



Summary of Findings

TAPP Grant Topic

Facility-Wide Ground Water Monitoring Program (FWGWMP)

February 19, 2014

Restoration Advisory Board (RAB)

Ravenna Army Ammunition Plant, Ravenna, Ohio

Presented by:

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History of FWGWMP

2004-2011

- In 2004, the United States Army and Ohio EPA finalized the FWGWMP Plan.
- The **FWGWMP Plan** (RVAAP-66) discusses future ground-water remedial efforts at the RVAAP, including pursuing a record of decision for ground-water using a **facility-wide approach**.
- To date, **243 wells** have been sampled a minimum of four quarters.

2012-date

- In 2012, **38 new wells** were installed.
- Current ground-water monitoring (*the focus of this review*) (October 1, 2011 thru September 30, 2012)
- Existing wells will be sampled **semi-annually**; new wells will be sampled for four consecutive quarters.

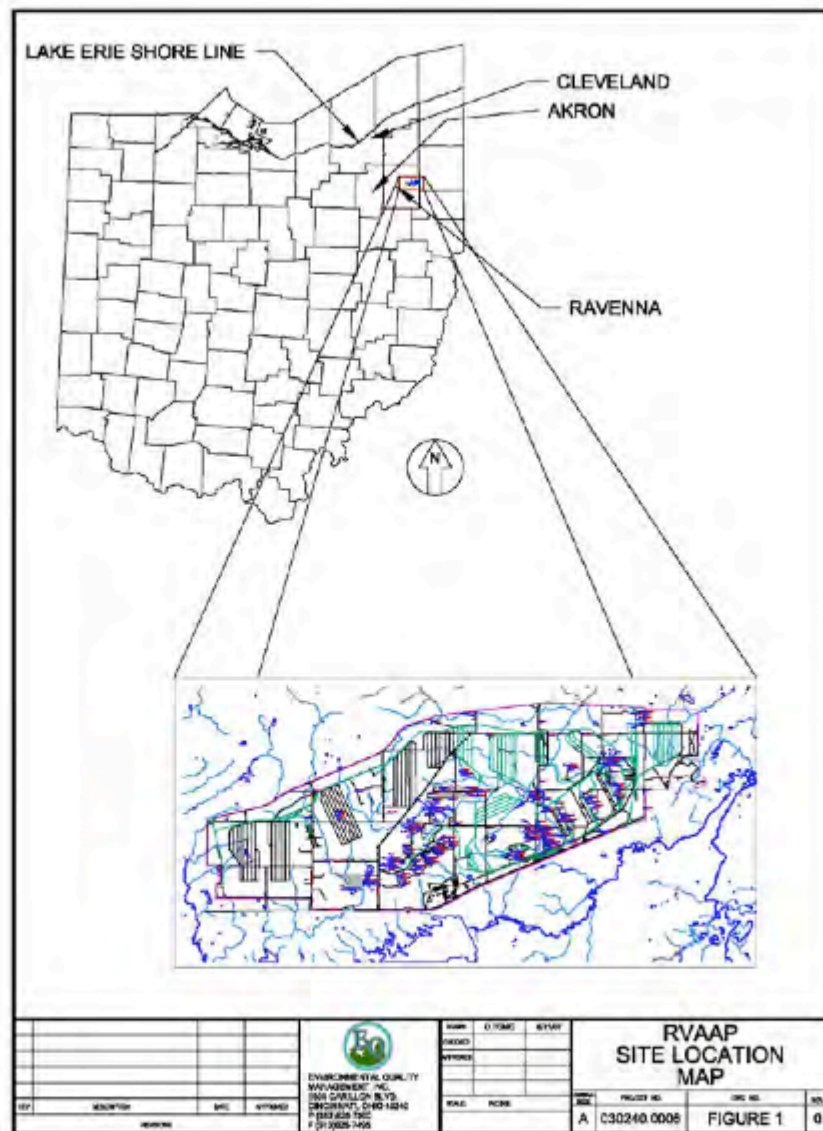


Figure 1-1. RVAAP General Location Map

What is the purpose of the FWGWMP?

- Implementing a FWGWMP will help determine if constituents from past activities may be posing a current or future risk via ground-water use on-site, or via ground-water migration to off-site receptors.

What is the advantage of a facility-wide approach to ground water?

- AOC constituents have the ability to migrate beyond identified AOC boundaries
- Constituents that reach ground water have the potential to become mobile.
- Identify and monitor a network of wells that represent the overall facility ground-water picture.
- Determine if some AOC constituents pose a risk on the RVAAP or off-site.

Potential Goals & Tasks

- Review & assess historic monitoring data for selected wells
- Identify constituents that exceed target levels (i.e., MCLs or RSLs)
- Emphasis on constituents detected near facility boundary
- Review results for shallow vs. deep aquifer wells
- Identify potential health implications of constituents

Task 1 – tonight's focus

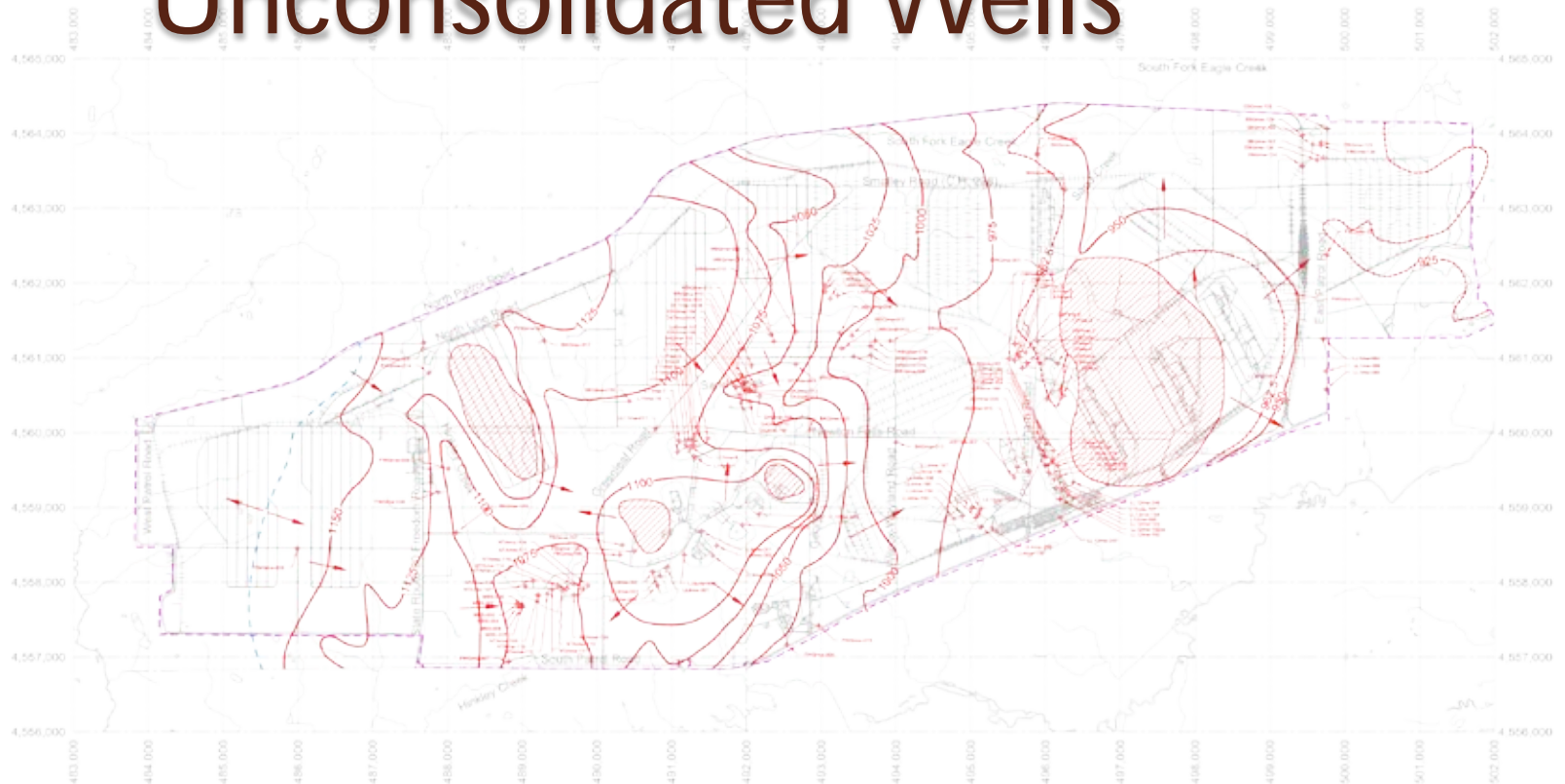
- Recap FY2011 sampling results (previously presented)
- Discuss findings of 2012 FWGWMP Annual Report
- Includes 4 sampling events (October 2011 thru September 2012)
- Identify exceedances/trends



Site Ground Water Basics

- Three ground-water formations
 1. Unconsolidated aquifer
 2. Sharon Sandstone (predominant)
 3. Homewood Sandstone (secondary)
- Ground water in all aquifers flows in a general easterly direction
- Wells represent *unconsolidated* wells and *bedrock* wells...reflecting a more regional flow pattern

Unconsolidated Wells



Well ID	Well Type	Depth (ft)	Static Water Level (ft)	Water Level Date	Flow Direction
W1	UW	100	1050	07/15/12	SE
W2	UW	120	1040	07/15/12	SE
W3	UW	150	1030	07/15/12	SE
W4	UW	180	1020	07/15/12	SE
W5	UW	200	1010	07/15/12	SE
W6	UW	250	1000	07/15/12	SE
W7	UW	300	990	07/15/12	SE
W8	UW	350	980	07/15/12	SE
W9	UW	400	970	07/15/12	SE
W10	UW	450	960	07/15/12	SE
W11	UW	500	950	07/15/12	SE
W12	UW	550	940	07/15/12	SE
W13	UW	600	930	07/15/12	SE
W14	UW	650	920	07/15/12	SE
W15	UW	700	910	07/15/12	SE
W16	UW	750	900	07/15/12	SE
W17	UW	800	890	07/15/12	SE
W18	UW	850	880	07/15/12	SE
W19	UW	900	870	07/15/12	SE
W20	UW	950	860	07/15/12	SE
W21	UW	1000	850	07/15/12	SE
W22	UW	1050	840	07/15/12	SE
W23	UW	1100	830	07/15/12	SE
W24	UW	1150	820	07/15/12	SE
W25	UW	1200	810	07/15/12	SE
W26	UW	1250	800	07/15/12	SE
W27	UW	1300	790	07/15/12	SE
W28	UW	1350	780	07/15/12	SE
W29	UW	1400	770	07/15/12	SE
W30	UW	1450	760	07/15/12	SE
W31	UW	1500	750	07/15/12	SE
W32	UW	1550	740	07/15/12	SE
W33	UW	1600	730	07/15/12	SE
W34	UW	1650	720	07/15/12	SE
W35	UW	1700	710	07/15/12	SE
W36	UW	1750	700	07/15/12	SE
W37	UW	1800	690	07/15/12	SE
W38	UW	1850	680	07/15/12	SE
W39	UW	1900	670	07/15/12	SE
W40	UW	1950	660	07/15/12	SE
W41	UW	2000	650	07/15/12	SE
W42	UW	2050	640	07/15/12	SE
W43	UW	2100	630	07/15/12	SE
W44	UW	2150	620	07/15/12	SE
W45	UW	2200	610	07/15/12	SE
W46	UW	2250	600	07/15/12	SE
W47	UW	2300	590	07/15/12	SE
W48	UW	2350	580	07/15/12	SE
W49	UW	2400	570	07/15/12	SE
W50	UW	2450	560	07/15/12	SE
W51	UW	2500	550	07/15/12	SE
W52	UW	2550	540	07/15/12	SE
W53	UW	2600	530	07/15/12	SE
W54	UW	2650	520	07/15/12	SE
W55	UW	2700	510	07/15/12	SE
W56	UW	2750	500	07/15/12	SE
W57	UW	2800	490	07/15/12	SE
W58	UW	2850	480	07/15/12	SE
W59	UW	2900	470	07/15/12	SE
W60	UW	2950	460	07/15/12	SE
W61	UW	3000	450	07/15/12	SE
W62	UW	3050	440	07/15/12	SE
W63	UW	3100	430	07/15/12	SE
W64	UW	3150	420	07/15/12	SE
W65	UW	3200	410	07/15/12	SE
W66	UW	3250	400	07/15/12	SE
W67	UW	3300	390	07/15/12	SE
W68	UW	3350	380	07/15/12	SE
W69	UW	3400	370	07/15/12	SE
W70	UW	3450	360	07/15/12	SE
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W72	UW	3550	340	07/15/12	SE
W73	UW	3600	330	07/15/12	SE
W74	UW	3650	320	07/15/12	SE
W75	UW	3700	310	07/15/12	SE
W76	UW	3750	300	07/15/12	SE
W77	UW	3800	290	07/15/12	SE
W78	UW	3850	280	07/15/12	SE
W79	UW	3900	270	07/15/12	SE
W80	UW	3950	260	07/15/12	SE
W81	UW	4000	250	07/15/12	SE
W82	UW	4050	240	07/15/12	SE
W83	UW	4100	230	07/15/12	SE
W84	UW	4150	220	07/15/12	SE
W85	UW	4200	210	07/15/12	SE
W86	UW	4250	200	07/15/12	SE
W87	UW	4300	190	07/15/12	SE
W88	UW	4350	180	07/15/12	SE
W89	UW	4400	170	07/15/12	SE
W90	UW	4450	160	07/15/12	SE
W91	UW	4500	150	07/15/12	SE
W92	UW	4550	140	07/15/12	SE
W93	UW	4600	130	07/15/12	SE
W94	UW	4650	120	07/15/12	SE
W95	UW	4700	110	07/15/12	SE
W96	UW	4750	100	07/15/12	SE
W97	UW	4800	90	07/15/12	SE
W98	UW	4850	80	07/15/12	SE
W99	UW	4900	70	07/15/12	SE
W100	UW	4950	60	07/15/12	SE

- LEGEND**
- UNCONSOLIDATED WELL
 - PROPERTY LINE
 - 1100 LINE OF EQUAL GROUNDWATER ELEVATION (ft. amsl) [DASHED WHERE INFERRED]
 - GROUNDWATER DIRECTION
 - UNCONSOLIDATED AQUIFER MISSING
 - INFERRED GROUNDWATER DIVIDE



0 500 1000
SCALE (METERS)

COORDINATE SYSTEM UTM NAD83 ZONE 17

<p>PROJECT NO. 030174-0016</p> <p>DATE: 07/15/12</p> <p>SCALE: AS SHOWN</p> <p>PROJECT: POTENTIOMETRIC SURFACE OF UNCONSOLIDATED AQUIFER (JULY 2012)</p>	<p>ENVIRONMENTAL HEALTH MANAGEMENT, INC.</p> <p>200 S. 10th St., Suite 100, Anchorage, AK 99501</p> <p>TEL: 907.562.1100 FAX: 907.562.1101</p> <p>WWW.EHM-INC.COM</p>	<p>POTENTIOMETRIC SURFACE OF UNCONSOLIDATED AQUIFER (JULY 2012)</p> <p>E 030174-0016 PLATE 2 2</p>
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Homewood Sandstone

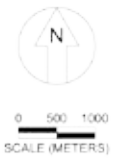


1030	1035	1040	1045	1050	1055	1060	1065	1070	1075	1080	1085	1090	1095	1100
1030	1035	1040	1045	1050	1055	1060	1065	1070	1075	1080	1085	1090	1095	1100

NOTES

1. BEDROCK GEOLOGY ADOPTED FROM "GEOLOGY AND GROUND-WATER RESOURCES OF PORTAGE COUNTY, OHIO" (WINSLOW AND WHITE, 1966). NOT ALL LITHOLOGIC UNITS ARE PRESENTED.

- LEGEND**
- ★ HOMEWOOD MEMBER WELL
 - - - - - PROPERTY LINE
 - - - - - 1100
 - --- --- LINE OF EQUAL GROUNDWATER ELEVATION (ft. amsl) (INTERMEDIATE DASHED)
 - --- --- 1030
 - GROUNDWATER DIRECTION
 - HOMEWOOD MEMBER
 - SHARON MEMBER
 - SHARON SHALE

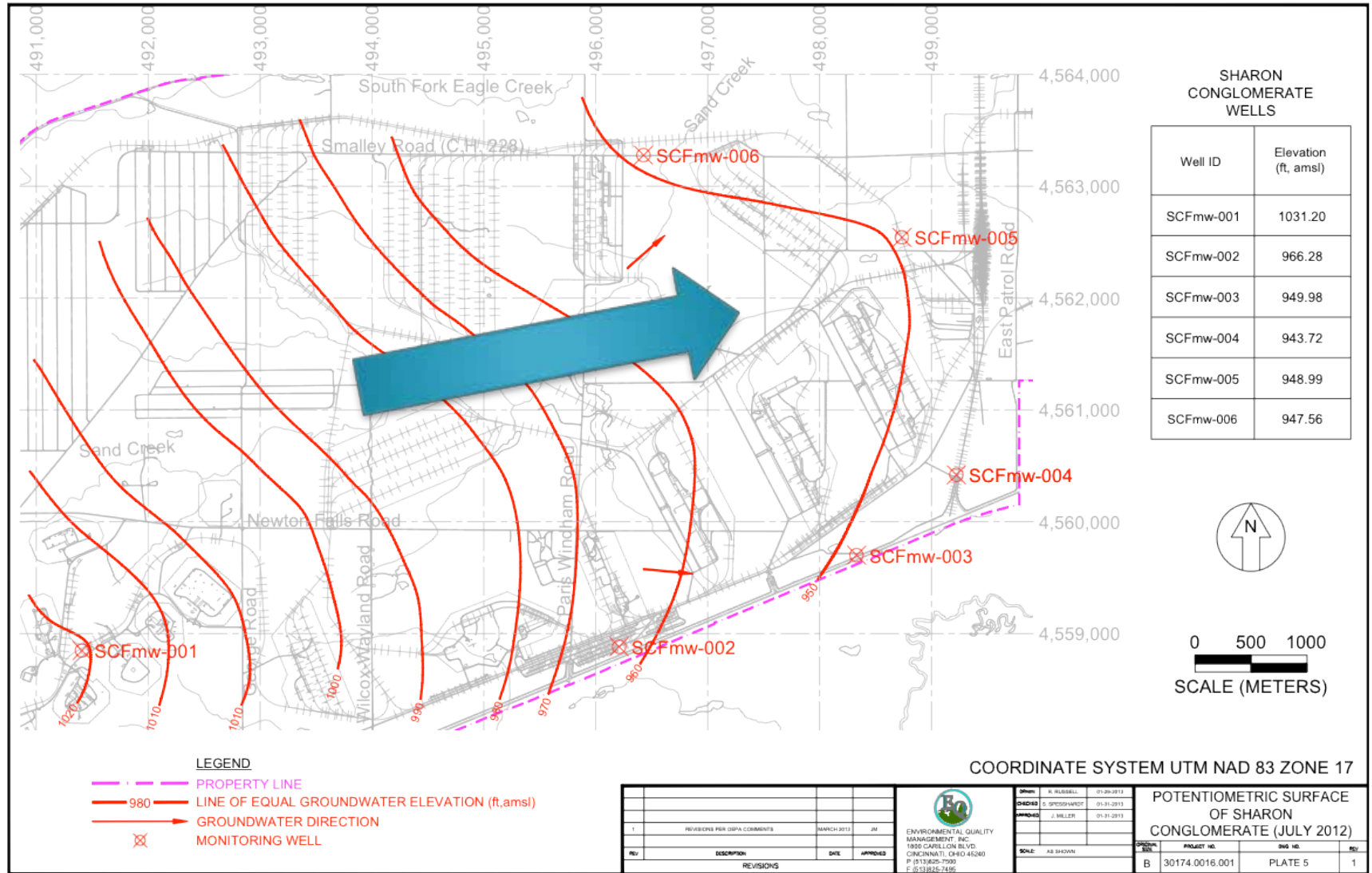


COORDINATE SYSTEM: UTM NAD 83 ZONE 17

POTENTIOMETRIC SURFACE OF
HOMEWOOD (JULY 2012)

E 030174.0016 PLATE 3 2

Sharon Sandstone



SHARON CONGLOMERATE WELLS

Well ID	Elevation (ft. amsl)
SCFmw-001	1031.20
SCFmw-002	966.28
SCFmw-003	949.98
SCFmw-004	943.72
SCFmw-005	948.99
SCFmw-006	947.56



0 500 1000
SCALE (METERS)

LEGEND

- PROPERTY LINE
- 980 LINE OF EQUAL GROUNDWATER ELEVATION (ft.amsl)
- GROUNDWATER DIRECTION
- MONITORING WELL

COORDINATE SYSTEM UTM NAD 83 ZONE 17

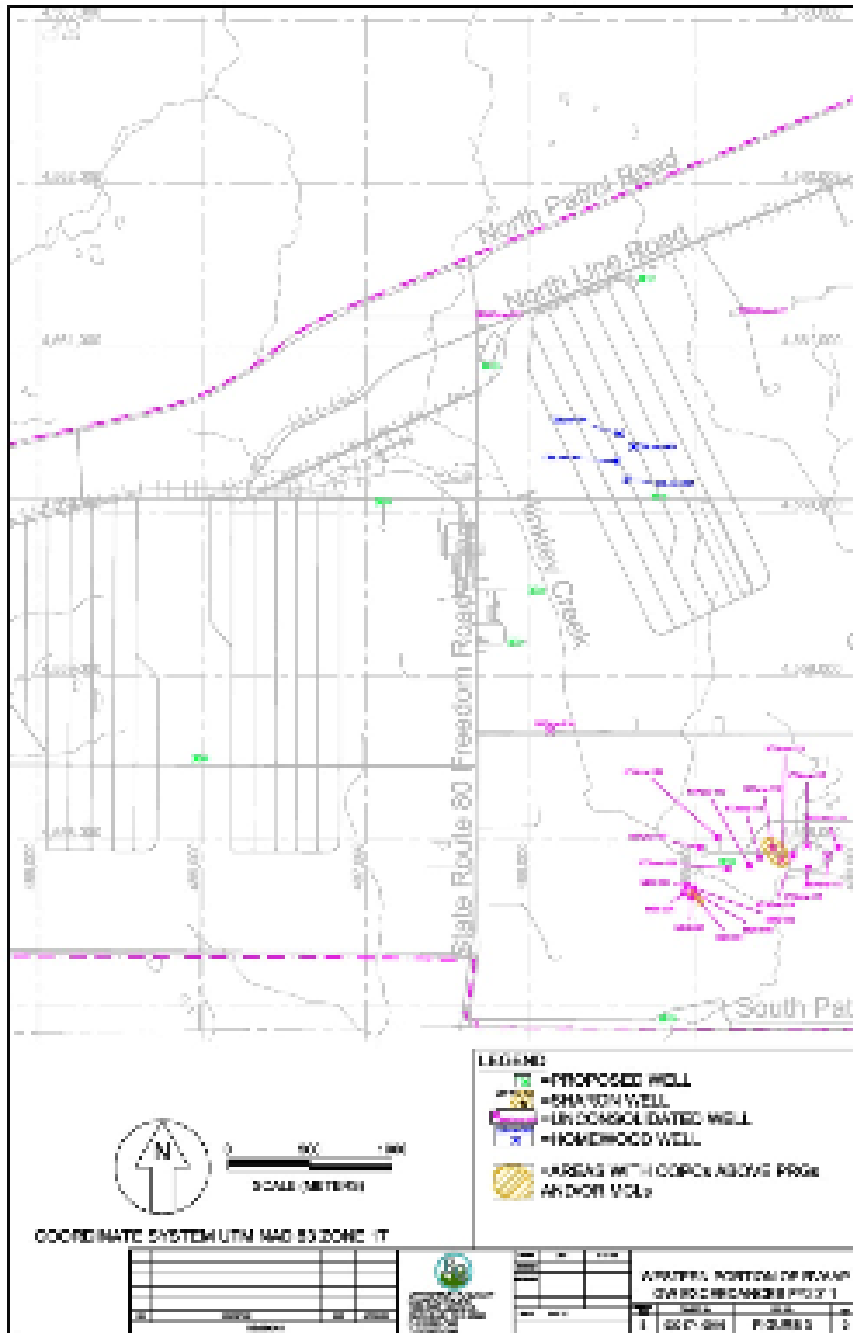
REV	DESCRIPTION	DATE	APPROVED	DATE	APPROVED	SCALE	PROJECT NO.	SHEET NO.	TITLE
1	REVISIONS PER OSPA COMMENTS	MARCH 2013	JM			AS SHOWN	30174.0016.001	500	POTENTIOMETRIC SURFACE OF SHARON CONGLOMERATE (JULY 2012)
REVISIONS				ENVIRONMENTAL QUALITY MANAGEMENT, INC. 1989 CARROLL BLVD. CINCINNATI, OHIO 45240 P: 513.625.7228 F: 513.625.7495		CHECKED: K. RUSSELL (01.20.2013) D. SPRESSHARDT (01.21.2013) APPROVED: J. MILLER (01.21.2013)		PROJECT NO.: 30174.0016.001 SHEET NO.: PLATE 5 TOTAL SHEETS: 1	

Recap: FY2011 FWGWMP Summary

EQM Presentation to RAB – “Facility-Wide Groundwater”, January 2012

CPOCs detected above MCLs/RSLs

- ✓ Metals
- ✓ VOCs
- ✓ SVOCs
- ✓ Pesticides
- ✓ Explosives
- ✓ Nitrates (as Nitrites)

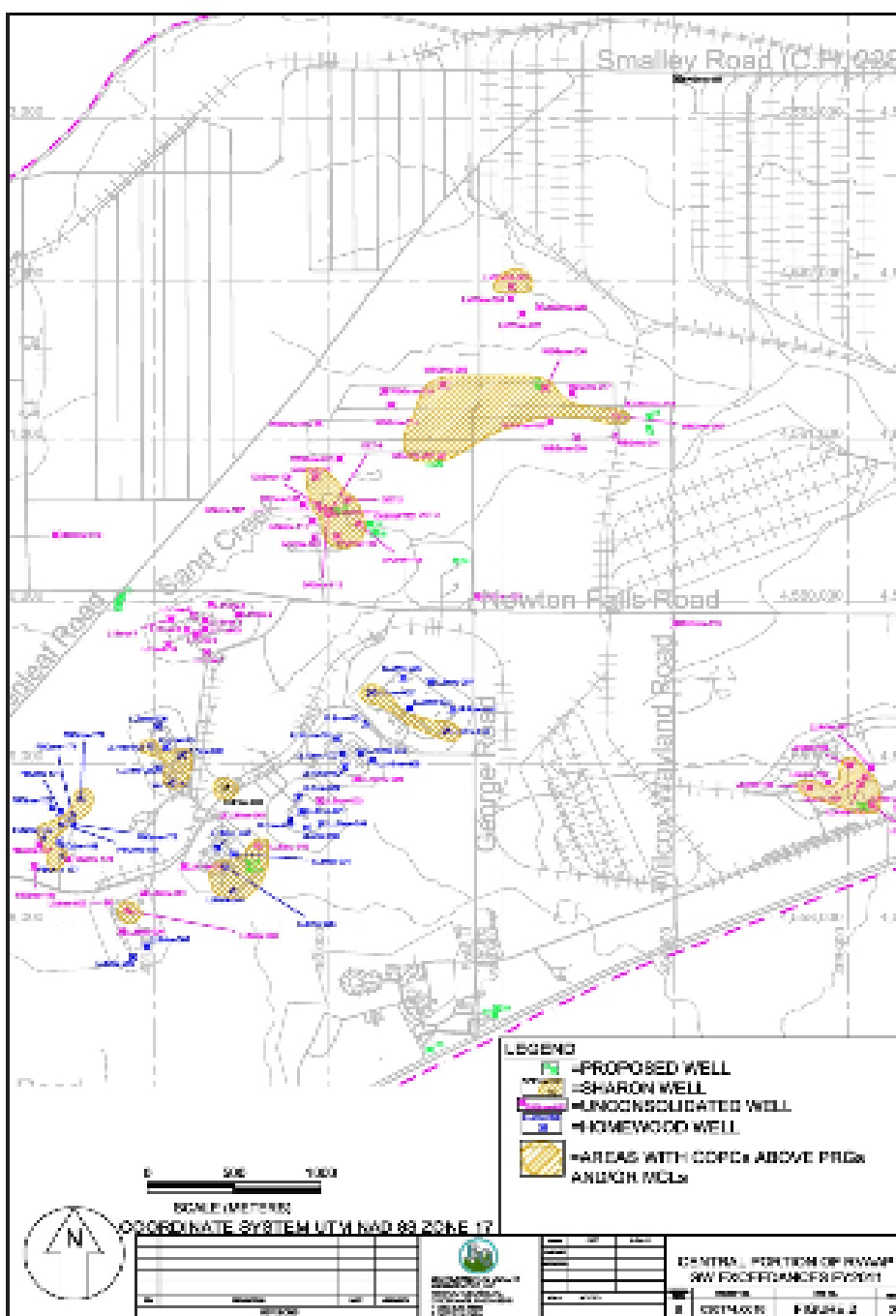


West Portion of RVAAP

Monitoring well locations with
CPOCs above MCL/RSL –
All constituents of concern

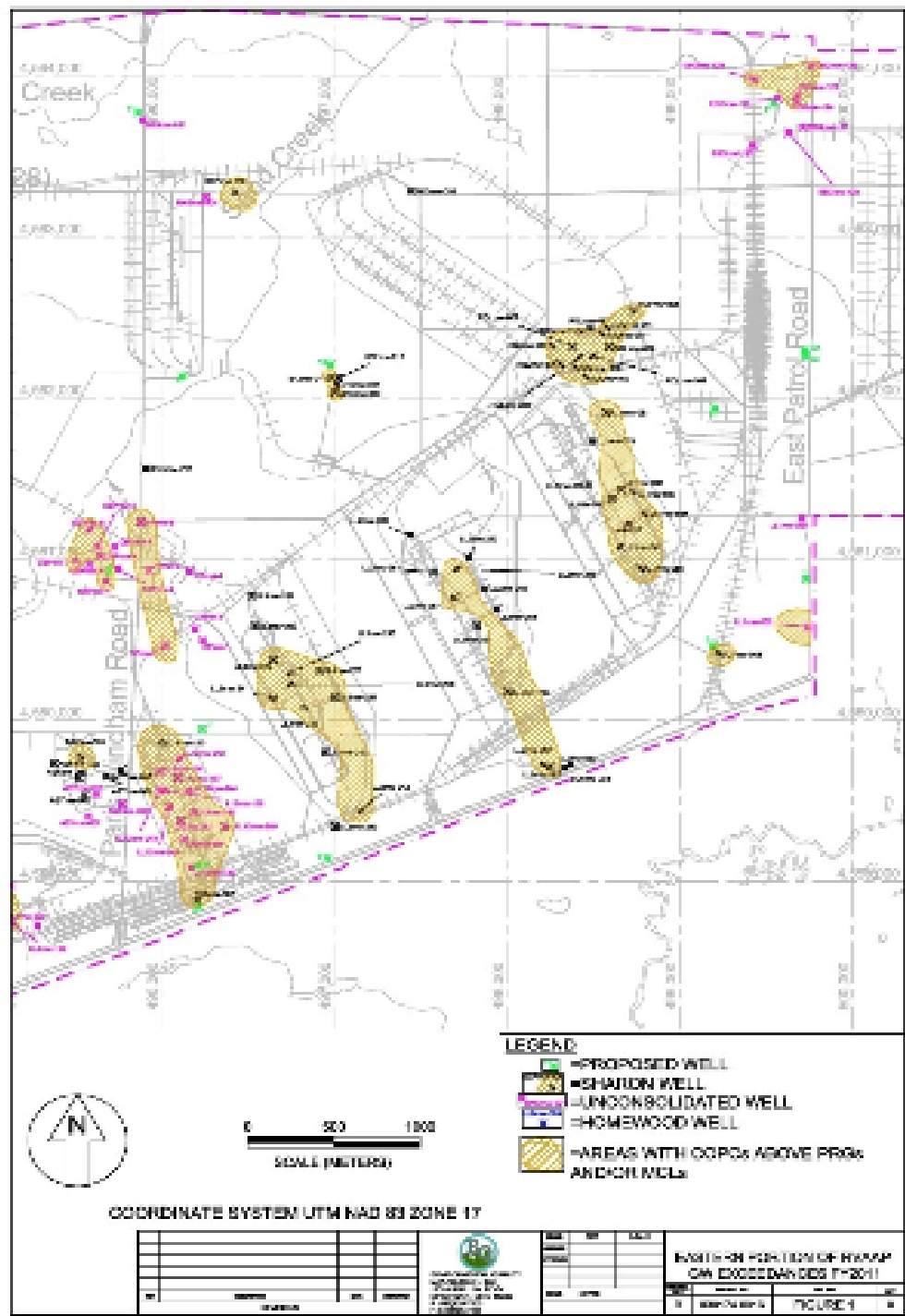
Central Portion of RVAAP

Monitoring well locations with
CPOCs above MCL/RSL –
All constituents of concern



East Portion of RVAAP

Monitoring well locations with CPOCs above MCL/RSL – All constituents of concern



FY2012 FWGWMP Results

CPOCs detected above MCLs/RSLs

- ✓ Metals (inorganics)
- ✓ VOCs
- ✓ SVOCs
- ✓ Pesticides/Herbicides
- ✓ Explosives
- ✓ Nitrate (as Nitrites)

Inorganics (metals)

- Aluminum (15 wells)
- **Arsenic (36 wells)**
- Beryllium (1 well)
- Chromium (1 well)
- Cobalt (18 wells)
- **Iron (58 wells)**
- Lead (1 well)
- **Manganese (73 wells)**
- Thallium (1 well)
- Vanadium (1 well)
- Hex Chromium (5 wells)

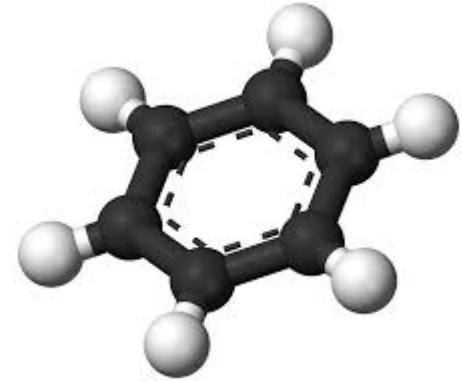


Metals - Frequent detections

Inorganic	Conc. Range (ug/l)	Potential Health Effects (drinking water)	MCL (ug/L)	USEPA RSL (ug/L)	Highest Detections
Arsenic (As)	10-170	Skin damage, circulation system effects, increased cancer risk	10 <i>Primary</i>	0.045	South-east/East portion of RVAAP – unconsolidated & bedrock
Iron	300-340,000	Taste, color	300 <i>Secondary</i>	11,000	South-east/East portion of RVAAP – unconsolidated & bedrock
Manganese	57-11,000	Nervous system, neurological effects	50 <i>Secondary</i>	320	Eastern portion of RVAAP – unconsolidated & bedrock

VOCs

- Benzene (1 well)



- Carbon Tetrachloride (1 well)

- Chloroform (1 well)

VOCs - Frequent detections

Organic	Conc. Range (ug/l)	Potential Health Effects (drinking water)	MCL (ug/L)	USEPA RSL (ug/L)	Highest Detections
Benzene	0.67-1.5	Anemia, decrease in blood platelets, increased cancer risk	5.0	0.39	Western portion of RVAAP – unconsolidated
Carbon Tetrachloride	0.47-2.1	Liver problems, increased cancer risk	5.0	0.39	Central portion of RVAAP – bedrock
Chloroform	0.25	Blood, liver and kidney problems	None	0.19	Central portion of RVAAP – bedrock

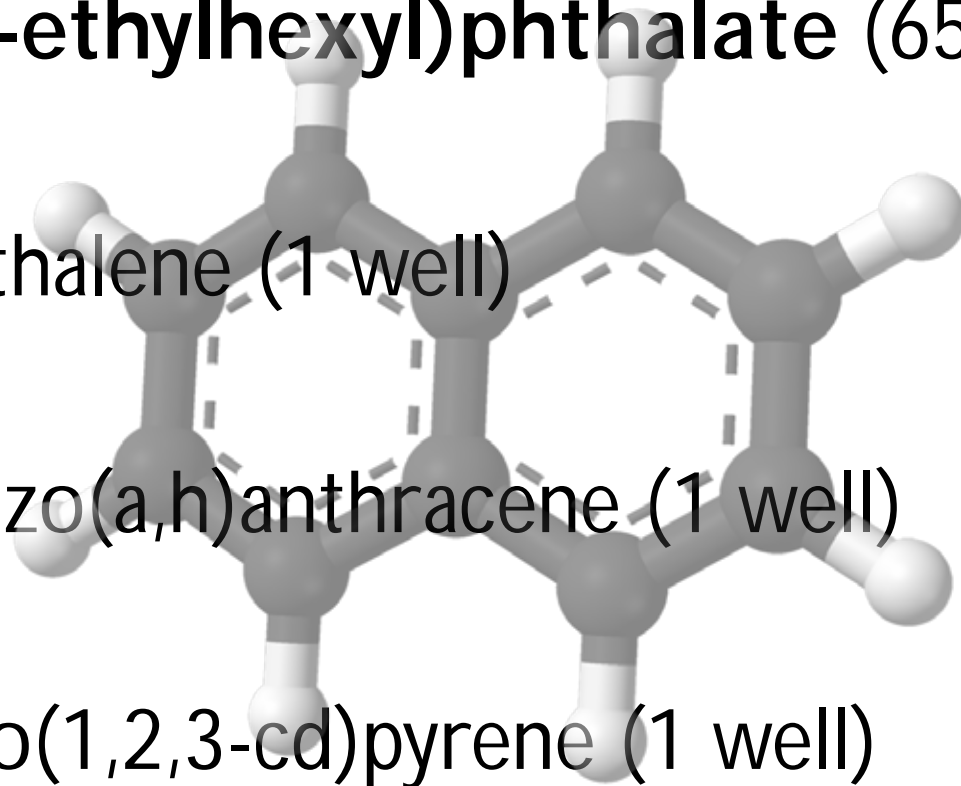
SVOCs

– **Bis(2-ethylhexyl)phthalate** (65 wells)

– Naphthalene (1 well)

– Dibenzo(a,h)anthracene (1 well)

– Indeno(1,2,3-cd)pyrene (1 well)

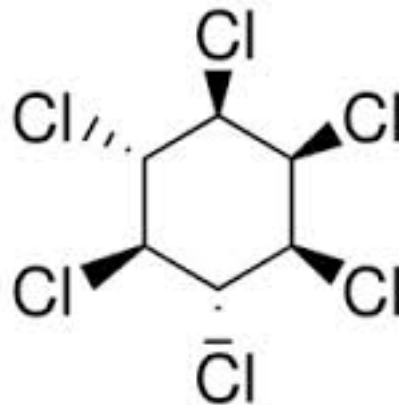


SVOCs - Frequent detections

Organic	Conc. Range (ug/l)	Potential Health Effects (drinking water)	MCL (ug/L)	USEPA RSL (ug/L)	Highest Detections
Bis(2-ethylhexyl) phthalate	0.76-32	Liver problems, reproductive difficulties, increased cancer risk	6.0	0.071	Sitewide –unconsolidated & bedrock

Pesticides/Herbicides

- Beta-BHC (3 wells)

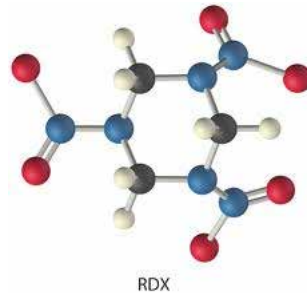


Pesticides - Frequent detections

Inorganic	Conc. Range (ug/l)	Potential Health Effects (drinking water)	MCL (ug/L)	USEPA RSL (ug/L)	Highest Detections
beta-BHC (beta-hexachloro-cyclohexane)	0.0095-0.075	Central nervous system, human reproduction	-	0.022	Eastern portion of RVAAP – unconsolidated & bedrock

Explosives & Propellants

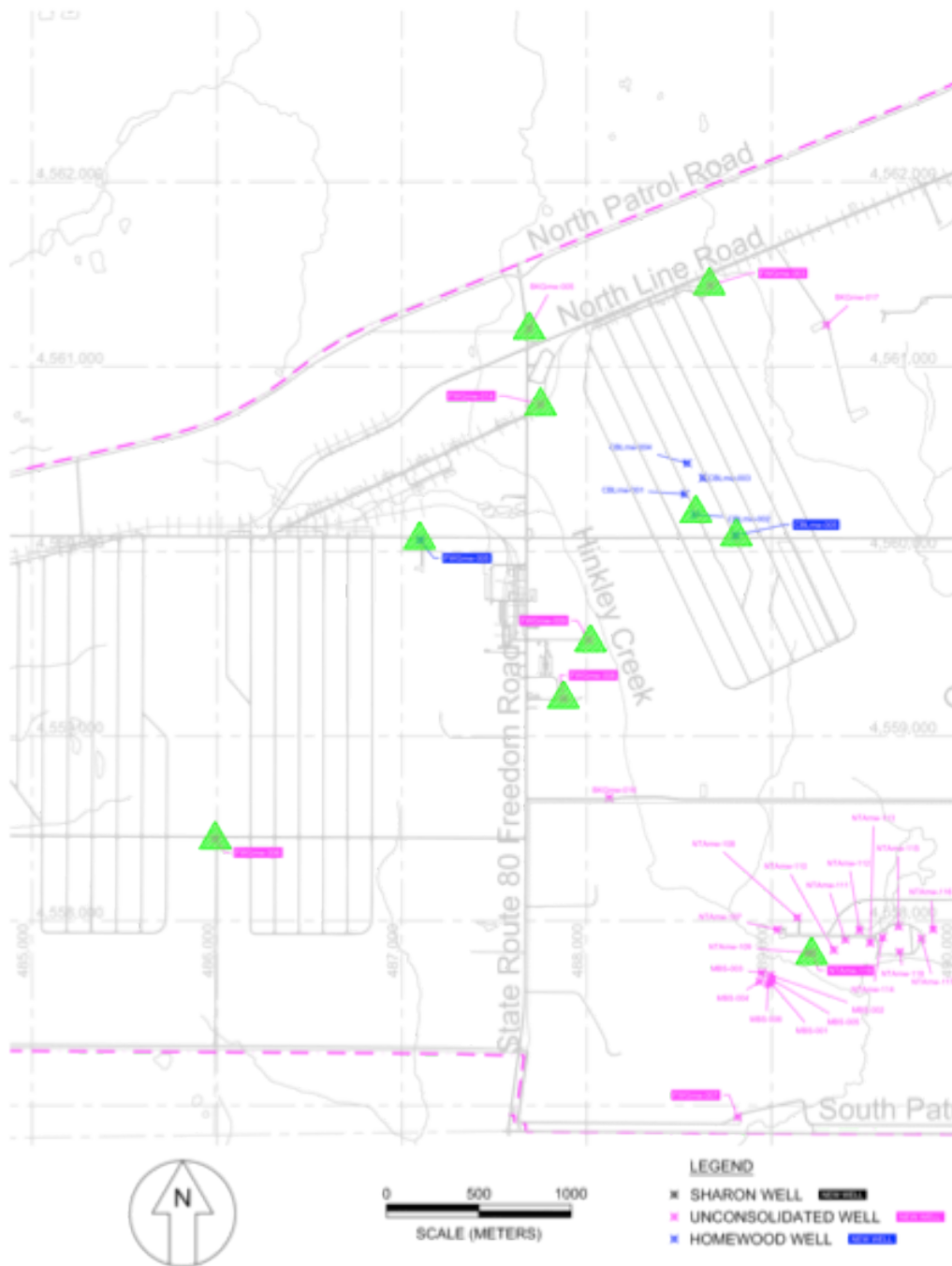
- 2,4-dinitrotoluene (1 well)
- **2,4,6-TNT** (2 wells)
- Nitrobenzene (1 well)
- Nitrate as nitrite (1 well)
- **RDX** (4 wells)




Explosives - Frequent detections

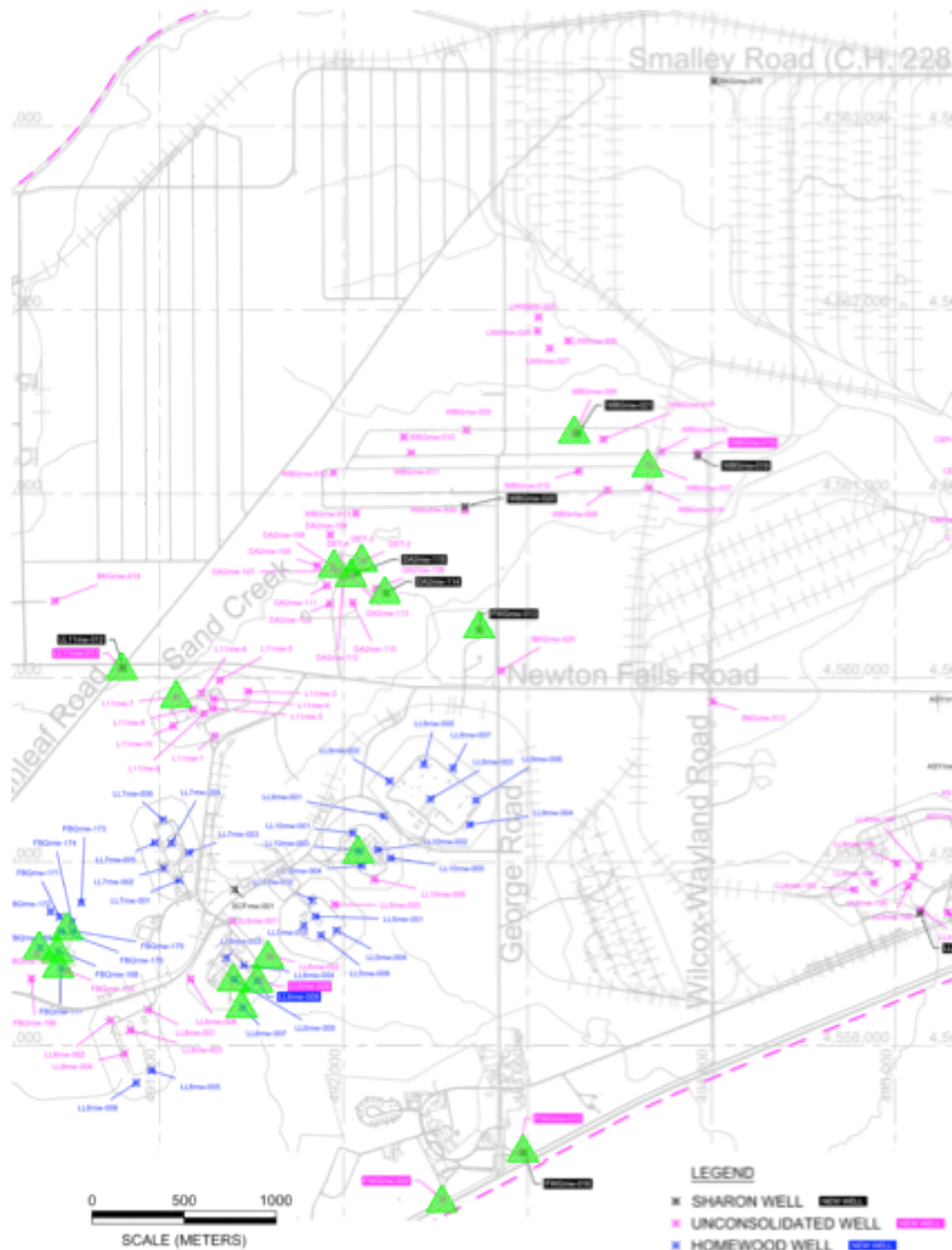
Inorganic	Conc. Range (ug/l)	Potential Health Effects (drinking water)	MCL (ug/L)	USEPA RSL (ug/L)	Highest Detections
2,4,6-TNT	3.5-10	Liver, blood, immune system and reproductive damage	-	2.2	South-Eastern & Central portion of RVAAP –bedrock
RDX	0.5-25	Targets the nervous system	-	0.61	South-Eastern & Central portion of RVAAP –unconsolidated & bedrock

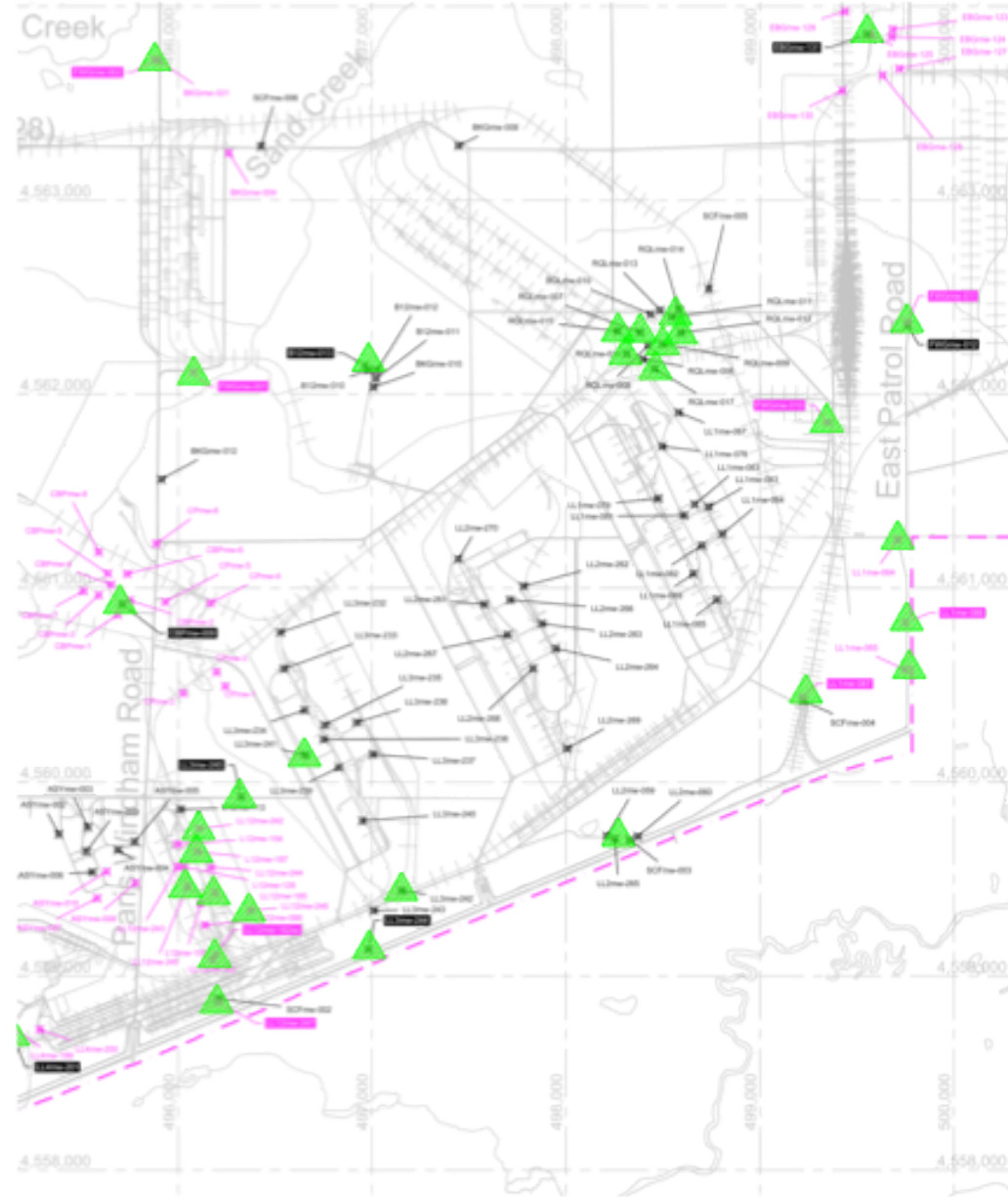
Western Portion of RVAAP



Central Portion of RVAAP

 MONITORING WELL LOCATION WITH CPOCs ABOVE MCL/RSL

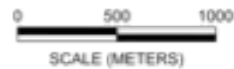




Eastern Portion of RVAAP



MONITORING WELL LOCATION
WITH CPOCs ABOVE MCL/RSL



LEGEND

- ✱ SHARON WELL
- ✱ UNCONSOLIDATED WELL
- ✱ HOMEWOOD WELL

Comparison: 2011 vs. 2012

For those wells sampled during both annual events...

- Metal (As, Mn, Fe) concentrations have a general decreasing trend or remain unchanged



Questions & Discussions

- Recommendations for future tasks?