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 III

Sections 8 and 9

TABLE OF CONTENTS

VOLUME III

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

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

ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

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
Crab Orchard AUS OU PA/SI Report

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

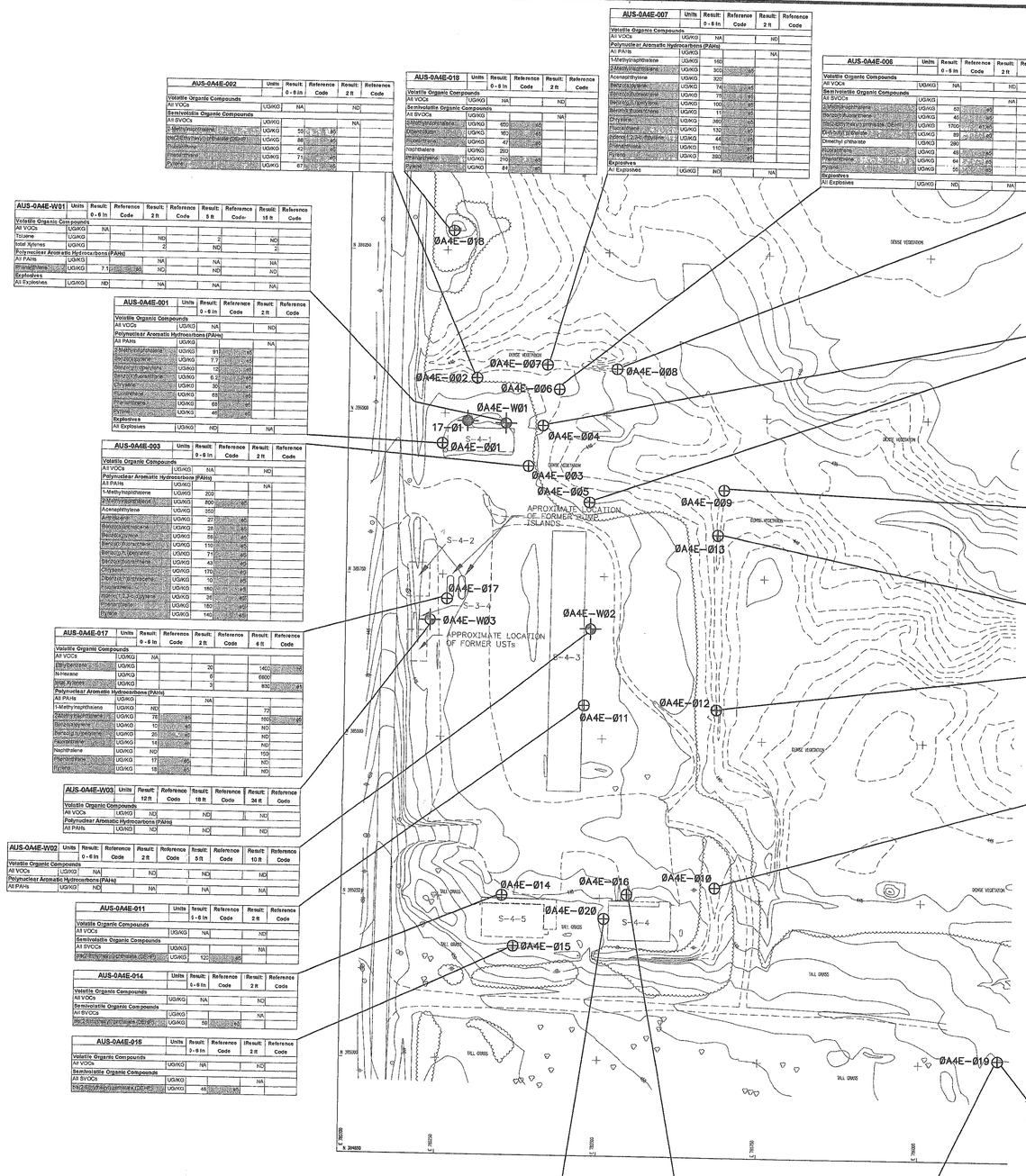
ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

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

AREA 4 EAST–EAST SHOP AREA



AUS-0A4E-002	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	50	J	85	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	66	J	45	
Fluoranthene	UG/KG	42	J	45	
Phenanthrene	UG/KG	71	J	45	
Pyrene	UG/KG	67	J	45	

AUS-0A4E-018	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	650	J	45	
Dibenzofuran	UG/KG	160	J	45	
Fluoranthene	UG/KG	47	J	45	
Naphthalene	UG/KG	250	J	45	
Phenanthrene	UG/KG	210	J	45	
Pyrene	UG/KG	84	J	45	

AUS-0A4E-007	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)					
All PAHs	UG/KG			NA	
1-Methylnaphthalene	UG/KG	160	J	45	
2-Methylnaphthalene	UG/KG	300	J	45	
Acenaphthylene	UG/KG	320	J	45	
Benzo(a)pyrene	UG/KG	74	J	45	
Benzo(b)fluoranthene	UG/KG	70	J	45	
Benzo(g,h,i)perylene	UG/KG	100	J	45	
Benzo(k)fluoranthene	UG/KG	110	J	45	
Chrysene	UG/KG	130	J	45	
Fluoranthene	UG/KG	44	J	45	
Naphthalene	UG/KG	110	J	45	
Pyrene	UG/KG	380	J	45	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A4E-006	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	52	J	45	
Benzo(b)fluoranthene	UG/KG	45	J	45	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	1700		4100	
Di-n-butyl phthalate	UG/KG	89	J	45	
Dimethyl phthalate	UG/KG	280			
Fluoranthene	UG/KG	45	J	45	
Phenanthrene	UG/KG	64	J	45	
Pyrene	UG/KG	55	J	45	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A4E-008	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Polynuclear Aromatic Hydrocarbons (PAHs)					
1-Methylnaphthalene	UG/KG	44	J	45	
2-Methylnaphthalene	UG/KG	67	J	45	
Acenaphthene	UG/KG	7.7	J	45	
Benz(a)anthracene	UG/KG	8.2	J	45	
Benzo(a)pyrene	UG/KG	7.1	J	45	
Benzo(b)fluoranthene	UG/KG	16	J	45	
Benzo(g,h,i)perylene	UG/KG	10	J	45	
Chrysene	UG/KG	20	J	45	
Fluoranthene	UG/KG	28	J	45	
Indeno(1,2,3-c,d)pyrene	UG/KG	13	J	45	
Phenanthrene	UG/KG	21	J	45	
Pyrene	UG/KG	22	J	45	
Explosives					
All Explosives	UG/KG	ND			

AUS-0A4E-W01	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code	Result: 5 ft	Reference Code	Result: 15 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA							
Toluene	UG/KG			ND		2		ND	
total Xylenes	UG/KG			2		ND		2	
Polynuclear Aromatic Hydrocarbons (PAHs)									
All PAHs	UG/KG			NA		NA		NA	
Phenanthrene	UG/KG	7.1	J 45	ND		ND		ND	
Explosives									
All Explosives	UG/KG	ND		NA		NA		NA	

AUS-0A4E-001	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)					
All PAHs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	91		45	
Benzo(a)pyrene	UG/KG	7.7	J	45	
Benzo(b)fluoranthene	UG/KG	12	J	45	
Benzo(k)fluoranthene	UG/KG	6.2	J	45	
Chrysene	UG/KG	30	J	45	
Fluoranthene	UG/KG	68	J	45	
Phenanthrene	UG/KG	63	J	45	
Pyrene	UG/KG	49	J	45	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A4E-003	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)					
All PAHs	UG/KG			NA	
1-Methylnaphthalene	UG/KG	200		45	
2-Methylnaphthalene	UG/KG	800		45	
Acenaphthylene	UG/KG	350		45	
Anthracene	UG/KG	27	J	45	
Benzo(a)anthracene	UG/KG	28	J	45	
Benzo(a)pyrene	UG/KG	55	J	45	
Benzo(b)fluoranthene	UG/KG	110	J	45	
Benzo(g,h,i)perylene	UG/KG	71	J	45	
Benzo(k)fluoranthene	UG/KG	43	J	45	
Chrysene	UG/KG	170	J	45	
Dibenz(a,h)anthracene	UG/KG	10	J	45	
Fluoranthene	UG/KG	180	J	45	
Indeno(1,2,3-c,d)pyrene	UG/KG	36	J	45	
Phenanthrene	UG/KG	180	J	45	
Pyrene	UG/KG	140	J	45	

AUS-0A4E-004	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	500	J	45	
Benzo(b)fluoranthene	UG/KG	60	J	45	
Chrysene	UG/KG	100	J	45	
Dibenzofuran	UG/KG	160	J	45	
Fluoranthene	UG/KG	73	J	45	
Naphthalene	UG/KG	170		45	
Phenanthrene	UG/KG	410		45	
Pyrene	UG/KG	120	J	45	

AUS-0A4E-005	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	1900		45	
Anthracene	UG/KG	50	J	45	
Benzo(a)anthracene	UG/KG	100	J	45	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	58	J	45	
Chrysene	UG/KG	100	J	45	
Dibenzofuran	UG/KG	450	J	45	
Fluoranthene	UG/KG	76	J	45	
Naphthalene	UG/KG	880		45	
Phenanthrene	UG/KG	620		45	
Pyrene	UG/KG	170	J	45	

AUS-0A4E-009	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	50	J	45	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	70	J	45	
Explosives					
All Explosives	UG/KG	ND		NA	

AUS-0A4E-013	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	

AUS-0A4E-012	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	130	J	45	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	80	J	45	
Chrysene	UG/KG	57	J	45	
Fluoranthene	UG/KG	45	J	45	
Naphthalene	UG/KG	79			
Phenanthrene	UG/KG	110		45	
Pyrene	UG/KG	81	J	45	

AUS-0A4E-010	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)					
All PAHs	UG/KG			NA	
1-Methylnaphthalene	UG/KG	200		45	
2-Methylnaphthalene	UG/KG	300	J	45	
Acenaphthylene	UG/KG	150		45	
Anthracene	UG/KG	13	J	45	
Benzo(a)anthracene	UG/KG	15	J	45	
Benzo(b)fluoranthene	UG/KG	26	J	45	
Benzo(g,h,i)perylene	UG/KG	20	J	45	
Benzo(k)fluoranthene	UG/KG	7.9	J	45	
Chrysene	UG/KG	34	J	45	
Fluoranthene	UG/KG	35	J	45	
Indeno(1,2,3-c,d)pyrene	UG/KG	10	J	45	
Naphthalene	UG/KG	90			
Phenanthrene	UG/KG	51	J	45	
Pyrene	UG/KG	27	J	45	

AUS-0A4E-017	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code	Result: 6 ft	Reference Code
Volatile Organic Compounds							
All VOCs	UG/KG	NA					
Ethylbenzene	UG/KG			20		1400	
N-Hexane	UG/KG			6		6800	
total Xylenes	UG/KG			3		930	J 45
Polynuclear Aromatic Hydrocarbons (PAHs)							
All PAHs	UG/KG			NA			
1-Methylnaphthalene	UG/KG	ND				72	
2-Methylnaphthalene	UG/KG	75	J 45			150	J 45
Benzo(a)pyrene	UG/KG	10	J 45			ND	
Benzo(g,h,i)perylene	UG/KG	26	J 45			ND	
Acenaphthylene	UG/KG	14	J 45			ND	
Naphthalene	UG/KG	ND				100	
Phenanthrene	UG/KG	17	J 45			ND	
Pyrene	UG/KG	18	J 45			ND	

AUS-0A4E-W03	Units	Result: 12 ft	Reference Code	Result: 18 ft	Reference Code	Result: 24 ft	Reference Code
Volatile Organic Compounds							
All VOCs	UG/KG	ND		ND		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)							
All PAHs	UG/KG	ND		ND		ND	

AUS-0A4E-W02	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code	Result: 5 ft	Reference Code	Result: 10 ft	Reference Code
Volatile Organic Compounds									
All VOCs	UG/KG	NA		ND		ND		ND	
Polynuclear Aromatic Hydrocarbons (PAHs)									
All PAHs	UG/KG	ND		NA		NA		NA	

AUS-0A4E-011	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	120		45	

AUS-0A4E-014	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	59	J	45	

AUS-0A4E-015	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	48	J	45	

AUS-0A4E-020	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Benzo(a)anthracene	UG/KG	77	J	45	
Benzo(a)pyrene	UG/KG	64	J	45	
Benzo(b)fluoranthene	UG/KG	120	J	45	
Bis(2-ethylhexyl)phthalate (DEHP)	UG/KG	47	J	45	
Chrysene	UG/KG	93	J	45	
Fluoranthene	UG/KG	170	J	45	
Phenanthrene	UG/KG	130	J	45	
Pyrene	UG/KG	200	J	45	

AUS-0A4E-016	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	

AUS-0A4E-019	Units	Result: 0 - 0.5 ft	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
2-Methylnaphthalene	UG/KG	1020		45	
Anthracene	UG/KG	43	J	45	
Benzo(a)anthracene	UG/KG	90		45	
Chrysene	UG/KG	100		45	
Di-n-octyl phthalate	UG/KG	66	J	45	
Dibenzofuran	UG/KG	900		45	
Fluoranthene	UG/KG	94		45	
Naphthalene	UG/KG	340			
Phenanthrene	UG/KG	610		45	
Pyrene	UG/KG	190		45	

LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATIONS

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

N

100 0 100

SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.

2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.

3. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4–DINITROTOLUENE, 2,6–DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

Revision No.	Description	Date	By	App.

REVISIONS

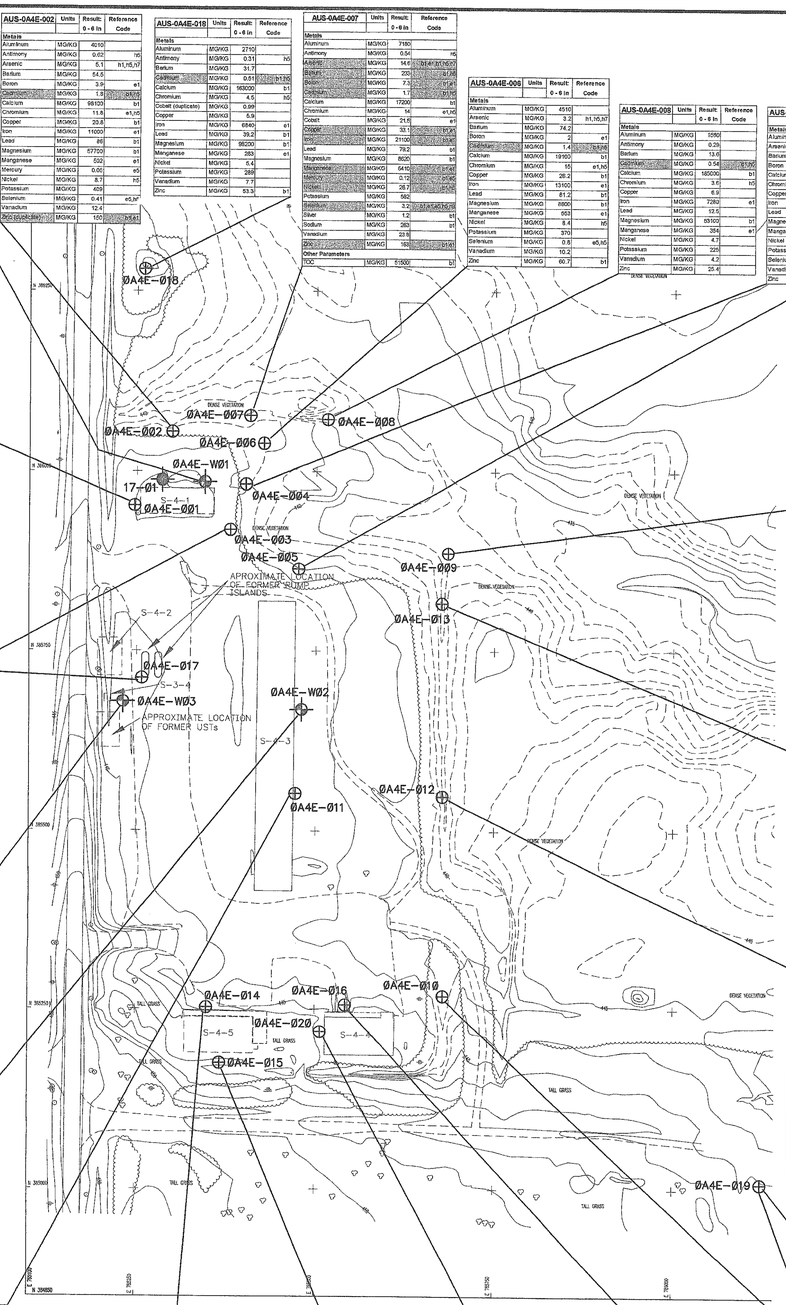
PA/SI REPORT–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

AUS–OA4E
Sample Locations and Detections of Organic Compounds in Soils

Date:	Project Number:	Figure Number:
11/14/00	2320000026.00	8–3
Drawn by: DJD	Design by: MAM	Checked by: CMW

URS

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-0A4E.DWG Last edited: AUG. 03, 01 @ 10:30 a.m. URS Corp.



AUS-0A4E-W01	Units	Result: 0 - 6 ft	Reference Code
Metals			
Aluminum	MG/KG	7310	
Arsenic	MG/KG	5.4	h1,h5,h7
Barium	MG/KG	111	h5
Calcium	MG/KG	10400	b1
Chromium	MG/KG	10.1	e1,h5
Cobalt	MG/KG	5.8	
Copper	MG/KG	10.6	
Iron	MG/KG	12500	e1
Lead	MG/KG	24.8	b1
Magnesium	MG/KG	4970	b1
Manganese	MG/KG	219	e1
Nickel	MG/KG	10.6	h5
Potassium	MG/KG	427	
Vanadium	MG/KG	21.4	
Zinc	MG/KG	30.1	

AUS-0A4E-001	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6100	
Arsenic	MG/KG	4.2	h1,h5,h7
Barium	MG/KG	98.4	h5
Cadmium	MG/KG	0.28	b1
Calcium	MG/KG	2160	b1
Chromium	MG/KG	8.6	e1,h5
Copper	MG/KG	9.4	
Iron	MG/KG	11700	e1
Lead	MG/KG	66	b1
Magnesium	MG/KG	24900	b1
Manganese	MG/KG	253	e1
Nickel	MG/KG	9	h5
Potassium	MG/KG	427	
Selenium	MG/KG	0.67	e5,h5
Vanadium	MG/KG	18	
Zinc	MG/KG	42.3	

AUS-0A4E-003	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	3600	
Arsenic	MG/KG	5.8	h1,h5,h7
Barium	MG/KG	126	h5
Boron	MG/KG	2.6	e1
Cadmium	MG/KG	3.5	b1,h5
Calcium	MG/KG	130000	b1
Chromium	MG/KG	19.7	e1,h5
Copper	MG/KG	26.1	b1
Iron	MG/KG	9120	e1
Lead	MG/KG	223	b1
Magnesium	MG/KG	28800	b1
Manganese	MG/KG	282	e1
Mercury	MG/KG	0.12	b1,e5
Nickel	MG/KG	13.8	h5
Potassium	MG/KG	405	
Selenium	MG/KG	0.55	e5,h5
Sodium	MG/KG	272	b1
Vanadium	MG/KG	9.2	
Zinc	MG/KG	199	b1,h1

AUS-0A4E-017	Units	Result: 0 - 6 in	Reference Code	Result: 6 ft	Reference Code
Metals					
Aluminum	MG/KG	486		7450	
Arsenic	MG/KG	ND		4.1	b1,h5,h7
Barium	MG/KG	6.1		137	h5
Cadmium	MG/KG	ND		0.05	
Calcium	MG/KG	177000	b1	2000	
Chromium	MG/KG	1.1		12.3	e1,h5
Cobalt	MG/KG	ND		14.5	
Copper	MG/KG	ND		9.6	
Iron	MG/KG	7600	e1	11300	e1
Lead	MG/KG	5.3		11	
Magnesium	MG/KG	114000	b1	1810	b1
Manganese	MG/KG	118	e1	266	e1
Mercury	MG/KG	ND		0.1	b1,e5
Nickel	MG/KG	2.5		10	h5
Potassium	MG/KG	151		329	
Selenium	MG/KG	ND		0.28	e5
Vanadium	MG/KG	0.75		18.9	
Zinc	MG/KG	10.2		34.1	

AUS-0A4E-W03	Units	Result: 12 ft	Reference Code	Result: 18 ft	Reference Code	Result: 24 ft	Reference Code
Metals							
Aluminum	MG/KG	7660		9340		7150	
Arsenic	MG/KG	ND		4.2	h1,h5,h7	2.8	h1,h5
Barium	MG/KG	66.9		361	b1,h5	37.1	
Boron	MG/KG	ND		3.5	e1	3.8	e1
Cadmium	MG/KG	ND		ND		0.25	b1
Calcium	MG/KG	1920		2730	b1	31400	b1
Chromium	MG/KG	12.4	e1,h5	19.8	e1,h5	14.3	e1,h5
Cobalt	MG/KG	7.5		5.9		7.7	
Copper	MG/KG	5.5		12.4	b1	13.5	b1
Iron	MG/KG	11700	e1	19100	e1	15900	e1,b1
Lead	MG/KG	9.6		8.3		7.7	
Magnesium	MG/KG	1560		3000	b1	16300	b1
Manganese	MG/KG	185	e1	304	b1	232	e1
Nickel	MG/KG	8.3	h5	19	b1,h5	20.3	b1,h5
Potassium	MG/KG	335		900	b1	926	b1
Sodium	MG/KG	373	b1	370	b1	308	b1
Vanadium	MG/KG	17		10.7		16.2	
Zinc	MG/KG	19.7		50.4		65.1	b1

AUS-0A4E-W02	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5460	
Arsenic	MG/KG	7.3	h1,h5,h7
Barium	MG/KG	127	h5
Boron	MG/KG	2.1	e1
Calcium	MG/KG	977	
Chromium	MG/KG	9.2	e1,h5
Cobalt	MG/KG	7.5	
Copper	MG/KG	5.6	
Iron	MG/KG	13000	e1
Lead	MG/KG	14.1	
Magnesium	MG/KG	1090	
Manganese	MG/KG	876	e1
Nickel	MG/KG	6.8	
Potassium	MG/KG	315	
Selenium	MG/KG	1	e5,h5
Vanadium	MG/KG	26.5	
Zinc	MG/KG	22.5	

AUS-0A4E-011	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	2470	
Arsenic	MG/KG	3.3	h1,h5,h7
Barium	MG/KG	23.1	
Cadmium	MG/KG	0.35	b1,h5
Calcium	MG/KG	150000	b1
Chromium	MG/KG	3.5	h5
Copper	MG/KG	15.4	b1
Iron	MG/KG	5670	e1
Lead	MG/KG	102	b1
Magnesium	MG/KG	102000	b1
Manganese	MG/KG	184	e1
Nickel	MG/KG	7.6	h5
Potassium	MG/KG	283	
Vanadium	MG/KG	2.9	
Zinc	MG/KG	262	b1,h1

AUS-0A4E-002	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4010	
Antimony	MG/KG	0.62	h5
Arsenic	MG/KG	5.1	h1,h5,h7
Barium	MG/KG	54.5	
Boron	MG/KG	3.9	e1
Cadmium	MG/KG	1.8	b1,h5
Calcium	MG/KG	98100	b1
Chromium	MG/KG	11.8	e1,h5
Copper	MG/KG	23.8	b1
Iron	MG/KG	11000	e1
Lead	MG/KG	86	b1
Magnesium	MG/KG	57700	b1
Manganese	MG/KG	532	e1
Mercury	MG/KG	0.05	e5
Nickel	MG/KG	8.7	h5
Potassium	MG/KG	459	
Selenium	MG/KG	0.41	e5,h5
Vanadium	MG/KG	12.4	
Zinc (duplicate)	MG/KG	150	b1,e1

AUS-0A4E-018	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	2710	
Antimony	MG/KG	0.31	h5
Barium	MG/KG	31.7	
Cadmium	MG/KG	0.51	b1,h5
Calcium	MG/KG	183000	b1
Chromium	MG/KG	4.5	h5
Cobalt (duplicate)	MG/KG	0.99	
Copper	MG/KG	5.9	
Iron	MG/KG	6840	e1
Lead	MG/KG	39.2	b1
Magnesium	MG/KG	68200	b1
Manganese	MG/KG	283	e1
Nickel	MG/KG	5.4	
Potassium	MG/KG	288	
Vanadium	MG/KG	7.7	
Zinc	MG/KG	53.3	b1

AUS-0A4E-007	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7180	
Antimony	MG/KG	0.54	h5
Arsenic	MG/KG	14.6	b1,e1,h1,h5,h7
Barium	MG/KG	250	b1,h5
Boron	MG/KG	7.3	b1,e1
Cadmium	MG/KG	1.7	b1,h5
Calcium	MG/KG	17200	b1
Chromium	MG/KG	14	e1,h5
Cobalt	MG/KG	21.6	e1
Copper	MG/KG	33.1	b1,e1
Iron	MG/KG	21100	b1,e1
Lead	MG/KG	79.2	b1
Magnesium	MG/KG	8620	b1
Manganese	MG/KG	541	e1,b1
Mercury	MG/KG	0.12	b1,e5
Nickel	MG/KG	28.7	h5
Potassium	MG/KG	582	
Selenium	MG/KG	3.2	b1,e1,e5,h5
Silver	MG/KG	1.2	b1
Sodium	MG/KG	260	b1
Vanadium	MG/KG	23.8	
Zinc	MG/KG	164	b1,e1
Other Parameters			
TOC	MG/KG	51000	b1

AUS-0A4E-006	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	4510	
Arsenic	MG/KG	3.2	h1,h5,h7
Barium	MG/KG	74.2	
Boron	MG/KG	2	e1
Cadmium	MG/KG	1.4	b1,h5
Calcium	MG/KG	19100	b1
Chromium	MG/KG	10	e1,h5
Copper	MG/KG	28.2	b1
Iron	MG/KG	13100	e1
Lead	MG/KG	61.2	b1
Magnesium	MG/KG	6600	b1
Manganese	MG/KG	553	e1
Nickel	MG/KG	8.4	h5
Potassium	MG/KG	370	
Selenium	MG/KG	0.8	e5,h5
Vanadium	MG/KG	10.2	
Zinc	MG/KG	60.7	b1

AUS-0A4E-005	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5580	
Antimony	MG/KG	0.29	
Arsenic	MG/KG	5.6	h1,h5,h7
Barium	MG/KG	13.6	
Cadmium	MG/KG	0.54	b1,h5
Calcium	MG/KG	165000	b1
Chromium	MG/KG	3.6	h5
Copper	MG/KG	6.9	
Iron	MG/KG	7280	e1
Lead	MG/KG	13.5	
Magnesium	MG/KG	69100	b1
Manganese	MG/KG	354	e1
Nickel	MG/KG	4.7	
Potassium	MG/KG	225	
Selenium	MG/KG	4.2	
Vanadium	MG/KG	25.4	
Zinc	MG/KG	39.5	

AUS-0A4E-004	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	2930	
Arsenic	MG/KG	5.7	h1,h5,h7
Barium	MG/KG	74.9	
Boron	MG/KG	2	e1
Calcium	MG/KG	31200	b1
Chromium	MG/KG	10.2	e1,h5
Copper	MG/KG	8.6	
Iron	MG/KG	13000	e1
Lead	MG/KG	11.5	
Magnesium	MG/KG	2100	b1
Manganese	MG/KG	388	e1
Nickel	MG/KG	6.2	
Potassium	MG/KG	349	
Selenium	MG/KG	0.97	e5,h5
Vanadium	MG/KG	20.1	
Zinc	MG/KG	39.9	

AUS-0A4E-008	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5580	
Antimony	MG/KG	0.29	
Arsenic	MG/KG	5.6	h1,h5,h7
Barium	MG/KG	13.6	
Cadmium	MG/KG	0.54	b1,h5
Calcium	MG/KG	165000	b1
Chromium	MG/KG	3.6	h5
Copper	MG/KG	6.9	
Iron	MG/KG	7280	e1
Lead	MG/KG	13.5	
Magnesium	MG/KG	69100	b1
Manganese	MG/KG	354	e1
Nickel	MG/KG	4.7	
Potassium	MG/KG	225	
Selenium	MG/KG	4.2	
Vanadium	MG/KG	25.4	
Zinc	MG/KG	39.5	

AUS-0A4E-009	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7790	
Arsenic	MG/KG	13.7	b1,h1,h5,h7
Barium	MG/KG	105	h5
Beryllium (duplicate)	MG/KG	0.78	b1
Boron	MG/KG	3.5	e1
Cadmium	MG/KG	0.35	b1
Calcium	MG/KG	7930	b1
Chromium	MG/KG	15.5	e1,h5
Cobalt	MG/KG	7.6	
Copper	MG/KG	28.8	b1
Iron	MG/KG	21500	b1,e1
Lead	MG/KG	79.5	b1
Magnesium	MG/KG	6210	b1
Manganese	MG/KG	446	e1
Mercury	MG/KG	0.05	b1,e5
Nickel	MG/KG	12.4	h5
Potassium	MG/KG	623	
Selenium	MG/KG	1.4	e1,e5,h5
Silver (duplicates)	MG/KG	0.44	
Vanadium (duplicate)	MG/KG	48.1	b1,e1
Zinc	MG/KG	112	b1

AUS-0A4E-013	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	9010	
Arsenic	MG/KG	12	e1,h1,h5,h7
Barium	MG/KG	105	h5
Boron	MG/KG	1.7	e1
Calcium	MG/KG	5480	b1
Chromium	MG/KG	14.4	e1,h5
Cobalt	MG/KG	6.3	
Copper	MG/KG	17.5	b1
Iron	MG/KG	21700	b1,e1
Lead	MG/KG	32.3	b1
Magnesium	MG/KG	3790	b1
Manganese	MG/KG	553	e1
Nickel	MG/KG	12.2	h5
Potassium	MG/KG	501	
Selenium	MG/KG	1	e5,h5
Silver	MG/KG	0.26	
Vanadium	MG/KG	32.9	
Zinc	MG/KG	81.3	b1

AUS-0A4E-012	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6040	
Arsenic	MG/KG	7	h1,h5,h7
Barium	MG/KG	98.3	h5
Boron	MG/KG	2	e1
Cadmium	MG/KG	0.69	b1,h5
Calcium	MG/KG	15800	b1
Chromium	MG/KG	12.6	e1,h5
Cobalt	MG/KG	5.4	
Copper	MG/KG	28.9	b1
Iron	MG/KG	13500	e1
Lead	MG/KG	81	b1
Magnesium	MG/KG	9240	b1
Manganese	MG/KG	421	e1
Mercury	MG/KG	0.09	b1,e5
Nickel	MG/KG	11.2	h5
Potassium	MG/KG	470	
Selenium	MG/KG	0.81	e5,h5
Vanadium	MG/KG	20.5	
Zinc	MG/KG	123	b1,e1

AUS-0A4E-014	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	5640	
Arsenic	MG/KG	3.0	h1,h5,h7
Barium	MG/KG	124	h5
Boron	MG/KG	4.7	e1
Calcium	MG/KG	67800	b1
Chromium	MG/KG	10.7	e1,h5
Cobalt	MG/KG	5	
Copper	MG/KG	8.7	
Iron	MG/KG	11100	e1
Lead	MG/KG	11.3	
Magnesium	MG/KG	3480	b1
Manganese	MG/KG	313	e1
Mercury	MG/KG	0.15	b1,e5,h5
Nickel	MG/KG	10.6	h5
Potassium	MG/KG	394	
Selenium	MG/KG	0.55	e5,h5
Sodium	MG/KG	264	b1
Vanadium	MG/KG	20.4	
Zinc	MG/KG	28.3	

AUS-0A4E-016	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7240	
Arsenic	MG/KG	6	h1,h5,h7
Barium	MG/KG	125	h5
Cadmium	MG/KG	0.61	b1,h5
Calcium	MG/KG	35800	b1
Chromium	MG/KG	13.9	e1,h5
Cobalt	MG/KG	10.5	
Copper	MG/KG	20.5	b1
Iron	MG/KG	16800	e1
Lead	MG/KG	36.6	b1
Magnesium	MG/KG	24100	b1
Manganese	MG/KG	728	e1
Mercury	MG/KG	0.24	b1,e5,h5
Nickel	MG/KG	13.2	h5
Potassium	MG/KG	482	
Selenium	MG/KG	0.88	e5,h5
Vanadium	MG/KG	25.8	
Zinc	MG/KG	147	b1,e1

AUS-0A4E-020	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	6770	
Arsenic	MG/KG	6	h1,h5,h7
Barium	MG/KG	86.9	h5
Cadmium	MG/KG	0.63	b1,h5
Calcium	MG/KG	59200	b1
Chromium	MG/KG	11.5	e1,h5
Cobalt	MG/KG	5.3	
Copper	MG/KG	12	b1
Iron	MG/KG	10500	e1
Lead	MG/KG	18.8	
Magnesium	MG/KG	9980	b1
Manganese	MG/KG	345	e1
Mercury	MG/KG	0.16	b1,e5,h5
Nickel	MG/KG	13	h5
Potassium	MG/KG	492	
Selenium	MG/KG	0.5	e5,h5
Vanadium	MG/KG	62.2	b1

AUS-0A4E-018	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	7180	
Arsenic	MG/KG	14.6	b1,e1,h1,h5,h7
Barium	MG/KG	250	b1,h5
Boron	MG/KG	7.3	b1,e1
Cadmium	MG/KG	1.7	b1,h5
Calcium	MG/KG	17200	b1
Chromium	MG/KG	14	e1,h5
Cobalt	MG/KG	21.6	e1
Copper	MG/KG	33.1	b1,e1
Iron	MG/KG	21100	b1,e1
Lead	MG/KG	79.2	b1
Magnesium	MG/KG	8620	b1
Manganese	MG/KG	541	e1,b1
Mercury	MG/KG	0.12	b1,e5
Nickel	MG/KG	28.7	h5
Potassium	MG/KG	582	
Selenium	MG/KG	3.2	b1,e1,e5,h5
Silver	MG/KG	1.2	b1
Sodium	MG/KG	260	b1
Vanadium	MG/KG	23.8	
Zinc	MG/KG	164	b1,e1
Other Parameters			
TOC	MG/KG	51000	b1

AUS-0A4E-019	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	3020	
Arsenic	MG/KG	2.3	h1,h5
Barium	MG/KG	19.4	b1,h5,h7
Beryllium	MG/KG	0.14	b1,h5,h7
Boron	MG/KG	59.5	h5
Cadmium	MG/KG	14.1	b1,h5
Calcium	MG/KG	1.1	b1,h5
Chromium	MG/KG	76700	b1
Cobalt	MG/KG	13.4	e1,h5
Copper	MG/KG	5.9	
Iron	MG/KG	8160	b1,e1
Lead	MG/KG	22900	b1,e1
Magnesium	MG/KG	126	h5
Manganese	MG/KG	47700	b1
Mercury	MG/KG	443	e1
Nickel	MG/KG	0.14	b1,h5
Potassium	MG/KG	18.8	h5
Selenium	MG/KG	234	
Thallium	MG/KG	0.21	
Vanadium	MG/KG	12.1	
Zinc	MG/KG	321	b1,e1

AUS-0A4E-010	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	10800	
Arsenic	MG/KG	4.7	h1,h5,h7
Barium	MG/KG	120	h5
Cadmium	MG/KG	0.46	b1,h5
Calcium	MG/KG	3960	b1
Chromium	MG/KG	15.7	e1,h5
Cobalt	MG/KG	6.8	
Copper	MG/KG	23.8	b1
Iron	MG/KG	14900	e1
Lead	MG/KG	54.2	b1
Magnesium	MG/KG	2790	b1
Manganese	MG/KG	224	e1
Mercury	MG/KG	0.09	b1,e5
Nickel	MG/KG	15.2	h5
Potassium	MG/KG	643	
Selenium	MG/KG	0.64	e5,h5
Vanadium	MG/KG	18.2	
Zinc	MG/KG	143	b1,e1

AUS-0A4E-015	Units	Result: 0 - 6 in	Reference Code
Metals			
Aluminum	MG/KG	8620	
Arsenic	MG/KG	7.2	h1,h5,h7
Barium	MG/KG	89.5	h5
Cadmium	MG/KG	0.28	b1
Calcium	MG/KG	7300	b1
Chromium	MG/KG	11.7	e1,h5
Cobalt	MG/KG	5.6	
Copper	MG/KG	21.7	b1
Iron	MG/KG	17400	e1
Lead	MG/KG	29.1	b1
Magnesium	MG/KG	4690	b1
Manganese	MG/KG	437	e1
Nickel	MG/KG	11	h5
Potassium	MG/KG	420	
Selenium	MG/KG	1.4	e1,e5,h5
Silver	MG/KG	0.25	
Vanadium	MG/KG	31.6	
Zinc	MG/KG	47.7	

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

LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATIONS

N

100 0 100

SCALE FEET

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.

2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.

Revision No.	Description	Date	By	App.

REVISIONS

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

AUS–0A4E
Sample Locations and Detections of Inorganic Compounds in Soils

Date: 11/14/00	Project Number: 2320000026.00	Figure Number: 8–4
Drawn by: DJD	Design by: MAM	Checked by: CMW

URS

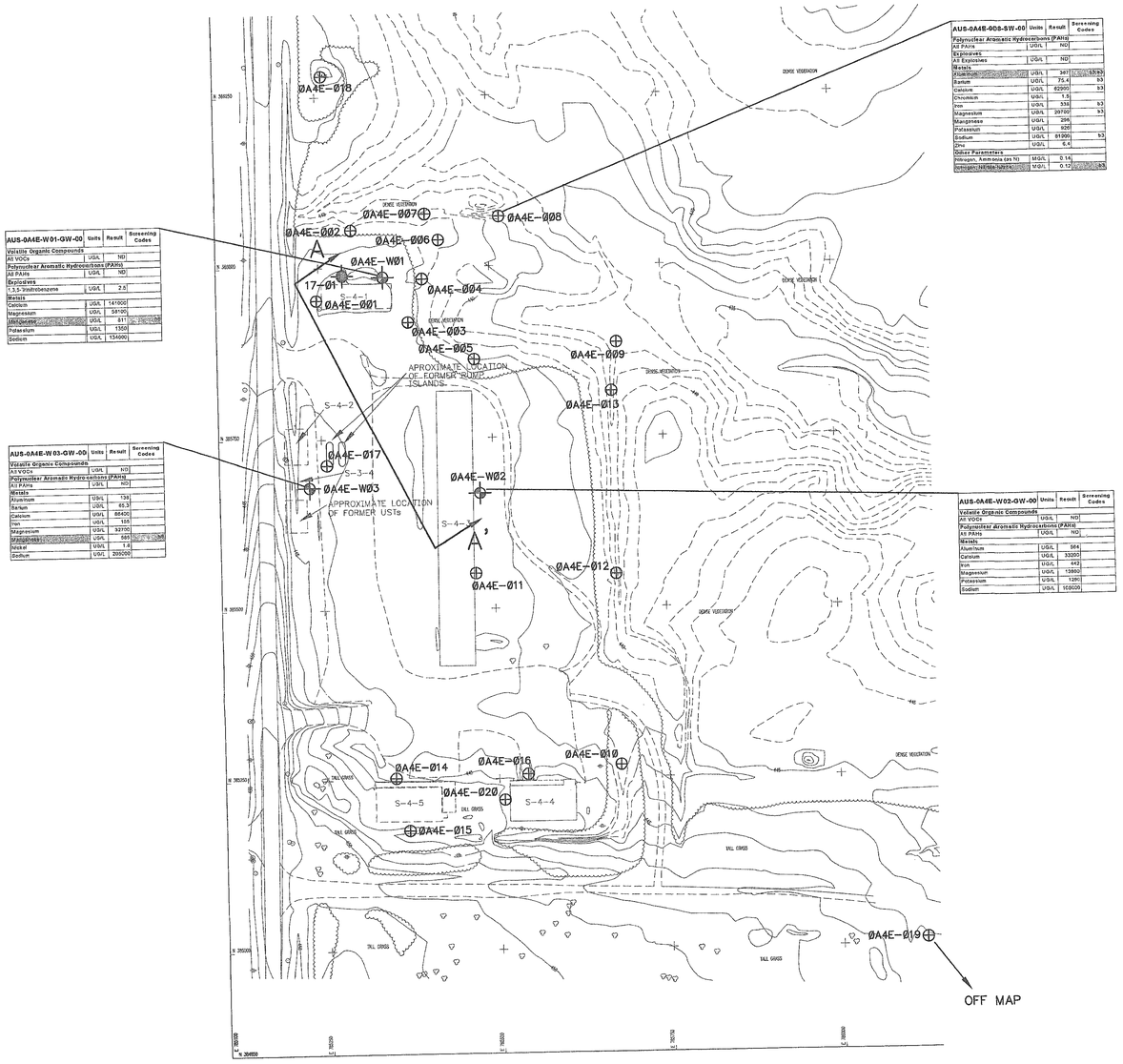
AREA 4 EAST–EAST SHOP AREA

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-0A4E.DWG Last edited: AUG. 03, 01 @ 10:38 am, URS Corp.

LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATIONS

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



AUS-ØA4E-W01-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Polynuclear Aromatic Hydrocarbons (PAHs)			
All PAHs	UG/L	ND	
Explosives			
1,3,5-Trinitrobenzene	UG/L	2.6	
Metals			
Calcium	UG/L	141000	
Magnesium	UG/L	59100	
Manganese	UG/L	811	h3 h4 h5 h7
Potassium	UG/L	1350	
Sodium	UG/L	134000	

AUS-ØA4E-W03-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Polynuclear Aromatic Hydrocarbons (PAHs)			
All PAHs	UG/L	ND	
Metals			
Aluminum	UG/L	139	
Barium	UG/L	65.3	
Calcium	UG/L	86400	
Iron	UG/L	105	
Magnesium	UG/L	32700	
Manganese	UG/L	583	h3 h4 h5 h7
Nickel	UG/L	1.6	
Sodium	UG/L	209000	

AUS-ØA4E-9DS-SW-00	Units	Result	Screening Codes
Polynuclear Aromatic Hydrocarbons (PAHs)			
All PAHs	UG/L	ND	
Explosives			
All Explosives	UG/L	ND	
Metals			
Aluminum	UG/L	347	h3 h5 h7
Barium	UG/L	75.4	h3
Calcium	UG/L	82900	h3
Chromium	UG/L	1.5	
Iron	UG/L	338	h3
Magnesium	UG/L	39700	h3
Manganese	UG/L	295	
Potassium	UG/L	930	
Sodium	UG/L	91900	h3
Zinc	UG/L	6.4	
Other Parameters			
Nitrogen, Ammonia (as N)	MG/L	0.16	
Nitrogen, Nitrate-Nitrite	MG/L	0.12	h5

AUS-ØA4E-W02-GW-00	Units	Result	Screening Codes
Volatile Organic Compounds			
All VOCs	UG/L	ND	
Polynuclear Aromatic Hydrocarbons (PAHs)			
All PAHs	UG/L	ND	
Metals			
Aluminum	UG/L	964	
Calcium	UG/L	33000	
Iron	UG/L	442	
Magnesium	UG/L	13900	
Potassium	UG/L	1280	
Sodium	UG/L	16900	

100 0 100
SCALE FEET

Revision No.	Description	Date	By	App.

REVISIONS

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

AUS-ØA4E Sample Locations and Detections in Surface Water and Groundwater

Date:	Project Number:	Figure Number:
11/14/00	2320000026.00	8-5
Drawn by: DJD	Design by: MAM	Checked by: CMW

URS

NOTES:

1. BASE TOPOGRAPHIC MAP PREPARED BY WALKER & ASSOCIATES FLYOVER IN JANUARY 2000. CONTOUR INTERVAL IS ONE FOOT.

2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED. REFER TO THE QCSR FOR DATA QUALIFIERS.

3. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

AREA 4 EAST-IOP EAST SHOP AREA

Area 4 is the former Illinois Ordnance Plant (IOP) Shop Area. Industrial tenants have used it since 1946.

Area 4, shown in Figure 8-1, is located 1.2 miles south of Illinois State Route 13 on Highway 148. For the purposes of this report, Area 4 has been divided into two separate areas: Area 4 East (East Shop Area), which includes all of the Area 4 buildings east of Highway 148, and Area 4 West (West Shop Area) which includes all Area 4 buildings west of Highway 148. This section addresses Area 4 East (AUS-0A4E).

AUS Original Site Designations

Two of the original Additional and Uncharacterized Sites Operable Unit (AUS OU) sites designated in 1997-1999 by the United States Fish & Wildlife Service (USFWS) were located in Area 4 East: AUS-0011 and AUS-0017. These sites have been incorporated into the current AUS-0A4E.

8.1 HISTORIC SEARCH INFORMATION

8.1.1 Site Description

Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department) operated this industrial shop area[1] from 1942 to 1945, as part of the IOP. The East Shop Area was originally built as an automotive shop to support IOP operations. All automotive shop buildings begin with the designation S-4 and are numbered from 1 to 5 from north to south, as follows:

- Wash and Grease House—Building S-4-1
- Gas Station—Building S-4-2
- Garage—Building S-4-3
- Oil Storage—Building S-4-4
- Auto Parts Storage—Building S-4-5.[2]

One additional IOP building was located in the East Shop Area (S-3-4), which was used to pump fuel to the West Shop Area. South of the automotive shop was an area designated as "Heavy Equipment and Truck Pool Parking Area."[3] The original configuration of Area 4 (East and West) is shown in Figure 8-2.

Of the six original buildings in the East Shop Area, only two remain on site. They are Buildings S-4-3 and S-4-4.[4] Figure 8-3 shows the current configuration of the site (based on 2000 topography).

[1] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (Plan No. 6544-101.06).
[2] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (Plan No. 6544-101.06).
[3] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).
[4] Information obtained from site reconnaissance performed by URS Corporation, April 7, 1999.

8.1.2 Operational History and Waste Characteristics

Table 8-1 lists the Area 4 East buildings, the operator during the IOP era and the post-World War II industrial tenants, the years occupied, and building use.

For several post-World War II (WWII) tenants, building numbers were not identified in the available lease information. These tenants are listed in Table 8-2, along with their lease duration and a description of their operations. Note that the tenants listed in Table 8-2 may have been in either Area 4 East or Area 4 West.

The following discussion expands on the information summarized in Table 8-1.

Building S-4-1 – IOP Wash and Grease House

During World War II, vehicles were cleaned and lubricated in Building S-4-1, the IOP Wash and Grease House.[5] This building contained two wash racks with mud traps beneath them on the western side of the building, and three grease pits located on the eastern side of the building.[6] These activities continued in Area 4 after World War II through management of the area by the War Assets Administration (WAA) and the USFWS. According to Mr. C. Hoffard, a former mechanic who was employed by SWDC, WAA, and USFWS, wash waters and lubricating fluids from Building S-4-1 were drained to a nearby field.[7] Since Buildings S-4-2 and S-4-3 are to the south and southeast and Highway 148 is to the west, it is likely that this field was located either north or east of Building S-4-1, as shown in Figure 8-2. These wash waters reportedly included cleaning solvents.[8] A 1951 aerial photograph of the area shows evidence of surficial discoloration from a possible liquid release just off the northeast corner of the building.[9] It is likely wash waters from this building were released in this area.

In 1958 Schilli Transportation began leasing Building S-4-1 as a truck transport service garage.[10] Schilli transported ammonium nitrate and dynamite for both Olin and U.S. Powder Company (a division of Commercial Solvents Corporation) until 1969.[11] A hauling contract between Schilli and U.S. Powder describes Schilli's work as receiving, handling, and transporting explosives and

[5] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 45 (Plan drawings for building S-4-1).
[6] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 45 (Plan drawings for building S-4-1).
[7] Interview with Mr. C.C. Hoffard as found in TechLaw, Inc., 1992, Final Draft Report, Site Operations and Ownership History, Crab Orchard National Wildlife Refuge, Page B-24.
[8] Interview with Mr. C.C. Hoffard as found in TechLaw, Inc., 1992, Final Draft Report, Site Operations and Ownership History, Crab Orchard National Wildlife Refuge, Page B-24.
[9] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951. 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).
[10] DPRA Document No. 0009324. U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport fisheries and Wildlife, Narrative Report, September thru December, 1958, Page 25.
[11] CRO 000117. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1969, Page 64.

other products handled by U.S. Powder.[12] A 1965 aerial photograph of this area shows a pit located in the same area that was previously described as having evidence of a liquid release (off the northeast corner of Building S-4-1).[13] The same aerial photograph also showed surficial discoloration on the western side of this building.

Mark Twain Marine Industries leased Building S-4-1 from July of 1970 through May of 1971.[14] Information regarding their operations at this building was not found.

From July of 1971[15] through June of 1972,[16] Shamrock Boat Manufacturing leased this building, which they used for storage.[17]

East Side Lumber (involved in wholesale lumber supplies[18]) leased Building S-4-1 from 1974 through at least 1990.[19,20,21,22] The 1980 aerial photograph showed trailers parked next to this building.[23] No information regarding their operations at this building was found. According to East Side's response to a Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) Section 104e request, they had both an underground storage tank (UST) on site that they were in the process of removing and an aboveground storage tank (AST) that was used for leaded fuel storage for tow motors.[24] The locations of these two tanks were not verified; the response did not indicate where the tanks were located, and East Side leased other buildings on the Refuge. By 1993, this building had been removed.[25] The site reconnaissance revealed that the foundation is still in place and has been covered with fill.

---

[12] DOI 0005121. Hauling Contract between U.S. Powder Company, Division of Commercial Solvents Corporation and Ben R. Schilli, doing business as Schilli Transportation, dated October 1, 1963.
[13] Entech, Inc., 2000, Site Specific Report on Area 4 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[14] ACC 000054. Listing of Area 4 leasing information as obtained from leases.
[15] CRO 000526. Lease Contract No. 14-16-0003-13539 by and between U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Shamrock Boat Manufacturing Company, dated July 1, 1971, Page 1.
[16] DPRA Document No. 00018250. Shamrock Boat Manufacturing Company, Letter to USFWS regarding cancellation of Lease no. 14-16-0003-13539, dated May 31, 1972.
[17] DPRA Document No. 00018242. Iowa Hardware Mutual Insurance Company, Binder Notice, Building S-4-1.
[18] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[19] FWM 000933. Lease Contract No. 14-16-0003-60,633 by and between U.S. Fish and Wildlife Service and East Side Lumberyard Supply Company, dated July 1, 1974, Page 1.
[20] FWM 000935. Amendment No. 1 to Lease Contract No. 14-16-0003-30,633, East Side Lumberyard Supply Company, dated July 1, 1979.
[21] DPRA Document No. 00006375. Building Lease Contract No. 14-16-0003-84-546 by and between U.S. Fish and Wildlife Service and East Side Lumberyard Supply Company, dated July 1, 1974, Pages 1-2.
[22] DPRA Document No. 00013091. Amendment No. 2 to Building Lease Contract No. 14-16-0003-84-546, East Side Lumberyard Supply Company, dated effective June 1, 1990.
[23] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 6 - dated August 23, 1980.
[24] CRO 000381. East Side Lumberyard Supply Co. Inc., Questionnaire for Federal Facilities or Environmental Compliance Profile, submitted as part of their CERCLA Section 104(e) response.
[25] Information obtained from site reconnaissance performed by URS Corporation, April 7, 1999.

Building S-4-2 and S-3-4 – IOP Gas Station and Pump House

According to IOP plan drawings for Area 4, the gas station consisted of fuel USTs, pumps for dispensing fuel, fuel distribution lines, and a Pump House (Building S-3-4) for pumping fuel across Highway 148 to a gasoline and fuel oil unloading platform.[26] According to plan drawings for Building S-4-2, the building contained restrooms, office space, and room for the station attendant.[27] Buildings S-4-2 and S-3-4 no longer exist, and no signs of the fuel dispensing stations are evident.[28] The 1943 aerial photograph shows two probable pump islands, and evidence of the USTs just south of Building S-4-2.[29] There was no evidence of removal of the USTs or piping in any of the aerial photographs. A magnetometer survey of the area indicated that the USTs may still be in place. Based on the magnetometer survey, it appears that there could be two large USTs lined up end to end due south of the former gas station building. (In the original IOP drawings there appeared to be four USTs lined up side by side.) There may also be some piping still in place between the USTs and the service station, and between the service station and the former pump islands; however, this is conjecture based on the magnetometer results.

A 1974 special use permit allowed Olin to use two underground storage tanks in Area 4 from January 1974 through June of 1974, for fuel storage.[30] The locations of these two tanks were not verified—they could be in either Area 4 East or Area 4 West. It is possible that the two tanks used by Olin were two of the former IOP gas station fuel tanks; however, this is conjecture.

Sometime between 1951 and 1960, Buildings S-3-4 and S-4-2 were removed from Area 4 East. Presumably, the gas station was no longer in service after that time.[31] According to a USFWS map of Area 4 containing notes by Refuge personnel, Buildings S-3-4 (USFWS #102)[32] and S-4-2 (USFWS #105)[33] were moved to the far eastern side of the shop area (Area 4 east).[34,35]Building

---

[26] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).

[27] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 46 (Plan drawings for building S-4-2).

[28] Information obtained from site reconnaissance performed by URS Corporation, April 7, 1999.

[29] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 1 – dated February 7, 1943.

[30] CRO 001570. Special Use Permit No. SUP-35-74, dated January 9, 1974.

[31] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951 and Figure 3 – dated May 1, 1960.

[32] DPRA Document No. 00006467. CONWR, List of Refuge buildings with both the USFWS and IOP building number designations, square footage, areas, and some handwritten notations. Contains some information regarding the moving of buildings and sometimes when this occurred, and some information regarding buildings that were removed. Document is not dated.

[33] DPRA Document No. 00006467. CONWR, List of Refuge buildings with both the USFWS and IOP building number designations, square footage, areas, and some handwritten notations. Contains some information regarding the moving of buildings and sometimes when this occurred, and some information regarding buildings that were removed. Document is not dated.

[34] Undated USFWS map of Area 4 with notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.

[35] DPRA Document No. 00006467. CONWR, List of Refuge buildings with both the USFWS and IOP building number designations, square footage, areas, and some handwritten notations. Contains some information regarding the moving of buildings and sometimes when this occurred, and some information regarding buildings that were removed. Document is not dated.

S-3-4 was moved slightly north of Building S-1-1; Building S-4-2 was moved directly east of S-3-4.[36] Aerial photographic interpretation indicates these buildings were located here until sometime between 1980 and 1993.[37]

These two buildings were leased by Southern Illinois University (SIU) – School of Technical Careers Career Development Center from 1983[38] through July of 1985.[39] In February of 1985, Diagraph Corporation began leasing these two buildings,[40] and continued to lease them until August of 1990.[41] Both SIU and Diagraph Corporation used Building S-3-4 as a valve house and Building S-4-2 as a gas house.[42,43]

Building S-4-3 – IOP Garage

This building had several bays for the repair of vehicles and equipment. On the south side it had facilities for painting, and there were blacksmithing and welding areas on the north side.[44] The 1951 aerial photograph of this area showed an area of surficial discoloration on the east side of this building that may have been the result of a liquid release.[45] There were no tenants identified in this building at that time.

The southern portion of Building S-4-3 was leased by GTE from 1951 through 1953,[46] and the northern portion of the building was leased by East Side Lumber during the same time period.[47,48] GTE used this building for storage of materials and supplies,[49] and East Side Lumber was involved in wholesale lumber supplies.[50] According to East Side's response to their

[36] Undated USFWS map of Area-4 with notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.
[37] 1980 and 1993 aerial photographs from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).
[38] DPRA Document No. 00007078. Building Lease Contract No. 14-16-0003-83-538 between U. S. Fish and Wildlife Service and Southern Illinois University (SIU-C) School of Technical Careers, Career Development Center, dated February 15, 1983, Pages 1-2.
[39] FWM 000911. Assignment of Lease, by and between Diagraph Corporation and Board of Trustees of Southern Illinois University, dated January 1985.
[40] DOI 000595. Amendment No. 2 to Building Lease Contract No. 14-16-0003-82-534, Diagraph Bradley Industries, Inc., dated February 1, 1985.
[41] DPRA Document No. 00019358. Amendment No. 10 to Building Lease Contract No. 14-16-0003-82-534, Diagraph Bradley, dated August 1, 1990.
[42] DPRA Document No. 00007078. Building Lease Contract No. 14-16-0003-83-538 between U. S. Fish and Wildlife Service and Southern Illinois University (SIU-C) School of Technical Careers, Career Development Center, dated February 15, 1983, Pages 1-2.
[43] DOI 000595. Amendment No. 2 to Building Lease Contract No. 14-16-0003-82-534, Diagraph Bradley Industries, Inc., dated February 1, 1985.
[44] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).
[45] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951.
[46] ACC 000054. Listing of Area 4 leasing information as obtained from leases.
[47] DPRA Document No. 00022854. Special Use Permit No. C.O. Ind.-18 , May 1951.
[48] DPRA Document No. 00022880. Special Use Permit No. C.O. Ind-69, dated April 1, 1953.
[49] DPRA Document No. 00009150. Special Use Permit No. C.O. Ind.-53, dated August 15, 1952.
[50] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.

CERCLA Section 104(e) request, they had an underground storage tank on site that they were in the process of removing and an aboveground storage tank on site that was used for leaded fuel storage for tow motors.[51] The locations of these two tanks were not determined; they could have been located next to any of East Side's buildings.

Dura Crates leased Building S-4-3 from 1958[52] likely through 1960, when E.T. Simonds began occupying this building.[53] Dura Crates manufactured cartons and crates.[54] Dura Crates used Building S-4-3 for production and storage.[55]

E.T. Simonds occupied Building S-4-3 for six months from 1960 through 1961.[56] They may have used this building for construction material storage because this is how they used other space at the Refuge in 1978.[57]

From 1962 through 1971 and again from 1973 through 1997,[58] SIU leased this building[59,60] for excess property storage.[61] The 1965 aerial photograph indicates that this building was probably used for vehicle maintenance.[62] The 1965 photograph shows what appear to be unused vehicles and materials on the east side of the building.[63] By 1971, there were still what appear to be surplus materials on site; however, most of the vehicles had been removed.[64] This suggests the building was no longer being used for vehicle maintenance but was still being used for some other operation. By 1980, all of the apparently surplus materials were removed and the building appeared to be unused.[65]

---

[51] CRO 000381. East Side Lumberyard Supply Co. Inc., Questionnaire for Federal Facilities or Environmental Compliance Profile, submitted as part of their 104Ie) response.
[52] DPRA Document No. 00009351. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1958, Page 18.
[53] ACC 000054. Listing of Area 4 leasing information as obtained from leases.
[54] ACO 002327. – United States Department of the Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, September Thru December, 1955, Page 17.
[55] DPRA Document No. 00009351. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1958, Page 18.
[56] ACC 000054. Listing of Area 4 leasing information as obtained from leases.
[57] ACO 002105. CONWR, Industrial Committee Report, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, August 1978 (Appendix J).
[58] United States Department of the Interior, Report of Survey, Enclosure 1, dated March 10, 1999, Page 2. This document was obtained from USFWS at CONWR .
[59] ACC 000054. Listing of Area 4 leasing information as obtained from leases.
[60] CRO 001864. Lists of Tenants containing Buildings, Rental Fees, and Expiration Dates at Crab Orchard National Wildlife Refuge, dated October 1, 1980.
[61] CRO 001864. Lists of Tenants containing Buildings, Rental Fees, and Expiration Dates at Crab Orchard National Wildlife Refuge, dated October 1, 1980.
[62] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 4 – dated October 16, 1965.
[63] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 4 – dated October 16, 1965.
[64] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 5 – dated October 14, 1971.
[65] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 6 – dated August 23, 1980.

A 1999 U.S. Department of the Interior (USDOI) property survey[66] of Building S-4-3 indicated asbestos materials were present in pipe wrapping and transite wall covering in this building. The survey also indicated this material was removed from this building by a contractor.[67]

Building S-4-4 – IOP Oil Storage Building

Specifics on the method of oil storage by the IOP were not available; however, there appears to have been a drum storage area located between this building and Building S-4-5 to the west.[68] It is possible that oil was stored in these drums, or that they were empty drums awaiting pickup.

In 1951, there was a long narrow shed present just east of Building S-4-4. The use of this shed was not determined, and it was removed by 1960.[69]

In 1958, the Southern Metal Arts Company moved into Building S-4-4.[70] Their operations included manufacturing and fabrication of wrought iron products.[71] They were present in the building through April 1962.[72]

From 1963 to 1982[73,74,75,76] Electric and Machine Corporation (also known as Elmac Corp.) leased Building S-4-4 (and Building S-4-5).[77] This company purchased used mine equipment, repaired and repainted the equipment, then sold it to operating mines.[78] These operations may have included solvent cleaning and used oil generation. The 1965 aerial photograph identified surficial discoloration and openly stored materials to the north of Building S-4-4.[79] There is the

[66] United States Department of the Interior, Report of Survey, Enclosure 1, dated March 10, 1999, Page 2. This document was obtained from USFWS at CONWR .
[67] United States Department of the Interior, Report of Survey, Enclosure 1, dated March 10, 1999, Page 2. This document was obtained from USFWS at CONWR .
[68] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 1 – dated February 7, 1943.
[69] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951.
[70] DPRA Document No. 00009351. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1958, Page 18.
[71] DPRA Document No. 00009351. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1958, Page 18.
[72] DPRA Document No. 00016020. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, January through April, 1962, Table No. 6; AND, DPRA Document No. 00016031. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, May thru August, 1962, Table No. VI.
[73] CRO 001217. Lease Contract No. 14-16-0003-6168 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Electric and Machine Company, dated November 12, 1963, Page 1.
[74] CRO 001237. Lease Contract No. 14-16-003-13,561 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Electric and Machine Company, dated October, 89, 1971, Page 1.
[75] CRO 000397 – CRO 000398. Building Lease Contract No. 14-16-0003-81-512 by and between U. S. Fish and Wildlife Service and ELMAC Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.
[76] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[77] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[78] CRO 000064. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Narrative Report, September thru December, 1963, Page 33.
[79] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 4 – dated October 16, 1965.

possibility that the openly stored materials may be drums; however, this could not be verified due to poor resolution of the photograph.[80]

In September 1982, Trojan Powder (which later became Ensign Bickford Industries, Inc. (Ensign Bickford)) began leasing Building S-4-4.[81] Information regarding their operations at this building was not found. At the time of the Site Investigation (SI) in the spring of 2000, Ensign Bickford still occupied the building.[82]

Building S-4-5 – IOP Auto Parts Storage Building

In a 1957 Refuge Narrative Report, this building was referred to as a "Service Stores Warehouse." It was damaged by fire from an explosion of an oil furnace.[83] McBrides Express was supposed to take occupancy of this building in July of 1957; however, this was delayed due to fire damage of the building.[84]

McBride Trucking Lines leased Building S-4-5 as a freight line terminal from July 1958[85] until February 1961.[86] The 1960 aerial photograph shows trailers parked at loading docks at this building.[87]

Massachusetts Electric Co. (a contractor for the new Marian Federal Penitentiary)[88] leased Building S-4-5[89] from May 1961[90] through March 1963.[91] Information regarding their operations at this building was not found.

From 1963 to 1982[92,93,94,95] Electric and Machine Corporation (Elmac Corp.) leased Building S-4-5 (and Building S-4-4).[96] This company restored used mining equipment and sold it to

---

[80] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 4 – dated October 16, 1965.
[81] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[82] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[83] CRO 000783. U. S. Department of the Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January Thru April, 1957, Page 3.
[84] CRO 000785. U. S. Department of the Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January Thru April, 1957, Page 18.
[85] DPRA Document No. 00009351. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1958, Page 18.
[86] CRO 000896. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Narrative Report, January thru April, 1961, Page 25.
[87] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 3 - dated May 1, 1960.
[88] DPRA Document No. 00016013. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1961, Table No. IV.
[89] DPRA Document No. 00009338. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1963, Page 27.
[90] DPRA Document No. 00016013. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1961, Table No. IV.
[91] DPRA Document No. 00016036. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1963, Table No. III.

operating mines.[97] These operations may have included solvent cleaning and used oil generation.

In 1982 Midwest Brush Corp. began leasing Building S-4-5;[98] they used this building to produce latex rolls for their "roll-it-on" products.[99] It was not determined how long they were present in the building.

Primex Technologies, Inc. (Primex)[100] occupied this building in 1998 until it was destroyed by fire.[101] Primex used this building for shipping and receiving.[102] Shipping and receiving was relocated to Building S-3-3 (in Area 4 West) after the building was destroyed in 1998.[103]

Aboveground Storage Tanks (ASTs)

Three structures located east of Building S-3-1 on the east side of Highway 148 were identified as probable ASTs in the 1943 aerial photograph.[104] These ASTs were identified as pumps in the War Department Facilities Inventory drawings.[105] These ASTs (or pumps) were removed by 1951.[106] There appeared to be some surficial discoloration in the area of the tanks (or pumps).[107] The contents and use of the tanks (or pumps) were not determined.

---

[92] CRO 001217. Lease Contract No. 14-16-0003-6168 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Electric and Machine Company, dated November 12, 1963, Page 1.
[93] CRO 001237. Lease Contract No. 14-16-003-13,561 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Electric and Machine Company, dated October, 89, 1971, Page 1.
[94] CRO 000397 – CRO 000398. Building Lease Contract No. 14-16-0003-81-512 by and between U. S. Fish and Wildlife Service and ELMAC Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.
[95] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[96] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[97] CRO 000064. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Narrative Report, September thru December, 1963, Page 33.
[98] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[99] DOI 000179. Diagraph Corporation's response to request for information pursuant to Section 104 (e), dated July 19, 1989, Page 2.
[100] Olin's ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end of 1996. General Dynamics Corporation acquired Primex in January 2001. Primex became a wholly owned subsidiary of General Dynamics and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS).
[101] DPRA Document No. 00017594. USFWS, copy of e-mail from Doyle Case to Gerald C, Mohl regarding an industrial building fire at Building S-4-5, dated July 6, 1998.
[102] DPRA Document No. 00017594. USFWS, copy of e-mail from Doyle Case to Gerald C, Mohl regarding an industrial building fire at Building S-4-5, dated July 6, 1998.
[103] DPRA Document No. 00017680. USFWS, Letter from Daniel Doshier to Primex Technologies, Inc. regarding the demolition of Building S-4-5 and the renovation of Building S-3-3, dated December 9, 1998.
[104] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 1 – dated February 7, 1943.
[105] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).
[106] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951.
[107] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951.

Heavy Equipment and Truck Pool Parking Area

This IOP parking area is shown in Figure 8-2. The 1951 aerial photograph showed this lot was no longer used for parking; it appeared that the northeasternmost portion of the lot was used for surface disposal.[108] The area of probable surface disposal partially overlaps with the area referred to as the Fire Station Landfill in the Metals Areas OU.[109] By 1960, the area of surface disposal had relocated (moved more to the northeast), and better correlated with the former Fire Station Landfill area.[110] By 1965 there was not much evidence of recent surface disposal in this area; instead it appeared as if a trench had been dug through the area.[111] By 1971, there was no evidence of either the surface disposal area or of a former trench location.[112] According to USFWS personnel, during remediation of the Fire Station Landfill, burnt material and ash were removed from the area of the former trench.[113]

According to the aerial photographs, this former parking lot was used from at least 1965 through 1971 as open storage for miscellaneous materials.[114] By 1980, the materials had all been removed from this area.[115] Elmac (discussed above) leased this parking area for storage.[116,117] It is assumed they used this area during the same period they occupied Buildings S-4-4 and S-4-5 (from 1963[118,119,120] to 1982[121]).

The 1993 aerial photograph showed what was interpreted as either surficial disturbance or vegetative cover in the former parking lot.[122]

---

[108] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 2 – dated August 5, 1951.
[109] The Fire Station Landfill was Site 29 of the Metals Areas Operable Unit. It was remediated in the mid-1990s.
[110] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 3 –dated May 1, 1960.
[111] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 4 – dated October 16, 1965.
[112] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 5 – dated October 14, 1971.
[113] Elaine L. Moore, USFWS, September 19, 2001.
[114] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 4 – dated October 16, 1965 and Figure 5 – dated October 14, 1971.
[115] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 6 – dated August 23, 1980.
[116] DPRA Document No. 00006406. Attachment "C", Land that identifies several companies at CONWR, dated November 8, 1976.
[117] DPRA Document No. 00006409. Special Area Designations Map associated with "Attachment C, Land," dated November 8, 1976.
[118] CRO 001217. Lease Contract No. 14-16-0003-6168 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Electric and Machine Company, dated November 12, 1963, Page 1.
[119] CRO 001237. Lease Contract No. 14-16-003-13,561 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Electric and Machine Company, dated October, 89, 1971, Page 1.
[120] CRO 000397 – CRO 000398. Building Lease Contract No. 14-16-0003-81-512 by and between U. S. Fish and Wildlife Service and ELMAC Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.
[121] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[122] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 7 dated March 28, 1993.

8.1.3 Area 4 East Previous Sampling Results

Metals Areas Operable Unit

The O'Brien & Gere Remedial Investigation (RI) included one site in Area 4 East: Site 29, the Fire Station Landfill. It was subsequently investigated further and then remediated as part of the Metals Areas Operable Unit (MAOU). The MAOU remediation was completed in 1996. Analytical data from Site 29 are not included in this report since the site was remediated. However, it was noted in the aerial photographs that at one time, surficial disposal in this area extended beyond the area that was remediated. This area was investigated further during the AUS OU SI.

1998 USEPA Sampling

In 1998, the United States Environmental Protection Agency (USEPA) collected one sample (17-1) from AUS-0017 (former Wash and Grease House – former Building S-4-1). The sample location is shown in Figures 8-3, 8-4, and 8-5. According to USEPA field notes, this site was the Vehicle Maintenance Facility. Sample AUS 17-1 was analyzed for Target Compound List (TCL) semi-volatile organic compounds (SVOCs) and Target Analyte List (TAL) metals. The results for all detected constituents are listed in Table 8-2A. No SVOCs were detected over Preliminary Assessment (PA) screening criteria, and all metals were detected within Refuge background limits.[123]

8.1.4 Observations During Site Visit

At the time of the site visit in the spring of 1999, only two buildings remained in this area, Building S-4-3 and S-4-4. Building S-4-3 was unoccupied and Building S-4-4 was occupied by Ensign Bickford. Most of the area was unused. The areas immediately surrounding the current and former buildings were either grass-covered or gravel-covered. The remaining areas were wooded. There was debris (mostly automotive related) scattered throughout the wooded areas, including an area of empty, abandoned drums located along a drainageway northeast of Building S-4-3.

8.1.5 Recommendations Based on Preliminary Assessment

Both original AUS OU sites (AUS-0011 and AUS-0017) and the rest of Area 4 East were included in the SI; except MAOU Site 29, the Fire Station Landfill, was not included. AUS-0011 was included because four underground storage tanks and two pump islands were identified historically at this site. The pump islands were removed but there is no evidence that the USTs and the piping were also removed. A magnetometer survey was done in the area of the USTs and pump islands. Based on the results of the survey, it appeared that the USTs may still be present on site along with some of the piping, but this could not be verified.

AUS-0017 was included in the SI because of its usage as a Wash and Grease House during the IOP era and because historical aerial photographs identified areas of potential liquid releases near the building.

[123] See Table 2-6 of this report for Refuge background soil values used for the PA.

Based on operations conducted in the buildings in this area and other areas of concern identified by the aerial photograph interpretation, several other areas in Area 4 East required further investigation during the SI. These are discussed below.

8.2 SITE INVESTIGATION INFORMATION

URS conducted a Site Investigation at AUS-0A4E from April 6 through May 18, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)[124] for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 8.1) has been updated to include that information. The sampling locations discussed below are based on the information 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 8-3, 8-4, and 8-5. Survey coordinates for all sample locations in Area 4 East are found in Table 8-3. Table 8-6 lists the sample locations and the matrix sampled at that location. All samples are soil samples unless otherwise noted. Groundwater samples were collected at monitoring wells.

8.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. The field investigation is summarized in this section, following the same order of description of site features as Section 8.1.2 of this report.

Building S-4-1 – IOP Wash and Grease House

Sample location 0A4E-001 was located next to the west side of former Building S-4-1 in an area of surficial discoloration that may have been the result of a liquid release.

Monitoring Well 0A4E-W01 was located in the area of a former possible liquid release that was later identified as a pit located behind (to the north of) Building S-4-1. This pit first appeared during Schilli Transportation's tenure and was still present at the time of the SI. This pit may have received solvent wastes since Schilli used this building as a truck transport service garage. This area may also have received surficial spillage from the IOP Wash and Grease House.

Sample locations 0A4E-002 through 0A4E-008 are in areas that may have received drainage from Building S-4-1. Mr. C. Hoffard, a former IOP, WAA, and USFWS mechanic, reported that wash waters and lubricating fluids from Building S-4-1 were drained to a nearby field. These sample locations were placed in the most likely area of the drainage. Sample locations 0A4E-007 and 0A4E-008 are located in a drainage ditch that flows east from the suspect field. Sample location 0A4E-008 included soil and surface water.

---

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

Building S-4-2 and S-3-4 – IOP Gas Station and Pump House

There were two sample locations related to the former IOP Gas Station. One of the locations (0A4E-W03) was south of former Building S-4-2, near the likely location of the underground storage tanks. A monitoring well was installed at this location. The other sample (0A4E-017) was near what was believed to be the location of the former pump islands.

Building S-4-3 – IOP Garage

There were two sample locations on the east side of Building S-4-3. Monitoring Well 0A4E-W02) was placed in the area of a possible liquid release identified in the 1951 aerial photograph. Soil Sample 0A4E-011 was located in an area of stressed vegetation outside one of the former garage bays. The areas just east of this building may have received wash waters from both IOP operations in this building and a later unknown tenant who also appears to have used this facility for vehicle maintenance based on the aerial photographs.

There is a north-flowing ditch approximately 200 to 250 ft east of this building. This ditch may have received drainage from Building S-4-3. Two samples were collected from this ditch (0A4E-012 and 0A4E-013).

Another ditch flows northeast starting about 125 ft northeast of the northeast corner of Building S-4-3. There is an area of abandoned drums located along this ditch (which may receive drainage from S-4-3) and sample 0A4E-009 was collected from this area.

Building S-4-4 – IOP Oil Storage Building

After the end of the IOP operations, the Elmac Corporation used this building for mine equipment restoration, and Southern Metal Arts Co. used it for manufacturing wrought iron products. Two samples were located near this building. Sample 0A4E-016 was located on the north side of the building near a former truck dock. This location was identified in the 1965 aerial photograph as an open storage area (possibly drums) with some surficial discoloration. This was during Elmac Corporation's tenure. Sample location 0A4E-020 was located on the west side of the building in another possible former drum storage area for the IOP—possibly oil storage since it is located adjacent to the Oil Storage Building.

Sample 0A4E-010 was located in the ditch next to Building S-4-4, which likely received drainage from this building.

Building S-4-5 – IOP Auto Parts Storage Building

Sample 0A4E-014 was located on the north side of former Building S-4-5 in what appears to have been a truck loading area. This building was used for storage of auto parts by the IOP, and later the Elmac Corporation used it for mine equipment restoration.

Sample 0A4E-015 was located in the ditch next to Building S-4-5, which likely received drainage from this building.

Aboveground Storage Tanks (ASTs)

Sample 0A4E-018 was taken in the area of ASTs or pumps that were identified on a historic aerial photograph. The features, identified as probable ASTs, were at the location of two former pumps identified in the IOP War Department Facilities Inventory.[125] There are no present-day landmarks to field locate these features so they were located using coordinates obtained from a historical aerial photograph[126]

Heavy Equipment and Truck Pool Parking Area

This IOP parking area was later used for open storage. An area of surficial disposal was evident on the northeast corner of this area. A portion of this disposal area (as seen in the 1951 aerial photograph) appears to overlap with the former Fire Station Landfill site (Site 29 of the MAOU); however, another portion of this disposal area does not appear to have been remediated as a part of the Fire Station Landfill. Sample location 0A4E-019 was placed in the questionable area that may not have been remediated.

8.2.2 Field Results

8.2.2.1 Site Conditions

8.2.2.1.1 Geologic Conditions

Three monitoring wells were installed at this site. Figure 8-6 is a geologic cross-section that was developed from the soil boring information from the monitoring wells. Figure 8-5 shows the location of the geologic cross-section. Boring logs and monitoring well construction diagrams are included in Appendices A and B, respectively. Boring depths ranged from 19 to 24 ft below ground surface (bgs).

As shown in the geologic cross-section in Figure 8-6, one to two ft of gravelly fill and/or topsoil overlays the site. Below the fill, there is a 9- to 12-ft thick layer of low plastic silty clay and silt loess. The loess overlies glacial till consisting of low to high plastic silty clay with sand and gravel. Sandstone bedrock was encountered below the till at a depth of 23 ft in Well 0A4E-W03. In Monitoring Well 0A4E-W02, there was a five-inch thick sand seam in the glacial till at a depth of 17.25 ft. Sand seams were not encountered in the other two borings.

The boring for Monitoring Well 0A4E-W02 had some elevated headspace readings (0-20 parts per million (ppm)) detected in the soils. The readings in the other borings were all less than two ppm and were likely background readings.

[125] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).

[126] At the beginning of the project, a test was conducted to estimate the accuracy of locating features from historic aerial photos. Using conventional methods, survey coordinates were obtained of a number of existing features at the Refuge that also appeared on a series of historic photos (for example, the corners of IOP buildings that are still existing). Entech independently obtained coordinates from the aerial photos. The coordinates obtained from the aerial photos were found to be in agreement with the coordinates obtained by conventional methods, within a few ft.

8.2.2.1.2 Hydrogeologic Conditions

Groundwater was encountered in all three soil borings during drilling, at depths ranging from 9 to 14.5 ft bgs as shown in Figure 8-6. Figure 8-7 is a groundwater elevation map of the site, for groundwater elevations obtained in October 2000. Table 8-4 presents the groundwater elevations measured in May, July, September, and October of 2000. Based on these three points and the four water level measurements, the flow direction appears to be toward the north. Slug tests were performed on each of the three wells in Area 4E, resulting in hydraulic conductivity values that ranged from 3.58E-06 to 8.97E-05 centimeters per second (cm/sec). Slug test results are presented in Table 8-5. Slug tests are included in Appendix C.

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

8.2.2.1.3 Hydrologic Conditions

The building area was leveled as part of the IOP construction, and there are perimeter ditches around the building area (Figure 8-4). The site is bordered on the west by Route 148. Surface flow is generally toward the north and east. There are no permanent surface water bodies on site.

8.2.2.2 Chemical Results

The sample analytical results are summarized in the following tables:

- Table 8-7--soil samples results,
- Table 8-8--groundwater results, and
- Table 8-9--surface water samples results.

These tables list all the chemicals detected in Area 4E 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 8-3--organic results for soil samples,
- Figure 8-4--inorganic results for soil samples, and
- Figure 8-5--all results for surface water and groundwater samples at this site.

8.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 8-10 through 8-14 as follows:

- Table 8-10--human health risk screening for soils,
- Table 8-11--human health risk screening for groundwater,
- Table 8-12--human health risk screening for surface water,
- Table 8-13--ecological risk screening for soils, and
- Table 8-14--ecological risk screening for surface water.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A4E. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

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

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

In Figures 8-3 through 8-5, the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 8-15 (human health risk) and 8-16 (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 8-15) and COPECs (Table 8-16) are shaded in the tables.

8.3.1 Human Health Risk

8.3.1.1 Soil

Human health screening results for soil samples are presented in Table 8-10. 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 x 10^{-6}. In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (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.

8.3.1.2 Groundwater

Human health screening results for groundwater are presented in Table 8-11. The maximum groundwater concentrations from AUS-0A4E were screened against maximum contaminant levels (MCLs) and Illinois Class I groundwater standards. Using MCL/Class I criteria is conservative for this site, since the groundwater at this site may be Class II rather than Class I.

8.3.1.3 Surface Water

Human health risk screening results for chemicals in surface water at AUS-0A4E are presented in Table 8-12. The maximum concentrations from AUS-0A4E were screened against the Illinois Environmental Protection Agency (IEPA) General Use Surface Water Quality Criteria – Human Health.

8.3.2 Ecological Risk

8.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 8-13. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[127]
- Environment Canada (1995)[128]
- Talmage *et al.* (1999)[129]
- Efroymson *et al.* (1997a, 1997b)[130]
- CCME (1999)[131]
- MHSPE (1994)[132]

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

[128] 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.

[129] 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.

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

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

[131] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

- 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)[133] 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.

8.3.2.2 Surface Water

Ecological screening results for surface water samples are presented in Table 8-14. 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)[134]
- EcoTox (USEPA 1996[135])
- USEPA Region IV Freshwater Screening Values (1999b)[136]
- 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)[137]
- 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

[132] 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.

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

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

[135] 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.

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

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

selecting a single ecological screening value (ESV) from among the multiple sources is presented in Appendix G.

The screening approach for ingestion pathway exposures was the same as for soils as presented in Section 8.3.2.1.

8.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A4E, 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 8-15; and on the COPEC list, Table 8-16. The only COPC in this category is chromium in soil. COPECs coded with "D" on Table 8-16 include chromium and cobalt 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 8-17.

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.

TABLE 8-1
AREA 4 EAST OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
S-3-4	1942-1945	SWDC/War Dep't	Pump House
	1983-1985	SIU-STC	Career Development Center (lease called this building a Valve House)
	1985-1990	Diagraph Corporation	Unknown (lease called this building a Valve House)
S-4-1	1942-1945	SWDC/War Dep't	Wash and Grease House
	1958-1969	Schilli Transportation	Service Garage
	1970-1971	Mark Twain Marine Industries	Fiberglass boat manufacturing
	1971-1972	Shamrock Boat Manufacturing	Storage
	1972-1990	East Side Lumber	Wholesale Lumber Supplies
S-4-2	1942-1945	SWDC/War Dep't	Fuel Dispensing Station
	1983-1985	SIU-STC	Career Development Center (lease called this building a Gas House)
	1985-1990	Diagraph Corporation	Unknown (lease called this building a Gas House)
S-4-3	1942-1945	SWDC/War Dep't	Maintenance Garage
	1951-1953	East Side Lumber (north portion of building)	Wholesale lumber supplies
	1951-1953	GTE (south portion of building)	Storage of materials and supplies
	1958-1960	Dura Crates, Inc.	Production and storage of crates and cartons
	1960-1961	E.T. Simonds	Construction material storage
	1962- 1971 1973-1997	SIU	Excess property storage and possibly vehicle maintenance, based on aerial photographs
S-4-4	1942-1945	SWDC/War Dep't	Oil Storage Building
	1958-1962	Southern Metal Arts Company	Manufacturer and fabricator of wrought iron products
	1963-1982	Electric & Machine Co.	Mining equipment refurbishment
	1982-Current	Trojan Powder/Ensign Bickford	Storage
S-4-5	1942-1945	SWDC/War Dep't	Auto Parts Storage Bldg.
	1958-1961	McBride Trucking	Freight line terminal
	1961-1963	Massachusetts Electric Co.	Construction support
	1963-1982	Electric & Machine Co.	Mining equipment refurbishment
	1982-?	Midwest Brush Corporation	Production of latex rolls
	?-1998	Primex Technologies	Shipping and receiving

Sheet 1 of 1

References for this table can be found in the Section 8.1.2 of this report.

TABLE 8-2
AREA 4 OPERATORS/LESSEES OF UNIDENTIFIED BUILDINGS

Company	Date	Operations or Products
Marion Civil Defense[138]	?-1980	Unknown

Sheet 1 of 1

[138] DPRA Document No. 00006432. List of Refuge Lessees -- unknown date.

TABLE 8-2A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
17-1	Bis(2-Ethylhexyl)phthalate	0.12J
	Aluminum	3,400
	Barium	31
	Calcium	23,000
	Chromium	8.7
	Cobalt	3.3
	Copper	7.2
	Iron	5,300
	Lead	62
	Magnesium	56,000
	Manganese	280
	Nickel	7.8
	Potassium	720
	Vanadium	6.4
	Zinc	73

Sheet 1 of 1

mg/kg = milligrams per kilogram
J = Estimated

TABLE 8-3
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A4E

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A4E-001	385953.0	785246.7	443.64	NA	
0A4E-002	386054.3	785298.9	441.89	NA	
0A4E-003	385919.8	785380.1	442.14	NA	
0A4E-004	385982.9	785401.8	441.32	NA	
0A4E-005	385864.8	785475.5	441.47	NA	
0A4E-006	386038.7	785426.5	442.45	NA	
0A4E-007	386076.8	785407.5	439.25	NA	
0A4E-008	386071.8	785515.6	437.31	NA	
0A4E-009	385887.2	785684.2	437.17	NA	
0A4E-010	385268.6	785678.5	440.46	NA	
0A4E-011	385551.8	785471.9	442.75	NA	
0A4E-012	385548.1	785677.1	438.19	NA	
0A4E-013	385816.9	785675.6	437.27	NA	
0A4E-014	385252.5	785348.8	442.26	NA	
0A4E-015	385175.2	785367.4	446.82	NA	
0A4E-016	385256.0	785542.1	441.53	NA	
0A4E-017	385712.0	785257.4	444.17	NA	
0A4E-018	386281.1	785259.6	443.88	NA	
0A4E-019	384989.4	786031.2	446.51	NA	
0A4E-020	385218.6	785507.4	445.77	NA	
0A4E-W01	385987.6	785345.0	443.52	445.96	New monitoring well
0A4E-W02	385668.8	785480.0	443.55	445.88	New monitoring well
0A4E-W03	385679.4	785231.3	444.51	447.15	New monitoring well

Sheet 1 of 1

NA = Not Applicable

TABLE 8-4
AREA 4 EAST WATER LEVEL DATA

Monitoring Well	Ground Surface Elevation (ft MSL)	TOC Elevation (ft MSL)	May-00		July-00		September-00		October-00	
			DTW (ft BTOC)	Water Elev. (ft MSL)	DTW (ft BTOC)	Water Elev. (ft MSL)	DTW (ft BTOC)	Water Elev. (ft MSL)	DTW (ft BTOC)	Water Elev. (ft MSL)
A4E-W01	443.52	445.96	5.95	440.01	6.23	439.73	8.30	437.66	9.18	436.78
A4E-W02	443.55	445.88	4.47	441.41	4.33	441.55	5.54	440.34	6.30	439.58
A4E-W03	444.51	447.15	4.96	442.19	5.27	441.88	7.27	439.88	7.64	439.51

Sheet 1 of 1

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

TABLE 8-5
SLUG TEST RESULTS

Well ID Number	Hydraulic Conductivity (cm/sec)
0A4E-W01	1.21E-05
0A4E-W02	3.58E-06
0A4E-W03	8.97E-05

Sheet 1 of 1

cm/sec = centimeters per second

TABLE 8-6
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A4E

Soil	Groundwater	Surface Water
AUS-0A4E-001	AUS-0A4E-W01	AUS-0A4E-008
AUS-0A4E-002	AUS-0A4E-W02	
AUS-0A4E-003	AUS-0A4E-W03	
AUS-0A4E-004		
AUS-0A4E-005		
AUS-0A4E-006		
AUS-0A4E-007*		
AUS-0A4E-008*		
AUS-0A4E-009*		
AUS-0A4E-010*		
AUS-0A4E-011		
AUS-0A4E-012*		
AUS-0A4E-013*		
AUS-0A4E-014		
AUS-0A4E-015		
AUS-0A4E-016		
AUS-0A4E-017		
AUS-0A4E-018		
AUS-0A4E-019		
AUS-0A4E-020		
AUS-0A4E-W01		
AUS-0A4E-W02		
AUS-0A4E-W03		

Sheet 1 of 1

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

TABLE 8-7
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
Ethylbenzene	2/28	20 ug/kg to 1,400 ug/kg
N-Hexane	2/28	6 ug/kg to 6,600 ug/kg
Toluene	1/28	2 ug/kg
Xylenes, Total	4/28	2 ug/kg to 830 ug/kg
Semivolatile Organic Compounds		
1-Methylnaphthalene	5/9	44 ug/kg to 200 ug/kg
2-Methylnaphthalene	14/23	50 ug/kg to 1,900ug/kg
Acenaphthylene	3/23	150 ug/kg to 350 ug/kg
Anthracene	5/23	7.7 ug/kg to 80 ug/kg
Benzo(a)anthracene	6/23	8 ug/kg to 100 ug/kg
Benzo(a)pyrene	7/23	7 ug/kg to 74 ug/kg
Benzo(b)fluoranthene	6/23	16 ug/kg to 120 ug/kg
Benzo(g,h,i)perylene	6/23	12 ug/kg to 100 ug/kg
Benzo(k)fluoranthene	4/23	6.2 ug/kg to 43 ug/kg
Bis(2-ethylhexyl) phthalate	9/14	43 ug/kg to 1,700 ug/kg
Chrysene	10/23	25 ug/kg to 380 ug/kg
Dibenz(a,h)anthracene	1/23	10 ug/kg
Dibenzofuran	4/14	160 ug/kg to 620 ug/kg
Dimethyl phthalate	1/14	290 ug/kg
Di-n-butyl phthalate	2/14	66 ug/kg to 89 ug/kg
Fluoranthene	14/23	14 ug/kg to 180 ug/kg
Indeno(1,2,3-c,d)pyrene	4/23	12 ug/kg to 44 ug/kg
Naphthalene	7/23	79 ug/kg to 880 mg/kg
Phenanthrene	15/23	7.1 ug/kg to 620 ug/kg
Pyrene	14/23	18 ug/kg to 390 ug/kg
Metals		
Aluminum	26/26	466 mg/kg to 10,800 mg/kg
Antimony	5/26	0.29 mg/kg to 2.3 mg/kg
Arsenic	22/26	2.8 mg/kg to 15.4 mg/kg
Barium	26/26	4.1 mg/kg to 361 mg/kg
Beryllium	1/26	0.78 mg/kg
Boron	13/26	1.7 mg/kg to 14.1 mg/kg
Cadmium	18/26	0.08 mg/kg to 3.5 mg/kg
Calcium	26/26	977 mg/kg to 185,000 mg/kg
Chromium, Total	26/26	1.1 mg/kg to 19.8 mg/kg
Cobalt	18/26	0.99 mg/kg to 21.5 mg/kg
Copper	25/26	5.5 mg/kg to 816 mg/kg
Iron	26/26	1,660 mg/kg to 22,900 mg/kg
Lead	26/26	5.3 mg/kg to 223 mg/kg
Magnesium	26/26	1,090 mg/kg to 114,000 mg/kg
Manganese	26/26	118 mg/kg to 5,410 mg/kg
Mercury	11/26	0.05 mg/kg to 0.24 mg/kg
Nickel	26/26	2.5 mg/kg to 26.7 mg/kg
Potassium	26/26	151 mg/kg to 926 mg/kg
Selenium	16/26	0.26 mg/kg to 3.2 mg/kg
Silver	4/26	0.24 mg/kg to 1.2 mg/kg
Sodium	6/26	263 mg/kg to 375 mg/kg

TABLE 8-7
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Thallium	1/26	0.21 mg/kg
Vanadium	26/26	0.75 mg/kg to 48.5 mg/kg
Zinc	26/26	10.2 mg/kg to 321 mg/kg
Other Inorganic Compounds		
Total Organic Carbon	1/1	51,500 mg/kg

Sheet 2 of 2

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

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are included only when the duplicate results are greater than original sample results, or when an analyte was detected in a duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are lower than the low end of the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/24/01

TABLE 8-8
GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Explosives Compounds		
1,3,5-Trinitrobenzene	1/1	2.5 ug/L
Metals		
Aluminum	2/3	138 ug/L to 564 ug/L
Barium	1/3	65.3 ug/L
Calcium	3/3	33,200 ug/L to 141,000 ug/L
Iron	2/3	155 ug/L to 442 ug/L
Magnesium	3/3	13,800 ug/L to 58,100 ug/L
Manganese	2/3	585 ug/L to 811 ug/L
Nickel	1/3	1.8 ug/L
Potassium	2/3	1,260 ug/L to 1,350 ug/L
Sodium	3/3	105,000 ug/L to 205,000 ug/L

Sheet 1 of 1

ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are included only when the duplicate results are greater than original sample results, or when an analyte was detected in a duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are lower than the low end of the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by ARE 5/24/01

TABLE 8-9
SURFACE WATER SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Metals		
Aluminum	1/1	367 ug/L
Barium	1/1	75.4 ug/L
Calcium	1/1	62,900 ug/L
Chromium, Total	1/1	1.5 ug/L
Iron	1/1	338 ug/L
Magnesium	1/1	20,700 ug/L
Manganese	1/1	298 ug/L
Potassium	1/1	926 ug/L
Sodium	1/1	61,900 ug/L
Zinc	1/1	6.4 ug/L
Other Organic Compounds		
Nitrogen, Ammonia (As N)	1/1	0.14 mg/L
Nitrogen, Nitrate-Nitrite	1/1	0.12 mg/L

Sheet 1 of 1

mg/L = milligrams per Liter
ug/L = micrograms per Liter

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are included only when the duplicate results are greater than original sample results, or when an analyte was detected in a duplicate and not in the original sample. There may be some duplicate results, not shown in the table, that are lower than the low end of the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by ARE 5/24/01

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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	500	U	UG/KG			1.50E-04	5.00E+00
79-34-5	1,1,2,2-Tetrachloroethane	500	U	UG/KG		5.57E-07	1.28E-04	2.50E+03
79-00-5	1,1,2-Trichloroethane	500	U	UG/KG		2.63E-07	3.29E-03	5.56E+02
75-34-3	1,1-Dichloroethane	500	U	UG/KG			2.43E-04	5.00E-01
75-35-4	1,1-Dichloroethene	500	U	UG/KG		4.21E-06	7.42E-03	1.67E+02
107-06-2	1,2-Dichloroethane (EDC)	500	U	UG/KG		6.54E-07	1.42E-02	5.00E+02
540-59-0	1,2-Dichloroethene (total)	500	U	UG/KG			3.39E-03	2.50E+01
78-87-5	1,2-Dichloropropane	500	U	UG/KG		6.51E-07	2.35E-02	5.00E+02
78-93-3	2-Butanone (MEK)	1000	U	UG/KG			3.61E-05	
591-78-6	2-Hexanone	1000	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	1000	U	UG/KG			3.46E-04	
67-64-1	Acetone	1000	U	UG/KG			1.61E-04	1.25E+00
71-43-2	Benzene	500	U	UG/KG		3.41E-07	2.06E-02	2.50E+02
75-27-4	Bromodichloromethane	500	U	UG/KG		2.12E-07	4.79E-04	1.67E+01
75-25-2	Bromoform	500	U	UG/KG		1.60E-09	2.84E-05	1.25E+01
74-83-9	Bromomethane	500	U	UG/KG			3.81E-02	5.00E+01
75-15-0	Carbon disulfide	500	U	UG/KG			4.14E-04	2.50E-01
56-23-5	Carbon tetrachloride	500	U	UG/KG		9.45E-07	7.15E-02	1.67E+02
108-90-7	Chlorobenzene	500	U	UG/KG			9.21E-04	7.14E+00
75-00-3	Chloroethane	500	U	UG/KG		7.68E-08	2.65E-05	
67-66-3	Chloroform	500	U	UG/KG		9.60E-07	3.88E-01	1.67E+01
74-87-3	Chloromethane	500	U	UG/KG		1.88E-07		
156-59-2	cis-1,2-Dichloroethene	500	U	UG/KG			3.39E-03	2.50E+01

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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	500	U	UG/KG		2.81E-06	1.14E-02	
124-48-1	Dibromochloromethane	500	U	UG/KG		1.88E-07	3.14E-04	2.50E+01
100-41-4	Ethylbenzene	1400	J	UG/KG			2.34E-04	2.00E+00
75-09-2	Methylene chloride	500	U	UG/KG		2.44E-08	5.11E-05	5.00E+02
110-54-3	N-Hexane	6600	J	UG/KG			1.64E-02	
100-42-5	Styrene	500	U	UG/KG			2.45E-05	2.50E+00
127-18-4	Tetrachloroethylene (PCE)	500	U	UG/KG		2.68E-08	2.94E-04	1.67E+02
108-88-3	Toluene	2	J	UG/KG			1.01E-06	3.33E-03
1330-20-7	total Xylenes	830	J	UG/KG			1.86E-04	8.30E-02
156-60-5	trans-1,2-Dichloroethene	500	U	UG/KG			2.33E-03	1.67E+01
10061-02-6	trans-1,3-Dichloropropene	500	U	UG/KG		2.81E-06	1.14E-02	
79-01-6	Trichloroethylene (TCE)	500	U	UG/KG		8.17E-08	6.32E-03	1.67E+02
75-01-4	Vinyl chloride	500	U	UG/KG		1.03E-05		7.14E+02
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	510	U	UG/KG			6.70E-05	1.70E+00
95-50-1	1,2-Dichlorobenzene	510	U	UG/KG			1.54E-04	5.67E-01
541-73-1	1,3-Dichlorobenzene	510	U	UG/KG			9.85E-03	
106-46-7	1,4-Dichlorobenzene	510	U	UG/KG		6.27E-08	2.65E-04	5.10E+00
95-95-4	2,4,5-Trichlorophenol	2500	U	UG/KG			2.84E-05	2.50E-01
88-06-2	2,4,6-Trichlorophenol	510	U	UG/KG		2.27E-09		6.38E+01
120-83-2	2,4-Dichlorophenol	510	U	UG/KG			1.93E-04	1.02E+01
105-67-9	2,4-Dimethylphenol	510	U	UG/KG			2.89E-05	1.28E+00
51-28-5	2,4-Dinitrophenol	2500	U	UG/KG			1.42E-03	2.50E+02
91-58-7	2-Chloronaphthalene	510	U	UG/KG			1.87E-05	

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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	510	U	UG/KG			2.11E-03	2.55E+00
90-12-0	1-Methylnaphthalene	200		UG/KG			1.06E-03	5.00E-02
91-57-6	2-Methylnaphthalene	1900		UG/KG			3.50E-05	9.50E-03
95-48-7	2-Methylphenol	510	U	UG/KG			1.16E-05	6.38E-01
88-74-4	2-Nitroaniline	2500	U	UG/KG			4.97E-02	
88-75-5	2-Nitrophenol	510	U	UG/KG			7.24E-05	
91-94-1	3,3'-Dichlorobenzidine	510	U	UG/KG		9.30E-08		1.70E+03
99-09-2	3-Nitroaniline	2500	U	UG/KG			4.97E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2500	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	510	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	510	U	UG/KG			1.16E-05	
106-47-8	4-Chloroaniline	1000	U	UG/KG			2.84E-04	3.33E+01
7005-72-3	4-Chlorophenyl phenyl ether	510	U	UG/KG				
106-44-5	4-Methylphenol	510	U	UG/KG			1.16E-04	
100-01-6	4-Nitroaniline	2500	U	UG/KG			4.97E-02	
100-02-7	4-Nitrophenol	2500	U	UG/KG			3.55E-04	
83-32-9	Acenaphthene	510	U	UG/KG			1.33E-05	1.70E-02
208-96-8	Acenaphthylene	350		UG/KG			6.45E-06	1.75E-03
120-12-7	Anthracene	80	J	UG/KG			2.05E-07	1.33E-04
56-55-3	Benzo(a)anthracene	100	J	UG/KG		3.46E-08		1.25E+00
50-32-8	Benzo(a)pyrene	74		UG/KG		2.56E-07		1.85E-01
205-99-2	Benzo(b)fluoranthene	120	J	UG/KG		4.16E-08		6.00E-01
191-24-2	Benzo(g,h,i)perylene	100		UG/KG			1.84E-06	5.00E-04
207-08-9	Benzo(k)fluoranthene	43		UG/KG		1.49E-09		2.15E-02

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
111-91-1	bis(2-Chloroethoxy)methane	510	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	510	U	UG/KG		8.23E-07		2.55E+04
108-60-1	bis(2-Chloroisopropyl) ether	510	U	UG/KG		6.31E-08	1.20E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	1700		UG/KG		9.65E-09	9.65E-05	
85-68-7	Butyl benzyl phthalate	510	U	UG/KG			2.89E-06	6.38E-04
86-74-8	Carbazole	510	U	UG/KG		4.14E-09		1.70E+01
218-01-9	Chrysene	380		UG/KG		1.32E-09		4.75E-02
84-74-2	Di-n-butyl phthalate	89	J	UG/KG			1.01E-06	2.97E-04
117-84-0	Di-n-octyl phthalate	510	U	UG/KG			2.89E-05	5.10E-05
53-70-3	Dibenz(a,h)anthracene	10		UG/KG		3.46E-08		1.25E-01
132-64-9	Dibenzofuran	620		UG/KG			1.22E-04	
84-66-2	Diethyl phthalate	510	U	UG/KG			7.24E-07	
131-11-3	Dimethyl phthalate	290	J	UG/KG			3.29E-08	
206-44-0	Fluoranthene	180		UG/KG			5.98E-06	9.00E-04
86-73-7	Fluorene	510	U	UG/KG			1.54E-05	1.70E-02
118-74-1	Hexachlorobenzene	510	U	UG/KG		3.31E-07	7.24E-04	5.10E+00
87-68-3	Hexachlorobutadiene	510	U	UG/KG		1.61E-08	2.89E-03	5.10E+00
77-47-4	Hexachlorocyclopentadiene	510	U	UG/KG			8.65E-05	2.55E-02
67-72-1	Hexachloroethane	510	U	UG/KG		2.89E-09	5.79E-04	2.55E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	44		UG/KG		1.52E-08		6.29E-02
78-59-1	Isophorone	510	U	UG/KG		1.96E-10	2.89E-06	1.70E+01
621-64-7	N-Nitroso-di-n-propylamine	510	U	UG/KG		1.45E-06		2.55E+05
86-30-6	N-Nitrosodiphenylamine	510	U	UG/KG		1.01E-09		8.50E+00
91-20-3	Naphthalene	880		UG/KG			4.67E-03	2.20E-01

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
87-86-5	Pentachlorophenol	2500	U	UG/KG		2.25E-07	1.75E-04	2.50E+03
85-01-8	Phenanthrene	620		UG/KG			1.14E-05	3.10E-03
108-95-2	Phenol	510	U	UG/KG			9.65E-07	1.02E-01
129-00-0	Pyrene	390		UG/KG			7.19E-06	1.95E-03
Explosives								
99-35-4	1,3,5-Trinitrobenzene	390	UJ	UG/KG			1.48E-05	
99-65-0	1,3-Dinitrobenzene	390	UJ	UG/KG			4.43E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	770	UJ	UG/KG		9.37E-09	1.75E-03	
121-14-2	2,4-Dinitrotoluene	480	U	UG/KG			2.72E-04	1.20E+04
606-20-2	2,6-Dinitrotoluene	770	UJ	UG/KG			8.74E-04	2.57E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	770	UJ	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	770	UJ	UG/KG				
99-08-1	3-Nitrotoluene	770	UJ	UG/KG			3.79E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	770	UJ	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	770	UJ	UG/KG			3.79E-04	
2691-41-0	HMX	770	UJ	UG/KG			1.75E-05	
98-95-3	Nitrobenzene	480	U	UG/KG			4.19E-03	
55-63-0	Nitroglycerin	1500	UJ	UG/KG		8.51E-09		
78-11-5	Pentaerythritol tetranitrate (PETN)	2400	U	UG/KG				
121-82-4	RDX	770	UJ	UG/KG		3.43E-08	2.91E-04	
479-45-8	Tetryl	1200	UJ	UG/KG			1.36E-04	
Metals								
7429-90-5	Aluminum	10800		MG/KG	3.75E-01		6.44E-03	
7440-36-0	Antimony	2.3		MG/KG	2.77E+00		2.81E-03	7.67E+00

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-38-2	Arsenic	23.6	J	MG/KG	1.75E+00	8.65E-06	5.37E-02	2.36E+01
7440-39-3	Barium	361		MG/KG	1.85E+00		2.90E-03	4.51E+00
7440-41-7	Beryllium	0.78		MG/KG	1.03E+00	3.48E-10	2.11E-04	2.60E-01
7440-42-8	Boron	14.1		MG/KG	2.66E+00		1.78E-04	
7440-43-9	Cadmium	3.5		MG/KG	1.84E+01	1.17E-09	4.32E-03	8.75E+00
7440-70-2	Calcium	185000		MG/KG	7.41E+01			
7440-47-3	Chromium	19.8		MG/KG	7.86E-01	4.42E-08		9.90E+00
7440-48-4	Cobalt	21.5		MG/KG	9.91E-01		1.75E-04	
7440-50-8	Copper	816		MG/KG	7.22E+01		1.07E-02	
7439-89-6	Iron	30100		MG/KG	1.56E+00		4.91E-02	
7439-92-1	Lead	223		MG/KG	9.53E+00			
7439-95-4	Magnesium	114000		MG/KG	7.35E+01			
7439-96-5	Manganese	5410		MG/KG	1.49E+00		1.68E-01	
7439-97-6	Mercury	0.24		MG/KG	4.00E+00			
7440-02-0	Nickel	26.7		MG/KG	1.41E+00		6.53E-04	3.81E+00
2023695	Potassium	926		MG/KG	1.48E+00			
7782-49-2	Selenium	3.2		MG/KG	1.37E+00		3.13E-04	1.07E+01
7440-22-4	Silver	1.2	J	MG/KG	2.07E+00		1.17E-04	6.00E-01
7440-23-5	Sodium	375		MG/KG	2.21E+00			
7440-28-0	Thallium	0.21	J	MG/KG	5.12E-01		1.47E-06	
7440-62-2	Vanadium	48.5		MG/KG	1.03E+00		3.39E-03	1.62E-01
7440-66-6	Zinc	321		MG/KG	6.25E+00		5.24E-04	5.35E-01
Other Parameters								
TOC	TOC	51500		MG/KG	1.64E+00			

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	500	U	UG/KG			2.50E-01
79-34-5	1,1,2,2-Tetrachloroethane	500	U	UG/KG			
79-00-5	1,1,2-Trichloroethane	500	U	UG/KG	6.10E-05	6.10E-05	2.50E+01
75-34-3	1,1-Dichloroethane	500	U	UG/KG	2.50E-06	2.50E-06	2.17E-02
75-35-4	1,1-Dichloroethene	500	U	UG/KG	2.78E-05	2.78E-04	8.33E+00
107-06-2	1,2-Dichloroethane (EDC)	500	U	UG/KG	7.94E-03	3.57E-04	2.50E+01
540-59-0	1,2-Dichloroethene (total)	500	U	UG/KG	2.50E-05	2.50E-05	1.25E+00
78-87-5	1,2-Dichloropropane	500	U	UG/KG	5.95E-03	2.78E-04	1.67E+01
78-93-3	2-Butanone (MEK)	1000	U	UG/KG			
591-78-6	2-Hexanone	1000	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	1000	U	UG/KG			
67-64-1	Acetone	1000	U	UG/KG	5.00E-06	5.00E-06	6.25E-02
71-43-2	Benzene	500	U	UG/KG	2.50E-03	1.16E-04	1.67E+01
75-27-4	Bromodichloromethane	500	U	UG/KG	5.43E-03	2.50E-04	8.33E-01
75-25-2	Bromoform	500	U	UG/KG	6.94E-04	3.13E-05	6.25E-01
74-83-9	Bromomethane	500	U	UG/KG	1.72E-04	5.00E-04	2.50E+00
75-15-0	Carbon disulfide	500	U	UG/KG	2.50E-06	2.50E-05	1.56E-02
56-23-5	Carbon tetrachloride	500	U	UG/KG	1.14E-02	1.22E-03	7.14E+00
108-90-7	Chlorobenzene	500	U	UG/KG	1.22E-05	1.22E-04	5.00E-01
75-00-3	Chloroethane	500	U	UG/KG			
67-66-3	Chloroform	500	U	UG/KG	5.32E-04	2.50E-04	8.33E-01
74-87-3	Chloromethane	500	U	UG/KG			
156-59-2	cis-1,2-Dichloroethene	500	U	UG/KG	2.50E-05	2.50E-05	1.25E+00

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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	500	U	UG/KG			
124-48-1	Dibromochloromethane	500	U	UG/KG	1.22E-05	1.22E-05	1.25E+00
100-41-4	Ethylbenzene	1400	J	UG/KG	7.00E-06	7.00E-05	1.08E-01
75-09-2	Methylene chloride	500	U	UG/KG	6.58E-04	4.17E-05	2.50E+01
110-54-3	N-Hexane	6600	J	UG/KG			
100-42-5	Styrene	500	U	UG/KG	1.22E-06	1.22E-05	1.25E-01
127-18-4	Tetrachloroethylene (PCE)	500	U	UG/KG	4.55E-03	2.08E-04	8.33E+00
108-88-3	Toluene	2	J	UG/KG	4.88E-09	4.88E-09	1.67E-04
1330-20-7	total Xylenes	830	J	UG/KG	8.30E-07	2.02E-06	5.53E-03
156-60-5	trans-1,2-Dichloroethene	500	U	UG/KG	1.22E-05	1.22E-05	7.14E-01
10061-02-6	trans-1,3-Dichloropropene	500	U	UG/KG			
79-01-6	Trichloroethylene (TCE)	500	U	UG/KG	9.62E-04	4.17E-04	8.33E+00
75-01-4	Vinyl chloride	500	U	UG/KG	1.67E-01	7.69E-03	5.00E+01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	510	U	UG/KG	2.55E-05	2.55E-04	1.02E-01
95-50-1	1,2-Dichlorobenzene	510	U	UG/KG	2.83E-06	2.83E-05	3.00E-02
541-73-1	1,3-Dichlorobenzene	510	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	510	U	UG/KG			2.55E-01
95-95-4	2,4,5-Trichlorophenol	2500	U	UG/KG	1.25E-05	1.25E-05	9.26E-03
88-06-2	2,4,6-Trichlorophenol	510	U	UG/KG	9.81E-04	4.64E-05	2.55E+00
120-83-2	2,4-Dichlorophenol	510	U	UG/KG	8.36E-05	8.36E-04	5.10E-01
105-67-9	2,4-Dimethylphenol	510	U	UG/KG	1.24E-05	1.24E-05	5.67E-02
51-28-5	2,4-Dinitrophenol	2500	U	UG/KG	6.10E-04	6.10E-03	1.25E+01
91-58-7	2-Chloronaphthalene	510	U	UG/KG			

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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	510	U	UG/KG	5.10E-05	5.10E-05	1.28E-01
90-12-0	1-Methylnaphthalene	200		UG/KG	2.44E-06	2.44E-05	2.38E-03
91-57-6	2-Methylnaphthalene	1900		UG/KG	3.11E-05	3.11E-05	4.52E-04
95-48-7	2-Methylphenol	510	U	UG/KG	5.10E-06	5.10E-06	3.40E-02
88-74-4	2-Nitroaniline	2500	U	UG/KG			
88-75-5	2-Nitrophenol	510	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	510	U	UG/KG	3.92E-02	1.82E-03	7.29E+01
99-09-2	3-Nitroaniline	2500	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2500	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	510	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	510	U	UG/KG			
106-47-8	4-Chloroaniline	1000	U	UG/KG	1.22E-04	1.22E-03	1.43E+00
7005-72-3	4-Chlorophenyl phenyl ether	510	U	UG/KG			
106-44-5	4-Methylphenol	510	U	UG/KG			
100-01-6	4-Nitroaniline	2500	U	UG/KG			
100-02-7	4-Nitrophenol	2500	U	UG/KG			
83-32-9	Acenaphthene	510	U	UG/KG	4.25E-06	4.25E-06	8.95E-04
208-96-8	Acenaphthylene	350		UG/KG	5.74E-06	5.74E-06	8.33E-05
120-12-7	Anthracene	80	J	UG/KG	1.31E-07	1.31E-07	6.67E-06
56-55-3	Benzo(a)anthracene	100	J	UG/KG	1.25E-02	5.88E-04	5.00E-02
50-32-8	Benzo(a)pyrene	74		UG/KG	9.25E-02	4.35E-03	9.25E-03
205-99-2	Benzo(b)fluoranthene	120	J	UG/KG	1.50E-02	7.06E-04	2.40E-02
191-24-2	Benzo(g,h,i)perylene	100		UG/KG	1.64E-06	1.64E-06	2.38E-05
207-08-9	Benzo(k)fluoranthene	43		UG/KG	5.51E-04	2.53E-05	8.78E-04

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-91-1	bis(2-Chloroethoxy)methane	510	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	510	U	UG/KG	1.02E-01	6.80E-03	1.28E+03
108-60-1	bis(2-Chloroisopropyl) ether	510	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	1700		UG/KG	4.15E-03	4.15E-04	4.72E-04
85-68-7	Butyl benzyl phthalate	510	U	UG/KG	1.24E-06	1.24E-06	5.48E-04
86-74-8	Carbazole	510	U	UG/KG	1.76E-03	8.23E-05	8.50E-01
218-01-9	Chrysene	380		UG/KG	4.87E-04	2.24E-05	2.38E-03
84-74-2	Di-n-butyl phthalate	89	J	UG/KG	4.45E-07	4.45E-07	3.87E-05
117-84-0	Di-n-octyl phthalate	510	U	UG/KG	1.24E-05	1.24E-04	5.10E-05
53-70-3	Dibenz(a,h)anthracene	10		UG/KG	1.25E-02	5.88E-04	5.00E-03
132-64-9	Dibenzofuran	620		UG/KG			
84-66-2	Diethyl phthalate	510	U	UG/KG	5.10E-07	5.10E-07	1.09E-03
131-11-3	Dimethyl phthalate	290	J	UG/KG			
206-44-0	Fluoranthene	180		UG/KG	2.20E-06	2.20E-06	4.19E-05
86-73-7	Fluorene	510	U	UG/KG	6.22E-06	6.22E-06	9.11E-04
118-74-1	Hexachlorobenzene	510	U	UG/KG	1.28E-01	6.54E-03	2.55E-01
87-68-3	Hexachlorobutadiene	510	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	510	U	UG/KG	3.64E-05	3.64E-05	1.28E-03
67-72-1	Hexachloroethane	510	U	UG/KG	2.55E-04	2.55E-04	1.02E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	44		UG/KG	5.50E-03	2.59E-04	3.14E-03
78-59-1	Isophorone	510	U	UG/KG	1.24E-06	1.24E-06	6.38E-02
621-64-7	N-Nitroso-di-n-propylamine	510	U	UG/KG	6.38E-01	2.83E-02	1.02E+04
86-30-6	N-Nitrosodiphenylamine	510	U	UG/KG	4.25E-04	2.04E-05	5.10E-01
91-20-3	Naphthalene	880		UG/KG	1.07E-05	1.07E-04	1.05E-02

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
87-86-5	Pentachlorophenol	2500	U	UG/KG	1.04E-01	4.81E-03	8.33E+01
85-01-8	Phenanthrene	620		UG/KG	1.02E-05	1.02E-05	1.48E-04
108-95-2	Phenol	510	U	UG/KG	5.10E-07	4.25E-06	5.10E-03
129-00-0	Pyrene	390		UG/KG	6.39E-06	6.39E-06	9.29E-05
Explosives							
99-35-4	1,3,5-Trinitrobenzene	390	UJ	UG/KG			
99-65-0	1,3-Dinitrobenzene	390	UJ	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	770	UJ	UG/KG			
121-14-2	2,4-Dinitrotoluene	480	U	UG/KG	5.71E-02	2.67E-03	6.00E+02
606-20-2	2,6-Dinitrotoluene	770	UJ	UG/KG	9.17E-02	4.28E-03	1.10E+03
35572-78-2	2-Amino-4,6-Dinitrotoluene	770	UJ	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	770	UJ	UG/KG			
99-08-1	3-Nitrotoluene	770	UJ	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	770	UJ	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	770	UJ	UG/KG			
2691-41-0.	HMX	770	UJ .	UG/KG			
98-95-3	Nitrobenzene	480	U	UG/KG	4.80E-04	4.80E-04	4.80E+00
55-63-0	Nitroglycerin	1500	UJ	UG/KG			
78-11-5	Pentaerythritol tetranitrate (PETN)	2400	U	UG/KG			
121-82-4	RDX	770	UJ	UG/KG			
479-45-8	Tetryl	1200	UJ	UG/KG			
Metals							
7429-90-5	Aluminum	10800		MG/KG			
7440-36-0	Antimony	2.3		MG/KG	2.80E-03	2.80E-02	4.60E-01

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

TABLE 8-10
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-38-2	Arsenic	23.6	J	MG/KG	7.87E+00	3.87E-01	8.43E-01
7440-39-3	Barium	361		MG/KG	2.58E-03	2.58E-02	3.01E-01
7440-41-7	Beryllium	0.78		MG/KG	7.80E-01	2.69E-02	1.18E-01
7440-42-8	Boron	14.1		MG/KG	7.83E-05	7.83E-04	
7440-43-9	Cadmium	3.5		MG/KG	1.75E-03	1.75E-02	9.46E-01
7440-70-2	Calcium	185000		MG/KG			
7440-47-3	Chromium	19.8		MG/KG	1.98E-03	4.83E-03	7.07E-01
7440-48-4	Cobalt	21.5		MG/KG	1.79E-04	1.79E-03	
7440-50-8	Copper	816		MG/KG	9.95E-03	9.95E-02	7.42E-02
7439-89-6	Iron	30100		MG/KG			
7439-92-1	Lead	223		MG/KG	5.58E-01	5.58E-01	
7439-95-4	Magnesium	114000		MG/KG			
7439-96-5	Manganese	5410		MG/KG	5.64E-02	5.64E-01	
7439-97-6	Mercury	0.24		MG/KG	3.93E-04	3.93E-03	1.60E+00
7440-02-0	Nickel	26.7		MG/KG	6.51E-04	6.51E-03	3.51E-01
2023695	Potassium	926		MG/KG			
7782-49-2	Selenium	3.2		MG/KG	3.20E-04	3.20E-03	1.33E+00
7440-22-4	Silver	1.2	J	MG/KG	1.20E-04	1.20E-03	8.00E-01
7440-23-5	Sodium	375		MG/KG			
7440-28-0	Thallium	0.21	J	MG/KG	1.31E-03	1.31E-03	8.75E-02
7440-62-2	Vanadium	48.5		MG/KG	3.46E-03	3.46E-02	4.95E-02
7440-66-6	Zinc	321		MG/KG	5.26E-04	5.26E-03	8.92E-02
Other Parameters							
TOC	TOC	51500		MG/KG			

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

TABLE 8-11
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	1	U	UG/L		1.26E-03	5.00E-03
79-34-5	1,1,2,2-Tetrachloroethane	1	U	UG/L	1.81E-05	2.74E-03	
79-00-5	1,1,2-Trichloroethane	1	U	UG/L	5.01E-06	4.11E-02	2.00E-01
75-34-3	1,1-Dichloroethane	1	U	UG/L		1.23E-03	
75-35-4	1,1-Dichloroethene	1	U	UG/L	2.19E-05	1.83E-02	1.43E-01
107-06-2	1,2-Dichloroethane (EDC)	1	U	UG/L	8.12E-06	9.88E-02	2.00E-01
78-87-5	1,2-Dichloropropane	1	U	UG/L	6.07E-06	1.45E-01	2.00E-01
78-93-3	2-Butanone (MEK)	5	U	UG/L		2.63E-03	
591-78-6	2-Hexanone	5	U	UG/L			
108-10-1	4-Methyl-2-pentanone (MIBK)	5	U	UG/L		3.17E-02	
67-64-1	Acetone	5	U	UG/L		8.22E-03	
71-43-2	Benzene	1	U	UG/L	2.44E-06	8.92E-02	2.00E-01
75-27-4	Bromodichloromethane	1	U	UG/L	5.53E-06	8.22E-03	
75-25-2	Bromoform	1	U	UG/L	1.18E-07	1.37E-03	
74-83-9	Bromomethane	1	U	UG/L		1.15E-01	
75-15-0	Carbon disulfide	1	U	UG/L		9.59E-04	
56-23-5	Carbon tetrachloride	1	U	UG/L	5.84E-06	2.35E-01	2.00E-01
108-90-7	Chlorobenzene	1	U	UG/L		9.43E-03	1.00E-02
75-00-3	Chloroethane	1	U	UG/L	2.16E-07	1.16E-04	
67-66-3	Chloroform	1	U	UG/L	6.08E-06	1.60E+00	
74-87-3	Chloromethane	1	U	UG/L	6.62E-07		
156-59-2	cis-1,2-Dichloroethene	1	U	UG/L		1.64E-02	1.43E-02
10061-01-5	cis-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	

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

TABLE 8-11
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
124-48-1	Dibromochloromethane	1	U	UG/L	7.50E-06	8.22E-03	
100-41-4	Ethylbenzene	1	U	UG/L		7.46E-04	1.43E-03
75-09-2	Methylene chloride	1	U	UG/L	2.34E-07	6.16E-04	2.00E-01
110-54-3	N-Hexane	1	U	UG/L		2.85E-03	
100-42-5	Styrene	1	U	UG/L		6.09E-04	1.00E-02
127-18-4	Tetrachloroethylene (PCE)	1	U	UG/L	9.24E-07	3.94E-03	2.00E-01
108-88-3	Toluene	1	U	UG/L		1.38E-03	1.00E-03
1330-20-7	total Xylenes	1	U	UG/L		6.99E-04	1.00E-04
156-60-5	trans-1,2-Dichloroethene	1	U	UG/L		8.22E-03	1.00E-02
10061-02-6	trans-1,3-Dichloropropene	1	U	UG/L	1.23E-05	1.15E-01	
79-01-6	Trichloroethylene (TCE)	1	U	UG/L	6.10E-07	2.74E-02	2.00E-01
75-01-4	Vinyl chloride	1	U	UG/L	5.06E-05		5.00E-01
Polynuclear Aromatic Hydrocarbons (PAHs)							
90-12-0	1-Methylnaphthalene	1	U	UG/L		1.61E-01	
91-57-6	2-Methylnaphthalene	1	U	UG/L		5.48E-03	
83-32-9	Acenaphthene	1	U	UG/L		2.74E-03	
208-96-8	Acenaphthylene	2	U	UG/L		1.10E-02	
120-12-7	Anthracene	0.15	U	UG/L		8.22E-05	
56-55-3	Benzo(a)anthracene	0.15	U	UG/L	1.63E-06		
50-32-8	Benzo(a)pyrene	0.15	U	UG/L	1.63E-05		7.50E-01
205-99-2	Benzo(b)fluoranthene	0.2	U	UG/L	2.17E-06		
191-24-2	Benzo(g,h,i)perylene	0.2	U	UG/L		1.10E-03	
207-08-9	Benzo(k)fluoranthene	0.15	U	UG/L	1.63E-07		
218-01-9	Chrysene	0.15	U	UG/L	1.63E-08		

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

TABLE 8-11
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
53-70-3	Dibenz(a,h)anthracene	0.25	U	UG/L	2.71E-05		
206-44-0	Fluoranthene	0.2	U	UG/L		1.37E-04	
86-73-7	Fluorene	0.2	U	UG/L		8.22E-04	
193-39-5	Indeno(1,2,3-c,d)pyrene	0.15	U	UG/L	1.63E-06		
91-20-3	Naphthalene	1	U	UG/L		1.61E-01	
85-01-8	Phenanthrene	0.15	U	UG/L		8.22E-04	
129-00-0	Pyrene	0.2	U	UG/L		1.10E-03	
Explosives							
99-35-4	1,3,5-Trinitrobenzene	2.5		UG/L		2.28E-03	
99-65-0	1,3-Dinitrobenzene	0.25	UJ	UG/L		6.85E-02	
118-96-7	2,4,6-Trinitrotoluene (TNT)	0.5	U	UG/L	2.23E-07	2.74E-02	
121-14-2	2,4-Dinitrotoluene	0.25	UJ	UG/L		3.42E-03	
606-20-2	2,6-Dinitrotoluene	0.5	U	UG/L		1.37E-02	
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.5	U	UG/L			
88-72-2	2-Nitrotoluene (ONT)	0.5	U	UG/L			
99-08-1	3-Nitrotoluene	0.5	UJ	UG/L		8.22E-03	
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.5	U	UG/L			
99-99-0	4-Nitrotoluene (PNT)	0.5	U	UG/L		8.22E-03	
2691-41-0	HMX	0.5	U	UG/L		2.74E-04	
98-95-3	Nitrobenzene	0.25	UJ	UG/L		7.36E-02	
55-63-0	Nitroglycerin	1	U	UG/L	2.08E-07		
78-11-5	Pentaerythritol tetranitrate (PETN)	2	U	UG/L			
121-82-4	RDX	0.5	U	UG/L	8.18E-07	4.57E-03	
479-45-8	Tetryl	0.75	U	UG/L		2.05E-03	

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

TABLE 8-11
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
Metals							
7429-90-5	Aluminum	1320	J	UG/L		3.62E-02	
7440-36-0	Antimony	6	U	UG/L		4.11E-01	1.00E+00
7440-38-2	Arsenic	10	U	UG/L	2.23E-04	9.13E-01	2.00E-01
7440-39-3	Barium	65.3	J	UG/L		2.56E-02	3.27E-02
7440-41-7	Beryllium	5	U	UG/L		6.85E-02	1.25E+00
7440-42-8	Boron	100	U	UG/L		3.04E-02	5.00E-02
7440-43-9	Cadmium	5	U	UG/L		2.74E-01	1.00E+00
7440-70-2	Calcium	141000		UG/L			
7440-47-3	Chromium	10	U	UG/L			1.00E-01
7440-48-4	Cobalt	50	U	UG/L		2.28E-02	5.00E-02
7440-50-8	Copper	10	U	UG/L		7.38E-03	1.54E-02
7439-89-6	Iron	805	J	UG/L		7.35E-02	1.61E-01
7439-92-1	Lead	3	U	UG/L			4.00E-01
7439-95-4	Magnesium	58100		UG/L			
7439-96-5	Manganese	811		UG/L		9.26E-01	5.41E+00
7439-97-6	Mercury	0.2	U	UG/L			1.00E-01
7440-02-0	Nickel	1.8	J	UG/L		2.47E-03	1.80E-02
2023695	Potassium	1350	J	UG/L			
7782-49-2	Selenium	5	U	UG/L		2.74E-02	1.00E-01
7440-22-4	Silver	10	U	UG/L		5.48E-02	2.00E-01
7440-23-5	Sodium	205000		UG/L			
7440-28-0	Thallium	10	U	UG/L		3.91E+00	5.00E+00
7440-62-2	Vanadium	50	U	UG/L		1.96E-01	

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

TABLE 8-11
HUMAN HEALTH SCREENING OF GROUNDWATER RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Cancer Risk Based on USEPA Region 9 PRG for Carcinogens (Tap Water)	Hazard Quotient (HQ) Based on USEPA Region 9 PRG for Toxins (Tap Water)	Ratio of Max Concentration (or Max RL) to USEPA MCL and/or IEPA Class I Groundwater Standard
7440-66-6	Zinc	20	U	UG/L		1.83E-03	4.00E-03

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

TABLE 8-12
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 4E (AUS-0A4E)

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
Polynuclear Aromatic Hydrocarbons						
90-12-0	1-Methylnaphthalene	1	UJ	UG/L		
91-57-6	2-Methylnaphthalene	1	UJ	UG/L		2.86E-04
83-32-9	Acenaphthene	1	UJ	UG/L		
208-96-8	Acenaphthylene	2	UJ	UG/L		5.71E-04
120-12-7	Anthracene	0.15	UJ	UG/L		4.29E-06
56-55-3	Benzo(a)anthracene	0.15	UJ	UG/L		1.50E+00
50-32-8	Benzo(a)pyrene	0.15	UJ	UG/L		1.50E+01
205-99-2	Benzo(b)fluoranthene	0.2	UJ	UG/L		2.00E+00
191-24-2	Benzo(g,h,i)perylene	0.2	UJ	UG/L		5.71E-05
207-08-9	Benzo(k)fluoranthene	0.15	UJ	UG/L		
218-01-9	Chrysene	0.15	UJ	UG/L		1.50E-02
53-70-3	Dibenz(a,h)anthracene	0.25	UJ	UG/L		
206-44-0	Fluoranthene	0.2	UJ	UG/L		1.67E-03
86-73-7	Fluorene	0.2	UJ	UG/L		4.44E-05
193-39-5	Indeno(1,2,3-c,d)pyrene	0.15	UJ	UG/L		1.50E+00
91-20-3	Naphthalene	1	UJ	UG/L		
85-01-8	Phenanthrene	0.15	UJ	UG/L		4.29E-05
129-00-0	Pyrene	0.2	UJ	UG/L		5.71E-05
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		
55-63-0	Nitroglycerin	1	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	367		UG/L	1.84E+00	
7440-36-0	Antimony	6	U	UG/L	1.00E+00	
7440-38-2	Arsenic	10	U	UG/L	1.00E+00	
7440-39-3	Barium	75.4	J	UG/L	3.32E+00	1.51E-02

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

TABLE 8-12
HUMAN HEALTH SCREENING OF SURFACE WATER RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (Surface Water)	Ratio of Max Concentration (or Max RL) to IEPA General Use Surface Water Quality Criteria - Human Health
7440-41-7	Beryllium	5	U	UG/L	1.00E+00	
7440-42-8	Boron	100	U	UG/L		1.00E-01
7440-43-9	Cadmium	5	U	UG/L	1.00E+00	
7440-70-2	Calcium	62900		UG/L	8.74E+00	
7440-47-3	Chromium	1.5	J	UG/L	1.50E-01	
7440-48-4	Cobalt	50	U	UG/L	1.00E+00	
7440-50-8	Copper	10	U	UG/L	1.00E+00	
7439-89-6	Iron	338		UG/L	3.38E+00	3.38E-01
7439-92-1	Lead	3	U	UG/L	1.50E+00	
7439-95-4	Magnesium	20700		UG/L	8.17E+00	
7439-96-5	Manganese	298		UG/L	5.12E-01	2.98E-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	926	J	UG/L	5.74E-01	
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	61900		UG/L	1.95E+01	
7440-28-0	Thallium	10	U	UG/L	1.00E+00	
7440-62-2	Vanadium	50	U	UG/L	1.00E+00	
7440-66-6	Zinc	6.4	J	UG/L	3.20E-01	6.40E-03
Other Parameters						
7664-41-7	Nitrogen, Ammonia (as N)	0.14	J	MG/L	5.38E-01	
Nitrate+Nitrite	Nitrogen, Nitrate-Nitrite	0.12	J	MG/L	2.40E+00	

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

TABLE 8-13
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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		500	U	UG/KG	1.68E-02	
79-34-5	1,1,2,2-Tetrachloroethane		500	U	UG/KG	3.93E+00	
79-00-5	1,1,2-Trichloroethane		500	U	UG/KG	1.75E-02	
75-34-3	1,1-Dichloroethane		500	U	UG/KG	2.49E-02	
75-35-4	1,1-Dichloroethene		500	U	UG/KG	6.04E-02	
107-06-2	1,2-Dichloroethane (EDC)		500	U	UG/KG	2.36E-02	
540-59-0	1,2-Dichloroethene (total)		500	U	UG/KG	6.35E-01	
78-87-5	1,2-Dichloropropane		500	U	UG/KG	7.14E-04	
78-93-3	2-Butanone (MEK)		1000	U	UG/KG	1.12E-02	
591-78-6	2-Hexanone		1000	U	UG/KG	7.94E-02	
108-10-1	4-Methyl-2-pentanone (MIBK)		1000	U	UG/KG	2.26E-03	
67-64-1	Acetone		1000	U	UG/KG	4.00E-01	
71-43-2	Benzene		500	U	UG/KG	3.13E-02	
75-27-4	Bromodichloromethane		500	U	UG/KG	9.26E-01	
75-25-2	Bromoform		500	U	UG/KG	3.14E-02	
74-83-9	Bromomethane		500	U	UG/KG	2.13E+00	
75-15-0	Carbon disulfide		500	U	UG/KG	5.31E+00	
56-23-5	Carbon tetrachloride		500	U	UG/KG	5.00E-04	
108-90-7	Chlorobenzene		500	U	UG/KG	1.25E-02	
75-00-3	Chloroethane		500	U	UG/KG		
67-66-3	Chloroform		500	U	UG/KG	4.20E-01	
74-87-3	Chloromethane		500	U	UG/KG	4.81E-02	
156-59-2	cis-1,2-Dichloroethene		500	U	UG/KG	6.35E-01	
10061-01-5	cis-1,3-Dichloropropene		500	U	UG/KG	1.26E+00	
124-48-1	Dibromochloromethane		500	U	UG/KG	2.44E-01	
100-41-4	Ethylbenzene		1400	J	UG/KG	2.80E-01	
75-09-2	Methylene chloride		500	U	UG/KG	1.23E-01	
110-54-3	N-Hexane		6600	J	UG/KG		
100-42-5	Styrene		500	U	UG/KG	1.67E-03	
127-18-4	Tetrachloroethylene (PCE)		500	U	UG/KG	3.85E-02	
108-88-3	Toluene		2	J	UG/KG	6.67E-04	
1330-20-7	total Xylenes		830	J	UG/KG	1.38E+00	
156-60-5	trans-1,2-Dichloroethene		500	U	UG/KG	6.35E-01	
10061-02-6	trans-1,3-Dichloropropene		500	U	UG/KG	1.26E+00	
79-01-6	Trichloroethylene (TCE)		500	U	UG/KG	5.56E-02	
75-01-4	Vinyl chloride		500	U	UG/KG	7.74E-01	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		510	U	UG/KG	2.55E-02	
95-50-1	1,2-Dichlorobenzene		510	U	UG/KG	1.72E-01	
541-73-1	1,3-Dichlorobenzene		510	U	UG/KG	1.35E-02	
106-46-7	1,4-Dichlorobenzene		510	U	UG/KG	2.55E-02	

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

TABLE 8-13
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

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
90-12-0	1-Methylnaphthalene		200		UG/KG		
95-95-4	2,4,5-Trichlorophenol		2500	U	UG/KG	6.25E-01	
88-06-2	2,4,6-Trichlorophenol		510	U	UG/KG	5.10E-02	
120-83-2	2,4-Dichlorophenol		510	U	UG/KG	5.83E-03	
105-67-9	2,4-Dimethylphenol		510	U	UG/KG	5.10E+01	
51-28-5	2,4-Dinitrophenol		2500	U	UG/KG	1.25E-01	
91-58-7	2-Chloronaphthalene		510	U	UG/KG	4.19E+01	
95-57-8	2-Chlorophenol		510	U	UG/KG	2.10E+00	
91-57-6	2-Methylnaphthalene		1900		UG/KG	5.86E-01	YES
95-48-7	2-Methylphenol		510	U	UG/KG	1.26E-02	
88-74-4	2-Nitroaniline		2500	U	UG/KG	3.37E-02	
88-75-5	2-Nitrophenol		510	U	UG/KG	3.19E-01	
91-94-1	3,3'-Dichlorobenzidine		510	U	UG/KG	7.89E-01	
99-09-2	3-Nitroaniline		2500	U	UG/KG	7.91E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2500	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		510	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		510	U	UG/KG	6.42E-02	
106-47-8	4-Chloroaniline		1000	U	UG/KG	9.09E-01	
7005-72-3	4-Chlorophenyl phenyl ether		510	U	UG/KG		
106-44-5	4-Methylphenol		510	U	UG/KG	3.13E-03	
100-01-6	4-Nitroaniline		2500	U	UG/KG	1.14E-01	
100-02-7	4-Nitrophenol		2500	U	UG/KG	3.57E-01	
83-32-9	Acenaphthene		510	U	UG/KG	7.47E-04	
208-96-8	Acenaphthylene		350		UG/KG	5.13E-04	
120-12-7	Anthracene		80	J	UG/KG	5.41E-05	YES
56-55-3	Benzo(a)anthracene		100	J	UG/KG	1.92E-02	YES
50-32-8	Benzo(a)pyrene		74		UG/KG	1.68E-05	YES
205-99-2	Benzo(b)fluoranthene		120	J	UG/KG	2.01E-03	YES
191-24-2	Benzo(g,h,i)perylene		100		UG/KG	8.40E-04	YES
207-08-9	Benzo(k)fluoranthene		43		UG/KG	7.19E-04	YES
111-91-1	bis(2-Chloroethoxy)methane		510	U	UG/KG	1.68E+00	
111-44-4	bis(2-Chloroethyl) ether		510	U	UG/KG	2.15E-02	
108-60-1	bis(2-Chloroisopropyl) ether		510	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		1700		UG/KG	1.84E+00	YES
85-68-7	Butyl benzyl phthalate		510	U	UG/KG	2.13E+00	
86-74-8	Carbazole		510	U	UG/KG		
218-01-9	Chrysene		380		UG/KG	8.03E-02	YES
84-74-2	Di-n-butyl phthalate		89	J	UG/KG	4.45E-04	YES
117-84-0	Di-n-octyl phthalate		510	U	UG/KG	7.19E-04	
53-70-3	Dibenz(a,h)anthracene		10		UG/KG	5.43E-04	YES
132-64-9	Dibenzofuran		620		UG/KG		YES
84-66-2	Diethyl phthalate		510	U	UG/KG	5.10E-03	

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

TABLE 8-13
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
131-11-3	Dimethyl phthalate		290	J	UG/KG	1.45E-03	
206-44-0	Fluoranthene		180		UG/KG	1.48E-03	YES
86-73-7	Fluorene		510	U	UG/KG	1.70E-02	
118-74-1	Hexachlorobenzene		510	U	UG/KG	5.10E-04	
87-68-3	Hexachlorobutadiene		510	U	UG/KG	1.28E+01	
77-47-4	Hexachlorocyclopentadiene		510	U	UG/KG	5.10E-02	
67-72-1	Hexachloroethane		510	U	UG/KG	8.55E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		44		UG/KG	4.04E-04	YES
78-59-1	Isophorone		510	U	UG/KG	3.67E-03	
621-64-7	N-Nitroso-di-n-propylamine		510	U	UG/KG	9.38E-01	
86-30-6	N-Nitrosodiphenylamine		510	U	UG/KG	2.55E-02	
91-20-3	Naphthalene		880		UG/KG	3.53E-03	
87-86-5	Pentachlorophenol		2500	U	UG/KG	4.17E-01	
85-01-8	Phenanthrene		620		UG/KG	1.36E-02	YES
108-95-2	Phenol		510	U	UG/KG	1.28E-02	
129-00-0	Pyrene		390		UG/KG	4.97E-03	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		390	UJ	UG/KG	1.04E+00	
99-65-0	1,3-Dinitrobenzene		390	UJ	UG/KG	5.96E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		770	UJ	UG/KG	2.57E-02	
121-14-2	2,4-Dinitrotoluene		480	U	UG/KG	3.75E-01	
606-20-2	2,6-Dinitrotoluene		770	UJ	UG/KG	2.35E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		770	UJ	UG/KG	9.63E-03	
88-72-2	2-Nitrotoluene (ONT)		770	UJ	UG/KG		
99-08-1	3-Nitrotoluene		770	UJ	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		770	UJ	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		770	UJ	UG/KG		
2691-41-0	HMX		770	UJ	UG/KG	3.08E-02	
98-95-3	Nitrobenzene		480	U	UG/KG	1.20E-02	
55-63-0	Nitroglycerin		1500	UJ	UG/KG		
78-11-5	Pentaerythritol tetranitrate (PETN)		2400	U	UG/KG		
121-82-4	RDX		770	UJ	UG/KG	7.70E-03	
479-45-8	Tetryl		1200	UJ	UG/KG		
Metals							
7429-90-5	Aluminum	28800	10800		MG/KG		
7440-36-0	Antimony	0.83	2.3		MG/KG	4.60E-01	
7440-38-2	Arsenic	13.5	23.6	J	MG/KG	2.62E+00	
7440-39-3	Barium	195	361		MG/KG	7.22E-01	
7440-41-7	Beryllium	0.76	0.78		MG/KG	7.80E-02	
7440-42-8	Boron	5.3	14.1		MG/KG	2.82E+01	
7440-43-9	Cadmium	0.19	3.5		MG/KG	1.21E-01	
7440-70-2	Calcium	2497	185000		MG/KG		

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

TABLE 8-13
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4E (AUS-0A4E)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-47-3	Chromium	25.2	19.8		MG/KG	3.96E+00	
7440-48-4	Cobalt	21.7	21.5		MG/KG	1.08E+00	
7440-50-8	Copper	11.3	816		MG/KG	2.63E+01	
7439-89-6	Iron	19306	30100		MG/KG	1.51E+02	
7439-92-1	Lead	23.4	223		MG/KG	5.15E-01	
7439-95-4	Magnesium	1552	114000		MG/KG		
7439-96-5	Manganese	3640	5410		MG/KG	5.41E+01	
7439-97-6	Mercury	0.06	0.24		MG/KG	3.43E-02	YES
7440-02-0	Nickel	18.9	26.7		MG/KG	8.90E-01	
2023695	Potassium	625	926		MG/KG		
7782-49-2	Selenium	2.34	3.2		MG/KG	3.20E+00	YES
7440-22-4	Silver	0.58	1.2	J	MG/KG	6.00E-01	
7440-23-5	Sodium	170	375		MG/KG		
7440-28-0	Thallium	0.41	0.21	J	MG/KG	2.10E-01	
7440-62-2	Vanadium	47.2	48.5		MG/KG	1.05E+00	
7440-66-6	Zinc	51.4	321		MG/KG	2.68E+00	
Other Parameters							
TOC	TOC	31393	51500		MG/KG		

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

TABLE 8-14
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 4E (AUS-0A4E)

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							
90-12-0	1-Methylnaphthalene		1	UJ	UG/L		
91-57-6	2-Methylnaphthalene		1	UJ	UG/L	2.40E-03	
83-32-9	Acenaphthene		1	UJ	UG/L	5.88E-02	
208-96-8	Acenaphthylene		2	UJ	UG/L	3.01E-03	
120-12-7	Anthracene		0.15	UJ	UG/L	2.50E-02	
56-55-3	Benzo(a)anthracene		0.15	UJ	UG/L	5.56E+00	
50-32-8	Benzo(a)pyrene		0.15	UJ	UG/L	1.07E+01	
205-99-2	Benzo(b)fluoranthene		0.2	UJ	UG/L	3.57E+01	
191-24-2	Benzo(g,h,i)perylene		0.2	UJ	UG/L	2.62E-02	
207-08-9	Benzo(k)fluoranthene		0.15	UJ	UG/L	2.68E+01	
218-01-9	Chrysene		0.15	UJ	UG/L	9.38E-03	
53-70-3	Dibenz(a,h)anthracene		0.25	UJ	UG/L	1.56E+02	
206-44-0	Fluoranthene		0.2	UJ	UG/L	2.47E-02	
86-73-7	Fluorene		0.2	UJ	UG/L	5.13E-02	
193-39-5	Indeno(1,2,3-c,d)pyrene		0.15	UJ	UG/L	3.48E-02	
91-20-3	Naphthalene		1	UJ	UG/L	8.33E-02	
85-01-8	Phenanthrene		0.15	UJ	UG/L	2.38E-02	
129-00-0	Pyrene		0.2	UJ	UG/L	3.28E-03	
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	
55-63-0	Nitroglycerin		1	UJ	UG/L	5.00E-03	
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	367		UG/L	4.22E+00	
7440-36-0	Antimony	6	6	U	UG/L	2.00E-01	
7440-38-2	Arsenic	10	10	U	UG/L	5.26E-02	
7440-39-3	Barium	22.7	75.4	J	UG/L	1.51E-02	
7440-41-7	Beryllium	5	5	U	UG/L	9.43E+00	
7440-42-8	Boron		100	U	UG/L	1.00E-01	

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

TABLE 8-14
ECOLOGICAL SCREENING OF SURFACE WATER RESULTS FROM AREA 4E (AUS-0A4E)

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	62900		UG/L	5.42E-01	
7440-47-3	Chromium	10	1.5	J	UG/L	7.25E-03	
7440-48-4	Cobalt	50	50	U	UG/L	2.17E+01	
7440-50-8	Copper	10	10	U	UG/L	8.47E-01	
7439-89-6	Iron	100	338		UG/L	3.38E-01	
7439-92-1	Lead	2	3	U	UG/L	1.49E-01	
7439-95-4	Magnesium	2534	20700		UG/L	2.52E-01	
7439-96-5	Manganese	582	298		UG/L	2.98E-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	926	J	UG/L	1.75E-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	61900		UG/L	9.10E-02	
7440-28-0	Thallium	10	10	U	UG/L	2.50E+00	
7440-62-2	Vanadium	50	50	U	UG/L	2.63E+00	
7440-66-6	Zinc	20	6.4	J	UG/L	6.40E-03	
Other Parameters							
7664-41-7	Nitrogen, Ammonia (as N)	0.26	0.14	J	MG/L		
Nitrate+Nitrite	Nitrogen, Nitrate-Nitrite	0.05	0.12	J	MG/L		

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

TABLE 8-15, AUS-0A4E
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 8-15, AUS-0A4E
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 8-15, AUS-0A4E
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 8-15, AUS-0A4E
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

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

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

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

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

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

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

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

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

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

NA - Not Analyzed or not applicable.

TABLE 8-16, AUS-0A4E
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	Uncertainty	B
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	Uncertainty	B
Carbon disulfide	NA	NA	NA	NA	Uncertainty	B
Carbon tetrachloride	NA	NA	NA	NA	No	A
Chlorobenzene	NA	NA	NA	NA	No	A
Chloroethane	NA	NA	NA	NA	No	C
Chloroform	NA	NA	NA	NA	No	A
Chloromethane	NA	NA	NA	NA	No	A
cis-1,2-Dichloroethene	NA	NA	NA	NA	No	A
cis-1,3-Dichloropropene	NA	NA	NA	NA	Uncertainty	B
Dibromochloromethane	NA	NA	NA	NA	No	A
Ethylbenzene	NA	NA	NA	NA	No	F
Methylene chloride	NA	NA	NA	NA	No	A
N-Hexane	NA	NA	NA	NA	Uncertainty	G
Styrene	NA	NA	NA	NA	No	A
Tetrachloroethylene (PCE)	NA	NA	NA	NA	No	A
Toluene	NA	NA	NA	NA	No	F
total Xylenes	NA	NA	NA	NA	Yes	E
trans-1,2-Dichloroethene	NA	NA	NA	NA	No	A
trans-1,3-Dichloropropene	NA	NA	NA	NA	Uncertainty	B
Trichloroethylene (TCE)	NA	NA	NA	NA	No	A
Vinyl chloride	NA	NA	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	NA	NA	NA	NA	No	A
1,2-Dichlorobenzene	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	No	A
2,4,5-Trichlorophenol	NA	NA	NA	NA	No	A

TABLE 8-16, AUS-0A4E
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 8-16, AUS-0A4E
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	No	A	NA	NA	No	A
Hexachlorobenzene	NA	NA	NA	NA	No	A
Hexachlorobutadiene	NA	NA	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	NA	NA	No	A
Hexachloroethane	NA	NA	NA	NA	No	A
Indeno(1,2,3-c,d)pyrene	No	A	NA	NA	Yes	E
Isophorone	NA	NA	NA	NA	No	A
N-Nitroso-di-n-propylamine	NA	NA	NA	NA	No	A
N-Nitrosodiphenylamine	NA	NA	NA	NA	No	A
Naphthalene	No	A	NA	NA	No	F
Pentachlorophenol	NA	NA	NA	NA	No	A
Phenanthrene	No	A	NA	NA	Yes	E
Phenol	NA	NA	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	E
Barium	No	F	NA	NA	No	F
Beryllium	Uncertainty	B	NA	NA	No	F
Boron	No	A	NA	NA	Yes	E
Cadmium	Uncertainty	B	NA	NA	No	F
Calcium	No	F,H	NA	NA	Uncertainty	G,H
Chromium	No	F	NA	NA	Yes	D
Cobalt	Uncertainty	B	NA	NA	Yes	D
Copper	No	A	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	NA	NA
Iron	No	F	NA	NA	Yes	E
Lead	No	A	NA	NA	No	F
Magnesium	No	F,H	NA	NA	Uncertainty	G,H
Manganese	No	F	NA	NA	Yes	E
Mercury	No	A	NA	NA	Yes	E
Nickel	No	A	NA	NA	No	F
Potassium	No	F,H	NA	NA	Uncertainty	G,H
Selenium	No	A	NA	NA	Yes	E
Silver	Uncertainty	B	NA	NA	No	F
Sodium	No	F,H	NA	NA	Uncertainty	G,H
Thallium	Uncertainty	B	NA	NA	No	F
Vanadium	Uncertainty	B	NA	NA	Yes	E
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 8-16, AUS-0A4E
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

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

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

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

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

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

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

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

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

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

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

NA - Not Analyzed or not applicable.

TABLE 8-17
AUS-0A4E - EAST SHOP AREA
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					
Ethylbenzene		**H**	NA		NA
total Xylenes		**E**	NA		NA
SVOCs					
2-Methylnaphthalene		**E**	NA		
Anthracene		**E**	NA		
Benzo(a)anthracene		**H,E**	NA		
Benzo(a)pyrene		**E**	NA		
Benzo(b)fluoranthene		**E**	NA		
Benzo(g,h,i)perylene		**E**	NA		
Benzo(k)fluoranthene		**E**	NA		
bis(2-Ethylhexyl)phthalate		**E**	NA	NA	NA
Chrysene		**E**	NA		
Di-n-butyl phthalate		**E**	NA	NA	NA
Dibenz(a,h)anthracene		**E**	NA		
Dibenzofuran		**E**	NA	NA	NA
Fluoranthene		**E**	NA		
Indeno(1,2,3-c,d)pyrene		**E**	NA		
Phenanthrene		**E**	NA		
Pyrene		**E**	NA		
Metals					
Aluminum			NA		**E**
Antimony		**H**	NA		
Arsenic		**H,E**	NA		
Barium		**H**	NA		
Boron		**E**	NA		
Cadmium		**H**	NA		
Copper		**E**	NA		
Iron		**E**	NA		
Manganese		**E**	NA	**H**	
Mercury		**H,E**	NA		
Nickel		**H**	NA		
Selenium		**H,E**	NA		
Vanadium		**E**	NA		
Zinc		**E**	NA		

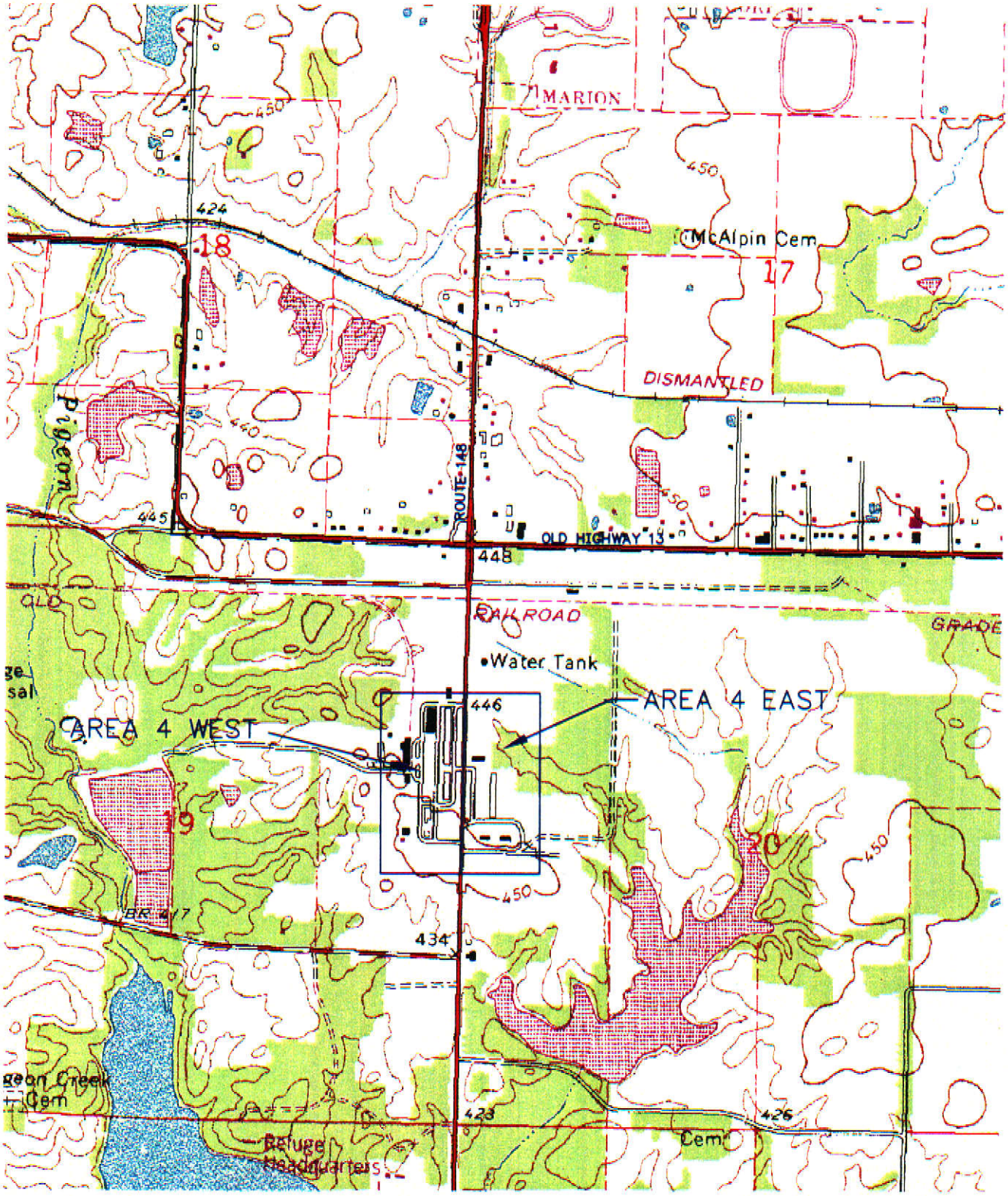
Key:

[1] Drums were not present at this site.

NA = not analyzed

H = human health screening criteria exceeded

E = ecological screening criteria exceeded



SOURCE: USGS DIGITAL RASTER GRAPHIC

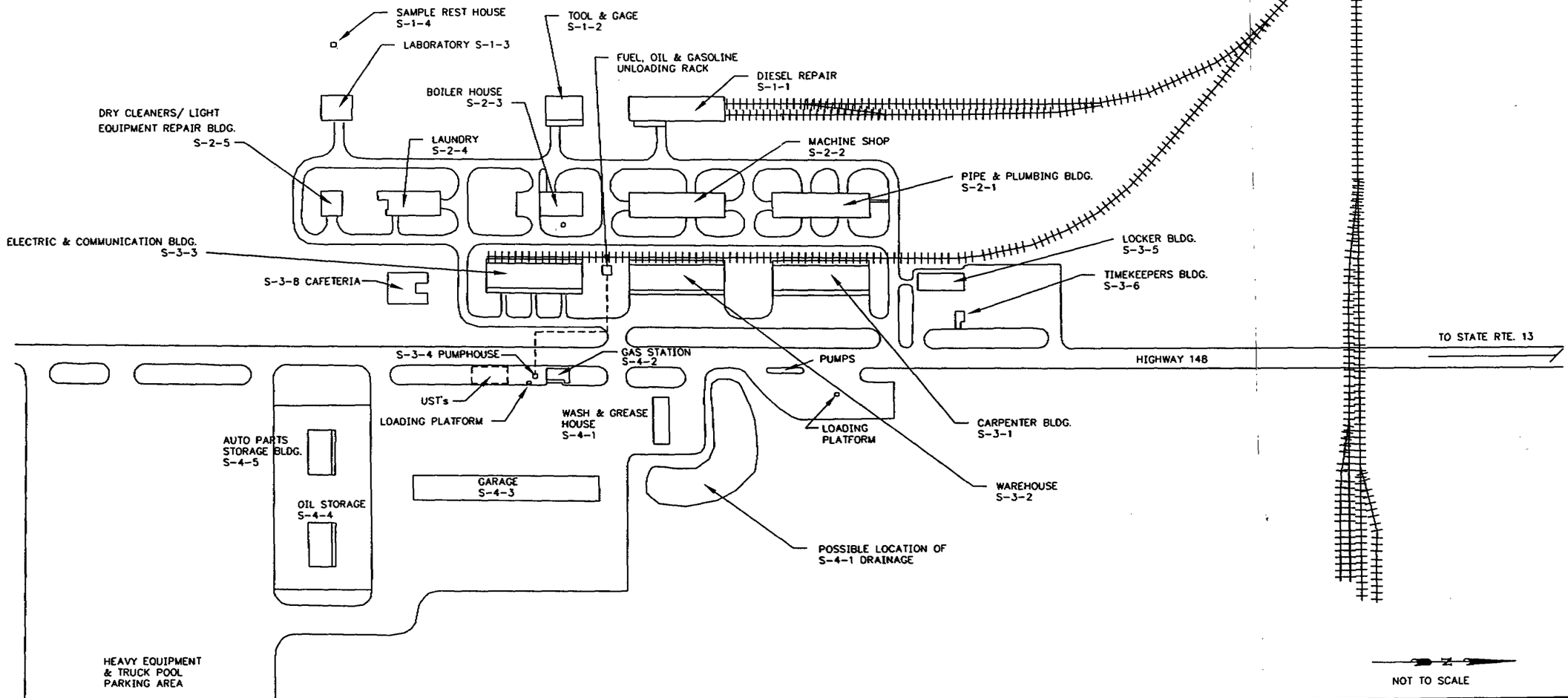
N

0 2000

SCALE FEET

PA/SI REPORT–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 8/25/99 DSGN. BY: mch CHKD. BY: cmw	Area 4 Location Map — FIG. NO. 8–1

File: E:\45FOM9602N\FIG_8-1.DWG Last edited: 06/28/01 @ 4:58 p.m. @ WCC-ST.LOUIS



SOURCE: U.S. ACE. 1944, WAR DEPARTMENT
FACILITIES INVENTORY OF THE ILLINOIS
ORDNANCE PLANT
PART I SECT. 5 PAGE 2
(PLAN NO. 6544-101.06)

PA/SI REPORT – AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS Corporation	
DRN. BY:djd 8/21/99 DSGN. BY:mch CHKD. BY:mch	Original IOP Layout of Area 4 (Shop Area)
	FIG. NO. 8-2

File: E:\2320000026.00\PA-SI REPORT-AUS OU\CRABFIG8-2LS.DWG Last edited: 06/29/01 @ 09:43 a.m. @ WCC-ST.LOUIS

Refer to the
Book of Large Figures

for

Figure 8-3

Refer to the
Book of Large Figures

for

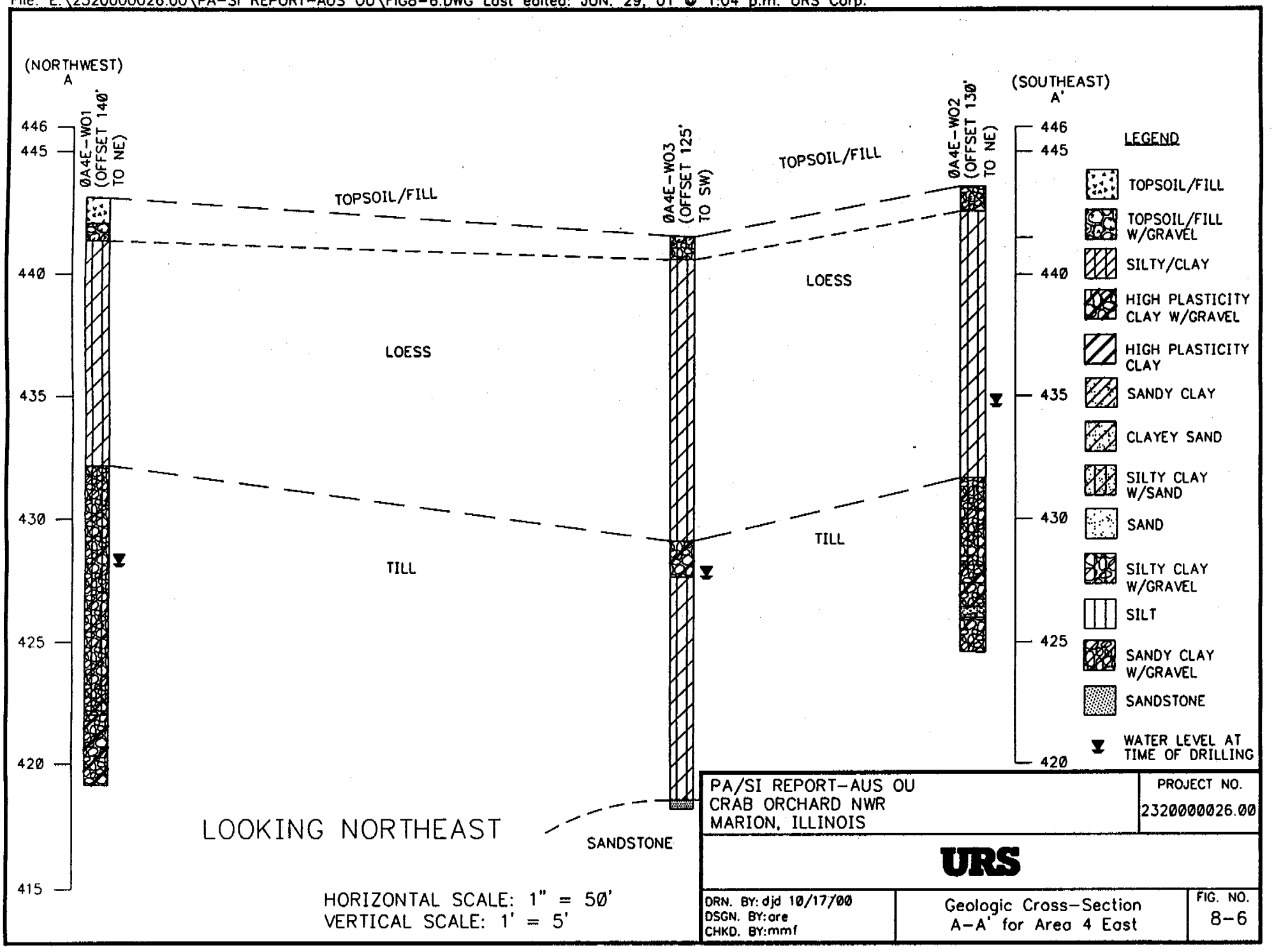
Figure 8-4

Refer to the
Book of Large Figures

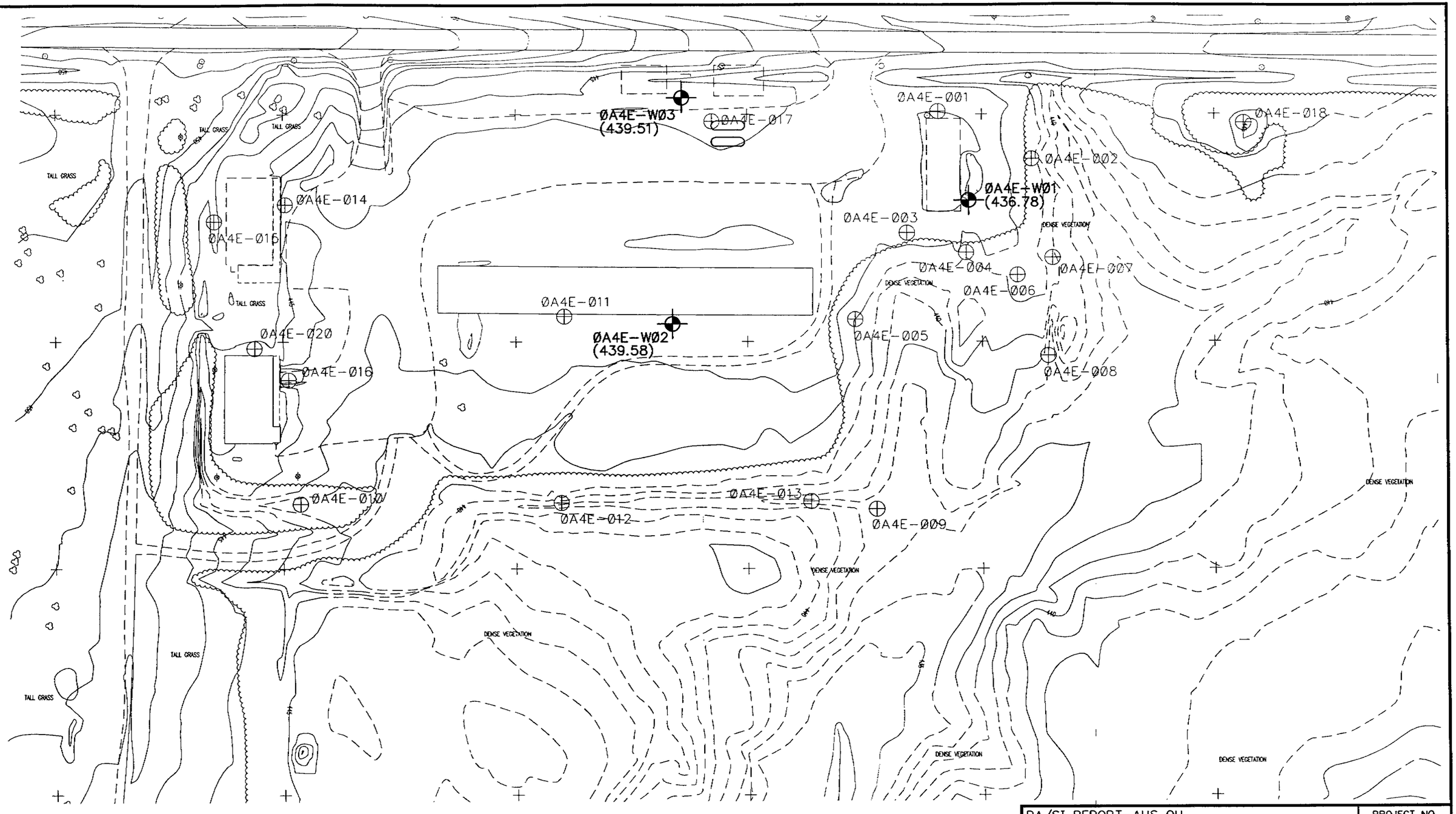
for

Figure 8-5

File: E:\2320000026.00\PA-SI REPORT-AUS OU\FIG8-6.DWG Last edited: JUN. 29, 01 @ 1:04 p.m. URS Corp.



PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 10/17/00 DSGN. BY: are CHKD. BY: mmf	Geologic Cross-Section A-A' for Area 4 East
	FIG. NO. 8-6



LEGEND

⊕ MONITORING WELL LOCATION

⊕ HAND AUGER LOCATION

N

100 0 100

SCALE FEET

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 12/20/00 DSGN. BY: mam CHKD. BY: cmw	Area 4 East Groundwater Elevation Map-October 2000
	FIG. NO. 8-7

File: E:\2320000026.00\PA-SI REPORT-AUS OU\AUS-0A4E 8-7DWG.DWG Last edited: JUN. 29, 01 @ 09:50 a.m. URS Corp.

Area 4 is the former Illinois Ordnance Plant (IOP) Shop Area. Industrial tenants have used it since 1946.

Area 4, shown in Figure 8-1, is located 1.2 miles south of Illinois State Route 13 on Highway 148. For the purposes of this report, Area 4 has been divided into two separate areas: Area 4 East (East Shop Area – which includes all of the Area 4 buildings east of Highway 148) and Area 4 West (West Shop Area – which includes all Area 4 buildings west of Highway 148). This section addresses Area 4 West (AUS-0A4W).

AUS Original Site Designations

Three of the original sites designated in 1997-1999 by the United States Fish & Wildlife Service (USFWS) as part of the Additional and Uncharacterized Sites Operable Unit (AUS OU) were located in Area 4 West: AUS-0012, AUS-0013, AUS-0014, AUS-0015, and AUS-0016. Most of these sites have been incorporated into the current AUS-0A4W.

9.1 HISTORIC SEARCH INFORMATION

9.1.1 Site Description

Sherwin Williams Defense Corporation, under contract with the War Department (SWDC/War Department) operated this industrial shop area[1] from 1942 to 1945, as part of the IOP.

The West Shop Area contained the buildings that supported plant infrastructure and operation. All of the buildings in this area started with the prefixes S-1, S-2 or S-3. The buildings are arranged in three north-south oriented rows. The buildings in the western row are labeled with the prefix S-1, the buildings in the eastern row with the prefix S-3, and the buildings in the middle row with the prefix S-2. The original configuration of Area 4 (East and West) is shown in Figure 8-2.

9.1.2 Operational History and Waste Characteristics

Table 9-1 lists the Area 4 West buildings, the operator during the IOP era and the post-World War II tenants, the years occupied, and building use.

For several post-World War II (WWII) tenants, building numbers were not identified in the available lease information. It should be noted, generally, that there are gaps in the historic lease information. The tenants are listed in Table 8-2, along with the duration of their leases and a description of their operations. Note that the tenants listed in Table 8-2 may have been in either Area 4 East or Area 4 West. General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS), as successor to Olin Corporation and Primex Technologies, Inc.,[2,3] is the major current tenant in Area 4 West.

---

[1] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (Plan No. 6544-101.06).

[2] General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.

Building S-1-1 – IOP Diesel Repair

The SWDC/War Department used Building S-1-1 for maintenance and repairs of the IOP locomotives. Locomotives are powered by diesel-electric engines (a combination of a diesel generator and a DC motor) and require all the maintenance that a diesel engine requires and more. Maintenance and repair of these machines would generate large amounts of waste oil and other lubricants and possibly chlorinated solvents.

Southern Illinois University leased this building from 1983[4] up until February of 1985.[5]

The Diagraph Corporation (formerly Diagraph Bradley Industries, Inc.) leased Building S-1-1 from February 1985[6] to August 1990.[7]

GDO&TS is the current tenant in this building.[8] Information regarding their operations at this building was not found.

A wood treating facility just west of this building was identified in aerial photographs. It appeared to be in operation from at least 1960 through 1971, and included several buildings and aboveground storage tanks (ASTs).[9] Pentachlorophenol and dioxin contamination was identified in this yard as a result of the lumber treatment operations. This facility was Site 22A of the Miscellaneous Areas Operable Unit (MISCA OU), the Post Treating Facility, and was remediated in 1996. Therefore, no further investigation of this area was necessary for the AUS OU.

Building S-1-2 – IOP Tool and Gage

The SWDC/War Department used this building for a gage laboratory and for tool inspection.[10] It may also have been used for repair of tools and gages. A 1944 letter from the U.S. Public Health

---

[3] Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.

[4] DPRA Document No. 00007078. Building Lease Contract No. by and between U. S. Fish and Wildlife Service and Southern Illinois University (SIU-C), School of Technical Careers, Career Development Center, February 15, 1983, Pages 1-2.

[5] FWM 001288. Amendment No. 1 to Building Lease Contract No. 14-16-0003-83-538, "University Lease No. 22259326," Southern Illinois University (SIU-C), School of Technical Careers, Career Development Center, Dated February 1, 1985.

[6] DOI 000595. Amendment No. 2 to Building Lease Contract No. 14-16-0003-82-534, Diagraph Bradley Industries, Inc., dated February 1, 1985.

[7] DPRA Document No. 00019358. Amendment No. 10 to Building Lease Contract No. 14-16-0003-82-534, Diagraph Corporation, dated August 1, 1990.

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

[9] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 3 -dated May 1, 1960 and Figure 5 - dated October 14, 1971. 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).

[10] DPRA Document No. CO01651. Illinois Ordnance Plant, Carbondale Illinois, Tool &Gage Shop, Shop Area Building S-1-2, Plumbing Layout, Plan No. 6544 400.21, dated December 4, 1941.

Service-Bureau of State Services to the War Department recommended that the use of carbon tetrachloride in the Tool and Gage Shop be stopped, and a less toxic solvent such as Varisol, Stanisol or Stoddard solvent be used.[11]

In 1949, the R.K. Manufacturing Company (later known as American Magnetics Corporation)[12] began leasing Building S-1-2.[13,14] The R.K. Manufacturing Company manufactured specialty transformers[15,16] for the audio and radio industry.[17] According to American Magnetics, all of their products were impregnated and sealed with electrical insulating wax or varnish and all excess runoff was drained back into the tanks.[18] They also reported that they never manufactured oil-filled transformers.[19] According to their CERCLA Section 104(e) response, they were present on the Refuge from 1946 through 1958.[20]

National Reproductions leased this building from 1959 to 1973[21] for use as a printing shop.[22] Printing activities may have included the use of solvents and inks. Christian Press succeeded National Reproductions in 1973; the United States Fish & Wildlife Service (USFWS) terminated their lease in 1974.[23]

Midwest Brush (a division of Diagraph) leased Building S-1-2 from 1974 through at least 1982.[24] They used this facility for the assembly of coder cartridges.[25]

The Illinois Department of Natural Resources currently leases this building.[26]

---

[11] NAR 000498. U. S. Public Health Service, Letter to the War Department regarding an industrial hygiene medical re-survey of the IOP, dated February 15, 1944, (part of a document entitled "Illinois Ordnance Plant, Carbondale, Illinois, Historical Record," dated January 1, 1944 to April 1, 1944.
[12] DOI 000098. American Magnetics Corporation's response to Section 104 (e) request, dated June 12, 1989.
[13] DPRA Document No. 00009081. Lease Data – Industrial Unit, Crab Orchard Refuge, dated August 31, 1949, Page 2.
[14] DPRA Document No. 00009039. Crab Orchard National Wildlife Refuge, Lease data, Industrial Unit, June 1, 1951, Page 16.
[15] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[16] CRO 001575A. Herrin Daily Journal, Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.
[17] DOI 000098. American Magnetics Corporation's response to Section 104 (e) request, dated June 12, 1989.
[18] DOI 000098. American Magnetics Corporation's response to Section 104 (e) request, dated June 12, 1989.
[19] DOI 000098. American Magnetics Corporation's response to Section 104 (e) request, dated June 12, 1989.
[20] DOI 000098. American Magnetics Corporation's response to Section 104 (e) request, dated June 12, 1989.
[21] CRO 000445. National Reproductions, Inc., Letter to the USFWS regarding termination of their lease, dated March 30, 1973.
[22] CRO 000825. U. S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1959, Page 25.
[23] CRO 000445. National Reproductions, Inc., Letter to the USFWS regarding termination of their lease, dated March 30, 1973.
[24] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[25] DOI 000179. Diagraph Corporation's response to request for information pursuant to Section 104 (e), dated July 19, 1989, Page 2.
[26] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Building S-1-3 and S-1-4 – IOP Laboratory and Sample Rest House

There was a paint laboratory and a physical explosives room in the laboratory building.[27] Based on the remote location of Building S-1-4, the Sample Rest House, it is possible that tests were performed here on explosives.

Lease records indicate that B. E. Brennan and Company leased Buildings S-1-3 and S-1-4 from 1946 through 1951[28] and that Fred W. Ervin leased Building S-1-3 from July 16, 1947 through July of 1949.[29,30] Since the dates overlap, presumably B. E. Brennan and Company vacated the building before the end of their lease.

According to the Diagraph Corporation/Midwest Brush CERCLA Section 104(e) response, in approximately 1955, Midwest Brush began manufacturing stencils and stencil brushes in Building S-1-3.[31] However, Refuge Narrative Reports indicate that Midwest Brush did not lease a building at the Refuge until August of 1962.[32] It is likely that this reference was to Building S-1-3.[33] It is also possible that Midwest Brush began using this building before there was a formal lease.

In 1959, the Department of Special Education for Southern Illinois University leased Building S-1-3.[34] They used this building as a training center for the mentally handicapped.[35] They were also reported to have been in this building from 1961 through 1963.[36]

Midwest Brush reportedly leased Building S-1-3 again from 1965 through at least 1982.[37] Based on discussions with Refuge personnel, Midwest did not leave this building until November 1997.[38]

Both buildings are still on site and the Williamson County Emergency Management Agency is currently leasing Building S-1-3.[39]

---

[27] DPRA Document No. COC1663. Illinois Ordnance Plant, Carbondale Illinois, Laboratory Building, Shop Area, S-1-3, Plumbing Layout, Plan No. 6544 400.43, dated March 25, 1942.
[28] ACL 000692. Lease for B. E. Brennan and Company dated September 18, 1946, Page 1.
[29] DPRA Document No. 00009059. Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, April 12, 1949, Page 4.
[30] DPRA Document No. 00009081. Lease Data – Industrial Unit, Crab Orchard Refuge, dated August 31, 1949, Page 1.
[31] DOI 000179. Diagraph Corporation's response to request for information pursuant to Section 104 (e), dated July 19, 1989, Page 2.
[32] DPRA Document No. 00016031. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1962, Page 27 and Table No. VI.
[33] DPRA Document No. 00016031. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, May thru August, 1962, Page 27 and Table No. VI.
[34] DPRA Document No. 00009398. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Narrative Report, Crab Orchard National Wildlife Refuge, January Thru April, 1959, Page 24.
[35] DPRA Document No. 00009398. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Narrative Report, Crab Orchard National Wildlife Refuge, January Thru April, 1959, Page 24.
[36] ACC 000056. Listing of Area 4 leasing information as obtained from leases.
[37] ACC 000056. Listing of Area 4 leasing information as obtained from leases.
[38] Doyle Case, personal interview, August 2001.

Building S-2-1 – IOP Piping and Plumbing Building

As part of the IOP, this building contained a radio service department and a concrete testing laboratory, in addition to being used for piping and plumbing.[40] IOP work in this area may have included the use of lead (a common component of plumbing) and chlorinated solvents.

Diagraph (originally the Diagraph Bradley Stencil Machine Corporation) occupied Building S-2-1 beginning sometime in 1947[41] and ending later in that same year (July 1947).[42]

In 1949, USFWS occupied Building S-2-1 and used it as a shop.[43]

The General Radiator Company leased Building S-2-1 from August 1951 through April 1954, when they moved their plant.[44,45] The General Radiator Company rehabilitated these buildings for the production of industrial engine cooling radiators.[46]

Dura Crates leased either Building S-2-1 or S-2-2 for its crate manufacturing business possibly from 1955 (when Dura Crates first moved to the Refuge)[47] through February 1961.[48] See also discussion under Building S-2-2.

In May, 1961 the Handicapped Training Center for Southern Illinois University moved into Building S-2-1[49] and occupied this building until 1974.[50]

From 1974 through 1978, the Mental Health Services of Franklin and Williamson Counties, Inc. leased Building S-2-1.[51,52] The building burned down on March 16, 1978.[53] According to Mr.

---

[39] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[40] DPRA Document No. COC1650. Illinois Ordnance Plant, Marion, Illinois, Pipe & Plumbing Building, Shop Area, Building S-2-1, Plumbing Layout, Plan No. 6544 400.20, dated December 27, 1941.
[41] CRO 001204. Letter to Diagraph regarding the leasing Building S-2-1, dated February 19, 1947.
[42] DPRA Document No. 00001298. IOP, Memorandum to the IOP CONWR regarding Diagraph Bradley lease for Building S-2-1, dated December 30, 1947.
[43] DPRA Document No. 00009059. Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, April 12, 1949, Page 17.
[44] DPRA Document No. 00009039. Crab Orchard National Wildlife Refuge, Lease data, Industrial Unit, June 1, 1951, Page 6.
[45] CRO 000211. CONWR, Analysis of Industrial Tenants employing labor, dated March 18, 1955, Page 1.
[46] CRO 001577. Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.
[47] ACO 000037. United States Department of Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, September through December, 1955, Table VIII.
[48] DPRA Document No. 00009343. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1961, Page 25.
[49] DPRA Document No. 00009343. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1961, Page 25.
[50] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[51] CRO 001353. Lease Contract No. 14-16-0003-30,634 by and between U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and Mental Health Services of Franklin and Williamson Counties, Inc., May 1, 1974, Page 1.
[52] CRO 001369. Amendment No. 4 to Lease Contract No. 14-16-0003-30,364, Mental Health Services of Franklin and Williamson Counties, Inc.
[53] ACC 000055. Listing of Area 4 leasing information as obtained from leases.

Frank Wilkie who worked for Supreme Plating in Area 4 at this time, handicapped people were hired here, but no manufacturing was done at this location.[54]

Building S-2-2 – IOP Machine Shop

IOP operations in this building may have included the use of chlorinated solvent metal cleaners.

In 1949, the R.K. Manufacturing Company (later known as American Magnetics Corporation)[55] briefly leased Building S-2-2.[56,57] See the discussion under Building S-1-2 above. The lease for this building was cancelled in 1949 and the company moved to Building S-1-2.[58]

The Ordill Machine Corporation leased Building S-2-2 from at least 1951 through 1954 (when the lease expired).[59] They used this building for tool and die working.[60]

Dura Crates leased either Building S-2-2 or S-2-1 for its crate manufacturing business possibly from 1955[61] through December 1959, when a fire destroyed Building S-2-2.[62] In 1960, Dura Crates began leasing the concrete ramp that was formerly Building S-2-2.[63] The building foundation was used for open storage.[64] Dura Crates manufactured cartons and crates at the Refuge.[65] It is assumed that they terminated their lease for this concrete ramp, when they terminated their lease for Building S-2-1 in February 1961.[66]

---

[54] Deposition of Frank Wilkie, October 14, 1999, Pages 51-52.
[55] DOI 000098. American Magnetics Corporation's response to Section 104 (e) request, dated June 12, 1989.
[56] DPRA Document No. 00009059. Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, April 12, 1949, Page 11.
[57] DPRA Document No. 00009081. Lease Data – Industrial Unit, Crab Orchard Refuge, dated August 31, 1949, Page 2.
[58] DPRA Document No. 00009081. Lease Data – Industrial Unit, Crab Orchard Refuge, dated August 31, 1949, Page 2.
[59] DPRA Document No. 00009039. Crab Orchard National Wildlife Refuge, Lease data, Industrial Unit, June 1, 1951, Page 13.
[60] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[61] ACO 000037. United States Department of Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, September through December, 1955, Table VIII.
[62] DPRA Document No. 00009378. U. S. Department of Interior, Bureau of Sport Fisheries and Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, September thru December, 1955, Page 33.
[63] DPRA Document No. 000093747. U. S. Department of Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Narrative Report, January thru April, 1960, Page 25.
[64] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 3 – dated May 1, 1960.
[65] ACO 002327. U. S. Department of Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, September Thru December, 1955, Page 17.
[66] DPRA Document No. 00009343. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1961, Page 25.

Building S-2-3 – IOP Boiler House

Building S-2-3 was the original IOP Boiler House for Area 4.[67] There were no underground storage tanks associated with the boiler house, based on the IOP design drawings.[68] The boiler house used coal-fired boilers.[69] It was removed between 1960 and 1965.[70]

Building S-2-4 – IOP Laundry Facility

SWDC/War Department

SWDC/War Department originally used Building S-2-4 as the IOP Laundry facility.[71] This laundry may have been used to wash explosives-contaminated work clothes. No specific information on the use of the laundry is available. The 1943 aerial photograph identified two probable basins on the western side of this building.[72] These basins may have received the wash waters from the laundry.

B.E. Brennan

B. E. Brennan and Company leased Building S-2-4 from 1946 through 1951, according to their lease.[73] This period of time conflicts with the lease information for East Side Lumberyard Supply Company, discussed below; therefore it is likely that B. E. Brennan and Company vacated this building either prior to or during 1950.

East Side Lumberyard Supply Company

East Side Lumberyard Supply Company leased Building S-2-4 from 1950 through 1954[74,75] and again from 1956 through 1969.[76,77] They likely occupied the building only up until 1966, since Midwest Brush was reported to have occupied this building beginning in 1966. East Side

[67] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).
[68] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 22.
[69] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 22.
[70] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 3 – dated May 1, 1960 and Figure 4 – dated October 16, 1965.
[71] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (plan no. 6544-101.06).
[72] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 1 – dated February 7, 1943.
[73] ACL 000692. Lease for B. E. Brennan and Company dated September 18, 1946, Page 1.
[74] CRO 001839. Special Use Permit No. C.O. Ind.-4, dated April 1, 1950.
[75] DPRA Document No. 00022939. East Side Lumberyard Supply Co., Letter to CONWR regarding cancellation of Special Use Permit No. 21641 for Building S-2-4, dated October 29, 1954.
[76] DPRA Document No. 00022947. Special Use Permit No. 25785, dated June 27, 1956.
[77] FWM 000930. Lease Contract No. 14-1-6-0003-13037 by and between U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and East Side Lumberyard Supply Company, Page 1, dated June 9, 1969. *New lease for East Side did not renew lease for Building S-2-4.*

Lumberyard used this building for temporary storage of building materials.[78] In April of 1951, the company reported that someone broke into their gas storage tank and stole approximately 150 gallons of gas.[79] Since East Side only leased two buildings in Area 4 at this time, this gas storage tank would have been located either next to this building (Building S-2-4) or next to Building S-3-3 (the other building that they leased at this time). According to East Side's response to their CERCLA Section 104(e) request, they had both an underground storage tank on site that they were in the process of removing and an AST on site that was used for leaded fuel storage for tow motors.[80]

Midwest Brush

Midwest Brush leased Building S-2-4 from 1966 through 1970.[81]

Supreme Plating

The contamination associated with Supreme Plating's operation in Building S-2-4 was largely remediated, first in response to notices by the IEPA and later as part of the Metals Area Operable Unit (MAOU) remediation, discussed below. The activities are summarized here because some contamination that probably originated from Supreme Plating's operation is apparently still present at this site.

Supreme Plating started operations at the Refuge in December 1963, occupying Building S-2-5 according to Frank Wilkie, the owner's son.[82,83] After receiving a substantial contract with Olin, Supreme Plating moved into the larger Building S-2-4.[84] This move probably took place in 1970, when Supreme Plating terminated its lease for Building S-2-5.[85] The company terminated its lease for Building S-2-4 effective February 1, 1984.[86]

The following information regarding operations at Supreme Plating is from Mr. Frank Wilkie and Mr. Robert Wilkie, both sons of the owner (R.A. Wilkie), and sometime employees at the plating facility. Supreme Plating did cadmium plating, zinc plating, chromium plating, aluminum anodizing, phosphatizing, coating with Bondalube, some black oxide coating, and some gun bluing.[87,88] They did cadmium plating on a ring for the 105-mm shells for Olin. Cadmium plating was slowly phased out due to the expense and because military specifications

[78] DPRA Document No. 00022883. CONWR, Letter to East Side Lumberyard Supply Co. regarding Special Use Permit No. C.O. Ind.-4, dated March 28, 1950.
[79] DPRA Document No. 00022860. East Side Lumberyard Supply Co., Letter to CONWR regarding 150 gallons of stolen gasoline from East Side's gas storage tank, dated April 30, 1961.
[80] CRO 000381. East Side Lumberyard Supply Co. Inc., Questionnaire for Federal Facilities or Environmental Compliance Profile, submitted as part of their CERCLA Section 104(e) response.
[81] ACC 000054. Listing of Area 4 leasing information as obtained from leases.
[82] CRO 000064 and CRO 000067. U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Narrative Report, September thru December, 1963, Page 33 and Table No. 3.
[83] Deposition of Frank Wilkie, October 14, 1999, Page 36.
[84] Deposition of Frank Wilkie, October 14, 1999, Pages 38-39.
[85] ACC 000056. Listing of Area 4 leasing information as obtained from leases.
[86] DPRA Document No. 00012663. Amendment No. 2 to Building Lease Contract No. 14-16-0003-81-521, Supreme Plating Company, dated February 1, 1984.
[87] Deposition of Frank Wilkie, October 14, 1999, Pages 47, 53, 58, 108, and 118.
[88] Frank Wilkie, Personal Interview, July 28, 1999.

(from Olin) no longer required cadmium plating.[89] They mostly did zinc plating, most often for the internal components of flares for Olin, which likely contained lead[90,91] They put a phosphate coating on 105-mm shells, and anodized aluminum fins for Olin.[92] They also did chromium plating ("gold dip") for Norge.[93] They used cyanide baths up until the late 1960s; however, they did not use these baths in Building S-2-4.[94]

According to Mr. Frank Wilkie, spillage from the plating operation was hosed into the concrete troughs inside the building that drained into the outside holding tanks, and solid waste was collected and disposed of at a location off the Refuge.[95] Presumably because of problems with the effluent from the holding tanks, in 1984 the Refuge sealed the pipe connecting Supreme Plating's effluent with the wastewater treatment plant.[96,97] That same year, in response to an anonymous complaint regarding the abandonment of liquid waste in an old acid filter tank at the Supreme Plating operation, the IEPA inspected the site and collected and analyzed a sample of the waste material.[98,99] This is presumably the same holding tank that Frank Wilkie described. Under the IEPA directive, Supreme Plating cleaned and emptied the tank.[100] Analysis of samples from the tank revealed elevated levels of cadmium, chromium, lead and zinc. [101,102,103] USFWS then filled the tank with clean material, demolished Building S-2-4, and covered the site.[104,105] In 1985, the IEPA directed Supreme Plating to clean up the yard as well.[106,107] High levels of lead were found in the samples.[108] In 1986, IEPA decided that the pit (holding tanks) and soil would have to be excavated and disposed of as hazardous waste.[109] The documentation does not conclusively state that this was ever done. However, a closure plan was prepared on

[89] Deposition of Frank Wilkie, October 14, 1999, Pages 95-96.
[90] Deposition of Robert A. Wilkie, October 15, 1999, Page 80.
[91] Deposition of Frank Wilkie, October 14, 1999, Pages 96-97.
[92] Deposition of Frank Wilkie, October 14, 1999, Page 47.
[93] Frank Wilkie, Personal Interview, July 28, 1999.
[94] Frank Wilkie, Personal Interview, July 28, 1999.
[95] Deposition of Frank Wilkie, October 14, 1999, Pages 84-104.
[96] Deposition of Robert Andrew Wilkie, October 15, 1999, Pages 51-52 and page 79.
[97] IEP 004038. Illinois Environmental Protection Agency, Memorandum to the file regarding Herrin/Supreme Plating (R.A. Wilkie Machine Co.), dated September 12, 1985.
[98] DPRA Document No. 00006286. Illinois Environmental Protection Agency, Letter to CONWR regarding inspection of operations of Supreme Plating at the Refuge, dated March 22, 1984, Page 1.
[99] DPRA Document No. 00006328. CONWR, Chronological Listing of events regarding Supreme Plating Co. and Building S-2-4, Page 1.
[100] DPRA Document No. 00011094. Notification of Hazardous Waste Site (Federal Register Form) dated November 26, 1984, Page 2.
[101] DPRA Document No. 00006286. Illinois Environmental Protection Agency, Letter to CONWR regarding inspection of operations of Supreme Plating at the Refuge, dated March 22, 1984, Page 1.
[102] DPRA Document No. 00006328. CONWR, Chronological Listing of events regarding Supreme Plating Co. and Building S-2-4, Page 1.
[103] IEP 004032. Envirite, Envirite Analytical Report, dated December 16, 1985.
[104] CRO 000610. R.A. Wilkie Machine Company, Letter to Illinois Environmental Protection Agency in response to IEPA compliance inquiry, dated October 31, 1985.
[105] Deposition of Robert Andrew Wilkie, October 15, 1999, Page 65.
[106] Deposition of Robert Andrew Wilkie, October 15, 1999, Page 50.
[107] CRO 000613. USDOI, Letter to R. A. Wilkie Machine Company regarding a meeting held with IEPA discussing soil sampling and tank removal action, dated April 7, 1986.
[108] Deposition of Robert Andrew Wilkie, October 15, 1999, Page 58.
[109] CRO 001745

March 28, 1986,[110] and on July 9, 1987 samples were collected from soil borings done next to the tank for analysis.[111,112] The IEPA notified Robert Wilkie on September 30, 1988, that the tank had been properly closed[113] and, according to the IEPA, this tank was closed in place.[114]

The concrete holding tanks discussed above were not included in this Preliminary Assessment/Site Investigation (PA/SI), since according to IEPA, they were closed in place in 1988.[115] They also were not included in the MAOU remediation of this area, discussed below, presumably for the same reason.

Building S-2-5 – IOP Light Equipment Repair Building and Dry Cleaners

SWDC/War Dep't

According to the War Department's 1944 Facility Inventory technical drawing revision dated June 1942, this building was the IOP Light Equipment Repair Building.[116] It was also a dry cleaners.

B.E. Brennan and Company

B. E. Brennan and Company leased Building S-2-5 from 1946 through 1951, according to their lease.[117] This period of time conflicts with the lease information for both Shepard and the Herrin Plating Company, as discussed below; therefore, it is likely that B. E. Brennan and Company vacated this building either prior to or during 1948.

Shepard

Shepard leased Building S-2-5 from July of 1948 up until April of 1949.[118] Information regarding their operations at this building was not found; however, according to the Refuge, they never went into production.[119]

---

[110] IEP 004034. Illinois Environmental Protection Agency, Letter to R. A. Wilkie Machine Company regarding tank closure at Herrin/Supreme Painting, dated September 30, 1988.
[111] U.S. Government, 1987. U.S. Government Memorandum from USFWS Project Manager, Norrel Wallace to USFWS files, dated July 9, 1987.
[112] United States Fish and Wildlife Service, 1987. Letter to Andy Wilkie, Wilkie Machine Company, dated March 11, 1987.
[113] IEP 004034. Illinois Environmental Protection Agency, Letter to R. A. Wilkie Machine Company regarding tank closure at Herrin/Supreme Painting, dated September 30, 1988.
[114] IEP 004034. Illinois Environmental Protection Agency, Letter to R. A. Wilkie Machine Company regarding tank closure at Herrin/Supreme Painting, dated September 30, 1988.
[115] IEP 004034. Illinois Environmental Protection Agency, Letter to R. A. Wilkie Machine Company regarding tank closure at Herrin/Supreme Painting, dated September 30, 1988.
[116] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (Plan No. 6544-101.06). According to an early drawing (DPRA Document No. CO01192. Illinois Ordnance Plant, Marion, Illinois, Drainage, Shop Area, Plan No. 6544-151.17) Building S-2-5 was originally designated as a dry cleaning shop. It was apparently never used for that purpose.
[117] ACL 000692. Lease for B. E. Brennan and Company dated September 18, 1946, Page 1.
[118] CRO 000211. CONWR, Analysis of Industrial Tenants employing labor, dated March 18, 1955, Page 1.
[119] DPRA Document No. 00009075. Undated Refuge lease information document showing new leases up until 10/1/49, from the CONWR files.

Herrin Plating Company/Radionic Products

As of April 1, 1949, the Herrin Plating Company leased Building S-2-5.[120] Refuge records indicate that they were in Building S-2-5 at least from 1949 to 1952.[121,122] The Herrin Plating Company did electroplating.[123] Harry Stiles, a USFWS employee at the Refuge from 1951 to 1963 (Refuge Manager part of that time), recalled that Herrin Plating did cadmium plating in Area 4. He thought that some plating wastes were discharged to a ditch, and he recalled seeing dead vegetation in the ditch in the vicinity of the plating operation.[124] Herrin Plating was taken over by Radionic Products in April of 1950.[125] Radionic Products was reported to have manufactured radio components at the Refuge.[126]

Supreme Plating

Supreme Plating leased this building from 1963 through 1970.[127] According to Mr. Frank Wilkie, they used cyanide baths for zinc plating operations in this building, which were discontinued when Supreme Plating moved from Building S-2-5 to Building S-2-4.[128] Supreme Plating's operations are described above in the description of Building S-2-4. It is assumed that the same operations were performed in both buildings, with the exception of the cyanide baths that were used in Building S-2-5 only.

Midwest Brush

Midwest Brush leased Building S-2-5 from 1970 through at least 1982.[129]

Williamson County Emergency Management Agency

The Williamson County Emergency Management Agency is currently leasing Building S-2-5[130] for the storage of equipment.[131]

---

[120] DPRA Document No. 00009075. Undated Refuge lease information document showing new leases up until 10/1/49, from the CONWR files.
[121] DPRA Document No. 00009059. Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, April 12, 1949, Page 6.
[122] DPRA Document No. 00009039. Crab Orchard National Wildlife Refuge, Lease data, Industrial Unit, June 1, 1951, Page 8.
[123] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[124] Deposition of Harry Stiles, November 18, 1997, Pages 25 to 32.
[125] CRO 000211. CONWR, Analysis of Industrial Tenants employing labor, dated March 18, 1955, Page 1.
[126] CRO 001575A. Herrin Daily Journal, Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.
[127] ACC 000056. Listing of Area 4 leasing information as obtained from leases.
[128] Deposition of Frank Wilkie, October 14, 1999, Pages 108-109.
[129] ACC 000056. Listing of Area 4 leasing information as obtained from leases.
[130] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[131] Elaine L. Moore, USFWS, September 19, 2001.

Building S-3-1 – IOP Carpenters Building

The SWDC/War Department used this building as the carpenter shop.[132] Basic building and repair activities dealing with IOP structures would likely have been performed in this building.

The Furniture Company of Southern Illinois leased Buildings S-3-1 and S-3-2 from 1946 through 1951.[133,134] They manufactured molding and furniture.[135]

The General Radiator Company leased Buildings S-3-1 and S-3-2 from August 1951 through April of 1954 when they moved their plant.[136,137] The General Radiator Company rehabilitated these buildings for the production of industrial engine cooling radiators.[138]

Norge leased Building S-3-1 from 1957 through 1965[139] for warehouse storage.[140]

East Side Lumber Company leased Building S-3-1 from 1965 through at least 1990.[141,142] The East Side Lumber Company dealt with wholesale lumber supplies.[143] According to East Side, as noted above (see discussion under Building S-2-4), they had an underground storage tank on site that they were in the process of removing and an AST that was used for leaded fuel storage for tow motors.[144] The locations of these two tanks were not determined; they could have been located next to any of East Side's buildings.

---

[132] DPRA Document No. CO01809. Illinois Ordnance Plant, Carbondale, Illinois, Carpenter Shop Building, Equipment Layout, Plan No. 6544 450391, dated May 8, 1942.
[133] ACL 000713. Lease for The Furniture Company of Southern Illinois, dated September 1, 1946.
[134] DPRA Document No. 00009059. Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, April 12, 1949, Page 5.
[135] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[136] DPRA Document No. 00009039. Crab Orchard National Wildlife Refuge, Lease data, Industrial Unit, June 1, 1951, Page 6.
[137] CRO 000211. CONWR, Analysis of Industrial Tenants employing labor, dated March 18, 1955, Page 1.
[138] CRO 001577. Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.
[139] ACC 000055. Listing of Area 4 leasing information as obtained from leases.
[140] ACO 002327. U. S. Department of Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, September Thru December, 1955, Page 17.
[141] FWM 000927. Amendment No. 1 to Lease Contract No. 14-16-0003-6260, East Side Lumberyard Supply Company, dated November 24, 1965.
[142] DPRA Document No. 00006375. Building Contract No. 14-16-0003-84-546 by and between U. S. Fish and Wildlife Service and East Side Lumberyard Supply Company by and between U. S. Fish and Wildlife Service and East Side Lumberyard Supply Company, dated July 1, 1984, Pages 1-2; and, DPRA Document No. 00013091. Amendment No. 2 to Building Lease Contract No. 14-16-0003-84-546, East Side Lumberyard Supply Company.
[143] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[144] CRO 000381. East Side Lumberyard Supply Co. Inc., Questionnaire for Federal Facilities or Environmental Compliance Profile, submitted as part of their 104le) response.

This building is still present on site and GDO&TS (successor to Olin and Primex Technologies, Inc.) is the current tenant.[145] Primex Technologies, Inc. reportedly used this building as a warehouse.[146]

FAM-3-2

According to Refuge personnel, Building FAM-3-2 from the finished ammunition area (Area 3), was moved to Area 4 and positioned between Buildings "5-3-1" and "5-3-2."[147] These are likely Buildings S-3-1 and S-3-2. A 1951 aerial photographs shows one long continuous building from S-3-1 to S-3-2 which indicates another building was put in between these two buildings, connecting all three with one long roof.[148] By 1993, this large, continuous structure was no longer on site.[149]

Building S-3-2 – IOP Warehouse

The SWDC/War Department used this building as a warehouse during World War II.[150]

The Furniture Company of Southern Illinois leased Buildings S-3-1 and S-3-2 from 1946 through at least 1951.[151,152] They manufactured molding and furniture.[153]

The General Radiator Company leased Buildings S-3-1 and S-3-2 from August 1951 through April of 1954, when they moved their plant.[154,155] The General Radiator Company rehabilitated these buildings for the production of industrial engine cooling radiators.[156] Norge leased Building S-3-2 from 1957 through 1965[157] for warehouse storage.[158]

---

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

[146] DPRA Document No. 00017570. Primex Technologies, Proposed location of staging area regarding request for FWS Special Use Permit to temporarily stage empty 20-ft trailers alongside warehouse north of present location of S-4-5, dated December 1, 1997.

[147] Original IOP Plan No.6544-101.07, last revision, May 11, 1942 with later notations added by Refuge personnel. The notations recorded some information about leases, building uses, and buildings that were removed or destroyed.

[148] 1951 aerial photograph from the National Archives and Records Administration, College Park, Maryland (same photographs used by Entech, Inc.).

[149] 1993 aerial photograph from the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Aerial Photography Field Office, Salt Lake City, Utah (same photographs used by Entech, Inc.).

[150] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (Plan No. 6544-101.06).

[151] ACL 000713. Lease for The Furniture Company of Southern Illinois, dated September 1, 1946.

[152] DPRA Document No. 00009059. Lease Data and Income Pertaining to Industrial Unit, Crab Orchard National Wildlife Refuge, April 12, 1949, Page 5.

[153] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.

[154] DPRA Document No. 00009039. Crab Orchard National Wildlife Refuge, Lease data, Industrial Unit, June 1, 1951, Page 6.

[155] CRO 000211. CONWR, Analysis of Industrial Tenants employing labor, dated March 18, 1955, Page 1.

[156] CRO 001577. Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.

[157] ACC 000055. Listing of Area 4 leasing information as obtained from leases.

East Side Lumber Company leased Building S-3-1 from 1965 through at least 1990.[159,160] As noted above, East Side Lumber was involved in wholesale lumber supplies.[161] This building is still present on site, and GDO&TS (successor to Olin and Primex Technologies, Inc.) currently occupies it.[162] Primex Technologies, Inc. reportedly used this building as a warehouse.[163]

Building S-3-3 – IOP Electric and Communications Building

The SWDC/War Department used Building S-3-3 as an Electric and Communications Building during WWII.[164] A 1944 letter from the U.S. Public Health Service-Bureau of State Services to the War Department, indicated that the use of carbon tetrachloride should be stopped in the Electrical Shop and a less toxic solvent such as Varisol, Stanisol or Stoddard solvent should be used.[165]

Smoler Brothers, Inc. leased Building S-3-3[166] from 1946 through 1947[167] and again in 1949.[168] They manufactured women's dresses.[169]

East Side Lumber Company leased Building S-3-1 from 1953 through at least 1990.[170,171]

---

[158] ACO 002327. U. S. Department of Interior, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, September Thru December, 1955, Page 17.
[159] FWM 000927. Amendment No. 2 to Lease Contract No. 14-16-0003-6260, East Side Lumberyard Supply Company, dated November 24, 1965.
[160] DPRA Document No. 00006375. Building Contract No. 14-16-0003-84-546 by and between U. S. Fish and Wildlife Service and East Side Lumberyard Supply Company by and between U. S. Fish and Wildlife Service and East Side Lumberyard Supply Company, dated July 1, 1984, Pages 1-2; and, DPRA Document No. 00013091. Amendment No. 2 to Building Lease Contract No. 14-16-0003-84-546, East Side Lumberyard Supply Company.
[161] CRO 000230. U.S. Department of the Interior, Fish and Wildlife Service, 1950, Map of Crab Orchard National Wildlife Refuge showing Recreational Facilities and Industrial Tenants.
[162] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[163] DPRA Document No. 00017570. Primex Technologies, Proposed location of staging area regarding request for FWS Special Use Permit to temporarily stage empty 20-foot trailers alongside warehouse north of present location of S-4-5, dated December 1, 1997.
[164] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 2 (Plan No. 6544-101.06).
[165] NAR 000498. U. S. Public Health Service, Letter to the War Department regarding an industrial hygiene medical re-survey of the IOP, dated February 15, 1944, (part of a document entitled "Illinois Ordnance Plant, Carbondale, Illinois, Historical Record," dated January 1, 1944 to April 1, 1944.
[166] ACL 000699. Lease for Smoler Bros, Inc. *Note that the date of this lease is illegible.*
[167] CRO 000212. CONWR, Analysis of Industrial Tenants employing labor, dated March 18, 1955, Page 2.
[168] CRO 001575A. Herrin Daily Journal, Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.
[169] CRO 001575A. Herrin Daily Journal, Newspaper article about factories attending a Chamber of Commerce dinner, dated March 30, 1949.
[170] DPRA Document No. 0022977. Special Use Permit No. 20013, dated November 18, 1957.
[171] DPRA Document No. 00006375. Building Contract No. 14-16-0003-84-546 by and between U. S. Fish and Wildlife Service and East Side Lumberyard Supply Company by and between U. S. Fish and Wildlife Service and East Side Lumberyard Supply Company, dated July 1, 1984, Pages 1-2; and, DPRA Document No. 00013091. Amendment No. 2 to Building Lease Contract No. 14-16-0003-84-546, East Side Lumberyard Supply Company.

Primex Technologies, Inc. relocated their shipping and receiving facility to Building S-3-3 after Building S-4-5 (in Area 4 East) was destroyed in 1998.[172] This building is still on site and GDO&TS (successor to Olin and Primex Technologies, Inc.) currently leases it.[173]

Building S-3-5 – IOP Locker Building

This IOP building contained a locker room and showering facilities.[174]

In 1958, this building was used as the Refuge Headquarters by the USFWS.

Midwest Brush (part of Diagraph) leased Building S-3-5 from 1983[175] through 1990.[176] They used this building for corporate office space.[177]

Illinois Department of Natural Resources currently occupies this building and has since 1991 as a USFWS fisheries office.[178,179]

Building S-3-6 – IOP Timekeepers Building

This IOP building was removed between 1943 and 1951.[180]

Building S-3-8 – IOP Cafeteria

This IOP building was removed between 1943 and 1951.[181]

9.1.3 Area 4 West Previous Sampling Results

Metals Areas Operable Unit (MAOU)

Site 22, the Old Refuge Shop Channel, was investigated during the O'Brien & Gere Remedial Investigation (RI) and was remediated as part of the MAOU. The MAOU remediation was completed in 1996. Analytical data from this investigation is not shown because the sites were

[172] DPRA Document No. 00017680. CONWR, Letter to Primex Technologies regarding the renovation of Building S-3-3, dated December 9, 1998.
[173] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[174] U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 8, Page 43.
[175] DOI 000593 – DOI 000954. Amendment No. 1 to Building Lease Contract No. 14-16-0003-82-534, Diagraph Bradley Industries, Inc., dated September 1, 1983.
[176] DPRA Document No. 00007244. Diagraph Corporation, Letter to USFWS regarding cancellation of lease for Building S-3-5, dated October 24, 1990.
[177] DOI 000179. Diagraph Corporation's response to request for information pursuant to Section 104 (e), dated July 19, 1989, Page 2.
[178] Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.
[179] Information obtained from Elaine L. Moore, USFWS, August 10, 2001.
[180] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 1 – dated February 7, 1943, and Figure2 – dated August 5, 1951.
[181] Entech, Inc., 2000, Historical Aerial Photographic Analysis of Area 4, Crab Orchard National Wildlife Refuge (CONWR), Figure 1 – dated February 7, 1943, and Figure2 – dated August 5, 1951.

remediated. During remediation of Site 22, the contamination (cadmium, chromium, lead, and cyanide) was found to be more widespread than originally delineated, and an additional investigation was done during the remedial action to delineate the additional extent of contamination.[182] Areas remediated by excavation as a result of that investigation are shown in Figure 9-1. The cleanup standard for cadmium for Site 22 was 10 milligrams per kilogram (mg/kg). The screening level for this report is Refuge background, 1.4 mg/kg. The figure shows cadmium detections in soil above 1.4 mg/kg outside the remediated area.

Miscellaneous Areas Operable Unit (MISCA OU)

Site 22A (Post Treating Facility) was part of the MISCA OU and it was investigated and remediated in a removal action in 1996. Analytical data from this investigation is not shown because the site was remediated.

1998 USEPA Sampling

1998 USEPA sampling included original AUS OU Sites from AUS-0013 (former IOP Laundry Facility) and AUS-0015 (former IOP Boiler House). All samples are shallow soil samples. Locations are shown in Figure 9-2.[183] The results for all detected constituents are listed in Table 9-1A.

Samples 13-01C, 13-02, 13-02C, and 13-03C were analyzed for Target Compound List (TCL) semi-volatile organic compounds (SVOCs),[184] and Target Analyte List (TAL) metals. No SVOC detections exceeded PA screening criteria. Barium (180 mg/kg), cadmium (29 mg/kg) and nickel (24 mg/kg) exceeded USEPA Soil Screening Levels (SSLs) and Refuge background.[185]

Sample 15-01 was analyzed for SVOCs, polynuclear aromatic hydrocarbons (PAHs), and metals. Benzo[b]fluoranthene (1.7 mg/kg) exceeded USEPA SSLs. Benzo[k]fluoranthene (1.7 mg/kg) exceeded CSOQGs. Cadmium (21 mg/kg) exceeded USEPA SSLs and background for the Refuge.[186]

9.1.4 Observations During Site Visit

Buildings S-1-1, S-1-2, S-1-3, S-2-5, S-3-1, S-3-2, S-3-3 and S-3-5 were still on site at the time of the site visit in the spring of 1999. Buildings S-3-1 and S-3-2 have been combined into one building. Most of the areas surrounding the current and former buildings are either grass-covered or gravel-covered. The areas surrounding the industrialized portion of Area 4 West are mostly wooded or grass-covered.

[182] Woodward-Clyde, 1996. Report of Investigation, West Shop Area, Metals Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[183] Sample designated 13-02C? may be 13-02 or 13-02C. The distinction is not made in the survey information.
[184] SVOCs results could not be found for 13-03C.
[185] See Table 1-11 of this report for Refuge background soil values used for the PA.
[186] See Table 1-11 of this report for Refuge background soil values used for the PA.

9.1.5 Recommendations Based On Preliminary Assessment

Sites Eliminated

Original AUS-0012 (Possible Waste Oil Tank at Old Refuge Shop) was eliminated from the SI, since there was no evidence found during the historic records search that this tank ever existed.[187]

Original AUS-0016 (Concrete Pit of Supreme Plating located west of former Building S-2-4) was also eliminated from the SI, since documentation was found that this pit (or "tank") was closed in place, as discussed above.

Sites Recommended for an SI

Original AUS OU sites AUS-0013, AUS-0014, and AUS-0015 were included in the RI. They were incorporated into the larger, current site, Area 4 West (AUS-0A4W) which includes the entire former West Shop Area, except for those area remediated as part of MAOU Site 22 (shown in Figure 9-1). The MISCA Site 22A (Post Treating Facility) and most of the MAOU Site 22 (Old Refuge Shop Channel) are both just west of the West Shop Area.

Original AUS-0013 (former IOP Laundry Facility and Supreme Plating Operation) was included because although portions of this area were previously investigated, USEPA samples collected near this building contained cadmium contamination above cleanup criteria for the MAOU remedial action and above the PA screening criteria. Other constituents exceeded PA screening criteria in the USEPA samples.

Original AUS-0014 was included in the SI because this site was not previously investigated. This was the former IOP Dry Cleaners/Light Equipment Maintenance Facility (Building S-2-5). Supreme Plating also operated out of this building for a few years before relocating to former Building S-2-4, and other companies did plating in this building before Supreme Plating.

Original AUS-0015 (IOP Boiler House – Building S-2-3) was included in the SI based on exceedances of PA screening criteria in the USEPA 1998 samples.

Based on operations conducted in the buildings in this area and other areas of concern identified by the aerial photograph interpretation, several other areas in Area 4 West required further investigation during the SI as discussed in Section 9.2.1 below.

9.2 SITE INVESTIGATION INFORMATION

URS conducted a Site Investigation at AUS-0A4W from April 3 through April 17, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan

[187] According to the Environmental Science & Engineering, Inc. (ESE) Uncharacterized Sites Report, in a discussion of the former Area 4 gasoline service station (AUS-011 – located in Area 4 East), "It is conjectured that a waste oil tank may have been associated with the Old Refuge Shop, but no specific evidence was located." Based on this comment by ESE, this site was added to the AUS OU and since no evidence of this tank was found, it was eliminated.

(FSP)[188] for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 9.1) 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 Figure 9-2. Survey coordinates for all sample locations in Area 4 West are listed in Table 9-2. Table 9-3 lists the sample locations and the matrix sampled at that location. Soil was the only media sampled at this site.

9.2.1 Field Investigation

Sampling was done in accordance with the FSP, except as noted. The field investigation is summarized in this section, following the same order of description of site features as Section 9.1.2 of this report.

Building S-1-3 and S-1-4 – IOP Laboratory and Sample Rest House

One sample (0A4W-012) was collected from behind the former IOP Laboratory (Building S-1-3). This building also housed Diagraph Bradley/Midwest Brush. Sample 0A4W-012 was placed in an area that was likely to receive dumping/spillage of chemicals used by these two tenants. Sample location 0A4W-011 was located in a ditch to the northeast of Building S-1-3 that likely received drainage from the area surrounding this building.

Building S-2-4 – IOP Laundry Facility

The area surrounding Building S-2-4 was previously investigated and remediated as a part of the MAOU (Site 22 (West Shop Area) of the MAOU). Sample locations 0A4W-007 and 0A4W-008 were located between Buildings S-2-4 and S-2-3 (former Boiler House), since samples were not previously collected from this area during the MAOU investigation (potential data gap). The USEPA also collected three samples from the area of Building S-2-4 in 1998, and several compounds were detected above preliminary screening levels (including a cadmium detection that was above the MAOU cleanup levels). Sample 0A4W-009 was collected southeast of this building in a drainage ditch that was located on the south side of the roadway.

Building S-2-5 – IOP Light Equipment Repair Building or Dry Cleaner

Building S-2-5 was identified as a former IOP Light Equipment Repair Building. This building was used for plating, probably from the early 1950s to 1970. This building was investigated since the areas immediately surrounding the building were not included in previous investigations. The ditches surrounding this building were previously investigated as a part of the MAOU (West Shop Area investigation). Four sample locations (0A4W-003 through 0A4W-006) – one on each side of this building – were collected from the areas immediately surrounding this building to determine the potential for contamination as a result of the activities performed

[188] 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.

in the building. Sample 0A4W-010 was collected east of this building in a drainage ditch located on the south side of the roadway.

Former AST Location

Two former ASTs were located to the west of the northwest corner of Building S-1-1.[189] Sample location 0A4W-013 was collected from a depth of 5 to 6 ft in this location since this area was included in an area that was previously excavated to a depth of 4 ft for other contamination as part of MAOU Site 22 cleanup. A possible third tank was located due west of these two tanks;[190] however, this tank was located within the boundaries of the remediation at Site 22A so no further investigation was done at the location of this tank.

Former Trench Location

Three possible former trenches were located southwest of the industrial portion of Area 4 West. These trenches were identified in the 1971 historical aerial photograph. A test pit (0A4W-001) was excavated in the location of the center trench identified using coordinates obtained from the historical aerial photograph.[191]

Former Disposal Area

A possible disposal area was located south of the former Post Treating Facility (prior to the presence of the Post Treating Facility on site). It was identified in the 1951 aerial photograph, and it was located using coordinates obtained from the aerial photograph. One surficial sample was collected from this area, 0A4W-002.

9.2.2 Field Results

The following sections present the results of the field investigation.

9.2.2.1 Site Conditions

9.2.2.1.1 Geologic Conditions

No borings or monitoring wells were installed as part of this investigation. In a previous investigation done as part of the Metals Area OU, three monitoring wells were installed.[192] The soil from the borings was described as low to high plastic silty clay with some sand. Sand, possibly residual, was encountered at a depth of 15.5 ft in one boring, and 22 ft in another. In the

[189] Entech, Inc., 2000, Site Specific Report on Area 4 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[190] Entech, Inc., 2000, Site Specific Report on Area 4 at the Former Illinois Ordnance Plant, Crab Orchard National Wildlife Refuge, Marion, Illinois.
[191] At the beginning of the project, a test was conducted to estimate the accuracy of locating features from historic aerial photos. Using conventional methods, survey coordinates were obtained of a number of existing features at the Refuge that also appeared on a series of historic photos (for example, the corners of IOP buildings that are still existing). Entech independently obtained coordinates from the aerial photos. The coordinates obtained from the aerial photos were found to be in agreement with the coordinates obtained by conventional methods, within a few ft.
[192] Woodward-Clyde, 1996. Report of Investigation, West Shop Area, Metals Areas Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois.

third boring, a hard high plastic clay, possible residual from shale, was encountered at a depth of 22 ft. Monitoring wells were installed at depths of 15.5 ft, 21 ft, and 23.5 ft.

9.2.2.1.2 Hydrogeologic Conditions

Based on wells previously installed at the site, the groundwater flow direction appears to be to the west.

9.2.2.1.3 Hydrologic Conditions

This area is fairly flat and drained by a series of shallow ditches installed at the time of the IOP construction. Localized flooding occurs after heavy rains. Drainage is toward the north.

9.2.2.2 Chemical Results

Table 9-4 lists the chemicals detected in Area 4W 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). Results are presented in Figure 9-2.

9.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 9-5 and 9-6, as follows:

- Table 9-5--results of human health risk screening for soils, and
- Table 9-6--results of ecological risk screening for soils.

Each table lists the maximum detected concentration for each constituent analyzed at AUS-0A4W. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of an HQ.

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

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

In Figure 9-2 the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are

qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 9-7 (human health risk) and 9-8 (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 9-7) and COPECs (Table 9-8) are shaded in the tables.

9.3.1 Human Health Risk

9.3.1.1 Soil

Human health screening results for soil samples are presented in Table 9-5. 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.

9.3.2 Ecological Risk

9.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 9-6. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)[193]
- Environment Canada (1995)[194]
- Talmage *et al.* (1999)[195]
- Efroymson *et al.* (1997a, 1997b)[196]

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

[194] 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.

[195] 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.

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

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

- CCME (1999)[197]
- MHSPE (1994)[198]
- 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)[199] 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.

9.4 SCIENTIFIC MANAGEMENT DECISION POINT

An RI is recommended for Site AUS-0A4W, 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 9-7, and on the COPEC list, Table 9-8. There are no COPCs in this category. The only COPEC coded with "D" on Table 9-8 is manganese. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method; if new information on site usage suggests they should be evaluated; or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 9-9.

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

[197] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.
[198] 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.
[199] USEPA 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

TABLE 9-1
AREA 4 WEST OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
S-1-1	1942-1945	SWDC/War Dep't	Locomotive diesel repair
	1983-1985	Southern Illinois University	Unknown
	1985-1990	Diagraph	Unknown
	Current	GDO&TS	Unknown
S-1-2	1942-1945	SWDC/War Dep't	Tool and Gage Shop
	1949-1958	R.K. Manufacturing Company (successor: American Magnetic Corporation)	Manufacturing specialty transformers
	1959-1974	National Reproductions (successor: Christian Press)	Printing shop
	1974-1982	Midwest Brush	Manufacturing coder cartridges
	?-Current	Illinois Department of Natural Resources	Unknown
S-1-3	1942-1945	SWDC/War Dep't	Laboratory
	1946-1947	B.E. Brennan & Company	Unknown
	1947-1949	Fred W. Ervin	Unknown
	1959, 1961-1963	Southern Illinois University-Department of Special Education	Training center for mentally handicapped
	1962? 1965-1997	Midwest Brush	Stencil and stencil brush manufacture
	Current	Williamson County Emergency Management Agency	Unknown
S-1-4	1942-1945	SWDC/War Dep't	Rest House (for laboratory samples)
	1946-1947	B.E. Brennan & Company	Unknown
	1947-1949	Fred W. Ervin	Unknown
	?-Current	Williamson County Emergency Management Agency	Unknown
S-2-1	1942-1945	SWDC/War Dep't	Piping and plumbing shop
	1947	Diagraph (formerly Diagraph Bradley Industries)	Unknown
	1949	USFWS	Shop
	1951-1954	General Radiator Company	Production of industrial engine cooling radiators
	1955-1961	Dura Crates, Inc. (possibly)	Crate manufacturer
	1961-1974	Southern Illinois University	Handicapped training center
	1974-1978	Mental Health Services of Franklin and Williamson Counties, Inc.	Unknown
S-2-2	1942-1945	SWDC/War Dep't	Machine shop
	1947-1949	R.K. Manufacturing Company	Manufacturing specialty transformers
	1951-1954	Ordill Machine Corporation	Tool and dye working
	1955-1959, 1960-1961	Dura Crates, Inc.	Crate manufacturing/open storage
S-2-3	1942-1945	SWDC/War Dep't	Boiler house

TABLE 9-1
AREA 4 WEST OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
S-2-4	1942-1945	SWDC/War Dep't	Laundry facility
	1946-1950	B.E. Brennan & Company	Unknown
	1950-1954, 1956-1966	East Side Lumberyard Supply	Temporary storage of building materials
	1966-1970	Midwest Brush	Unknown
	1970-1984	Supreme Plating	Metal plating
S-2-5	1942-1945	SWDC/War Dep't	Light equipment repair/dry cleaners
	1946-1948	B.E. Brennan & Company	Unknown
	1948-1949	Shepard	Never got into production
	1949-1952	The Herrin Plating Company/Radionic Products, Inc.	Electroplating
	1963-1970	Supreme Plating	Metal plating
	1970-1982	Midwest Brush	Unknown
	?-Current	Williamson County Emergency Management Agency	Storage of Equipment
S-3-1	1942-1945	SWDC/War Dep't	Carpenters shop
	1946-1951	Furniture Company of Southern Illinois	Manufacturing molding and furniture
	1951-1954	The General Radiator Company	Production of engine cooling radiators
	1957-1965	Norge	Warehouse storage
	1965-1990	East Side Lumberyard Supply	Wholesale lumber supplies
	?-2001	Primex	Unknown
	Current	GDO&TS	Warehouse
S-3-2	1942-1945	SWDC/War Dep't	Warehouse
	1946-1951	Furniture Company of Southern Illinois	Manufacturing molding and furniture
	1951-1954	The General Radiator Company	Production of engine cooling radiators
	1957-1965	Norge	Warehouse storage
	1965-1990	East Side Lumberyard Supply	Wholesale lumber supplies
	?-2001	Primex	Unknown
	Current	GDO&TS	Warehouse
S-3-3	1942-1945	SWDC/War Dep't	Electric and communication shop
	1946-1947, 1949	Smoler Brothers, Inc.	Manufacturing women's dresses
	1953-1990	East Side Lumberyard Supply	Wholesale lumber supplies
	1998-Present	Primex/GDO&TS	Shipping and receiving

TABLE 9-1
AREA 4 WEST OPERATORS/LESSEES AND BUILDING USES

Building No.	Year	Operator/Lessee	Product Line or Use
S-3-5	1942-1945	SWDC/War Dep't	Locker building
	1958	USFWS	Refuge headquarters
	1983-1990	Midwest Brush/Diagraph	Corporate office space
	1991-Current	Illinois Department of Natural Resources	FWS Fisheries Office[200]
S-3-6	1942-1945	SWDC/War Dep't	Timekeepers building
S-3-8	1942-1945	SWDC/War Dep't	Cafeteria building

Sheet 3 of 3

References for this table can be found in the Section 9.1.2 of this report.

[200] Information obtained from Elaine L. Moore, USFWS, August 10, 2001.

TABLE 9-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
13-01C	Bis(2-Ethylhexyl)phthalate	0.13J
	Aluminum	13,000
	Barium	180
	Beryllium	0.6
	Cadmium	5.8
	Calcium	13,000
	Chromium	19
	Cobalt	15
	Copper	10
	Iron	18,000
	Magnesium	8,300
	Manganese	2,100
	Mercury	0.04
	Nickel	18
	Potassium	88
	Vanadium	35
	Zinc	48
13-02	Aluminum	9,900
	Barium	91
	Beryllium	0.5
	Cadmium	24
	Calcium	7,300
	Chromium	30
	Cobalt	7.1
	Copper	15
	Iron	16,000
	Lead	16
	Magnesium	4,300
	Manganese	630
	Nickel	15
	Potassium	690
	Vanadium	26
	Zinc	64
13-02C	Bis(2-Ethylhexyl)phthalate	0.13J
	Aluminum	11,000
	Barium	140
	Beryllium	0.6
	Cadmium	15
	Calcium	6,900
	Chromium	23
	Cobalt	13
	Copper	11
	Iron	18,000
	Lead	19
	Magnesium	4,600
	Manganese	1,200
	Nickel	24
	Potassium	790

TABLE 9-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
13-02C	Vanadium	31
	Zinc	60
13-03C	Aluminum	10,000
	Barium	110
	Beryllium	0.6
	Cadmium	29
	Calcium	8,200
	Chromium	40
	Cobalt	8
	Copper	13
	Iron	18,000
	Lead	21
	Magnesium	5,200
	Manganese	550
	Nickel	17
	Potassium	810
	Vanadium	28
	Zinc	77
15-01	Benzo[b]fluoranthene	1.7J
	Benzo[k]fluoranthene	1.7J
	Aluminum	6,300
	Barium	66
	Beryllium	0.5
	Cadmium	21
	Calcium	1,500
	Chromium	29
	Cobalt	9.4
	Copper	9.8
	Iron	13,000
	Magnesium	1,400
	Manganese	430
	Nickel	13
	Potassium	640
	Vanadium	20
	Zinc	27

Sheet 2 of 2

mg/kg = milligrams per kilogram
J = Estimated

TABLE 9-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A4W

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A4W-001	385431.1	783585.1		NA	No ground elevation for this point.
0A4W-002	385678.1	784304.9	445.12	NA	
0A4W-003	385260.6	784874.3	453.37	NA	
0A4W-004	385219.6	784840.7	454.03	NA	
0A4W-005	385239.4	784815.5	453.36	NA	
0A4W-006	385290.4	784821.5	452.36	NA	
0A4W-007	385569.8	784875.1	446.80	NA	
0A4W-008	385569.4	784805.2	446.92	NA	
0A4W-009	385344.5	784942.4	448.93	NA	
0A4W-010	385280.9	784941.4	449.91	NA	
0A4W-011	385289.7	784735.8	448.56	NA	
0A4W-012	385250.4	784551.7	447.65	NA	
0A4W-013	386096.4	784450.8	445.54	NA	

Sheet 1 of 1

NA = Not Applicable

TABLE 9-3
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A4W

Soil
AUS-0A4W-001
AUS-0A4W-002
AUS-0A4W-003
AUS-0A4W-004
AUS-0A4W-005
AUS-0A4W-006
AUS-0A4W-007
AUS-0A4W-008
AUS-0A4W-009*
AUS-0A4W-010*
AUS-0A4W-011
AUS-0A4W-012
AUS-0A4W-013

Sheet 1 of 1

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

TABLE 9-4
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Volatile Organic Compounds		
Acetone	2/14	30 ug/kg to 35 ug/kg
Chloroform	1/14	2 ug/kg
Semivolatile Organic Compounds		
2-Methylnaphthalene	1/6	3500 ug/kg
Acenaphthylene	1/6	67 ug/kg
Anthracene	1/6	65 ug/kg
Benzo(a)anthracene	1/6	130 ug/kg
Benzo(a)pyrene	1/6	97 ug/kg
Benzo(b)fluoranthene	1/6	50 ug/kg
Benzo(k)fluoranthene	1/6	100 ug/kg
Benzyl butyl phthalate	1/6	46 ug/kg
Bis(2-ethylhexyl) phthalate	1/6	100 ug/kg
Carbazole	1/6	92 ug/kg
Chrysene	1/6	170 ug/kg
Dibenzofuran	1/6	790 ug/kg
Fluoranthene	1/6	120 ug/kg
Naphthalene	1/6	1800 ug/kg
Phenanthrene	1/6	990 ug/kg
Pyrene	1/6	320 ug/kg
Explosive		
HMX	1/6	1200 ug/kg
Metals		
Aluminum	14/14	4640 mg/kg to 16500 mg/kg
Antimony	9/14	0.27 mg/kg to 4.4 mg/kg
Arsenic	14/14	3.4 mg/kg to 60.1 mg/kg
Barium	14/14	67.8 mg/kg to 214 mg/kg
Boron	6/14	1.8 mg/kg to 34.2 mg/kg
Cadmium	9/14	1.9 mg/kg to 4520 mg/kg
Calcium	14/14	620 mg/kg to 43600 mg/kg
Chromium, Total	14/14	7.3 mg/kg to 298 mg/kg
Cobalt	11/14	5.1 mg/kg to 32.8 mg/kg
Copper	14/14	3.6 mg/kg to 178 mg/kg
Iron	14/14	11000 mg/kg to 27000 mg/kg
Lead	14/14	7.6 mg/kg to 275 mg/kg
Magnesium	14/14	676 mg/kg to 21000 mg/kg
Manganese	14/14	124 mg/kg to 2160 mg/kg
Mercury	9/14	0.06 mg/kg to 0.72 mg/kg
Nickel	14/14	3.8 mg/kg to 114 mg/kg
Potassium	14/14	213 mg/kg to 786 mg/kg
Selenium	11/14	0.24 mg/kg to 4 mg/kg
Thallium	2/14	0.19 mg/kg to 1.2 mg/kg
Vanadium	14/14	14.7 mg/kg to 29.1 mg/kg
Zinc	14/14	12.3 mg/kg to 780 mg/kg

Sheet 1 of 2

TABLE 9-4
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituents	Number of Detections	Range of Detections
Other Inorganics		
Total Organic Carbon	1/1	16400 mg/kg

Sheet 2 of 2

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

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

Checked by: ARE 5/24/01

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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)	13	U	UG/KG			4.69E-07	
591-78-6	2-Hexanone	13	U	UG/KG				
108-10-1	4-Methyl-2-pentanone (MIBK)	13	U	UG/KG			4.50E-06	
67-64-1	Acetone	35		UG/KG			5.63E-06	4.38E-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 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	19	U	UG/KG		9.26E-10	1.94E-06	1.90E+01
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	3	J	UG/KG			1.51E-06	5.00E-03
1330-20-7	total Xylenes	8		UG/KG			1.80E-06	8.00E-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)	7	U	UG/KG		1.14E-09	8.85E-05	2.33E+00
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	440	U	UG/KG			5.78E-05	1.47E+00
95-50-1	1,2-Dichlorobenzene	440	U	UG/KG			1.33E-04	4.89E-01
541-73-1	1,3-Dichlorobenzene	440	U	UG/KG			8.50E-03	
106-46-7	1,4-Dichlorobenzene	440	U	UG/KG		5.41E-08	2.29E-04	4.40E+00
95-95-4	2,4,5-Trichlorophenol	2200	U	UG/KG			2.50E-05	2.20E-01
88-06-2	2,4,6-Trichlorophenol	440	U	UG/KG		1.96E-09		5.50E+01
120-83-2	2,4-Dichlorophenol	440	U	UG/KG			1.66E-04	8.80E+00
105-67-9	2,4-Dimethylphenol	440	U	UG/KG			2.50E-05	1.10E+00
51-28-5	2,4-Dinitrophenol	2200	U	UG/KG			1.25E-03	2.20E+02
91-58-7	2-Chloronaphthalene	440	U	UG/KG			1.61E-05	

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
95-57-8	2-Chlorophenol	440	U	UG/KG			1.82E-03	2.20E+00
91-57-6	2-Methylnaphthalene	3500		UG/KG			6.45E-05	1.75E-02
95-48-7	2-Methylphenol	440	U	UG/KG			9.99E-06	5.50E-01
88-74-4	2-Nitroaniline	2200	U	UG/KG			4.37E-02	
88-75-5	2-Nitrophenol	440	U	UG/KG			6.24E-05	
91-94-1	3,3'-Dichlorobenzidine	440	U	UG/KG		8.03E-08		1.47E+03
99-09-2	3-Nitroaniline	2200	U	UG/KG			4.37E-02	
534-52-1	4,6-Dinitro-2-methylphenol	2200	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	440	U	UG/KG				
59-50-7	4-Chloro-3-methylphenol	440	U	UG/KG			9.99E-06	
106-47-8	4-Chloroaniline	870	U	UG/KG			2.47E-04	2.90E+01
7005-72-3	4-Chlorophenyl phenyl ether	440	U	UG/KG				
106-44-5	4-Methylphenol	440	U	UG/KG			9.99E-05	
100-01-6	4-Nitroaniline	2200	U	UG/KG			4.37E-02	
100-02-7	4-Nitrophenol	2200	U	UG/KG			3.12E-04	
83-32-9	Acenaphthene	440	U	UG/KG			1.15E-05	1.47E-02
208-96-8	Acenaphthylene	67	J	UG/KG			1.24E-06	3.35E-04
120-12-7	Anthracene	65	J	UG/KG			1.67E-07	1.08E-04
56-55-3	Benzo(a)anthracene	130	J	UG/KG		4.50E-08		1.63E+00
50-32-8	Benzo(a)pyrene	97	J	UG/KG		3.36E-07		2.43E-01
205-99-2	Benzo(b)fluoranthene	63	J	UG/KG		2.18E-08		3.15E-01
191-24-2	Benzo(g,h,i)perylene	440	U	UG/KG			8.11E-06	2.20E-03
207-08-9	Benzo(k)fluoranthene	100	J	UG/KG		3.46E-09		5.00E-02
111-91-1	bis(2-Chloroethoxy)methane	440	U	UG/KG				

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
111-44-4	bis(2-Chloroethyl) ether	440	U	UG/KG		7.10E-07		2.20E+04
108-60-1	bis(2-Chloroisopropyl) ether	440	U	UG/KG		5.45E-08	1.04E-04	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	100	J	UG/KG		5.68E-10	5.68E-06	
85-68-7	Butyl benzyl phthalate	46	J	UG/KG			2.61E-07	5.75E-05
86-74-8	Carbazole	92	J	UG/KG		7.46E-10		3.07E+00
218-01-9	Chrysene	170	J	UG/KG		5.89E-10		2.13E-02
84-74-2	Di-n-butyl phthalate	440	U	UG/KG			4.99E-06	1.47E-03
117-84-0	Di-n-octyl phthalate	440	U	UG/KG			2.50E-05	4.40E-05
53-70-3	Dibenz(a,h)anthracene	440	U	UG/KG		1.52E-06		5.50E+00
132-64-9	Dibenzofuran	790		UG/KG			1.56E-04	
84-66-2	Diethyl phthalate	440	U	UG/KG			6.24E-07	
131-11-3	Dimethyl phthalate	440	U	UG/KG			4.99E-08	
206-44-0	Fluoranthene	120	J	UG/KG			3.99E-06	6.00E-04
86-73-7	Fluorene	440	U	UG/KG			1.33E-05	1.47E-02
118-74-1	Hexachlorobenzene	440	U	UG/KG		2.85E-07	6.24E-04	4.40E+00
87-68-3	Hexachlorobutadiene	440	U	UG/KG		1.39E-08	2.50E-03	4.40E+00
77-47-4	Hexachlorocyclopentadiene	440	U	UG/KG			7.46E-05	2.20E-02
67-72-1	Hexachloroethane	440	U	UG/KG		2.50E-09	4.99E-04	2.20E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	440	U	UG/KG		1.52E-07		6.29E-01
78-59-1	Isophorone	440	U	UG/KG		1.69E-10	2.50E-06	1.47E+01
621-64-7	N-Nitroso-di-n-propylamine	440	U	UG/KG		1.25E-06		2.20E+05
86-30-6	N-Nitrosodiphenylamine	440	U	UG/KG		8.74E-10		7.33E+00
91-20-3	Naphthalene	1800		UG/KG			9.55E-03	4.50E-01
87-86-5	Pentachlorophenol	2200	U	UG/KG		1.98E-07	1.54E-04	2.20E+03

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	990		UG/KG			1.83E-05	4.95E-03
108-95-2	Phenol	440	U	UG/KG			8.32E-07	8.80E-02
129-00-0	Pyrene	320	J	UG/KG			5.90E-06	1.60E-03
Explosives								
99-35-4	1,3,5-Trinitrobenzene	330	U	UG/KG			1.25E-05	
99-65-0	1,3-Dinitrobenzene	330	U	UG/KG			3.75E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	660	U	UG/KG		8.03E-09	1.50E-03	
121-14-2	2,4-Dinitrotoluene	430	U	UG/KG			2.44E-04	1.08E+04
606-20-2	2,6-Dinitrotoluene	440	U	UG/KG			4.99E-04	1.47E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	660	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	660	U	UG/KG				
99-08-1	3-Nitrotoluene	660	U	UG/KG			3.25E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	660	U	UG/KG				
99-99-0	4-Nitrotoluene (PNT)	660	U	UG/KG			3.25E-04	
2691-41-0	HMX	3800	J	UG/KG			8.63E-05	
98-95-3	Nitrobenzene	430	U	UG/KG	.		3.76E-03	.
121-82-4	RDX	660	U	UG/KG		2.94E-08	2.50E-04	
479-45-8	Tetryl	990	U	UG/KG			1.12E-04	
Metals								
7429-90-5	Aluminum	16500		MG/KG	5.73E-01		9.84E-03	
7440-36-0	Antimony	4.5		MG/KG	5.42E+00		5.50E-03	1.50E+01
7440-38-2	Arsenic	60.1		MG/KG	4.45E+00	2.20E-05	1.37E-01	6.01E+01
7440-39-3	Barium	214		MG/KG	1.10E+00		1.72E-03	2.68E+00
7440-41-7	Beryllium	0.66	U	MG/KG	8.68E-01	2.94E-10	1.79E-04	2.20E-01

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	34.2		MG/KG	6.45E+00		4.32E-04	
7440-43-9	Cadmium	4520		MG/KG	2.38E+04	1.51E-06	5.58E+00	1.13E+04
7440-70-2	Calcium	43600		MG/KG	1.75E+01			
7440-47-3	Chromium	298		MG/KG	1.18E+01	6.65E-07		1.49E+02
7440-48-4	Cobalt	32.8		MG/KG	1.51E+00		2.68E-04	
7440-50-8	Copper	178		MG/KG	1.58E+01		2.34E-03	
7439-89-6	Iron	27000		MG/KG	1.40E+00		4.41E-02	
7439-92-1	Lead	275		MG/KG	1.18E+01			
7439-95-4	Magnesium	21000		MG/KG	1.35E+01			
7439-96-5	Manganese	2160		MG/KG	5.93E-01		6.70E-02	
7439-97-6	Mercury	0.72		MG/KG	1.20E+01			
7440-02-0	Nickel	114		MG/KG	6.03E+00		2.79E-03	1.63E+01
2023695	Potassium	786		MG/KG	1.26E+00			
7782-49-2	Selenium	4		MG/KG	1.71E+00		3.91E-04	1.33E+01
7440-22-4	Silver	1.3	U	MG/KG	2.24E+00		1.27E-04	6.50E-01
7440-23-5	Sodium	300	U	MG/KG	1.76E+00			
7440-28-0	Thallium	1.2		MG/KG	2.93E+00		8.39E-06	
7440-62-2	Vanadium	29.1		MG/KG	6.17E-01		2.03E-03	9.70E-02
7440-66-6	Zinc	780		MG/KG	1.52E+01		1.27E-03	1.30E+00
Other Parameters								
TOC	TOC	16400		MG/KG	5.22E-01			

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Volatile Organic Compounds							
71-55-6	1,1,1-Trichloroethane	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)	13	U	UG/KG			
591-78-6	2-Hexanone	13	U	UG/KG			
108-10-1	4-Methyl-2-pentanone (MIBK)	13	U	UG/KG			
67-64-1	Acetone	35		UG/KG	1.75E-07	1.75E-07	2.19E-03
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 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	19	U	UG/KG	2.50E-05	1.58E-06	9.50E-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	3	J	UG/KG	7.32E-09	7.32E-09	2.50E-04
1330-20-7	total Xylenes	8		UG/KG	8.00E-09	1.95E-08	5.33E-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)	7	U	UG/KG	1.35E-05	5.83E-06	1.17E-01
75-01-4	Vinyl chloride	7	U	UG/KG	2.33E-03	1.08E-04	7.00E-01
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	440	U	UG/KG	2.20E-05	2.20E-04	8.80E-02
95-50-1	1,2-Dichlorobenzene	440	U	UG/KG	2.44E-06	2.44E-05	2.59E-02
541-73-1	1,3-Dichlorobenzene	440	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	440	U	UG/KG			2.20E-01
95-95-4	2,4,5-Trichlorophenol	2200	U	UG/KG	1.10E-05	1.10E-05	8.15E-03
88-06-2	2,4,6-Trichlorophenol	440	U	UG/KG	8.46E-04	4.00E-05	2.20E+00
120-83-2	2,4-Dichlorophenol	440	U	UG/KG	7.21E-05	7.21E-04	4.40E-01
105-67-9	2,4-Dimethylphenol	440	U	UG/KG	1.07E-05	1.07E-05	4.89E-02
51-28-5	2,4-Dinitrophenol	2200	U	UG/KG	5.37E-04	5.37E-03	1.10E+01
91-58-7	2-Chloronaphthalene	440	U	UG/KG			

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
95-57-8	2-Chlorophenol	440	U	UG/KG	4.40E-05	4.40E-05	1.10E-01
91-57-6	2-Methylnaphthalene	3500		UG/KG	5.74E-05	5.74E-05	8.33E-04
95-48-7	2-Methylphenol	440	U	UG/KG	4.40E-06	4.40E-06	2.93E-02
88-74-4	2-Nitroaniline	2200	U	UG/KG			
88-75-5	2-Nitrophenol	440	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	440	U	UG/KG	3.38E-02	1.57E-03	6.29E+01
99-09-2	3-Nitroaniline	2200	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	2200	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	440	U	UG/KG			
59-50-7	4-Chloro-3-methylphenol	440	U	UG/KG			
106-47-8	4-Chloroaniline	870	U	UG/KG	1.06E-04	1.06E-03	1.24E+00
7005-72-3	4-Chlorophenyl phenyl ether	440	U	UG/KG			
106-44-5	4-Methylphenol	440	U	UG/KG			
100-01-6	4-Nitroaniline	2200	U	UG/KG			
100-02-7	4-Nitrophenol	2200	U	UG/KG			
83-32-9	Acenaphthene	440	U	UG/KG	3.67E-06	3.67E-06	7.72E-04
208-96-8	Acenaphthylene	67	J	UG/KG	1.10E-06	1.10E-06	1.60E-05
120-12-7	Anthracene	65	J	UG/KG	1.07E-07	1.07E-07	5.42E-06
56-55-3	Benzo(a)anthracene	130	J	UG/KG	1.63E-02	7.65E-04	6.50E-02
50-32-8	Benzo(a)pyrene	97	J	UG/KG	1.21E-01	5.71E-03	1.21E-02
205-99-2	Benzo(b)fluoranthene	63	J	UG/KG	7.88E-03	3.71E-04	1.26E-02
191-24-2	Benzo(g,h,i)perylene	440	U	UG/KG	7.21E-06	7.21E-06	1.05E-04
207-08-9	Benzo(k)fluoranthene	100	J	UG/KG	1.28E-03	5.88E-05	2.04E-03
111-91-1	bis(2-Chloroethoxy)methane	440	U	UG/KG			

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
111-44-4	bis(2-Chloroethyl) ether	440	U	UG/KG	8.80E-02	5.87E-03	1.10E+03
108-60-1	bis(2-Chloroisopropyl) ether	440	U	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	100	J	UG/KG	2.44E-04	2.44E-05	2.78E-05
85-68-7	Butyl benzyl phthalate	46	J	UG/KG	1.12E-07	1.12E-07	4.95E-05
86-74-8	Carbazole	92	J	UG/KG	3.17E-04	1.48E-05	1.53E-01
218-01-9	Chrysene	170	J	UG/KG	2.18E-04	1.00E-05	1.06E-03
84-74-2	Di-n-butyl phthalate	440	U	UG/KG	2.20E-06	2.20E-06	1.91E-04
117-84-0	Di-n-octyl phthalate	440	U	UG/KG	1.07E-05	1.07E-04	4.40E-05
53-70-3	Dibenz(a,h)anthracene	440	U	UG/KG	5.50E-01	2.59E-02	2.20E-01
132-64-9	Dibenzofuran	790		UG/KG			
84-66-2	Diethyl phthalate	440	U	UG/KG	4.40E-07	4.40E-07	9.36E-04
131-11-3	Dimethyl phthalate	440	U	UG/KG			
206-44-0	Fluoranthene	120	J	UG/KG	1.46E-06	1.46E-06	2.79E-05
86-73-7	Fluorene	440	U	UG/KG	5.37E-06	5.37E-06	7.86E-04
118-74-1	Hexachlorobenzene	440	U	UG/KG	1.10E-01	5.64E-03	2.20E-01
87-68-3	Hexachlorobutadiene	440	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	440	U	UG/KG	3.14E-05	3.14E-05	1.10E-03
67-72-1	Hexachloroethane	440	U	UG/KG	2.20E-04	2.20E-04	8.80E-01
193-39-5	Indeno(1,2,3-c,d)pyrene	440	U	UG/KG	5.50E-02	2.59E-03	3.14E-02
78-59-1	Isophorone	440	U	UG/KG	1.07E-06	1.07E-06	5.50E-02
621-64-7	N-Nitroso-di-n-propylamine	440	U	UG/KG	5.50E-01	2.44E-02	8.80E+03
86-30-6	N-Nitrosodiphenylamine	440	U	UG/KG	3.67E-04	1.76E-05	4.40E-01
91-20-3	Naphthalene	1800		UG/KG	2.20E-05	2.20E-04	2.14E-02
87-86-5	Pentachlorophenol	2200	U	UG/KG	9.17E-02	4.23E-03	7.33E+01

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	990		UG/KG	1.62E-05	1.62E-05	2.36E-04
108-95-2	Phenol	440	U	UG/KG	4.40E-07	3.67E-06	4.40E-03
129-00-0	Pyrene	320	J	UG/KG	5.25E-06	5.25E-06	7.62E-05
Explosives							
99-35-4	1,3,5-Trinitrobenzene	330	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	330	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	660	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	430	U	UG/KG	5.12E-02	2.39E-03	5.38E+02
606-20-2	2,6-Dinitrotoluene	440	U	UG/KG	5.24E-02	2.44E-03	6.29E+02
35572-78-2	2-Amino-4,6-Dinitrotoluene	660	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	660	U	UG/KG			
99-08-1	3-Nitrotoluene	660	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	660	U	UG/KG			
99-99-0	4-Nitrotoluene (PNT)	660	U	UG/KG			
2691-41-0	HMX	3800	J	UG/KG			
98-95-3	Nitrobenzene	430	U	UG/KG	4.30E-04	4.30E-04	4.30E+00
121-82-4	RDX	660	U	UG/KG			
479-45-8	Tetryl	990	U	UG/KG			
Metals							
7429-90-5	Aluminum	16500		MG/KG			
7440-36-0	Antimony	4.5		MG/KG	5.49E-03	5.49E-02	9.00E-01
7440-38-2	Arsenic	60.1		MG/KG	2.00E+01	9.85E-01	2.15E+00
7440-39-3	Barium	214		MG/KG	1.53E-03	1.53E-02	1.78E-01
7440-41-7	Beryllium	0.66	U	MG/KG	6.60E-01	2.28E-02	1.00E-01

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

TABLE 9-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	34.2		MG/KG	1.90E-04	1.90E-03	
7440-43-9	Cadmium	4520		MG/KG	2.26E+00	2.26E+01	1.22E+03
7440-70-2	Calcium	43600		MG/KG			
7440-47-3	Chromium	298		MG/KG	2.98E-02	7.27E-02	1.06E+01
7440-48-4	Cobalt	32.8		MG/KG	2.73E-04	2.73E-03	
7440-50-8	Copper	178		MG/KG	2.17E-03	2.17E-02	1.62E-02
7439-89-6	Iron	27000		MG/KG			
7439-92-1	Lead	275		MG/KG	6.88E-01	6.88E-01	
7439-95-4	Magnesium	21000		MG/KG			
7439-96-5	Manganese	2160		MG/KG	2.25E-02	2.25E-01	
7439-97-6	Mercury	0.72		MG/KG	1.18E-03	1.18E-02	4.80E+00
7440-02-0	Nickel	114		MG/KG	2.78E-03	2.78E-02	1.50E+00
2023695	Potassium	786		MG/KG			
7782-49-2	Selenium	4		MG/KG	4.00E-04	4.00E-03	1.67E+00
7440-22-4	Silver	1.3	U	MG/KG	1.30E-04	1.30E-03	8.67E-01
7440-23-5	Sodium	300	U	MG/KG			
7440-28-0	Thallium	1.2		MG/KG	7.50E-03	7.50E-03	5.00E-01
7440-62-2	Vanadium	29.1		MG/KG	2.08E-03	2.08E-02	2.97E-02
7440-66-6	Zinc	780		MG/KG	1.28E-03	1.28E-02	2.17E-01
Other Parameters							
TOC	TOC	16400		MG/KG			

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

TABLE 9-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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)		13	U	UG/KG	1.45E-04	
591-78-6	2-Hexanone		13	U	UG/KG	1.03E-03	
108-10-1	4-Methyl-2-pentanone (MIBK)		13	U	UG/KG	2.93E-05	
67-64-1	Acetone		35		UG/KG	1.40E-02	
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		19	U	UG/KG	4.69E-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		3	J	UG/KG	1.00E-03	
1330-20-7	total Xylenes		8		UG/KG	1.33E-02	
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)		7	U	UG/KG	7.78E-04	
75-01-4	Vinyl chloride		7	U	UG/KG	1.08E-02	
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		440	U	UG/KG	2.20E-02	
95-50-1	1,2-Dichlorobenzene		440	U	UG/KG	1.49E-01	
541-73-1	1,3-Dichlorobenzene		440	U	UG/KG	1.17E-02	
106-46-7	1,4-Dichlorobenzene		440	U	UG/KG	2.20E-02	

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

TABLE 9-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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		2200	U	UG/KG	5.50E-01	
88-06-2	2,4,6-Trichlorophenol		440	U	UG/KG	4.40E-02	
120-83-2	2,4-Dichlorophenol		440	U	UG/KG	5.03E-03	
105-67-9	2,4-Dimethylphenol		440	U	UG/KG	4.40E+01	
51-28-5	2,4-Dinitrophenol		2200	U	UG/KG	1.10E-01	
91-58-7	2-Chloronaphthalene		440	U	UG/KG	3.61E+01	
95-57-8	2-Chlorophenol		440	U	UG/KG	1.81E+00	
91-57-6	2-Methylnaphthalene		3500		UG/KG	1.08E+00	YES
95-48-7	2-Methylphenol		440	U	UG/KG	1.09E-02	
88-74-4	2-Nitroaniline		2200	U	UG/KG	2.97E-02	
88-75-5	2-Nitrophenol		440	U	UG/KG	2.75E-01	
91-94-1	3,3'-Dichlorobenzidine		440	U	UG/KG	6.81E-01	
99-09-2	3-Nitroaniline		2200	U	UG/KG	6.96E-01	
534-52-1	4,6-Dinitro-2-methylphenol		2200	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		440	U	UG/KG		
59-50-7	4-Chloro-3-methylphenol		440	U	UG/KG	5.53E-02	
106-47-8	4-Chloroaniline		870	U	UG/KG	7.91E-01	
7005-72-3	4-Chlorophenyl phenyl ether		440	U	UG/KG		
106-44-5	4-Methylphenol		440	U	UG/KG	2.70E-03	
100-01-6	4-Nitroaniline		2200	U	UG/KG	1.00E-01	
100-02-7	4-Nitrophenol		2200	U	UG/KG	3.14E-01	
83-32-9	Acenaphthene		440	U	UG/KG	6.45E-04	
208-96-8	Acenaphthylene		67	J	UG/KG	9.82E-05	
120-12-7	Anthracene		65	J	UG/KG	4.39E-05	YES
56-55-3	Benzo(a)anthracene		130	J	UG/KG	2.50E-02	YES
50-32-8	Benzo(a)pyrene		97	J	UG/KG	2.20E-05	YES
205-99-2	Benzo(b)fluoranthene		63	J	UG/KG	1.05E-03	YES
191-24-2	Benzo(g,h,i)perylene		440	U	UG/KG	3.70E-03	
207-08-9	Benzo(k)fluoranthene		100	J	UG/KG	1.67E-03	YES
111-91-1	bis(2-Chloroethoxy)methane		440	U	UG/KG	1.45E+00	
111-44-4	bis(2-Chloroethyl) ether		440	U	UG/KG	1.86E-02	
108-60-1	bis(2-Chloroisopropyl) ether		440	U	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		100	J	UG/KG	1.08E-01	YES
85-68-7	Butyl benzyl phthalate		46	J	UG/KG	1.93E-01	YES
86-74-8	Carbazole		92	J	UG/KG		YES
218-01-9	Chrysene		170	J	UG/KG	3.59E-02	YES
84-74-2	Di-n-butyl phthalate		440	U	UG/KG	2.20E-03	
117-84-0	Di-n-octyl phthalate		440	U	UG/KG	6.21E-04	
53-70-3	Dibenz(a,h)anthracene		440	U	UG/KG	2.39E-02	
132-64-9	Dibenzofuran		790		UG/KG		YES
84-66-2	Diethyl phthalate		440	U	UG/KG	4.40E-03	
131-11-3	Dimethyl phthalate		440	U	UG/KG	2.20E-03	

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

TABLE 9-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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		120	J	UG/KG	9.84E-04	YES
86-73-7	Fluorene		440	U	UG/KG	1.47E-02	
118-74-1	Hexachlorobenzene		440	U	UG/KG	4.40E-04	
87-68-3	Hexachlorobutadiene		440	U	UG/KG	1.11E+01	
77-47-4	Hexachlorocyclopentadiene		440	U	UG/KG	4.40E-02	
67-72-1	Hexachloroethane		440	U	UG/KG	7.38E-01	
193-39-5	Indeno(1,2,3-c,d)pyrene		440	U	UG/KG	4.04E-03	
78-59-1	Isophorone		440	U	UG/KG	3.17E-03	
621-64-7	N-Nitroso-di-n-propylamine		440	U	UG/KG	8.09E-01	
86-30-6	N-Nitrosodiphenylamine		440	U	UG/KG	2.20E-02	
91-20-3	Naphthalene		1800		UG/KG	7.23E-03	
87-86-5	Pentachlorophenol		2200	U	UG/KG	3.67E-01	
85-01-8	Phenanthrene		990		UG/KG	2.17E-02	YES
108-95-2	Phenol		440	U	UG/KG	1.10E-02	
129-00-0	Pyrene		320	J	UG/KG	4.08E-03	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		330	U	UG/KG	8.77E-01	
99-65-0	1,3-Dinitrobenzene		330	U	UG/KG	5.04E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		660	U	UG/KG	2.20E-02	
121-14-2	2,4-Dinitrotoluene		430	U	UG/KG	3.36E-01	
606-20-2	2,6-Dinitrotoluene		440	U	UG/KG	1.34E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		660	U	UG/KG	8.25E-03	
88-72-2	2-Nitrotoluene (ONT)		660	U	UG/KG		
99-08-1	3-Nitrotoluene		660	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		660	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		660	U	UG/KG		
2691-41-0	HMX		3800	J	UG/KG	1.52E-01	
98-95-3	Nitrobenzene		430	U	UG/KG	1.08E-02	
121-82-4	RDX		660	U	UG/KG	6.60E-03	
479-45-8	Tetryl		990	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	16500		MG/KG		
7440-36-0	Antimony	0.83	4.5		MG/KG	9.00E-01	
7440-38-2	Arsenic	13.5	60.1		MG/KG	6.68E+00	
7440-39-3	Barium	195	214		MG/KG	4.28E-01	
7440-41-7	Beryllium	0.76	0.66	U	MG/KG	6.60E-02	
7440-42-8	Boron	5.3	34.2		MG/KG	6.84E+01	
7440-43-9	Cadmium	0.19	4520		MG/KG	1.56E+02	
7440-70-2	Calcium	2497	43600		MG/KG		
7440-47-3	Chromium	25.2	298		MG/KG	5.96E+01	
7440-48-4	Cobalt	21.7	32.8		MG/KG	1.64E+00	
7440-50-8	Copper	11.3	178		MG/KG	5.74E+00	

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

TABLE 9-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 4W (AUS-0A4W)

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	27000		MG/KG	1.35E+02	
7439-92-1	Lead	23.4	275		MG/KG	6.35E-01	
7439-95-4	Magnesium	1552	21000		MG/KG		
7439-96-5	Manganese	3640	2160		MG/KG	2.16E+01	
7439-97-6	Mercury	0.06	0.72		MG/KG	1.03E-01	YES
7440-02-0	Nickel	18.9	114		MG/KG	3.80E+00	
2023695	Potassium	625	786		MG/KG		
7782-49-2	Selenium	2.34	4		MG/KG	4.00E+00	YES
7440-22-4	Silver	0.58	1.3	U	MG/KG	6.50E-01	
7440-23-5	Sodium	170	300	U	MG/KG		
7440-28-0	Thallium	0.41	1.2		MG/KG	1.20E+00	
7440-62-2	Vanadium	47.2	29.1		MG/KG	6.33E-01	
7440-66-6	Zinc	51.4	780		MG/KG	6.50E+00	
Other Parameters							
TOC	TOC	31393	16400		MG/KG		

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

TABLE 9-7, AUS-0A4W
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	F
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	Uncertainty	B
Vinyl chloride	NA	NA	NA	NA	NA	NA	Uncertainty	B
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	No	A

TABLE 9-7, AUS-0A4W
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 9-7, AUS-0A4W
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 9-7, AUS-0A4W
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	NA	NA	NA	NA	NA	NA	No	A
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	No	C
2-Nitrotoluene (ONT)	NA	NA	NA	NA	NA	NA	No	C
3-Nitrotoluene	NA	NA	NA	NA	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	No	C
4-Nitrotoluene (PNT)	NA	NA	NA	NA	NA	NA	No	A
HMX	NA	NA	NA	NA	NA	NA	Uncertainty	B
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA
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	No	F
RDX	NA	NA	NA	NA	NA	NA	No	A
Tetryl	NA	NA	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

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

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

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

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

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

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

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

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

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

NA - Not Analyzed or not applicable.

TABLE 9-8, AUS-0A4W
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	NA	NA	NA	NA	No	A
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	No	A
1,1,2-Trichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethane	NA	NA	NA	NA	No	A
1,1-Dichloroethene	NA	NA	NA	NA	No	A
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	No	A
1,2-Dichloroethene (total)	NA	NA	NA	NA	No	A
1,2-Dichloropropane	NA	NA	NA	NA	No	A
2-Butanone (MEK)	NA	NA	NA	NA	No	A
2-Hexanone	NA	NA	NA	NA	No	A
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	No	A
Acetone	NA	NA	NA	NA	No	F
Benzene	NA	NA	NA	NA	No	A
Bromodichloromethane	NA	NA	NA	NA	No	A
Bromoform	NA	NA	NA	NA	No	A
Bromomethane	NA	NA	NA	NA	No	A
Carbon disulfide	NA	NA	NA	NA	No	A
Carbon tetrachloride	NA	NA	NA	NA	No	A
Chlorobenzene	NA	NA	NA	NA	No	A
Chloroethane	NA	NA	NA	NA	No	C
Chloroform	NA	NA	NA	NA	No	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	A
Vinyl chloride	NA	NA	NA	NA	No	A
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	NA	NA	NA	NA	No	A
1,2-Dichlorobenzene	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	No	A
2,4,5-Trichlorophenol	NA	NA	NA	NA	No	A

TABLE 9-8, AUS-0A4W
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 9-8, AUS-0A4W
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

TABLE 9-8, AUS-0A4W
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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

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

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

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

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

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

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

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

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

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

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

NA - Not Analyzed or not applicable.

TABLE 9-9
AUS-0A4W - WEST SHOP AREA
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
SVOCs					
2-Methylnaphthalene		**E**	NA	NA	NA
Anthracene		**E**	NA	NA	NA
Benzo(a)anthracene		**H,E**	NA	NA	NA
Benzo(a)pyrene		**E**	NA	NA	NA
Benzo(b)fluoranthene		**H,E**	NA	NA	NA
Benzo(k)fluoranthene		**E**	NA	NA	NA
bis(2-Ethylhexyl)phthalate		**E**	NA	NA	NA
Butyl benzyl phthalate		**E**	NA	NA	NA
Carbazole		**H,E**	NA	NA	NA
Chrysene		**E**	NA	NA	NA
Dibenzofuran		**E**	NA	NA	NA
Fluoranthene		**E**	NA	NA	NA
Phenanthrene		**E**	NA	NA	NA
Pyrene		**E**	NA	NA	NA
Metals					
Antimony		**H**	NA	NA	NA
Arsenic		**H,E**	NA	NA	NA
Barium		**H**	NA	NA	NA
Boron		**E**	NA	NA	NA
Cadmium		**H,E**	NA	NA	NA
Chromium		**H,E**	NA	NA	NA
Cobalt		**E**	NA	NA	NA
Copper		**E**	NA	NA	NA
Iron		**E**	NA	NA	NA
Mercury		**H,E**	NA	NA	NA
Nickel		**H,E**	NA	NA	NA
Selenium		**H,E**	NA	NA	NA
Thallium		**E**	NA	NA	NA
Zinc		**H,E**	NA	NA	NA

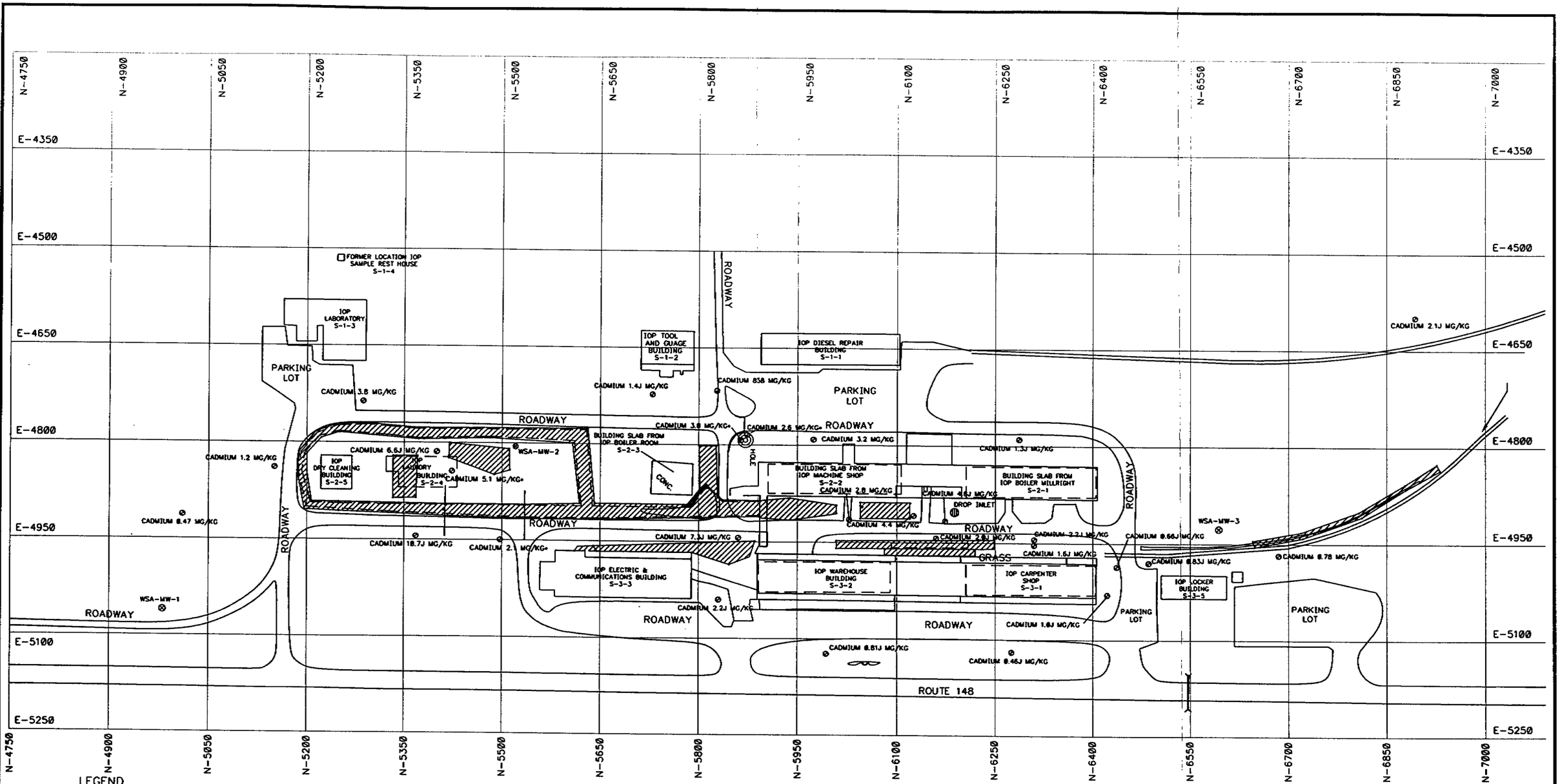
Key:

[1] Drums were not present at this site.

NA = not analyzed

H = human health screening criteria exceeded

E = ecological screening criteria exceeded



LEGEND

J=ESTIMATED

WSA-SL-12 SOIL SAMPLE OBTAINED BY WOODWARD-CLYDE, 1996

WSA-MW-1 MONITORING WELL

— — DASHED LINES INDICATE BUILDING WHICH NO LONGER EXIST

* INDICATES APPROXIMATE LOCATION, NOT SURVEYED

AREA EXCAVATED DURING THE METALS AREA OU REMEDIATION

BASE MAP BY MARVIN JENKINS, OCTOBER 1995

N

0 150 300

SCALE FEET

PA/SI REPORT - AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 2320000026.00
URS	
DRN. BY: djd 8/28/99 DSGN. BY: ja CHKD. BY: mch/mmf	West Shop Area Previous Sampling Locations Outside of the Metals OU Remediation
	FIG. NO. 9-1

File: E:\2320000026.00\PA-SI REPORT-AUS OU\CRABFIG9-1LS.DWG Last edited: 08/16/01 @ 1:24 p.m. @ WCC-ST.LOUIS

AUS-0A4W-012	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs (Duplicate)	UG/KG	NA			
Toluene (Duplicate)	UG/KG			3	
total Xylenes (duplicate)	UG/KG			5	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Acenaphthylene	UG/KG	3000	a1,a5		
Acenaphthylene	UG/KG	67			
Anthracene	UG/KG	60	a5		
Benzo(a)anthracene	UG/KG	130	a5,h7		
Benzo(a)pyrene	UG/KG	97	a5		
Benzo(b)fluoranthene (Coronene)	UG/KG	50	a5		
Benzo(g,h,i)perylene	UG/KG	100	a5		
Benzo(k)fluoranthene	UG/KG	103	a5		
Butylbenzylphthalate	UG/KG	46	h2		
Carbazole	UG/KG	92	a5,h7		
Chrysene	UG/KG	170	a5		
Dibenzofuran	UG/KG	750	a5		
Fluoranthene	UG/KG	120	a5		
Naphthalene	UG/KG	1800			
Phenanthrene	UG/KG	990	a5		
Pyrene	UG/KG	320	a1,a5		
Explosives					
All Explosives	UG/KG			NA	
HMX	UG/KG	1200			
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	4640			
Antimony	MG/KG	0.35	h5		
Arsenic	MG/KG	6.6	h1,h5,h7		
Barium	MG/KG	68.8			
Boron	MG/KG	2.7			
Cadmium	MG/KG	5	a1,a5,h7		
Calcium	MG/KG	1660			
Chromium	MG/KG	9.7	h5		
Cobalt	MG/KG	6			
Copper	MG/KG	30.3	b1		
Iron	MG/KG	12900	e1		
Lead	MG/KG	22.9			
Magnesium	MG/KG	1140			
Manganese	MG/KG	835			
Mercury	MG/KG	0.18	a1,a5,h5		
Nickel	MG/KG	8.9			
Potassium	MG/KG	362			
Selenium	MG/KG	0.62	e5,h5		
Vanadium	MG/KG	14.7			
Zinc	MG/KG	502	a1,a3		

AUS-0A4W-001	Units	Result: 2 ft	Reference Code	Result: 6 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG			ND	
Chloroform	UG/KG	2			
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		ND	
Explosives					
All Explosives	UG/KG	ND		ND	
Metals					
Aluminum	MG/KG	16500		6280	
Arsenic	MG/KG	10.8	e1,h1,h5,h7	4.9	h1,h5,h7
Barium	MG/KG	66.5		78.8	
Calcium	MG/KG	620		1030	
Chromium	MG/KG	18.3	e1,h5	14.9	e1,h5
Cobalt	MG/KG	6.1		5.7	
Copper	MG/KG	15.5	b1	10.2	
Iron	MG/KG	24800	e1,e3	16700	e1
Lead	MG/KG	12.7		7.6	
Magnesium	MG/KG	2670	b1	2100	b1
Manganese	MG/KG	159	e1	339	e1
Nickel	MG/KG	12.5	h5	15.3	h5
Potassium	MG/KG	674	b1	385	
Selenium	MG/KG	0.65	e5,h5	0.58	e5,h5
Thallium	MG/KG	0.19		ND	
Vanadium	MG/KG	27.1		26.1	
Zinc	MG/KG	47.2		32.6	

AUS-0A4W-008	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG			NA	
Explosives					
All Explosives	UG/KG	ND		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	8330			
Antimony	MG/KG	1.5	a1,a5,h5		
Arsenic	MG/KG	8.6	h1,h5,h7		
Barium	MG/KG	78.4			
Cadmium	MG/KG	132	a1,a3,a5,h5		
Calcium	MG/KG	950			
Chromium	MG/KG	144	a1,a3,a5,h5		
Cobalt	MG/KG	6.9			
Copper	MG/KG	12.1	b1		
Iron	MG/KG	18100	e1		
Lead	MG/KG	28.4	b1		
Magnesium	MG/KG	1040	b1		
Manganese	MG/KG	550	e1		
Mercury	MG/KG	0.07	a1,a5		
Nickel	MG/KG	32.7	a1,a3,h5		
Potassium	MG/KG	920			
Selenium	MG/KG	0.75	e5,h5		
Vanadium	MG/KG	33.6			
Zinc	MG/KG	209	a1,a3,a5,h5		

AUS-0A4W-002	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA			
Acetone	UG/KG			38	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	6410			
Antimony	MG/KG	0.27			
Arsenic	MG/KG	7.5	h1,h5,h7		
Barium	MG/KG	81.9	h5		
Calcium	MG/KG	826			
Chromium	MG/KG	9.8	e1,h5		
Cobalt	MG/KG	9.2			
Copper	MG/KG	6.4			
Iron	MG/KG	15700	e1		
Lead	MG/KG	15.8			
Magnesium	MG/KG	1370			
Manganese	MG/KG	1910	e1		
Nickel	MG/KG	9.8	h5		
Potassium	MG/KG	419			
Selenium	MG/KG	0.83	e5,h5		
Vanadium	MG/KG	21.3			
Zinc	MG/KG	28.9			

AUS-0A4W-006	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	9020			
Arsenic	MG/KG	8.2	h1,h5,h7		
Barium	MG/KG	124	h5		
Calcium	MG/KG	968			
Chromium	MG/KG	11.7	e1,h5		
Copper	MG/KG	8.8			
Iron	MG/KG	13000	e1		
Lead	MG/KG	11.6			
Magnesium	MG/KG	1760	b1		
Manganese	MG/KG	126	e1		
Nickel	MG/KG	7.1	h5		
Potassium	MG/KG	406			
Vanadium	MG/KG	17.4			
Zinc	MG/KG	30.9			

AUS-0A4W-013	Units	Result: 6 ft	Reference Code
Volatile Organic Compounds			
Acetone	UG/KG	30	
Semivolatile Organic Compounds			
All SVOCs	UG/KG	ND	
Metals			
Aluminum	MG/KG	4770	
Arsenic	MG/KG	3.4	h1,h5,h7
Barium	MG/KG	67.6	
Boron	MG/KG	1.8	e1
Calcium	MG/KG	900	
Chromium	MG/KG	7.3	e1,h5
Cobalt	MG/KG	7.1	
Copper	MG/KG	3.6	
Iron	MG/KG	14100	e1
Lead	MG/KG	9.5	
Magnesium	MG/KG	670	
Manganese	MG/KG	365	e1
Nickel	MG/KG	3.8	
Potassium	MG/KG	213	
Vanadium	MG/KG	19.8	
Zinc	MG/KG	12.3	

AUS-0A4W-011	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Semivolatile Organic Compounds					
All SVOCs	UG/KG	ND		NA	
Explosives					
All Explosives	UG/KG	ND		NA	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	7940			
Antimony	MG/KG	0.79	h5		
Arsenic	MG/KG	10.4	e1,h1,h5,h7		
Barium	MG/KG	53.5	h5		
Boron	MG/KG	3.6	e1		
Cadmium	MG/KG	1.5	a1,a5		
Calcium	MG/KG	24000	b1		
Chromium	MG/KG	32.4	a1,e1,h5,h7		
Cobalt	MG/KG	7			
Copper	MG/KG	13.8	b1		
Iron	MG/KG	22200	a1,e1		
Lead	MG/KG	56.2	b1		
Magnesium	MG/KG	11500	b1		
Manganese	MG/KG	700	e1		
Mercury	MG/KG	0.22	b1,e2,h5		
Nickel	MG/KG	13.3	h5		
Potassium	MG/KG	714	b1		
Selenium	MG/KG	0.64	e5,h5		
Vanadium	MG/KG	28.1			
Zinc	MG/KG	97.1	b1		
Other Parameters					
All Other Parameters	UG/KG			NA	
TOC	MG/KG	16400			

AUS-0A4W-005	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	4970			
Antimony	MG/KG	4.3	a1,a5		
Arsenic	MG/KG	5.8	h1,h5,h7		
Barium	MG/KG	126	h5		
Cadmium	MG/KG	157	a1,a3,a5,h5		
Calcium	MG/KG	1500			
Chromium	MG/KG	212	a1,e1,h5,h7		
Cobalt	MG/KG	7.8			
Copper	MG/KG	43.6	b1,e1		
Iron	MG/KG	11000	e1		
Lead	MG/KG	39.3	b1		
Magnesium	MG/KG	918			
Manganese	MG/KG	1160	e1		
Mercury	MG/KG	0.14	b1,e2		
Nickel	MG/KG	114	a1,e1,e3,h5,h7		
Potassium	MG/KG	329			
Selenium	MG/KG	1.2	e1,e5,h5		
Vanadium	MG/KG	15.3			
Zinc	MG/KG	150	a1,e3		

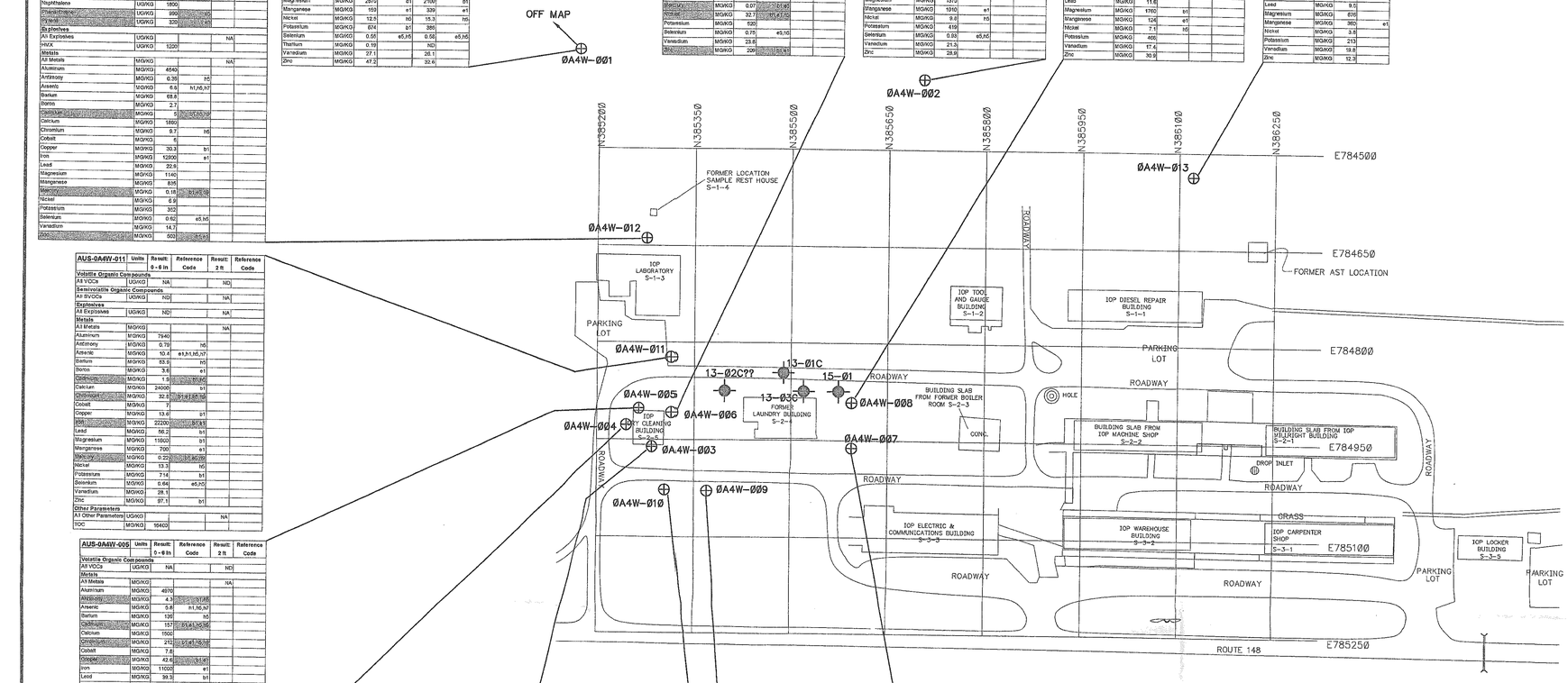
AUS-0A4W-004	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	6360			
Antimony	MG/KG	4	a1,a5		
Arsenic	MG/KG	10.2	e1,h1,h5,h7		
Barium	MG/KG	214	a1,a3,h5		
Boron	MG/KG	5.1	e1		
Cadmium	MG/KG	45.6	a1,a3,a5,h5		
Calcium	MG/KG	3020	b1		
Chromium	MG/KG	236	a1,a3,e1,h5		
Cobalt	MG/KG	18.9			
Copper	MG/KG	88.5	b1,e1		
Iron	MG/KG	27000	a1,e1		
Lead	MG/KG	160	b1		
Magnesium	MG/KG	1560	b1		
Manganese	MG/KG	2160	e1		
Mercury	MG/KG	0.25	a1,a5,h5		
Nickel	MG/KG	77.3	a1,a3,h5,h7		
Potassium	MG/KG	786	b1		
Selenium	MG/KG	0.79	e5,h5		
Vanadium	MG/KG	39.3			
Zinc	MG/KG	726	a1,a3,h5		

AUS-0A4W-003	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	5070			
Antimony	MG/KG	4.4	a1,a5		
Arsenic	MG/KG	60.1	a1,a3,e1,h1,h5,h7		
Barium	MG/KG	84.7	h5		
Boron	MG/KG	34.2	a1,e1		
Cadmium	MG/KG	4520	a1,a3,h1,h2,h5,h7,h5,h9		
Calcium	MG/KG	43600	b1		
Chromium	MG/KG	234	a1,e1,h5,h7		
Cobalt	MG/KG	32.8	a1,e1		
Copper	MG/KG	179	a1,e1		
Iron	MG/KG	21600	e1		
Lead	MG/KG	275	b1		
Magnesium	MG/KG	21000	b1		
Manganese	MG/KG	765	e1		
Mercury	MG/KG	0.72	a1,e2,h5		
Nickel	MG/KG	77.8	a1,e1,h5,h7		
Potassium	MG/KG	696			
Selenium	MG/KG	4	a1,e1,e5,h5,h9		
Thallium	MG/KG	1.2	a1,e1		
Vanadium	MG/KG	28.1			
Zinc	MG/KG	760	a1,a3,e1		

AUS-0A4W-010	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	9560			
Antimony	MG/KG	0.35	h5		
Arsenic	MG/KG	7.9	h1,h5,h7		
Barium	MG/KG	100	h5		
Cadmium	MG/KG	8.4	a1,a3,h5		
Calcium	MG/KG	8060	b1		
Chromium	MG/KG	17.7	e1,h5		
Copper	MG/KG	14.8	b1		
Iron	MG/KG	18000	e1		
Lead	MG/KG	17.6			
Magnesium	MG/KG	4260	b1		
Manganese	MG/KG	274	e1		
Mercury	MG/KG	0.06	e2		
Nickel	MG/KG	14.1	h5		
Potassium	MG/KG	561			
Vanadium	MG/KG	20.9			
Zinc	MG/KG	47.5			

AUS-0A4W-009	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	7230			
Antimony	MG/KG	0.45	h5		
Arsenic	MG/KG	7.3	h1,h5,h7		
Barium	MG/KG	85.5	h5		
Boron	MG/KG	3.8	e1		
Cadmium	MG/KG	12.6	a1,a3,h5		
Calcium	MG/KG	10500	b1		
Chromium	MG/KG	18.7	e1,h5		
Cobalt	MG/KG	7.5			
Copper	MG/KG	15.3	b1		
Iron	MG/KG	20200	a1,e1		
Lead	MG/KG	29.5	b1		
Magnesium	MG/KG	6260	b1		
Manganese	MG/KG	529	e1		
Mercury	MG/KG	0.07	a1,e2		
Nickel	MG/KG	13.6	h5		
Potassium	MG/KG	569			
Selenium	MG/KG	0.24	e5		
Vanadium	MG/KG	19.1			
Zinc	MG/KG	59.7	b1		

AUS-0A4W-007	Units	Result: 0 - 6 in	Reference Code	Result: 2 ft	Reference Code
Volatile Organic Compounds					
All VOCs	UG/KG	NA		ND	
Metals					
All Metals	MG/KG			NA	
Aluminum	MG/KG	10600			
Arsenic	MG/KG	10.2	e1,h1,h5,h7		
Barium	MG/KG	69.1			
Cadmium	MG/KG	8.3	a1,a3,h5		
Calcium	MG/KG	1020			
Chromium	MG/KG	21.6	e1,h5		
Copper	MG/KG	9.8			
Iron	MG/KG	20100	a1,e1		
Lead	MG/KG	16.4			
Magnesium	MG/KG	1880	b1		
Manganese	MG/KG	477	e1		
Mercury	MG/KG	0.075	a1,e2		
Nickel	MG/KG	8.8	h5		
Potassium	MG/KG	466			
Selenium	MG/KG	0.53	e5,h5		
Vanadium	MG/KG	28.7			
Zinc	MG/KG	41			



LEGEND

- MONITORING WELL LOCATION
- HAND AUGER LOCATION
- USEPA 1998 SAMPLE LOCATIONS

SAMPLE LOCATIONS ARE APPROXIMATE

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

SOURCES:

1. U.S. ARMY CORPS OF ENGINEERS, 1994, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT, PART 1, SECTION 5, PAGE 2 (PLAN NO. 6544-101.56), DATED JANUARY 12, 1942.
2. DPRA DATABASE DOCUMENT NO. CØØ1192, ILLINOIS ORDNANCE PLANT, "DRAINAGE, SHOP AREA," PLAN NO. 6544-151.17 DATED MARCH 27, 1942.

AREA 4 WEST

NOTES:

1. BASE MAP PREPARED BY MARVIN JENKINS, REGISTERED SURVEYOR, OCTOBER 1995.
2. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED, REFER TO THE QCSR FOR DATA QUALIFIERS.
3. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

N

Ø 1ØØ 2ØØ

SCALE FEET

(APPROXIMATE)

Revision No.	Description	Date	By	App.

REVISIONS

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

AUS-ØA4W Area 4 West
Sample Locations and Detections in Soils

Date: 6/28/00	Project Number: 232ØØØØØ26.ØØ	Figure Number: 9-2
Drawn by: DJD	Design by: MM	Checked by: CMW

URS

File: E:\232ØØØØØ26.ØØ\PA-SI REPORT-AUS OU\CRABAUSFIG4-3WEST1.DWG Last edited: 09/21/01 @ 10:55 a.m. @ MCC-ST.LOUIS