and 1973.

There were no buildings in the area when Olin began its activities in Area 10 in 1968,^{26,27} nor were there any industrial tenants in the area. However, documents provided by Olin (including a burning ground layout map) indicate that Olin constructed the burning grounds in Area 10 (in the area between former Buildings FBM-2-2 and FBM-2-3)²⁸ and used them for incinerating production wastes from approximately 1968²⁹ until July of 1970. The pits were apparently covered sometime shortly after the burning ended. Historical aerial photographs confirm this information; they show no evidence of the burning pits in 1965, but show a ground disturbance (but no evidence of pits or trenches) in the 1971 aerial photographs.³⁰ The area of ground disturbance was also observed during the site reconnaissance in 1999.

Most of the information regarding the Area 10 burning grounds is from an incident report following an accident in February of 1970 at one of the burn pits, in which an Olin employee was severely burned and died a few weeks later.³¹ The burning grounds consisted of four 50-ft square pits spaced 30 ft apart, which were surrounded by a chain-link fence.³² There was also a corrugated metal personnel shelter, a metal transportainer for storing small quantities of either black or smokeless powder used as igniter powders and a permanently installed wiring system³³ for ignition of the burns.

Scrap explosive wastes from Olin's Technical Systems Operations (TSO) and Power Systems Operations (PSO) (assumed to be located in Areas 9 and 2 since these were Olin's two main production areas at the time), were burned in the pits.^{34,35} Two of the pits were used by the TSO;

²² DOI 004465, DOI 004467, and DOI 004469. Olin document submitted as part of their Section 104(e) response regarding open burning at the Refuge.

²³ CRO 001662. CONWR, Letter to Trojan – U. S. Powder regarding discontinuing open burning at the Refuge, dated March 17, 1970.

²⁴ Deposition of George Wisely, June 28, 1999, Pages 49-50.

²⁵ Deposition of Mr. John Miller, April 9, 1998, Pages 131 and 132.

²⁶ DOI 004465. Olin document submitted as part of their Section 104(e) response regarding open burning at the Refuge.

²⁷ Deposition of Mr. John Miller, April 9, 1998, Page 81.

²⁸ PRI 005214. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 13. *Note, the Bates identification number for Page 13 is not fully legible; because the previous page is identified as PRI-005213, it is assumed that Page 13 is PRI-005214.*

²⁹ DOI 004465. Olin document submitted as part of their Section 104(e) response regarding open burning at the Refuge.

³⁰ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 59 and Figure 3.

³¹ PRI 005202. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 1.

³² PRI 005214. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 13.

³³ PRI 005202. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 1.

³⁴ PRI 005202. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 1.

³⁵ PRI 005218. Olin, Standard Operating Procedure for Explosive Waste Burning Grounds, SOP No. 90,157.

the other two pits were used by the PSO.³⁶ Scrap explosive wastes consisted of propellant, illumination scrap mix, igniter scrap, laboratory waste pyrotechnic materials, and other explosives and explosive contaminated materials.³⁷ Oil was added to explosive material to cushion and dampen the material to prevent explosions prior to burning.³⁸ Scrap was collected at workstations or scrap areas to be taken to the burning grounds.^{39,40,41} The scraps were dumped off trucks into the burn pits and then topped with small quantities of ignitable powders.^{42,43} According to Robert Myers, a former Olin truck driver and laborer, large quantities of magnesium powder from Area 9 were burned in Area 10.⁴⁴ They were then ignited remotely by electrical charges from the remote control house.⁴⁵ The pits were supposed to be cleaned at least once a week by the responsible departments,⁴⁶ but this was not always done, and sometimes excessive amounts of metal rings, fiber packs, and ash would build up in the pit and in the surrounding areas.^{47,48} Also, there was always water standing in the pits, which precluded complete burning of the explosive materials.⁴⁹

At the Olin TSO in Area 9, three general categories of explosive waste materials were generated: general pyrotechnics, high explosives and special wastes (from engineering and development).⁵⁰ The TSO scrap areas were next to Area 9 Buildings I-1-20 and I-1-23.⁵¹ Pyrotechnic scrap was collected at workstations or scrap areas and placed in covered, polyethylene-lined, magnesium cans that were filled with oil for cushioning.^{52,53,54} Non-pyrotechnic scrap was kept in a dry state for transportation to the burning grounds.⁵⁵ High explosive scrap was kept separate from pyrotechnic scrap until it was transported to the burning grounds.⁵⁶ The MK52/PBA was also

³⁶ PRI 005202. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 1.

³⁷ PRI 005218. Olin, Standard Operating Procedure for Explosive Waste Burning Grounds, SOP No. 90,157.

³⁸ Deposition of George Wisely, June 28, 1999, Page 78.

³⁹ PRI 005223. Olin, Inter Office Memorandum entitled "Disposal of Explosive Waste," date is illegible, Page 1.

⁴⁰ PRI 005228. Olin, Inter Office Memorandum entitled "Explosive Waste Procedures," dated November 18, 1969, Page 1.

⁴¹ PRI 005230. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 1.

⁴² PRI 005219 – PRI-005220. Olin, Standard Operating Procedure for Explosive Waste Burning Grounds, SOP No. 90,157.

⁴³ PRI 005223. Olin, Inter Office Memorandum entitled "Disposal of Explosive Waste," date is illegible, Page 1.

⁴⁴ Deposition of Robert Myers, April 10, 1998, Pages 88-89.

⁴⁵ PRI 005220. Olin, Standard Operating Procedure for Explosive Waste Burning Grounds, SOP No. 90,157.

⁴⁶ PRI 005221. Olin, Standard Operating Procedure for Explosive Waste Burning Grounds, SOP No. 90,157.

⁴⁷ PRI 005224. Olin, Inter Office Memorandum entitled "Scrap Explosive Burning Ground," date is illegible, Page 1.

⁴⁸ PRI 005225. Olin, Inter Office Memorandum entitled "Scrap Explosive Burning Grounds," date is illegible, Page 1.

⁴⁹ PRI 005232. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 3.

⁵⁰ PRI 005230. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 1.

⁵¹ PRI 005230. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 1.

⁵² PRI 005223. Olin, Inter Office Memorandum entitled "Disposal of Explosive Waste," date is illegible, Page 1.

⁵³ PRI 005228. Olin, Inter Office Memorandum entitled "Explosive Waste Procedures," dated November 18, 1969, Page 1.

⁵⁴ PRI 005230. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 1.

⁵⁵ PRI 005230. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 1.

⁵⁶ PRI 005231. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 2.

kept in covered magnesium cans, east of the production area in Building I-1-20.⁵⁷ These materials were supposed to be burned in a small pit separate from the pyrotechnics, however they were sometimes burned with the pyrotechnics or by themselves, between (not inside) the pits.⁵⁸ Special engineering and development (E&D) materials were taken to the burning grounds only at the request of the E&D department.⁵⁹ This department generated very little waste and it was handled separately from pyrotechnic and high explosive waste.⁶⁰

Olin has estimated that 120,000 pounds (lbs) of waste were burned at Area 10, and that about 1,000 lbs of residue remained consisting mainly of metal oxides.⁶¹ Olin reported that the soils in the vicinity of this burning ground possibly contained lead contamination,⁶² also that fuel oil, acetone, and lupersol,⁶³ would have been present in these pits.⁶⁴

The pits are no longer visible on site. The former burn areas lack vegetation, and some debris, such as gravel, spent smoke grenades, tear gas canisters, and canister cans, are present in these barren areas.

According to Mr. John Miller, there was a building in Area 10 where Olin cast propellant systems with nitroglycerin at one time.⁶⁵ Mr. Miller believed this building was either burned or torn down by the USFWS.⁶⁶ The 1960 aerial photograph of Area 10 three buildings still present in Area 10: Building FBM-3-1, FBM-3-2 and FBM-3-3.⁶⁷ It is likely that one of these was the building Mr. Miller was referring to. All three of these buildings were gone by 1965.⁶⁸

14.1.3 Area 10 Previous Sampling Results

Parsons Engineering, 1997

In 1997, Parsons completed a visual walk-through of Area 10 as a part of the Explosives and Munitions Manufacturing Area Operable Unit (EMMA OU) investigation, using Schonstedts

⁵⁷ PRI 005231. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 2.

⁵⁸ PRI 005231. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 2.

⁵⁹ PRI 005231. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 2.

⁶⁰ PRI 005231. Olin, Inter Office Memorandum entitled "Procedures for Explosive Waste Burning at TSO," dated November 18, 1969, Page 2.

⁶¹ DOI 004465. Olin document submitted as part of their Section 104(e) response regarding open burning at the Refuge.

⁶² DOI 004465. Olin document submitted as part of their Section 104(e) response regarding open burning at the Refuge.

⁶³ Lupersol is a synonym for methyl ethyl ketone peroxide (CAS No. 1338-23-4) and it is used in reinforced plastics according to the Environmental Defense Scorecard for this chemical (located at www.scorecard.org). Lupersol may have also contained several admixtures such as: toluene, mineral spirits, di-octyl phthalate, di-methyl phthalate, di-butyl phthalate, methyl ethyl ketone, butyl benzyl phthalate, etc., as seen in MSDS for various forms of the chemical (located at www.hazard.com).

⁶⁴ PRI 005210. Olin Corporation, Final Investigation Report, Burning Ground Incident of 5 February 1970, dated February 26, 1970, Page 9.

⁶⁵ Deposition of Mr. John Miller on April 9, 1998, Page 161.

⁶⁶ Deposition of Mr. John Miller on April 9, 1998, Page 161.

⁶⁷ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 57 and Figure 2.

⁶⁸ Entech, Inc., 2000, Historical Aerial Photographic Analysis – Selected Area Facilities: Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (CONWR), Marion Illinois, Page 59.

(magnetometers) to aid in the visual investigation for ordnance.⁶⁹ One smoke grenade (M-18) was discovered slightly north of the firing range and detonated as part of the EMMA OU activities.⁷⁰

USEPA Sampling, 1998

The USEPA collected samples at AUS OU Sites AUS-0041 and -0042 in 1998. Sample locations are shown in Figures 14-2 and 14-3. The results for all detected constituents are listed in Table 14-1A.

In 1998, the United States Environmental Protection Agency (USEPA) collected a sample from AUS-0041 (Firing Range) and analyzed it for metals. Arsenic (43 milligrams per kilogram (mg/kg)) exceeded USEPA Soil Screening Levels (SSLs) and Refuge background.⁷¹ Copper (470 mg/kg), lead (65,000 mg/kg), and zinc (140 mg/kg) exceeded New Dutchlist Soil Optimum Levels (DSOLs) and Refuge background.

The USEPA also collected two samples (AUS 42-01 and AUS 42-02) from AUS-0042 (Burning Grounds) for semi-volatile organic compounds (SVOCs) and metals analyses. The following SVOC compounds were detected at the site above either USEPA SSLs and/or CSOQGs: benzo[b]fluoranthene (0.8 mg/kg) and benzo[k]fluoranthene (0.8 mg/kg). Total PAHs also exceeded DSOLs. Barium (3,900 mg/kg), cadmium (2 mg/kg) and silver (32 mg/kg) exceeded USEPA SSLs and Refuge background levels. Copper (280 mg/kg) and zinc (230 mg/kg) exceeded DSOLs and Refuge background levels.

14.1.4 Observations During Site Visit

This site is fenced and woodlands bound it on all sides. It is generally flat and contains some sparsely vegetated areas and abandoned drums and explosives-related debris.

During the site reconnaissance in the spring of 1999, some evidence of burned materials was noted at two locations: one just to the southeast of the former burn pits, and another near the southwest corner of the firing range. According to Mr. John Mahan of the USFWS,⁷² the burn area near the firing range is used for burning scrap paper targets and cardboard from the firing range. This burning area measures approximately 20 ft by 12 ft. The surface of this burn area is covered with gravel, burnt wood, and other burnt debris.

Most drainage ditches in this area paralleled the roadways. Several ponded areas were also identified in Area 10 during the site reconnaissance. Two small ponded areas were noted on the northern portion of Area 10 that appear to have resulted from the changes in drainage during IOP construction (Figure 14-1). A sheen was observed on one of the ponded areas.

⁶⁹ Parsons Engineering Science, Inc., 1997, Engineering Evaluation and Cost Analysis – Final Report. Former Illinois Ordnance Plant – Marion, Illinois, October. Pages 2-50.

⁷⁰ Parsons Engineering Science, Inc., 1997, Engineering Evaluation and Cost Analysis – Final Report. Former Illinois Ordnance Plant – Marion, Illinois, October. Pages 2-50.

⁷¹ See Table 1-11 of this report for Refuge background soil values used for the PA.

⁷² John Mahan, personal interview, September 2, 1999.

14.1.5 Recommendations Based on Preliminary Assessment

Area 10 was retained for the Site Investigation (SI) because it was a former industrial area that has not been previously characterized, and because USEPA 1998 sampling results indicated exceedances of screening levels. The firing range, which is still in use, was excluded from the PA/SI.

14.2 SITE INVESTIGATION INFORMATION

URS conducted an SI at AUS-0A10 on April 13 and April 14, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)⁷³ for the AUS OU PA/SI. Since additional information became available after the FSP was prepared, the historic discussion (Section 14.1) 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 14-2 and 14-3. Survey coordinates for all sample locations in Area 10 are listed in Table 14-1. Table 14-2 lists the sample locations and the matrix sampled at that location. All samples are soil or surface water and are noted as such.

14.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. There were several areas of concern investigated during the SI. They are as follows:

Former Burning Grounds

Test pits (soil sample locations 0A10-001 and 0A10-002) were excavated through two of the former burn pits at this site, to evaluate contamination remaining from burning activities. As discussed above, Olin reported that approximately 1,000 lbs of metal oxides might remain in these former burn pits.

All samples were collected in accordance to the tables in the Field Sampling Plan with the following exceptions:

- AUS-0A10-001-GW-00 This sample was not collected because no groundwater was encountered during excavation.
- AUS-0A10-002-GW-00 This sample was not collected because no groundwater was encountered during excavation.

Ponded Areas

Two small ponded areas, which appeared to be man-made, were observed in Area 10 during the site reconnaissance. These appear to be remnants of larger ponds observed in historical aerial

⁷³ 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.

photographs. These ponded areas appear to have been drained sometime between 1980 and 1993, as discussed in Section 14.1.2.1 above. Samples were collected from both of the small ponds currently present on site (sample locations 0A10-003 (soil) and 0A10-004 (soil and surface water). There was a sheen observed during the site reconnaissance on one of these ponded areas, at sample location 0A10-003. Conditions were drier in the spring of 2000 when the SI was done, compared to the previous spring when the site reconnaissance was done. There was no longer water in the ponded area at location 0A10-003 at the time of the Site Inspection.

All samples were collected in accordance with the tables in the Field Sampling Plan with the following exception:

- AUS-0A10-003-SW-00 This sample was not collected because no surface water was present at time of sampling.

14.2.2 Field Results

14.2.2.1 Site Conditions

14.2.2.1.1 *Geologic Conditions*

No monitoring wells were installed in Area 10. The available geologic information for Area 10 was obtained through test pits. Test pit logs are included in Appendix A. Two test pits were excavated in Area 10 and are shown in Figure 14-2. Both test pits indicate that fill material (topsoil, etc.) is present from ground surface to 2 ft below ground surface (bgs). In both test pits the fill contained black ash and burnt material with metal. Below the fill to approximately 12.5 ft bgs, which was the bottom of pit depth for the deepest pit 0A10-001, is loess (low plastic, silty clay, and silt). The bottom of pit depth for 0A10-002 was 12 ft bgs and this pit also indicated loess to this depth. Both pits had a sweet/pesticide odor at approximately 4 ft bgs and this odor continued until 6 ft in pit 0A10-001.

14.2.2.1.2 *Hydrogeologic Conditions*

Hydrogeologic information for Area 10 is unavailable because water was not detected in the test pits installed at the site. The deepest test pit was excavated to 12.5 ft bgs (0A10-001).

14.2.2.1.3 *Hydrologic Conditions*

The site slopes gently to the northeast. There are two ponded areas at the northern end of the site, which, based on aerial photos and site observations, are sometimes dry. These ponds appear to be water backed up against roadway embankments in the area. Perhaps culverts installed as part of the IOP became clogged shortly after the IOP closed.

14.2.2.2 Chemical Results

The sample analytical results are summarized in the following tables:

- Table 14-3--soil sample results, and
- Table 14-4--surface water samples results.

These tables list all the chemicals detected in Area 10 during this investigation, along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report (QCSR).

Sample results are presented on the following figures:

- Figure 14-2--organic results for soil and surface water samples, and
- Figure 14-3--inorganic results for soil and surface water samples.

Tetrachlorodibenzo-p-Dioxin (TCDD) equivalent results for Area 10 are not shown in the screening tables. They are instead included in Table 14-9, and are discussed in the following human health and ecological risk sections.

14.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 14-5 through 14-8 as follows:

- Table 14-5--human health risk screening for soils,
- Table 14-6--human health risk screening for surface water,
- Table 14-7--ecological risk screening for soils, and
- Table 14-8--ecological risk screening for surface water.

Each table lists the maximum detected concentration for each constituent analyzed at Area 10. 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 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 14-2 through 14-3 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. 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 14-10 (human health risk) and 14-11 (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 14-10) and COPECs (Table 14-11) are shaded in the tables.

14.3.1 Human Health Risk

14.3.1.1 Soil

Human health screening results for soil samples are presented in Table 14-5. For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil Preliminary Remediation Goals (PRGs) as screening values. The cancer risk was derived by calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values. These ratios were then multiplied by 1×10^{-6} . In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (Dilution Attenuation Factor (DAF)=1), the Illinois Tiered Approach to Corrective Action Objectives (TACO) Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

Dioxin/furan congener concentrations were converted to 2,3,7,8-TCDD equivalents, for comparison against a 2,3,7,8-TCDD screening value. A toxic equivalency (TEQ) was calculated for each dioxin/furan congener by multiplying a congener-specific toxic equivalency factor (TEF) value by the congener's observed concentration. The TEQs for all congeners in a sample were summed. The summed TEQ values were then compared to the 2,3,7,8-TCDD screening value of 1 part per billion (ppb). Refer to Table 14-9.

There were two soil samples analyzed for dioxin/furan congeners with detections noted in both samples. However, none of the TEQ values calculated for the congeners exceeded the 2,3,7,8-TCDD screening level. Therefore, none of the dioxin/furan congeners detected within Area 10 are assumed to pose potential risk to human health.

14.3.1.2 Surface Water

Human health risk screening results for chemicals in surface water from Area 10 are presented in Table 14-6. The maximum concentrations from Area 10 were screened against the Illinois EPA General Use Surface Water Quality Criteria – Human Health.

14.3.2 Ecological Risk

14.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 14-7. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)⁷⁴
- Environment Canada (1995)⁷⁵
- Talmage *et al.* (1999)⁷⁶
- Efroymsen *et al.* (1997a, 1997b)⁷⁷
- CCME (1999)⁷⁸
- MHSPE (1994)⁷⁹
- 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)⁸⁰ used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

Direct exposure screening concentrations in soils were available for 2,3,7,8-TCDD, but not for other dioxin/furan congeners. Therefore, the potential for direct exposure effects were only screened in conjunction with 2,3,7,8-TCDD (Table 14-7). Based on the screening results in Table 14-7, 2,3,7,8-TCDD is not a concern relative to direct exposures (it was not detected). Other congeners, if detected, were retained as potentially bioaccumulative COPECs. Results of the dioxin/furan analyses are presented in Table 14-9. Congeners detected are summarized below:

⁷⁴ USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.

⁷⁵ 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.

⁷⁶ 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.

⁷⁷ 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.

⁷⁸ Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

⁷⁹ 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.

⁸⁰ USEPA 1991. *Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft)*. US Environmental Protection Agency Office of Research and Development, Washington, D.C.

Summary of Dioxins/Furans Detected in Soils (AUS-0A10)

1,2,3,7,8,9-HxCDD	1,2,3,7,8-PeCDF
1,2,3,4,6,7,8-HpCDD	
OCDD	

Each of these congeners is retained as a COPEC (note the individual congeners are not included in the COPEC summary of Table 14-11).

14.3.2.2 Surface Water

Ecological screening results for surface water samples are presented in Table 14-8. TRVs for direct exposure by aquatic organisms in surface water were obtained from:

- Illinois water quality standards
- National Recommended Ambient Water Quality Criteria (USEPA 1999a)⁸¹
- EcoTox (USEPA 1996)⁸²
- USEPA Region IV Freshwater Screening Values (1999b)⁸³
- Maximum Acceptable Toxicant Concentrations (MATCs) or lowest observed effect concentrations (LOECs) obtained from the USEPA Assessment Tools for the Evaluation of Risk database (ASTER 2000)⁸⁴
- Other sources

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

The screening approach for ingestion pathway exposures was the same as for soils as was presented in Section 14.3.2.1.

14.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A10, 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 14-10; and on the COPEC

⁸¹ USEPA. 1999a. National Recommended Water Quality Criteria--Correction. Office of Water. EPA 822-Z-99-001. April.

⁸² USEPA. 1996. ECO Update: Ecotox Thresholds. EPA-540/F-95/038. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. 12pp.

⁸³ USEPA. 1999b. Region IV Ecological Risk Assessment Bulletins – Supplement to RAGS. Available at <http://www.epa.gov/region4/waste/oftecser/ecolbul.htm>.

⁸⁴ ASTER. 2000. Assessment Tools for Evaluation of Risk Database. United States Environmental Protection Agency, Office of Research and Development.

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Area 10 (AUS-0A10)

list, Table 14-11. COPCs in this category include antimony and selenium in soil. COPECs coded with "D" on Table 14-11 include vanadium in surface water and manganese and selenium in soil. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method; if new information on site usage suggests they should be evaluated; or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 14-12.

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. Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. These issues will be addressed in the work plan for the RI.

SECTION FOURTEEN

Area 10 (AUS-0A10)

TABLE 14-1
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A10

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A10-001	370180.9	776750.1	425.23	NA	
0A10-002	370094.1	776872.3	426.43	NA	
0A10-003	370809.4	777284.2	409.71	NA	
0A10-004	370836.5	777260.6	410.95	NA	

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**TABLE 14-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY**

Sample ID	Constituent	Result (mg/kg)
41-01	Aluminum	18,000
	Arsenic	43
	Barium	110
	Beryllium	0.6
	Calcium	1,200
	Chromium	20
	Cobalt	6.1
	Copper	470
	Iron	24,000
	Lead	65,000
	Magnesium	3,200
	Manganese	370
	Mercury	0.05
	Nickel	16
	Potassium	1,600
	Silver	1.9
	Vanadium	37
Zinc	140	
42-01	Aluminum	15,000
	Barium	760
	Beryllium	0.5
	Cadmium	2
	Calcium	9,700
	Chromium	38
	Cobalt	8.6
	Copper	280
	Iron	18,000
	Lead	55
	Magnesium	15,000
	Manganese	530
	Nickel	14
	Potassium	1,300
	Silver	8.6
	Sodium	420
	Vanadium	30
Zinc	230	
42-02	Acenaphthene	0.5J
	Benzo[b]fluoranthene	0.8J
	Benzo[k]fluoranthene	0.8J
	Bis(2-Ethylhexyl)phthalate	0.25J
	Pyrene	0.6J
	Aluminum	14,000
	Barium	3,900
	Beryllium	0.6
	Calcium	16,000
	Chromium	52

TABLE 14-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
42-02	Cobalt	16
	Copper	120
	Iron	31,000
	Lead	34
	Magnesium	41,000
	Manganese	1,100
	Mercury	0.06
	Nickel	15
	Potassium	1,300
	Silver	32
	Sodium	1,300
	Vanadium	34
	Zinc	170

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mg/kg = milligrams per kilogram
J = Estimated

**TABLE 14-2
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A10**

Soil	Surface Water
AUS-0A10-001	AUS-0A10-004
AUS-0A10-002	
AUS-0A10-003*	
AUS-0A10-004*	

Sheet 1 of 1

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

**TABLE 14-3
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY**

Constituent	Number of Detections	Range of Detections
Volatile Organic Compounds		
Chloroform	1/4	2 ug/kg
Toluene	2/4	4 ug/kg to 6 ug/kg
Trichloroethylene (TCE)	2/4	32 ug/kg to 230 ug/kg
Xylenes, Total	1/4	2 ug/kg
Semivolatile Organic Compounds		
2-Methylnaphthalene	3/6	58 ug/kg to 590 ug/kg
Anthracene	1/6	85 ug/kg
Bis(2-Ethylhexyl) Phthalate	2/6	62 ug/kg to 680 ug/kg
Carbazole	1/6	62 ug/kg
Dibenzofuran	1/6	50 ug/kg
Fluoranthene	1/6	75 ug/kg
Flourene	2/6	47 ug/kg to 99 ug/kg
Naphthalene	2/6	110 ug/kg
Phenanthrene	3/6	74 ug/kg to 1,200 ug/kg
Pyrene	1/6	160 ug/kg
Dioxins		
2,3,7,8-TCDD	1/2	0.000128 ug/kg
Metals		
Aluminum	6/6	4,130 mg/kg to 9,500 mg/kg
Antimony	1/6	0.36 mg/kg
Arsenic	6/6	3.4 mg/kg to 8.4 mg/kg
Barium	6/6	21.3 mg/kg to 14,100 mg/kg
Boron	4/6	2.5 mg/kg to 513 mg/kg
Cadmium	4/6	0.08 mg/kg to 1.9 mg/kg
Calcium	6/6	848 mg/kg to 10,200 mg/kg
Chromium, Total	6/6	12.4 mg/kg to 31.4 mg/kg
Cobalt	6/6	4.1 mg/kg to 13.2 mg/kg
Copper	6/6	8.3 mg/kg to 517 mg/kg
Iron	6/6	8,550 mg/kg to 19,800 mg/kg
Lead	6/6	6.4 mg/kg to 67 mg/kg
Magnesium	6/6	1,730 mg/kg to 51,900 mg/kg
Manganese	6/6	258 mg/kg to 1,110 mg/kg
Mercury	2/6	0.07 mg/kg to 0.21 mg/kg
Nickel	6/6	11.4 mg/kg to 81 mg/kg
Potassium	6/6	376 mg/kg to 722 mg/kg
Selenium	3/6	0.51 mg/kg to 1.7 mg/kg
Silver	2/6	8.8 mg/kg to 39.5 mg/kg
Sodium	3/6	766 mg/kg to 1,070 mg/kg
Thallium	1/6	0.25 mg/kg

Sheet 1 of 2

**TABLE 14-3
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY**

Constituent	Number of Detections	Range of Detections
Vanadium	6/6	16.2 mg/kg to 28.3 mg/kg
Zinc	6/6	31.2 mg/kg to 362 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: SEA 7/19/01

TABLE 14-4
SURFACE WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituent	Number of Detections	Range of Detections
Metals		
Aluminum	1/1	13,300 ug/L
Barium	1/1	178 ug/L
Boron	1/1	24.1 ug/L
Calcium	1/1	8,110 ug/L
Chromium, Total	1/1	14.8 ug/L
Iron	1/1	13,100 ug/L
Lead	1/1	10.8 ug/L
Magnesium	1/1	5,580 ug/L
Manganese	1/1	397 ug/L
Potassium	1/1	3,020 ug/L
Vanadium	1/1	21.7 ug/L
Zinc	1/1	328 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

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

Checked by: SEA 7/19/01

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Volatile Organic Compounds								
71-55-6	1,1,1-Trichloroethane	7	U	UG/KG			2.10E-06	7.00E-02
79-34-5	1,1,2,2-Tetrachloroethane	7	U	UG/KG		7.79E-09	1.79E-06	3.50E+01
79-00-5	1,1,2-Trichloroethane	7	U	UG/KG		3.68E-09	4.60E-05	7.78E+00
75-34-3	1,1-Dichloroethane	7	U	UG/KG			3.40E-06	7.00E-03
75-35-4	1,1-Dichloroethene	7	U	UG/KG		5.90E-08	1.04E-04	2.33E+00
107-06-2	1,2-Dichloroethane (EDC)	7	U	UG/KG		9.15E-09	1.99E-04	7.00E+00
540-59-0	1,2-Dichloroethene (total)	7	U	UG/KG			4.75E-05	3.50E-01
78-87-5	1,2-Dichloropropane	7	U	UG/KG		9.12E-09	3.29E-04	7.00E+00
78-93-3	2-Butanone (MEK)	14	U	UG/KG			5.05E-07	
591-78-6	2-Hexanone	14	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	14	U	UG/KG			4.85E-06	
67-64-1	Acetone	14	U	UG/KG			2.25E-06	1.75E-02
71-43-2	Benzene	7	U	UG/KG		4.78E-09	2.89E-04	3.50E+00
75-27-4	Bromodichloromethane	7	U	UG/KG		2.97E-09	6.71E-06	2.33E-01
75-25-2	Bromoform	7	U	UG/KG		2.24E-11	3.97E-07	1.75E-01
74-83-9	Bromomethane	7	U	UG/KG			5.33E-04	7.00E-01
75-15-0	Carbon disulfide	7	U	UG/KG			5.79E-06	3.50E-03
56-23-5	Carbon tetrachloride	7	U	UG/KG		1.32E-08	1.00E-03	2.33E+00
108-90-7	Chlorobenzene	7	U	UG/KG			1.29E-05	1.00E-01
75-00-3	Chloroethane	7	U	UG/KG		1.08E-09	3.71E-07	
67-66-3	Chloroform	2	J	UG/KG		3.84E-09	1.55E-03	6.67E-02
74-87-3	Chloromethane	7	U	UG/KG		2.63E-09		
156-59-2	cis-1,2-Dichloroethene	7	U	UG/KG			4.75E-05	3.50E-01

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
10061-01-5	cis-1,3-Dichloropropene	7	U	UG/KG		3.94E-08	1.59E-04	
124-48-1	Dibromochloromethane	7	U	UG/KG		2.64E-09	4.40E-06	3.50E-01
100-41-4	Ethylbenzene	7	U	UG/KG			1.17E-06	1.00E-02
75-09-2	Methylene chloride	7	U	UG/KG		3.41E-10	7.16E-07	7.00E+00
110-54-3	N-Hexane	7	U	UG/KG			1.73E-05	
100-42-5	Styrene	7	U	UG/KG			3.42E-07	3.50E-02
127-18-4	Tetrachloroethylene (PCE)	7	U	UG/KG		3.75E-10	4.11E-06	2.33E+00
108-88-3	Toluene	6	J	UG/KG			3.02E-06	1.00E-02
1330-20-7	total Xylenes	2	J	UG/KG			4.49E-07	2.00E-04
156-60-5	trans-1,2-Dichloroethene	7	U	UG/KG			3.27E-05	2.33E-01
10061-02-6	trans-1,3-Dichloropropene	7	U	UG/KG		3.94E-08	1.59E-04	
79-01-6	Trichloroethylene (TCE)	230		UG/KG		3.76E-08	2.91E-03	7.67E+01
75-01-4	Vinyl chloride	7	U	UG/KG		1.44E-07		1.00E+01
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	550	U	UG/KG			7.22E-05	1.83E+00
95-50-1	1,2-Dichlorobenzene	550	U	UG/KG			1.66E-04	6.11E-01
541-73-1	1,3-Dichlorobenzene	550	U	UG/KG			1.06E-02	
106-46-7	1,4-Dichlorobenzene	550	U	UG/KG		6.77E-08	2.86E-04	5.50E+00
95-95-4	2,4,5-Trichlorophenol	2700	U	UG/KG			3.06E-05	2.70E-01
88-06-2	2,4,6-Trichlorophenol	550	U	UG/KG		2.45E-09		6.88E+01
120-83-2	2,4-Dichlorophenol	550	U	UG/KG			2.08E-04	1.10E+01
105-67-9	2,4-Dimethylphenol	550	U	UG/KG			3.12E-05	1.38E+00
51-28-5	2,4-Dinitrophenol	2700	U	UG/KG			1.53E-03	2.70E+02
91-58-7	2-Chloronaphthalene	550	U	UG/KG			2.02E-05	

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
95-57-8	2-Chlorophenol	550	U	UG/KG			2.28E-03	2.75E+00
91-57-6	2-Methylnaphthalene	1400		UG/KG			2.58E-05	7.00E-03
95-48-7	2-Methylphenol	550	U	UG/KG			1.25E-05	6.88E-01
88-74-4	2-Nitroaniline	2700	U	UG/KG			5.36E-02	
88-75-5	2-Nitrophenol	550	U	UG/KG			7.80E-05	
91-94-1	3,3'-Dichlorobenzidine	550	U	UG/KG		1.00E-07		1.83E+03
99-09-2	3-Nitroaniline	2700	U	UG/KG			5.36E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2700	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	550	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	550	U	UG/KG			1.25E-05	
106-47-8	4-Chloroaniline	1100	U	UG/KG			3.12E-04	3.67E+01
7005-72-3	4-Chlorophenyl phenyl ether	550	U	UG/KG				
106-44-5	4-Methylphenol	550	U	UG/KG			1.25E-04	
100-01-6	4-Nitroaniline	2700	U	UG/KG			5.36E-02	
100-02-7	4-Nitrophenol	2700	U	UG/KG			3.83E-04	
83-32-9	Acenaphthene	97	J	UG/KG			2.53E-06	3.23E-03
208-96-8	Acenaphthylene	550	U	UG/KG			1.01E-05	2.75E-03
120-12-7	Anthracene	190	J	UG/KG			4.88E-07	3.17E-04
56-55-3	Benzo(a)anthracene	550	U	UG/KG		1.91E-07		6.88E+00
50-32-8	Benzo(a)pyrene	550	U	UG/KG		1.91E-06		1.38E+00
205-99-2	Benzo(b)fluoranthene	550	U	UG/KG		1.91E-07		2.75E+00
191-24-2	Benzo(g,h,i)perylene	550	U	UG/KG			1.01E-05	2.75E-03
207-08-9	Benzo(k)fluoranthene	550	U	UG/KG		1.91E-08		2.75E-01
111-91-1	bis(2-Chloroethoxy)methane	550	U	UG/KG				

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
111-44-4	bis(2-Chloroethyl) ether	550	U	UG/KG		8.87E-07		2.75E+04
108-60-1	bis(2-Chloroisopropyl) ether	550	U	UG/KG		6.81E-08	1.29E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	680		UG/KG		3.86E-09	3.86E-05	
85-68-7	Butyl benzyl phthalate	550	U	UG/KG			3.12E-06	6.88E-04
86-74-8	Carbazole	62	J	UG/KG		5.03E-10		2.07E+00
218-01-9	Chrysene	550	U	UG/KG		1.91E-09		6.88E-02
84-74-2	Di-n-butyl phthalate	550	U	UG/KG			6.24E-06	1.83E-03
117-84-0	Di-n-octyl phthalate	550	U	UG/KG			3.12E-05	5.50E-05
53-70-3	Dibenz(a,h)anthracene	550	U	UG/KG		1.91E-06		6.88E+00
132-64-9	Dibenzofuran	100	J	UG/KG			1.98E-05	
84-66-2	Diethyl phthalate	550	U	UG/KG			7.80E-07	
131-11-3	Dimethyl phthalate	550	U	UG/KG			6.24E-08	
206-44-0	Fluoranthene	75	J	UG/KG			2.49E-06	3.75E-04
86-73-7	Fluorene	310	J	UG/KG			9.36E-06	1.03E-02
118-74-1	Hexachlorobenzene	550	U	UG/KG		3.57E-07	7.80E-04	5.50E+00
87-68-3	Hexachlorobutadiene	550	U	UG/KG		1.74E-08	3.12E-03	5.50E+00
77-47-4	Hexachlorocyclopentadiene	550	U	UG/KG			9.33E-05	2.75E-02
67-72-1	Hexachloroethane	550	U	UG/KG		3.12E-09	6.24E-04	2.75E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	550	U	UG/KG		1.91E-07		7.86E-01
78-59-1	Isophorone	550	U	UG/KG		2.12E-10	3.12E-06	1.83E+01
621-64-7	N-Nitroso-di-n-propylamine	550	U	UG/KG		1.56E-06		2.75E+05
86-30-6	N-Nitrosodiphenylamine	550	U	UG/KG		1.09E-09		9.17E+00
91-20-3	Naphthalene	250	J	UG/KG			1.33E-03	6.25E-02
87-86-5	Pentachlorophenol	2700	U	UG/KG		2.43E-07	1.89E-04	2.70E+03

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TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
85-01-8	Phenanthrene	2700	J	UG/KG			4.98E-05	1.35E-02
108-95-2	Phenol	550	U	UG/KG			1.04E-06	1.10E-01
129-00-0	Pyrene	370	J	UG/KG			6.82E-06	1.85E-03
Explosives								
99-35-4	1,3,5-Trinitrobenzene	410	UJ	UG/KG			1.55E-05	
99-65-0	1,3-Dinitrobenzene	410	UJ	UG/KG			4.65E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	820	UJ	UG/KG		9.97E-09	1.86E-03	
121-14-2	2,4-Dinitrotoluene	410	UJ	UG/KG			2.33E-04	1.03E+04
606-20-2	2,6-Dinitrotoluene	550	U	UG/KG			6.24E-04	1.83E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	820	UJ	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	820	UJ	UG/KG				
99-08-1	3-Nitrotoluene	820	UJ	UG/KG			4.04E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	820	UJ	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	820	UJ	UG/KG			4.04E-04	
2691-41-0	HMX	820	UJ	UG/KG			1.86E-05	
98-95-3	Nitrobenzene	410	UJ	UG/KG			3.58E-03	
121-82-4	RDX	820	UJ	UG/KG		3.66E-08	3.10E-04	
479-45-8	Tetryl	1200	UJ	UG/KG			1.36E-04	
Metals								
7429-90-5	Aluminum	10500		MG/KG	3.65E-01		6.26E-03	
7440-36-0	Antimony	0.36	J	MG/KG	4.34E-01		4.40E-04	1.20E+00
7440-38-2	Arsenic	8.4		MG/KG	6.22E-01	3.08E-06	1.91E-02	8.40E+00
7440-39-3	Barium	14100	J	MG/KG	7.23E+01		1.13E-01	1.76E+02
7440-41-7	Beryllium	0.82	U	MG/KG	1.08E+00	3.66E-10	2.22E-04	2.73E-01

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-42-8	Boron	513	J	MG/KG	9.68E+01		6.48E-03	
7440-43-9	Cadmium	1.9		MG/KG	1.00E+01	6.36E-10	2.35E-03	4.75E+00
7440-70-2	Calcium	10200		MG/KG	4.08E+00			
7440-47-3	Chromium	31.4	J	MG/KG	1.25E+00	7.00E-08		1.57E+01
7440-48-4	Cobalt	13.2		MG/KG	6.08E-01		1.08E-04	
7440-50-8	Copper	517		MG/KG	4.58E+01		6.81E-03	
7439-89-6	Iron	19800		MG/KG	1.03E+00		3.23E-02	
7439-92-1	Lead	67		MG/KG	2.86E+00			
7439-95-4	Magnesium	51900	J	MG/KG	3.34E+01			
7439-96-5	Manganese	1110		MG/KG	3.05E-01		3.44E-02	
7439-97-6	Mercury	0.21		MG/KG	3.50E+00			
7440-02-0	Nickel	81	J	MG/KG	4.29E+00		1.98E-03	1.16E+01
2023695	Potassium	722		MG/KG	1.16E+00			
7782-49-2	Selenium	1.7		MG/KG	7.26E-01		1.66E-04	5.67E+00
7440-22-4	Silver	39.5		MG/KG	6.81E+01		3.87E-03	1.98E+01
7440-23-5	Sodium	1070		MG/KG	6.29E+00			
7440-28-0	Thallium	0.25	J	MG/KG	6.10E-01		1.75E-06	
7440-62-2	Vanadium	28.3		MG/KG	6.00E-01		1.98E-03	9.43E-02
7440-66-6	Zinc	362		MG/KG	7.04E+00		5.91E-04	6.03E-01
Dioxins								
1746-01-6	2,3,7,8-TCDD	0.000166	U	UG/KG				

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**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

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CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	7	U	UG/KG			3.50E-03
79-34-5	1,1,2,2-Tetrachloroethane	7	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	7	U	UG/KG	8.54E-07	8.54E-07	3.50E-01
75-34-3	1,1-Dichloroethane	7	U	UG/KG	3.50E-08	3.50E-08	3.04E-04
75-35-4	1,1-Dichloroethene	7	U	UG/KG	3.89E-07	3.89E-06	1.17E-01
107-06-2	1,2-Dichloroethane (EDC)	7	U	UG/KG	1.11E-04	5.00E-06	3.50E-01
540-59-0	1,2-Dichloroethene (total)	7	U	UG/KG	3.50E-07	3.50E-07	1.75E-02
78-87-5	1,2-Dichloropropane	7	U	UG/KG	8.33E-05	3.89E-06	2.33E-01
78-93-3	2-Butanone (MEK)	14	U	UG/KG			
591-78-6	2-Hexanone	14	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	14	U	UG/KG			
67-64-1	Acetone	14	U	UG/KG	7.00E-08	7.00E-08	8.75E-04
71-43-2	Benzene	7	U	UG/KG	3.50E-05	1.63E-06	2.33E-01
75-27-4	Bromodichloromethane	7	U	UG/KG	7.61E-05	3.50E-06	1.17E-02
75-25-2	Bromoform	7	U	UG/KG	9.72E-06	4.38E-07	8.75E-03
74-83-9	Bromomethane	7	U	UG/KG	2.41E-06	7.00E-06	3.50E-02
75-15-0	Carbon disulfide	7	U	UG/KG	3.50E-08	3.50E-07	2.19E-04
56-23-5	Carbon tetrachloride	7	U	UG/KG	1.59E-04	1.71E-05	1.00E-01
108-90-7	Chlorobenzene	7	U	UG/KG	1.71E-07	1.71E-06	7.00E-03
75-00-3	Chloroethane	7	U	UG/KG			
67-66-3	Chloroform	2	J	UG/KG	2.13E-06	1.00E-06	3.33E-03
74-87-3	Chloromethane	7	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	7	U	UG/KG	3.50E-07	3.50E-07	1.75E-02

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
10061-01-5	cis-1,3-Dichloropropene	7	U	UG/KG			
124-48-1	Dibromochloromethane	7	U	UG/KG	1.71E-07	1.71E-07	1.75E-02
100-41-4	Ethylbenzene	7	U	UG/KG	3.50E-08	3.50E-07	5.38E-04
75-09-2	Methylene chloride	7	U	UG/KG	9.21E-06	5.83E-07	3.50E-01
110-54-3	N-Hexane	7	U	UG/KG			
100-42-5	Styrene	7	U	UG/KG	1.71E-08	1.71E-07	1.75E-03
127-18-4	Tetrachloroethylene (PCE)	7	U	UG/KG	6.36E-05	2.92E-06	1.17E-01
108-88-3	Toluene	6	J	UG/KG	1.46E-08	1.46E-08	5.00E-04
1330-20-7	total Xylenes	2	J	UG/KG	2.00E-09	4.88E-09	1.33E-05
156-60-5	trans-1,2-Dichloroethene	7	U	UG/KG	1.71E-07	1.71E-07	1.00E-02
10061-02-6	trans-1,3-Dichloropropene	7	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	230		UG/KG	4.42E-04	1.92E-04	3.83E+00
75-01-4	Vinyl chloride	7	U	UG/KG	2.33E-03	1.08E-04	7.00E-01
Semivolatle Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	550	U	UG/KG	2.75E-05	2.75E-04	1.10E-01
95-50-1	1,2-Dichlorobenzene	550	U	UG/KG	3.06E-06	3.06E-05	3.24E-02
541-73-1	1,3-Dichlorobenzene	550	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	550	U	UG/KG			2.75E-01
95-95-4	2,4,5-Trichlorophenol	2700	U	UG/KG	1.35E-05	1.35E-05	1.00E-02
88-06-2	2,4,6-Trichlorophenol	550	U	UG/KG	1.06E-03	5.00E-05	2.75E+00
120-83-2	2,4-Dichlorophenol	550	U	UG/KG	9.02E-05	9.02E-04	5.50E-01
105-67-9	2,4-Dimethylphenol	550	U	UG/KG	1.34E-05	1.34E-05	6.11E-02
51-28-5	2,4-Dinitrophenol	2700	U	UG/KG	6.59E-04	6.59E-03	1.35E+01
91-58-7	2-Chloronaphthalene	550	U	UG/KG			

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	550	U	UG/KG	5.50E-05	5.50E-05	1.38E-01
91-57-6	2-Methylnaphthalene	1400		UG/KG	2.30E-05	2.30E-05	3.33E-04
95-48-7	2-Methylphenol	550	U	UG/KG	5.50E-06	5.50E-06	3.67E-02
88-74-4	2-Nitroaniline	2700	U	UG/KG			
88-75-5	2-Nitrophenol	550	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	550	U	UG/KG	4.23E-02	1.96E-03	7.86E+01
99-09-2	3-Nitroaniline	2700	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2700	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	550	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	550	U	UG/KG			
106-47-8	4-Chloroaniline	1100	U	UG/KG	1.34E-04	1.34E-03	1.57E+00
7005-72-3	4-Chlorophenyl phenyl ether	550	U	UG/KG			
106-44-5	4-Methylphenol	550	U	UG/KG			
100-01-6	4-Nitroaniline	2700	U	UG/KG			
100-02-7	4-Nitrophenol	2700	U	UG/KG			
83-32-9	Acenaphthene	97	J	UG/KG	8.08E-07	8.08E-07	1.70E-04
208-96-8	Acenaphthylene	550	U	UG/KG	9.02E-06	9.02E-06	1.31E-04
120-12-7	Anthracene	190	J	UG/KG	3.11E-07	3.11E-07	1.58E-05
56-55-3	Benzo(a)anthracene	550	U	UG/KG	6.88E-02	3.24E-03	2.75E-01
50-32-8	Benzo(a)pyrene	550	U	UG/KG	6.88E-01	3.24E-02	6.88E-02
205-99-2	Benzo(b)fluoranthene	550	U	UG/KG	6.88E-02	3.24E-03	1.10E-01
191-24-2	Benzo(g,h,i)perylene	550	U	UG/KG	9.02E-06	9.02E-06	1.31E-04
207-08-9	Benzo(k)fluoranthene	550	U	UG/KG	7.05E-03	3.24E-04	1.12E-02
111-91-1	bis(2-Chloroethoxy)methane	550	U	UG/KG			

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-44-4	bis(2-Chloroethyl) ether	550	U	UG/KG	1.10E-01	7.33E-03	1.38E+03
108-60-1	bis(2-Chloroisopropyl) ether	550	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	680		UG/KG	1.66E-03	1.66E-04	1.89E-04
85-68-7	Butyl benzyl phthalate	550	U	UG/KG	1.34E-06	1.34E-06	5.91E-04
86-74-8	Carbazole	62	J	UG/KG	2.14E-04	1.00E-05	1.03E-01
218-01-9	Chrysene	550	U	UG/KG	7.05E-04	3.24E-05	3.44E-03
84-74-2	Di-n-butyl phthalate	550	U	UG/KG	2.75E-06	2.75E-06	2.39E-04
117-84-0	Di-n-octyl phthalate	550	U	UG/KG	1.34E-05	1.34E-04	5.50E-05
53-70-3	Dibenz(a,h)anthracene	550	U	UG/KG	6.88E-01	3.24E-02	2.75E-01
132-64-9	Dibenzofuran	100	J	UG/KG			
84-66-2	Diethyl phthalate	550	U	UG/KG	5.50E-07	5.50E-07	1.17E-03
131-11-3	Dimethyl phthalate	550	U	UG/KG			
206-44-0	Fluoranthene	75	J	UG/KG	9.15E-07	9.15E-07	1.74E-05
86-73-7	Fluorene	310	J	UG/KG	3.78E-06	3.78E-06	5.54E-04
118-74-1	Hexachlorobenzene	550	U	UG/KG	1.38E-01	7.05E-03	2.75E-01
87-68-3	Hexachlorobutadiene	550	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	550	U	UG/KG	3.93E-05	3.93E-05	1.38E-03
67-72-1	Hexachloroethane	550	U	UG/KG	2.75E-04	2.75E-04	1.10E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	550	U	UG/KG	6.88E-02	3.24E-03	3.93E-02
78-59-1	Isophorone	550	U	UG/KG	1.34E-06	1.34E-06	6.88E-02
621-64-7	N-Nitroso-di-n-propylamine	550	U	UG/KG	6.88E-01	3.06E-02	1.10E+04
86-30-6	N-Nitrosodiphenylamine	550	U	UG/KG	4.58E-04	2.20E-05	5.50E-01
91-20-3	Naphthalene	250	J	UG/KG	3.05E-06	3.05E-05	2.98E-03
87-86-5	Pentachlorophenol	2700	U	UG/KG	1.13E-01	5.19E-03	9.00E+01

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
85-01-8	Phenanthrene	2700	J	UG/KG	4.43E-05	4.43E-05	6.43E-04
108-95-2	Phenol	550	U	UG/KG	5.50E-07	4.58E-06	5.50E-03
129-00-0	Pyrene	370	J	UG/KG	6.07E-06	6.07E-06	8.81E-05
Explosives							
99-35-4	1,3,5-Trinitrobenzene	410	UJ	UG/KG			
99-65-0	1,3-Dinitrobenzene	410	UJ	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	820	UJ	UG/KG			
121-14-2	2,4-Dinitrotoluene	410	UJ	UG/KG	4.88E-02	2.28E-03	5.13E+02
606-20-2	2,6-Dinitrotoluene	550	U	UG/KG	6.55E-02	3.06E-03	7.86E+02
35572-78-2	2-Amino-4,6-Dinitrotoluene	820	UJ	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	820	UJ	UG/KG			
99-08-1	3-Nitrotoluene	820	UJ	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	820	UJ	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	820	UJ	UG/KG			
2691-41-0	HMX	820	UJ	UG/KG			
98-95-3	Nitrobenzene	410	UJ	UG/KG	4.10E-04	4.10E-04	4.10E+00
121-82-4	RDX	820	UJ	UG/KG			
479-45-8	Tetryl	1200	UJ	UG/KG			
Metals							
7429-90-5	Aluminum	10500		MG/KG			
7440-36-0	Antimony	0.36	J	MG/KG	4.39E-04	4.39E-03	7.20E-02
7440-38-2	Arsenic	8.4		MG/KG	2.80E+00	1.38E-01	3.00E-01
7440-39-3	Barium	14100	J	MG/KG	1.01E-01	1.01E+00	1.18E+01
7440-41-7	Beryllium	0.82	U	MG/KG	8.20E-01	2.83E-02	1.24E-01

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

**TABLE 14-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-42-8	Boron	513	J	MG/KG	2.85E-03	2.85E-02	
7440-43-9	Cadmium	1.9		MG/KG	9.50E-04	9.50E-03	5.14E-01
7440-70-2	Calcium	10200		MG/KG			
7440-47-3	Chromium	31.4	J	MG/KG	3.14E-03	7.66E-03	1.12E+00
7440-48-4	Cobalt	13.2		MG/KG	1.10E-04	1.10E-03	
7440-50-8	Copper	517		MG/KG	6.30E-03	6.30E-02	4.70E-02
7439-89-6	Iron	19800		MG/KG			
7439-92-1	Lead	67		MG/KG	1.68E-01	1.68E-01	
7439-95-4	Magnesium	51900	J	MG/KG			
7439-96-5	Manganese	1110		MG/KG	1.16E-02	1.16E-01	
7439-97-6	Mercury	0.21		MG/KG	3.44E-04	3.44E-03	1.40E+00
7440-02-0	Nickel	81	J	MG/KG	1.98E-03	1.98E-02	1.07E+00
2023695	Potassium	722		MG/KG			
7782-49-2	Selenium	1.7		MG/KG	1.70E-04	1.70E-03	7.08E-01
7440-22-4	Silver	39.5		MG/KG	3.95E-03	3.95E-02	2.63E-01
7440-23-5	Sodium	1070		MG/KG			
7440-28-0	Thallium	0.25	J	MG/KG	1.56E-03	1.56E-03	1.04E-01
7440-62-2	Vanadium	28.3		MG/KG	2.02E-03	2.02E-02	2.89E-02
7440-66-6	Zinc	362		MG/KG	5.93E-04	5.93E-03	1.01E-01
Dioxins							
1746-01-6	2,3,7,8-TCDD	0.000166	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
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TABLE 14-6
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 10 (AUS-0A10)

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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

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

**TABLE 14-6
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
218-01-9	Chrysene	10	U	UG/L		1.00E+00
84-74-2	Di-n-butyl phthalate	10	U	UG/L		
117-84-0	Di-n-octyl phthalate	10	U	UG/L		
53-70-3	Dibenz(a,h)anthracene	10	U	UG/L		
132-64-9	Dibenzofuran	10	U	UG/L		
84-66-2	Diethyl phthalate	10	U	UG/L		
131-11-3	Dimethyl phthalate	10	U	UG/L		
206-44-0	Fluoranthene	10	U	UG/L		8.33E-02
86-73-7	Fluorene	10	U	UG/L		2.22E-03
118-74-1	Hexachlorobenzene	10	U	UG/L		
87-68-3	Hexachlorobutadiene	10	U	UG/L		
77-47-4	Hexachlorocyclopentadiene	10	U	UG/L		
67-72-1	Hexachloroethane	10	U	UG/L		
193-39-5	Indeno(1,2,3-c,d)pyrene	10	U	UG/L		1.00E+02
78-59-1	Isophorone	10	U	UG/L		
621-64-7	N-Nitroso-di-n-propylamine	10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine	10	U	UG/L		
91-20-3	Naphthalene	10	U	UG/L		
87-86-5	Pentachlorophenol	50	U	UG/L		
85-01-8	Phenanthrene	10	U	UG/L		2.86E-03
108-95-2	Phenol	10	U	UG/L	1.00E+00	1.00E-01
129-00-0	Pyrene	10	U	UG/L		2.86E-03
Explosives						
99-35-4	1,3,5-Trinitrobenzene	0.25	UJ	UG/L		
99-65-0	1,3-Dinitrobenzene	0.25	UJ	UG/L		
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	UJ	UG/L		
121-14-2	2,4-Dinitrotoluene	0.25	UJ	UG/L		
606-20-2	2,6-Dinitrotoluene	0.5	UJ	UG/L		
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	UJ	UG/L		
88-72-2	2-Nitrotoluene (ONT)	0.5	UJ	UG/L		
99-08-1	3-Nitrotoluene	0.5	UJ	UG/L		
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	UJ	UG/L		
99-99-0	4-Nitrotoluene (PNT)	0.5	UJ	UG/L		
2691-41-0	HMX	0.5	UJ	UG/L		
98-95-3	Nitrobenzene	0.25	UJ	UG/L		
121-82-4	RDX	0.5	UJ	UG/L		
479-45-8	Tetryl	0.75	UJ	UG/L		
Metals						
7429-90-5	Aluminum	13300		UG/L	6.65E+01	
7440-36-0	Antimony	1.6	U	UG/L	2.67E-01	

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

TABLE 14-6
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 10 (AUS-0A10)

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
7440-38-2	Arsenic	10	U	UG/L	1.00E+00	
7440-39-3	Barium	178	J	UG/L	7.84E+00	3.56E-02
7440-41-7	Beryllium	5	U	UG/L	1.00E+00	
7440-42-8	Boron	26	J	UG/L		2.60E-02
7440-43-9	Cadmium	5	U	UG/L	1.00E+00	
7440-70-2	Calcium	8220		UG/L	1.14E+00	
7440-47-3	Chromium	14.8		UG/L	1.48E+00	
7440-48-4	Cobalt	50	U	UG/L	1.00E+00	
7440-50-8	Copper	7.7	U	UG/L	7.70E-01	
7439-89-6	Iron	13100		UG/L	1.31E+02	1.31E+01
7439-92-1	Lead	10.8		UG/L	5.40E+00	
7439-95-4	Magnesium	5580		UG/L	2.20E+00	
7439-96-5	Manganese	397		UG/L	6.82E-01	3.97E-01
7439-97-6	Mercury	0.2	U	UG/L	1.00E+00	1.67E+01
7440-02-0	Nickel	10	U	UG/L	1.00E+00	1.00E-02
2023695	Potassium	3020		UG/L	1.87E+00	
7782-49-2	Selenium	5	U	UG/L	1.85E+00	5.00E-03
7440-22-4	Silver	10	U	UG/L	1.00E+00	2.00E+00
7440-23-5	Sodium	2400	U	UG/L	7.57E-01	
7440-28-0	Thallium	10	U	UG/L	1.00E+00	
7440-62-2	Vanadium	21.7	J	UG/L	4.34E-01	
7440-66-6	Zinc	328		UG/L	1.64E+01	3.28E-01

**TABLE 14-7
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane		7	U	UG/KG	2.35E-04	
79-34-5	1,1,2,2-Tetrachloroethane		7	U	UG/KG	5.50E-02	
79-00-5	1,1,2-Trichloroethane		7	U	UG/KG	2.45E-04	
75-34-3	1,1-Dichloroethane		7	U	UG/KG	3.48E-04	
75-35-4	1,1-Dichloroethene		7	U	UG/KG	8.45E-04	
107-06-2	1,2-Dichloroethane (EDC)		7	U	UG/KG	3.30E-04	
540-59-0	1,2-Dichloroethene (total)		7	U	UG/KG	8.89E-03	
78-87-5	1,2-Dichloropropane		7	U	UG/KG	1.00E-05	
78-93-3	2-Butanone (MEK)		14	U	UG/KG	1.56E-04	
591-78-6	2-Hexanone		14	U	UG/KG	1.11E-03	
108-10-1	4-Methyl-2-pentanone (MIBK)		14	U	UG/KG	3.16E-05	
67-64-1	Acetone		14	U	UG/KG	5.60E-03	
71-43-2	Benzene		7	U	UG/KG	4.38E-04	
75-27-4	Bromodichloromethane		7	U	UG/KG	1.30E-02	
75-25-2	Bromoform		7	U	UG/KG	4.40E-04	
74-83-9	Bromomethane		7	U	UG/KG	2.98E-02	
75-15-0	Carbon disulfide		7	U	UG/KG	7.44E-02	
56-23-5	Carbon tetrachloride		7	U	UG/KG	7.00E-06	
108-90-7	Chlorobenzene		7	U	UG/KG	1.75E-04	
75-00-3	Chloroethane		7	U	UG/KG		
67-66-3	Chloroform		2	J	UG/KG	1.68E-03	
74-87-3	Chloromethane		7	U	UG/KG	6.73E-04	
156-59-2	cis-1,2-Dichloroethene		7	U	UG/KG	8.89E-03	
10061-01-5	cis-1,3-Dichloropropene		7	U	UG/KG	1.76E-02	
124-48-1	Dibromochloromethane		7	U	UG/KG	3.41E-03	
100-41-4	Ethylbenzene		7	U	UG/KG	1.40E-03	
75-09-2	Methylene chloride		7	U	UG/KG	1.73E-03	
110-54-3	N-Hexane		7	U	UG/KG		
100-42-5	Styrene		7	U	UG/KG	2.33E-05	
127-18-4	Tetrachloroethylene (PCE)		7	U	UG/KG	5.38E-04	
108-88-3	Toluene		6	J	UG/KG	2.00E-03	
1330-20-7	total Xylenes		2	J	UG/KG	3.33E-03	
156-60-5	trans-1,2-Dichloroethene		7	U	UG/KG	8.89E-03	
10061-02-6	trans-1,3-Dichloropropene		7	U	UG/KG	1.76E-02	
79-01-6	Trichloroethylene (TCE)		230		UG/KG	2.56E-02	
75-01-4	Vinyl chloride		7	U	UG/KG	1.08E-02	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		550	U	UG/KG	2.75E-02	
95-50-1	1,2-Dichlorobenzene		550	U	UG/KG	1.86E-01	
541-73-1	1,3-Dichlorobenzene		550	U	UG/KG	1.46E-02	
106-46-7	1,4-Dichlorobenzene		550	U	UG/KG	2.75E-02	

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

TABLE 14-7
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
95-95-4	2,4,5-Trichlorophenol		2700	U	UG/KG	6.75E-01	
88-06-2	2,4,6-Trichlorophenol		550	U	UG/KG	5.50E-02	
120-83-2	2,4-Dichlorophenol		550	U	UG/KG	6.29E-03	
105-67-9	2,4-Dimethylphenol		550	U	UG/KG	5.50E+01	
51-28-5	2,4-Dinitrophenol		2700	U	UG/KG	1.35E-01	
91-58-7	2-Chloronaphthalene		550	U	UG/KG	4.52E+01	
95-57-8	2-Chlorophenol		550	U	UG/KG	2.27E+00	
91-57-6	2-Methylnaphthalene		1400		UG/KG	4.32E-01	YES
95-48-7	2-Methylphenol		550	U	UG/KG	1.36E-02	
88-74-4	2-Nitroaniline		2700	U	UG/KG	3.64E-02	
88-75-5	2-Nitrophenol		550	U	UG/KG	3.44E-01	
91-94-1	3,3'-Dichlorobenzidine		550	U	UG/KG	8.51E-01	
99-09-2	3-Nitroaniline		2700	U	UG/KG	8.54E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2700	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		550	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		550	U	UG/KG	6.92E-02	
106-47-8	4-Chloroaniline		1100	U	UG/KG	1.00E+00	
7005-72-3	4-Chlorophenyl phenyl ether		550	U	UG/KG		
106-44-5	4-Methylphenol		550	U	UG/KG	3.37E-03	
100-01-6	4-Nitroaniline		2700	U	UG/KG	1.23E-01	
100-02-7	4-Nitrophenol		2700	U	UG/KG	3.86E-01	
83-32-9	Acenaphthene		97	J	UG/KG	1.42E-04	YES
208-96-8	Acenaphthylene		550	U	UG/KG	8.06E-04	
120-12-7	Anthracene		190	J	UG/KG	1.28E-04	YES
56-55-3	Benzo(a)anthracene		550	U	UG/KG	1.06E-01	
50-32-8	Benzo(a)pyrene		550	U	UG/KG	1.25E-04	
205-99-2	Benzo(b)fluoranthene		550	U	UG/KG	9.20E-03	
191-24-2	Benzo(g,h,i)perylene		550	U	UG/KG	4.62E-03	
207-08-9	Benzo(k)fluoranthene		550	U	UG/KG	9.20E-03	
111-91-1	bis(2-Chloroethoxy)methane		550	U	UG/KG	1.82E+00	
111-44-4	bis(2-Chloroethyl) ether		550	U	UG/KG	2.32E-02	
108-60-1	bis(2-Chloroisopropyl) ether		550	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		680		UG/KG	7.34E-01	YES
85-68-7	Butyl benzyl phthalate		550	U	UG/KG	2.30E+00	
86-74-8	Carbazole		62	J	UG/KG		YES
218-01-9	Chrysene		550	U	UG/KG	1.16E-01	
84-74-2	Di-n-butyl phthalate		550	U	UG/KG	2.75E-03	
117-84-0	Di-n-octyl phthalate		550	U	UG/KG	7.76E-04	
53-70-3	Dibenz(a,h)anthracene		550	U	UG/KG	2.99E-02	
132-64-9	Dibenzofuran		100	J	UG/KG		YES
84-66-2	Diethyl phthalate		550	U	UG/KG	5.50E-03	
131-11-3	Dimethyl phthalate		550	U	UG/KG	2.75E-03	

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

TABLE 14-7
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
206-44-0	Fluoranthene		75	J	UG/KG	6.15E-04	YES
86-73-7	Fluorene		310	J	UG/KG	1.03E-02	YES
118-74-1	Hexachlorobenzene		550	U	UG/KG	5.50E-04	
87-68-3	Hexachlorobutadiene		550	U	UG/KG	1.38E+01	
77-47-4	Hexachlorocyclopentadiene		550	U	UG/KG	5.50E-02	
67-72-1	Hexachloroethane		550	U	UG/KG	9.22E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		550	U	UG/KG	5.05E-03	
78-59-1	Isophorone		550	U	UG/KG	3.96E-03	
621-64-7	N-Nitroso-di-n-propylamine		550	U	UG/KG	1.01E+00	
86-30-6	N-Nitrosodiphenylamine		550	U	UG/KG	2.75E-02	
91-20-3	Naphthalene		250	J	UG/KG	1.00E-03	
87-86-5	Pentachlorophenol		2700	U	UG/KG	4.50E-01	
85-01-8	Phenanthrene		2700	J	UG/KG	5.91E-02	YES
108-95-2	Phenol		550	U	UG/KG	1.38E-02	
129-00-0	Pyrene		370	J	UG/KG	4.71E-03	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		410	UJ	UG/KG	1.09E+00	
99-65-0	1,3-Dinitrobenzene		410	UJ	UG/KG	6.26E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		820	UJ	UG/KG	2.73E-02	
121-14-2	2,4-Dinitrotoluene		410	UJ	UG/KG	3.20E-01	
606-20-2	2,6-Dinitrotoluene		550	U	UG/KG	1.68E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		820	UJ	UG/KG	1.03E-02	
88-72-2	2-Nitrotoluene (ONT)		820	UJ	UG/KG		
99-08-1	3-Nitrotoluene		820	UJ	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		820	UJ	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		820	UJ	UG/KG		
2691-41-0	HMX		820	UJ	UG/KG	3.28E-02	
98-95-3	Nitrobenzene		410	UJ	UG/KG	1.03E-02	
121-82-4	RDX		820	UJ	UG/KG	8.20E-03	
479-45-8	Tetryl		1200	UJ	UG/KG		
Metals							
7429-90-5	Aluminum	28800	10500		MG/KG		
7440-36-0	Antimony	0.83	0.36	J	MG/KG	7.20E-02	
7440-38-2	Arsenic	13.5	8.4		MG/KG	9.33E-01	
7440-39-3	Barium	195	14100	J	MG/KG	2.82E+01	
7440-41-7	Beryllium	0.76	0.82	U	MG/KG	8.20E-02	
7440-42-8	Boron	5.3	513	J	MG/KG	1.03E+03	
7440-43-9	Cadmium	0.19	1.9		MG/KG	6.55E-02	
7440-70-2	Calcium	2497	10200		MG/KG		
7440-47-3	Chromium	25.2	31.4	J	MG/KG	6.28E+00	
7440-48-4	Cobalt	21.7	13.2		MG/KG	6.60E-01	
7440-50-8	Copper	11.3	517		MG/KG	1.67E+01	

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

**TABLE 14-7
 ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
 CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7439-89-6	Iron	19306	19800		MG/KG	9.90E+01	
7439-92-1	Lead	23.4	67		MG/KG	1.55E-01	
7439-95-4	Magnesium	1552	51900	J	MG/KG		
7439-96-5	Manganese	3640	1110		MG/KG	1.11E+01	
7439-97-6	Mercury	0.06	0.21		MG/KG	3.00E-02	YES
7440-02-0	Nickel	18.9	81	J	MG/KG	2.70E+00	
2023695	Potassium	625	722		MG/KG		
7782-49-2	Selenium	2.34	1.7		MG/KG	1.70E+00	YES
7440-22-4	Silver	0.58	39.5		MG/KG	1.98E+01	
7440-23-5	Sodium	170	1070		MG/KG		
7440-28-0	Thallium	0.41	0.25	J	MG/KG	2.50E-01	
7440-62-2	Vanadium	47.2	28.3		MG/KG	6.15E-01	
7440-66-6	Zinc	51.4	362		MG/KG	3.02E+00	
Dioxins							
1746-01-6	2,3,7,8-TCDD		0.000166	U	UG/KG	3.32E-08	

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

**TABLE 14-8
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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

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

**TABLE 14-8
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
117-84-0	Di-n-octyl phthalate		10	U	UG/L	1.41E-02	
53-70-3	Dibenz(a,h)anthracene		10	U	UG/L	6.25E+03	
132-64-9	Dibenzofuran		10	U	UG/L	2.70E+00	
84-66-2	Diethyl phthalate		10	U	UG/L	4.76E-02	
131-11-3	Dimethyl phthalate		10	U	UG/L	3.03E-02	
206-44-0	Fluoranthene		10	U	UG/L	1.23E+00	
86-73-7	Fluorene		10	U	UG/L	2.56E+00	
118-74-1	Hexachlorobenzene		10	U	UG/L	2.72E+00	
87-68-3	Hexachlorobutadiene		10	U	UG/L	1.08E+01	
77-47-4	Hexachlorocyclopentadiene		10	U	UG/L	1.43E+02	
67-72-1	Hexachloroethane		10	U	UG/L	1.02E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		10	U	UG/L	2.32E+00	
78-59-1	Isophorone		10	U	UG/L	8.55E-03	
621-64-7	N-Nitroso-di-n-propylamine		10	U	UG/L		
86-30-6	N-Nitrosodiphenylamine		10	U	UG/L	1.71E-01	
91-20-3	Naphthalene		10	U	UG/L	8.33E-01	
87-86-5	Pentachlorophenol		50	U	UG/L	3.33E+00	
85-01-8	Phenanthrene		10	U	UG/L	1.59E+00	
108-95-2	Phenol	10	10	U	UG/L	1.00E-01	
129-00-0	Pyrene		10	U	UG/L	1.64E-01	
Explosives							
99-35-4	1,3,5-Trinitrobenzene		0.25	UJ	UG/L	8.33E-03	
99-65-0	1,3-Dinitrobenzene		0.25	UJ	UG/L	1.25E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)		0.5	UJ	UG/L	1.25E-02	
121-14-2	2,4-Dinitrotoluene		0.25	UJ	UG/L	1.09E-03	
606-20-2	2,6-Dinitrotoluene		0.5	UJ	UG/L	1.19E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene		0.5	UJ	UG/L	2.50E-02	
88-72-2	2-Nitrotoluene (ONT)		0.5	UJ	UG/L	6.85E-05	
99-08-1	3-Nitrotoluene		0.5	UJ	UG/L	6.02E-05	
19406-51-0	4-Amino-2,6-Dinitrotoluene		0.5	UJ	UG/L	9.26E-04	
99-99-0	4-Nitrotoluene (PNT)		0.5	UJ	UG/L	7.14E-05	
2691-41-0	HMX		0.5	UJ	UG/L	1.52E-03	
98-95-3	Nitrobenzene		0.25	UJ	UG/L	9.26E-04	
121-82-4	RDX		0.5	UJ	UG/L	2.63E-03	
479-45-8	Tetryl		0.75	UJ	UG/L		
Metals							
7429-90-5	Aluminum	200	13300		UG/L	1.53E+02	
7440-36-0	Antimony	6	1.6	U	UG/L	5.33E-02	
7440-38-2	Arsenic	10	10	U	UG/L	5.26E-02	
7440-39-3	Barium	22.7	178	J	UG/L	3.56E-02	
7440-41-7	Beryllium	5	5	U	UG/L	9.43E+00	
7440-42-8	Boron		26	J	UG/L	2.60E-02	

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

**TABLE 14-8
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 10 (AUS-0A10)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (Surface Water)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ)	Retained as Potential Bioaccumulator
7440-43-9	Cadmium	5	5	U	UG/L	4.55E+00	
7440-70-2	Calcium	7197	8220		UG/L	7.09E-02	
7440-47-3	Chromium	10	14.8		UG/L	7.15E-02	
7440-48-4	Cobalt	50	50	U	UG/L	2.17E+01	
7440-50-8	Copper	10	7.7	U	UG/L	6.53E-01	
7439-89-6	Iron	100	13100		UG/L	1.31E+01	
7439-92-1	Lead	2	10.8		UG/L	5.37E-01	
7439-95-4	Magnesium	2534	5580		UG/L	6.80E-02	
7439-96-5	Manganese	582	397		UG/L	3.97E-01	
7439-97-6	Mercury	0.2	0.2	U	UG/L	1.54E-01	
7440-02-0	Nickel	10	10	U	UG/L	1.00E-02	
2023695	Potassium	1613	3020		UG/L	5.70E-02	
7782-49-2	Selenium	2.7	5	U	UG/L	5.00E-03	
7440-22-4	Silver	10	10	U	UG/L	2.00E+00	
7440-23-5	Sodium	3169	2400	U	UG/L	3.53E-03	
7440-28-0	Thallium	10	10	U	UG/L	2.50E+00	
7440-62-2	Vanadium	50	21.7	J	UG/L	1.14E+00	
7440-66-6	Zinc	20	328		UG/L	3.28E-01	

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

TABLE 14-9

DIOXIN/FURAN TOXICITY EQUIVALENTS
FOR SOIL SAMPLES FROM AREA 10 (AUS-0A10)

ADDITIONAL AND UNCHARACTERIZED SITES OU

FIELD ID	TEF	AUS-0A10-001-SS-06			AUS-0A10-002-SS-07		
		Result	Qual	TEQ	Result	Qual	TEQ
DIOXINS / FURANS (ng/kg)							
2,3,7,8-TCDD	1.000	<	U		.128	U	0.128
1,2,3,7,8-PeCDD	1.000	<	U		.0568	U	0.0568
1,2,3,4,7,8-HxCDD	0.100	<	U		.0985	U	0.00985
1,2,3,6,7,8-HxCDD	0.100	<	U		.0959	U	0.00959
1,2,3,7,8,9-HxCDD	0.100	<	U		.131	XJ	0.0131
1,2,3,4,6,7,8-HpCDD	0.010	.429	XJ	0.00429	.494	XJ	0.00494
OCDD	0.0001	17.3		0.00173	35.3		0.00353
2,3,7,8-TCDF	0.100	<	U		<	U	
1,2,3,7,8-PeCDF	0.050	<	U		.0593	J	0.002965
2,3,4,7,8-PeCDF	0.500	<	U		<	U	
1,2,3,4,7,8-HxCDF	0.100	<	U		<	U	
1,2,3,6,7,8-HxCDF	0.100	<	U		<	U	
2,3,4,6,7,8-HxCDF	0.100	<	U		<	U	
1,2,3,7,8,9-HxCDF	0.100	<	U		<	U	
1,2,3,4,6,7,8-HpCDF	0.010	<	U		<	U	
1,2,3,4,7,8,9-HpCDF	0.010	<	U		<	U	
OCDF	0.0001	<	U		<	U	
Total TCDDs		<	U		<	U	
Total PeCDDs		<	U		<	U	
Total HxCDDs		.813	J		.374	J	
Total HpCDDs		.631	J		1.45	J	
Total TCDFs		<	U		<	U	
Total PeCDFs		<	U		<	U	
Total HxCDFs		<	U		<	U	
Total HpCDFs		<	U		<	U	

TOTAL TEQ

0.00602

0.228775

Diluted sample results were used, if available.

E = Value exceeds linear range

EDL = Estimated Detection Limit

J = Estimated

ND = Not Detected

Qual = Qualifier

TEF = Toxic Equivalency Factor

TEQ = Toxicity Equivalent

U = Nondetect

UJ = Estimated Nondetect

X = Estimated Maximum Possible Concentration (EMPC)

**TABLE 14-10, AUS-0A10
SUMMARY OF HUMAN HEALTH COPC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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

**TABLE 14-10, AUS-0A10
SUMMARY OF HUMAN HEALTH COPC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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

**TABLE 14-10, AUS-0A10
SUMMARY OF HUMAN HEALTH COPC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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

TABLE 14-10, AUS-0A10
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	C	NA	NA	NA	NA	No	A
2,4-Dinitrotoluene	No	C	NA	NA	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	No	C	NA	NA	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	C	NA	NA	NA	NA	No	C
2-Nitrotoluene (ONT)	No	C	NA	NA	NA	NA	No	C
3-Nitrotoluene	No	C	NA	NA	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	No	C	NA	NA	NA	NA	No	C
4-Nitrotoluene (PNT)	No	C	NA	NA	NA	NA	No	A
HMX	No	C	NA	NA	NA	NA	No	A
Nitrobenzene	No	C	NA	NA	NA	NA	Uncertainty	B
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	NA	NA
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	No	C	NA	NA	NA	NA	No	A
Tetryl	No	C	NA	NA	NA	NA	No	A
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins								
2,3,7,8-TCDD	NA	NA	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.
- 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 14-11, AUS-0A10
SUMMARY OF ECOLOGICAL COPEC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

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

TABLE 14-11, AUS-0A10
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 14-11, AUS-0A10
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 14-11, AUS-0A10
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	No	A	NA	NA	No	A
2,4-Dinitrotoluene	No	A	NA	NA	No	A
2,6-Dinitrotoluene	No	A	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	No	A	NA	NA	No	A
2-Nitrotoluene (ONT)	No	A	NA	NA	No	C
3-Nitrotoluene	No	A	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	No	A	NA	NA	No	C
4-Nitrotoluene (PNT)	No	A	NA	NA	No	C
HMX	No	A	NA	NA	No	A
Nitrobenzene	No	A	NA	NA	No	A
Nitroglycerin	NA	NA	NA	NA	NA	NA
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	No	A	NA	NA	No	A
Tetryl	No	C	NA	NA	No	C
Dioxins						
2,3,7,8-TCDD	NA	NA	NA	NA	No	A

- A - Chemical was not detected and the reporting limit does not exceed the screening concentration.
- B - Chemical was not detected, but reporting limit was equal to or 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 14-12
AUS-0A10 - IOP FUSE AND BOOSTER STORAGE MAGAZINES
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum ¹	Soil	Sediment	Ground Water	Surface Water
VOCs					
Trichloroethylene (TCE)		H	NA	NA	NA
SVOCs					
2-Methylnaphthalene		E	NA	NA	
Acenaphthene		E	NA	NA	
Anthracene		E	NA	NA	
Benzo(b)fluoranthene		H,E	NA	NA	
Benzo(k)fluoranthene		E	NA	NA	
bis(2-Ethylhexyl)phthalate		E	NA	NA	
Carbazole		H,E	NA	NA	
Dibenzofuran		E	NA	NA	
Fluoranthene		E	NA	NA	
Fluorene		E	NA	NA	
Phenanthrene		E	NA	NA	
Pyrene		E	NA	NA	
Metals					
Aluminum			NA	NA	E
Arsenic		H,E	NA	NA	
Barium		H,E	NA	NA	
Boron		E	NA	NA	
Cadmium		H	NA	NA	
Chromium		H,E	NA	NA	
Copper		E	NA	NA	
Iron		E	NA	NA	H,E
Lead		H,E	NA	NA	
Mercury		H,E	NA	NA	
Nickel		H,E	NA	NA	
Silver		H,E	NA	NA	
Zinc		E	NA	NA	

Key:

¹ Drums were not present at this site.

NA = not analyzed

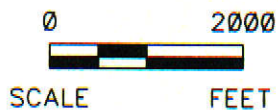
H = human health screening criteria exceeded

E = ecological screening criteria exceeded

File: E:\45r\09602N\FIG_14-1.DWG Last edited: 06/28/01 @ 5:08 p.m. © MDC-ST. LOUIS



SOURCE: USGS DIGITAL RASTER GRAPHIC



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

PROJECT NO.
232000026.00

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DRN. BY: djd 9/7/99
DSGN. BY: mch
CHKD. BY: cmw

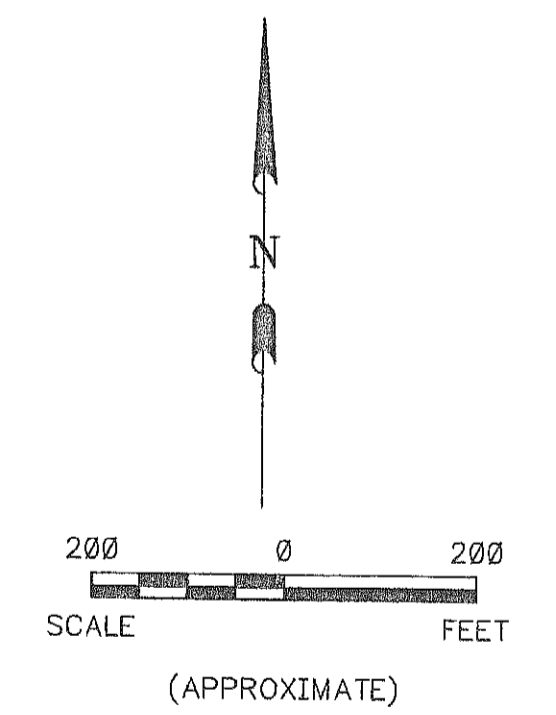
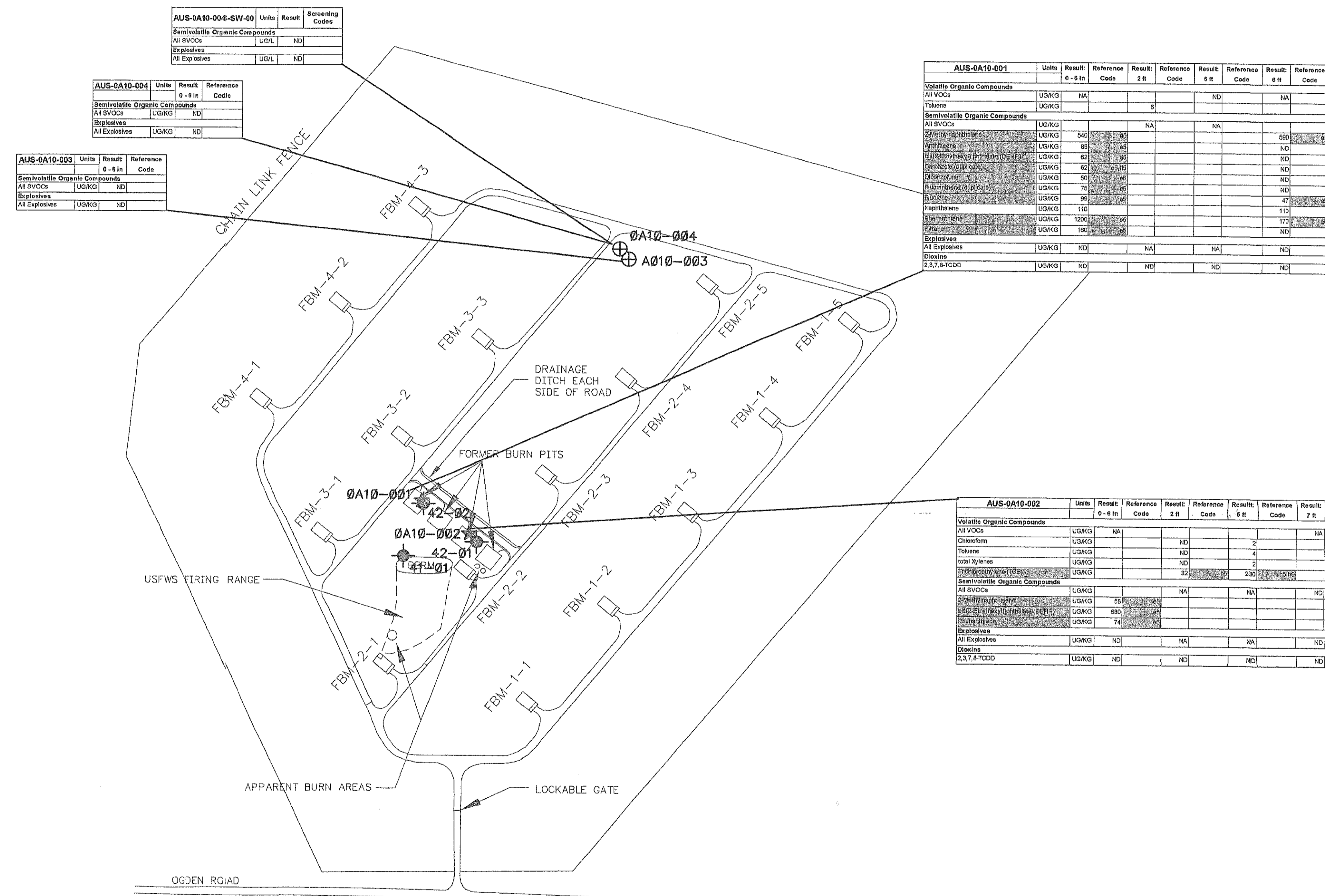
Area 10 Site Location Map

FIG. NO.
14-1

LEGEND

- ★ TEST PIT LOCATIONS
- ⊕ HAND SAMPLE LOCATIONS
- DITCHLINE
- ⊙ USEPA 1998 SAMPLE LOCATIONS

Screening Reference	Reference Code
AUS Background Soil LTT	b1
1-Mile Gravel Background Sediment LTT	b2
1-Mile Gravel Background Surface Water LTT	b3
Biological Direct Exposure Pathway TRV - Soil	e1
Biological Direct Exposure Pathway TRV - Sediment	e2
Biological Direct Exposure Pathway TRV - Surface Water	e3
IRPA Chemical Use Surface Water Quality Assessment Life Toxicity	e4
Superfund Chemical Data Matrix Key Values (potential noncompliance)	e5
USEPA Region IX Industrial Soil PRG - carcinogenic	h1
USEPA Region IX Industrial Soil PRG - noncarcinogenic	h2
USEPA Region IX Tap Water PRG - carcinogenic	h3
USEPA Region IX Tap Water PRG - noncarcinogenic	h4
USEPA Region IX Migration to Groundwater PRG (DA=1)	h5
USEPA MCL Drinking Water Standards	h6
IRPA TACO Industrial/Commercial Soil Ingestion	h7
IRPA TACO Construction Worker Soil Ingestion	h8
IRPA TACO Class I Soil Component of Groundwater	h9
IRPA General Use Surface Water Quality Human Health	h10



- NOTES:
- BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES FROM FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.
 - NONE OF THE BUILDINGS OR BURN PITS ARE CURRENTLY ON SITE.
 - DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.
- SOURCES: U.S. ACE, 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT, PART 1 SECT. 5 PAGE 14 (PLAN NO. 6544-101.28)
OLIN BURNING GROUND LAYOUT SOURCE: PRI-00521
- THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

REVISIONS

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

AUS-0A10 Sample Locations
and Detections of Organic Compounds in
Soils and Surface Water

Date: 12/19/00	Project Number: 232000026.00	Figure Number: 14-2
Drawn by: DJD	Design by: MAM	Checked by: MCH/CMW

URS

AUS-0A10-AREA 10-IOP FUSE AND BOOSTER STORAGE MAGAZINE

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- LEGEND**
- ★ TEST PIT LOCATIONS
 - ⊕ HAND SAMPLE LOCATIONS
 - DITCHLINE
 - ⊙ USEPA 1998 SAMPLE LOCATIONS

Screening Reference	Reference Code
AIS Background Soil UTL	b1
Little Green Background Sediment UTL	b2
Little Green Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	c1
Ecological Direct Exposure Pathway TRV - Sediment	c2
Ecological Direct Exposure Pathway TRV - Surface Water	c3
IEPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulators)	e5
USEPA Region IX Industrial Soil PRG - concenous	b1
USEPA Region IX Industrial Soil PRG - nonconenous	b2
USEPA Region IX Tap Water PRG - concenous	b3
USEPA Region IX Tap Water PRG - nonconenous	b4
USEPA Region IX Migration to 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

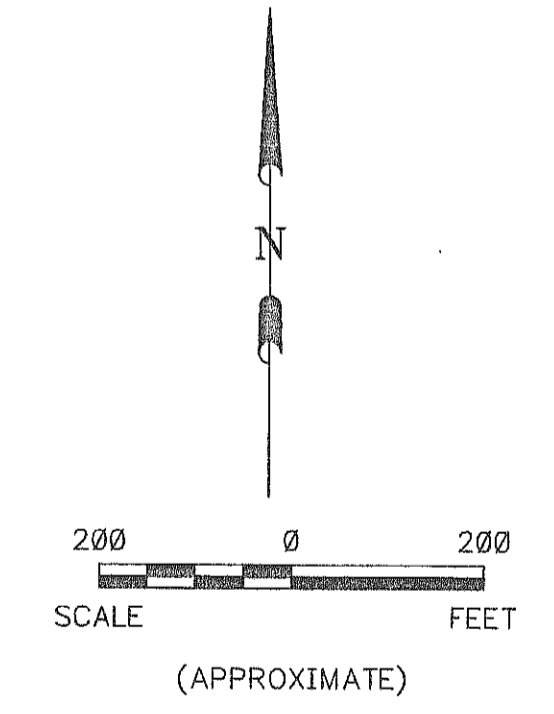
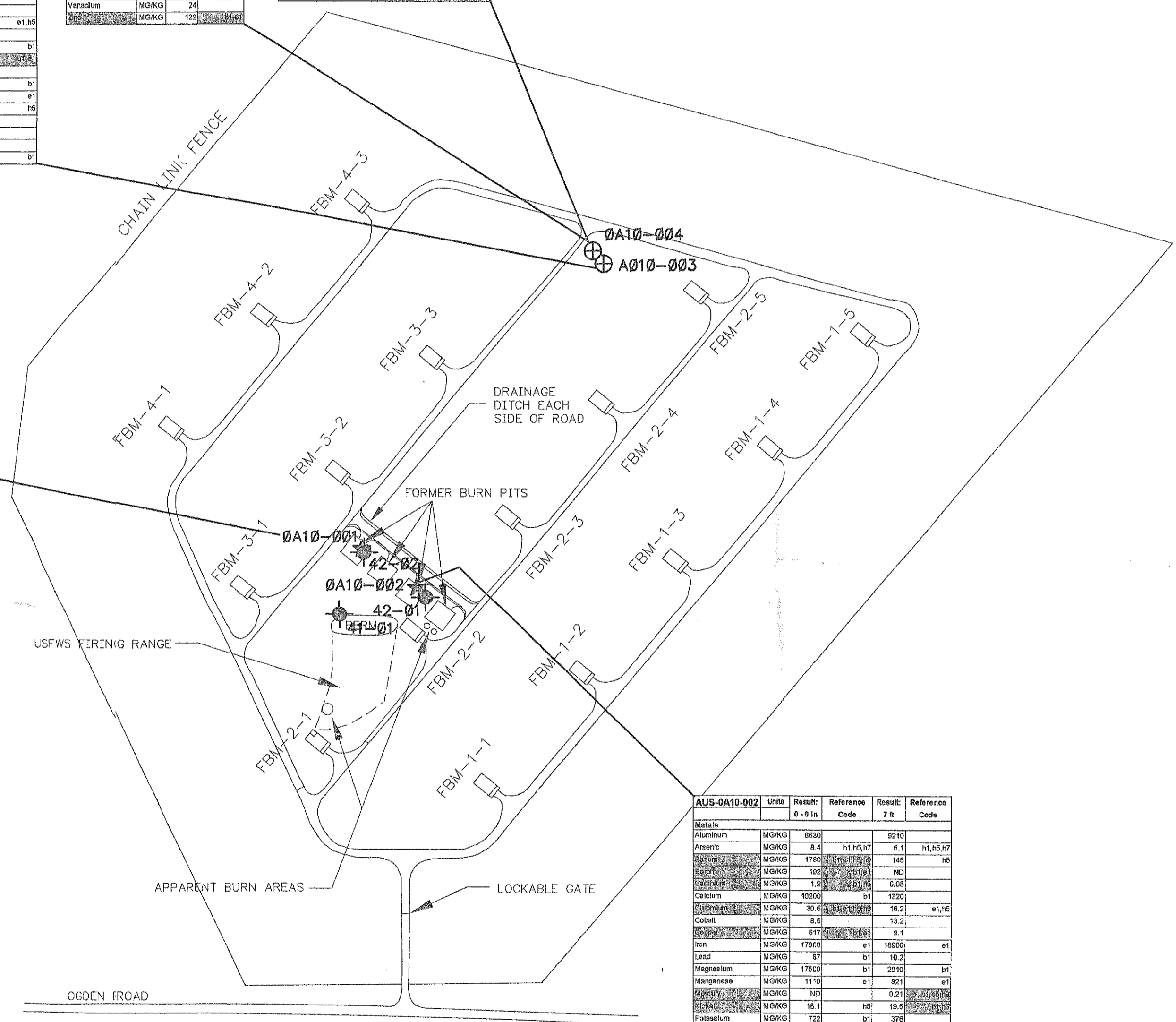
AUS-0A10-003	Units	Result	Reference Code
Metals			
Aluminum	MG/KG	9200	
Arsenic	MG/KG	2.4	b1, b5, b7
Antimony (stibnite)	MG/KG	0.36	b5
Boron	MG/KG	121	b5
Barium	MG/KG	3.5	b1
Calcium	MG/KG	848	
Chromium	MG/KG	18.6	e1, b5
Copper	MG/KG	6.4	
Cobalt	MG/KG	16.1	b1
Iron	MG/KG	11800	b1, b5, b7
Lead	MG/KG	19.1	b1
Magnesium	MG/KG	1720	b1
Manganese	MG/KG	308	e1
Nickel	MG/KG	12.4	b5
Potassium	MG/KG	690	
Thallium	MG/KG	0.25	
Vanadium	MG/KG	24.4	
Zinc	MG/KG	24.8	b1

AUS-0A10-004	Units	Result	Reference Code
Metals			
Aluminum	MG/KG	8090	
Arsenic	MG/KG	6.9	b1, b5, b7
Barium	MG/KG	115	b5
Boron	MG/KG	2.6	e1
Calcium	MG/KG	1290	
Chromium	MG/KG	12.4	b1, b5
Cobalt	MG/KG	7	
Copper	MG/KG	13.1	b1
Iron	MG/KG	16200	b1
Lead	MG/KG	16.9	e1
Magnesium	MG/KG	1790	b1
Manganese	MG/KG	487	e1
Nickel	MG/KG	11.4	b5
Potassium	MG/KG	591	
Vanadium	MG/KG	24	
Zinc	MG/KG	1200	b1, b5

AUS-0A10-004-SVV-00	Units	Result	Screening Codes
Metals			
Aluminum	UG/L	13300	b1, b5, b7
Barium	UG/L	176	b5
Boron	UG/L	24.1	
Chromium	UG/L	610	b1
Chromium	UG/L	54.9	b5
Copper	UG/L	13100	b1, b5, b7
Iron	UG/L	18.9	b5
Magnesium	UG/L	5500	b1
Manganese	UG/L	327	b5
Potassium	UG/L	3000	b5
Vanadium	UG/L	21.7	b5
Zinc	UG/L	328	b5

AUS-0A10-001	Units	Result	Reference Code	Result	Reference Code
Metals					
Aluminum	MG/KG	4130		7970	
Arsenic	MG/KG	4.4	b1, b5, b7	3.4	b1, b5, b7
Antimony (stibnite)	MG/KG	14100	b1, b5, b7, b9, b10	21.9	
Boron	MG/KG	61	b1	169	
Calcium	MG/KG	0.33	b1	0.09	
Chromium	MG/KG	1200		1290	
Copper	MG/KG	31.4	b1, b5, b7, b9, b10	14.4	e1, b5
Cobalt	MG/KG	11		4.1	
Iron	MG/KG	107	b1, b5, b7	6.3	
Lead	MG/KG	690	e1, b1	6.1	e1
Magnesium	MG/KG	16.1	b1	14.90	b1
Manganese	MG/KG	51800	b1	2050	b1
Nickel	MG/KG	700	e1	255	e1
Potassium	MG/KG	0.07	b1, b5	182	
Thallium	MG/KG	81	b1, b5, b7, b9, b10	21	b1, b5, b7, b9, b10
Vanadium	MG/KG	531		379	
Zinc	MG/KG	0.61	b1, b5	0.59	e1, b5
Barium	MG/KG	35.8	b1, b5, b7, b9, b10	141	b1, b5, b7, b9, b10
Boron	MG/KG	1070	b1	789	b1
Vanadium	MG/KG	16.2		22.2	
Zinc	MG/KG	114	b5	31.4	

AUS-0A10-002	Units	Result	Reference Code	Result	Reference Code
Metals					
Aluminum	MG/KG	8500		9210	
Arsenic	MG/KG	2.4	b1, b5, b7	6.1	b1, b5, b7
Barium	MG/KG	1790	b1, b5, b7, b9, b10	140	b5
Boron	MG/KG	180	b1, b5, b7, b9, b10	ND	ND
Calcium	MG/KG	1.8	b1, b5, b7, b9, b10	0.08	
Chromium	MG/KG	10000	b1	1300	
Copper	MG/KG	30.6	b1, b5, b7, b9, b10	18.2	e1, b5
Cobalt	MG/KG	8.5	b1, b5, b7, b9, b10	13.2	
Iron	MG/KG	917	b1	8.1	
Lead	MG/KG	17900	e1, b1, b5, b7, b9, b10	18000	e1
Magnesium	MG/KG	87	b1	16.2	
Manganese	MG/KG	17600	b1	2016	b1
Nickel	MG/KG	1110	e1	521	e1
Potassium	MG/KG	ND		0.21	b1, b5, b7, b9, b10
Vanadium	MG/KG	18.1	b5	19.9	b1, b5, b7, b9, b10
Zinc	MG/KG	722	b1	376	
Barium	MG/KG	1.7	e1, b5, b7, b9, b10	ND	ND
Boron	MG/KG	8.8	b1, b5, b7, b9, b10	ND	ND
Calcium	MG/KG	1000	b1	28.2	
Vanadium	MG/KG	24.8		28.2	
Zinc	MG/KG	362	e1	32	



- NOTES:**
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SOURCES: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT.
PART 1 SECT. 5 PAGE 14
(PLAN NO. 6544-101.28)
OLIN BURNING GROUND LAYOUT
SOURCE: PRI-00521

AUS-0A10-AREA 10-IOP FUSE AND BOOSTER STORAGE MAGAZINE

Revision No.	Description	Date	By	App.	
REVISIONS					
PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS					
AUS-0A10 Sample Locations and Detections of Inorganic Compounds in Soils and Surface Water					
Date:	12/19/00	Project Number:	2320000026.00	Figure Number:	14-3
Drawn by:	DJD	Design by:	MAM	Checked by:	MCH/CMW
URS					