

FINAL

**CALENDAR YEAR 2001
FACILITY-WIDE GROUNDWATER MONITORING WELL
INSPECTIONS AND POTENTIOMETRIC MAP**

FOR THE

**RAVENNA ARMY AMMUNITION PLANT,
RAVENNA, OHIO**

PREPARED FOR



**US Army Corps
of Engineers®**

**LOUISVILLE DISTRICT
CONTRACT No. F44650-99-0007
DELIVERY ORDER CY01**

July 2003



SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not
be considered an eligible contractor for its review.

CONTRACTORS STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Science Applications International Corporation (SAIC) has completed the report entitled *Calendar Year 2001 Facility-wide Groundwater Monitoring Well Inspections and Potentiometric Map, Ravenna Army Ammunition Plant, Ravenna, Ohio*. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.


Kevin Jago
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7-10-03
Date


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Date

Significant concerns and the explanation of the resolution are as follows:

No significant concerns.

As noted above, all concerns resulting from independent technical review of the project have been considered.


Principal with A-E Firm

7/10/03
Date

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Louisville District
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ACRONYMS

amsl	above mean sea level
AOC	area of concern
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant

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1.0 INTRODUCTION

This report documents the methods and results of a comprehensive inspection of groundwater monitoring wells and facility-wide groundwater potentiometric measurements at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. The inspection and water level measurement effort were conducted in August 2001 during Phase II Remedial Investigation (RI) field activities at Load Lines 2, 3, and 4, as outlined in the Sampling and Analysis Plan Addendum No. 1 for the Phase II Remedial Investigation of Load Lines 2, 3, and 4 (USACE 2001a).

The purpose of the groundwater monitoring well inspections was to: (1) upgrade security locks for each well, (2) assess the general condition of the wells, (3) identify the need for any required repairs to the above-grade well components, and (4) measure the total depth of the wells in order to document obstructions or excessive sediment accumulation within the monitoring interval.

The facility-wide potentiometric measurement effort was designed to obtain contemporaneous water table elevation data in order to assess overall groundwater flow patterns at RVAAP. Groundwater flow patterns in the vicinity of Load Lines 1, 2, 3, 4, and 12; Cobb's Pond; and Ramsdell Quarry in the eastern portion of RVAAP represent a particular area of focus, as all of these areas of concern (AOCs) have active or planned Comprehensive Environmental Response, Compensation, and Liability Act of 1980 investigations.

Chapter 2 of this report contains a brief summary of well inspection methods and results. Chapter 3 discusses potentiometric measurement field procedures and presents the basis and results for a facility-wide potentiometric map. Identification, interpretation, and discussion of specific groundwater flow discontinuities or exit pathways is beyond the scope of this report. These items are addressed in respective RI reports or groundwater studies for the individual AOCs in the form of site-specific conceptual models. [Appendix A](#) contains groundwater monitoring well inspection logs. [Appendix B](#) provides a summary of construction and potentiometric data for the monitoring wells included in the facility-wide survey.

2.0 FACILITY-WIDE GROUNDWATER MONITORING WELL INSPECTIONS

An inspection of the physical condition of all existing facility monitoring wells at RVAAP was conducted on August 27 and 28, 2001, with the exception of Load Line 4. At Load Line 4, inspection logs were completed for one randomly selected well (LL4mw-198), although water levels were obtained from all wells, as planned. The monitoring wells at Load Line 4 were completed in late July and early August 2001; therefore, the condition of these new wells is fully documented in the drilling and installation records. Additionally, downhole depths were not measured for new monitoring wells installed at Load Lines 2, 3, and 4 because these were completed in summer 2001 and had not been sampled prior to the inspection event. The well maintenance survey included the following elements:

- Following the collection of water level measurements at each well, the total depth of each monitoring well was sounded using a fiberglass tape fitted with a stainless steel weight for comparison;
- Visual examination of the condition of the above-ground components of each well, including access to the well, well identification tag or marking, protective casing, traffic guard post, protective cover, protective pad, weep hole, inner casing, and watertight cap;

- Recording of well inspection data and any maintenance needs on a well inspection/maintenance checklist (see [Appendix A](#)); and
- Replacement of all existing monitoring well security cover locks with new, common-keyed locks.

Sounding equipment was decontaminated between wells using a scrub wash with Alconox and potable water, followed by a rinse with DI water. Unexploded ordnance technicians accompanied inspection teams in the Winklepeck Burning Grounds and Demolition Area 2, as specified in the Sampling and Analysis Plan Addendum No. 1 (USACE 2001a). The functional areas or AOCs and the number of monitoring wells inspected in each area are outlined in [Table 1](#). A summary of construction data for each of the wells inspected is included in [Appendix B](#).

Table 1. Summary of RVAAP Facility-Wide Groundwater Monitoring Well Inspections

Functional Area	Number of Wells Inspected
Facility Background Wells (various locations)	14
Load Line 1	14
Ramsdell Quarry	11
Load Line 2	12
Load Line 3	12
Load Line 4	1
Load Line 11	10
Load Line 12	14
Winklepeck Burning Grounds	17
Demolition Area 2	4
TOTAL	109

RVAAP = Ravenna Army Ammunition Plant.

The well inspections did not reveal irreparable damage to any specific monitoring wells. Significant maintenance repairs (e.g., replacement of protective casing, concrete pads, or traffic posts) were identified only for wells LL1mw-080 (large crack in protective pad) and DET-4 (no protective pad). Light maintenance needs were identified for a number of monitoring wells ([Table 2](#)). Where possible, light maintenance needs, such as drilling of weep holes, clearing weep holes of obstructions, and adding sand to protective casing annular spaces, were performed during the field effort. Additionally, many wells were noted to have excessive vegetation growth in their vicinity, which may hinder easy access to the monitoring location. Maintenance items completed in the field are documented on the individual inspection forms ([Appendix A](#)). [Table 2](#) lists the remaining maintenance items that could not be readily addressed during the well inspection effort. Although not recorded during the facility-wide well inspection effort, some older wells at Ramsdell Quarry (e.g., MW series) were observed during a previous environmental study to have some cracks in their annular grout seals.

**Table 2. Identified Maintenance Needs from 2001 Facility-Wide
Groundwater Monitoring Well Inspections**

Functional Area	Well Identification	Maintenance Need
Facility Background Wells	BKGmw-010	Excessive sediment accumulation > 20% of the screened interval (2.4 ft). May require redevelopment prior to the next sampling event.
	BKGmw-012	Guard posts are spaced too far apart; potential for collision.
	BKGmw-015	Top of mortar collar is below pad; missing weep hole.
	BKGmw-017	Additional traffic post may be required; west side of well is unprotected.
	BKGmw-019	No permanent identification markings. Additional traffic post may be required; east side of well is unprotected.
	BKGmw-021	Additional traffic post may be required; west side of well is unprotected.
Winklepeck Burning Grounds	OBG-1 (flushmount)	Watertight inner casing cap was removed; missing lock. Dedicated bailer remains in well.
	OBG-2 (flushmount)	Watertight inner casing cap was removed; missing lock. Dedicated bailer remains in well.
	OBG-3 (flushmount)	Watertight inner casing cap was removed; missing lock. Dedicated bailer remains in well.
	OBG-4 (flushmount)	Watertight inner casing cap was removed; missing lock. Dedicated bailer remains in well.
	WBGmw-009	Excessive sediment accumulation > 20% of the screened interval (2.1ft). May require redevelopment prior to the next sampling event.
	WBGmw-012	Additional sand filler required in protective casing annular space.
Ramsdell Quarry	WBGmw-013	Additional sand filler required in protective casing annular space.
	MW-1	Missing inner casing cap. Top of mortar collar is below pad; missing weep hole.
	MW-2	Missing weep hole.
	MW-4	Missing weep hole.
	RQLmw-003	Missing weep hole.
	RQLmw-005	No permanent identification markings. Missing weep hole.
	RQLmw-006	Top of mortar collar below pad; missing weep hole.
	RQLmw-007	Missing weep hole. Excessive sediment accumulation > 20% of the screened interval (2.0 ft). May require redevelopment prior to the next sampling event.
	RQLmw-008	Top of mortar collar is below pad; missing weep hole.
	RQLmw-009	Missing weep hole. Excessive sediment accumulation > 20% of the screened interval (2.0 ft). May require redevelopment prior to the next sampling event.
	RQLmw-010	Missing weep hole. Excessive sediment accumulation > 20% of the screened interval (2.1 ft). May require redevelopment prior to the next sampling event.
Cobb's Pond	RQLmw-011	Missing weep hole.
	CPmw-001 (flush mount)	Missing lock on water-tight cap.
	CPmw-002 (flush mount)	Missing lock on water-tight cap.
	CPmw-003 (flush mount)	Missing lock on water-tight cap.
	CPmw-004	Missing weep hole.
	CPmw-005	Missing weep hole.
Central Burn Pits	CPmw-006	Missing weep hole.
	CBPmw-001 through CBPmw-008	No permanent identification markings. Missing weep holes on protective casings.

Table 2. Identified Maintenance Needs from 2001 Facility-Wide Groundwater Monitoring Well Inspections (continued)

Functional Area	Well Identification	Maintenance Need
Load Line 1	LL1mw-067	Traffic post requires additional concrete filler.
	LL1mw-080	Large crack in protective pad.
	LL1mw-083	Protective cover requires paint.
Central Burn Pits	CBPmw-003	No permanent identification markings. Missing weep hole.
	CBPmw-006	No permanent identification markings. Missing weep hole.
	CBPmw-007	No permanent identification markings. Missing weep hole.
	CBPmw-008	No permanent identification markings. Missing weep hole.
Load Line 12	LL12mw-088	Excessive sediment accumulation > 20% of the screened interval (3.6 ft). May require redevelopment prior to the next sampling event.
	LL12mw-113	Excessive sediment accumulation > 20% of the screened interval (2.1 ft). May require redevelopment prior to the next sampling event.
	LL12mw-153	Excessive sediment accumulation > 20% of the screened interval (3.4 ft). May require redevelopment prior to the next sampling event.
	LL12mw-154	Excessive sediment accumulation > 20% of screened interval (2.1 ft). May require redevelopment prior to the next sampling event.
	LL12mw-183	Excessive sediment accumulation > 20% of the screened interval (2.0 ft). May require redevelopment prior to the next sampling event.
	LL12mw-185	Excessive sediment accumulation > 20% of the screened interval (2.9 ft). May require redevelopment prior to the next sampling event.
	LL12mw-186	Excessive sediment accumulation > 20% of the screened interval (2.1ft). May require redevelopment prior to the next sampling event.
Demolition Area 2	DET-1	No permanent identification markings.
	DET-2	No permanent identification markings.
	DET-4	No permanent identification markings. No protective pad present.

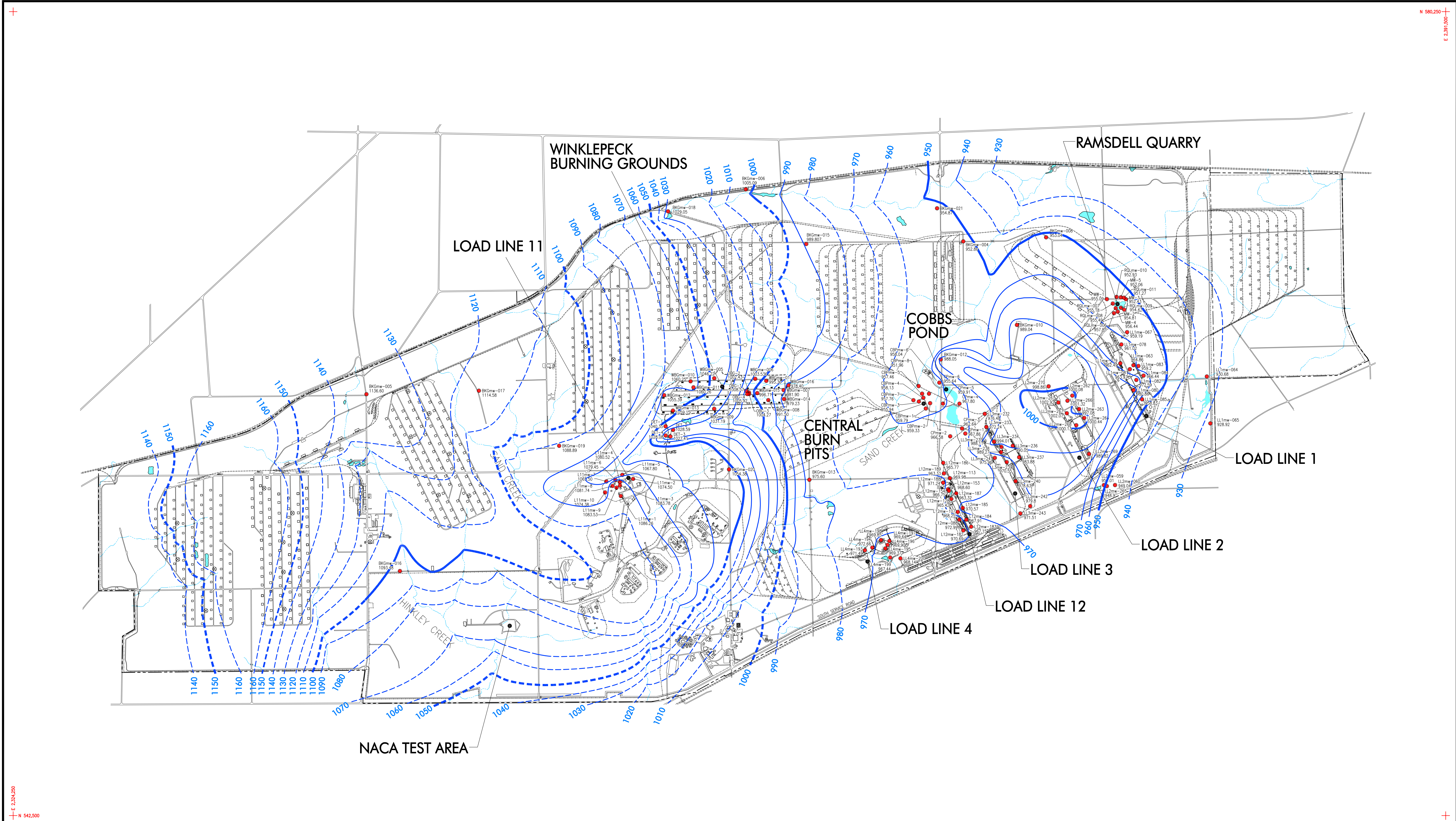
3.0 FACILITY-WIDE WATER-LEVEL MEASUREMENTS AND POTENTIOMETRIC SURFACE MAP

3.1 FIELD METHODS

Groundwater level measurements were obtained from all current facility monitoring wells over a 2-day period during the facility-wide well inspection effort (August 27 and 28, 2001). The measurement period was conducted at a minimum of 48 hours following any significant rainfall event and completed during a period in which no significant rainfall occurred. Thus, the groundwater potentiometric data obtained reflect baseflow and dry season conditions. Water level measurements were collected following the guidelines set forth in Section 4.3.3.1 of the RVAAP Facility-wide Sampling and Analysis Plan (USACE 2001b). [Appendix B](#) contains summary construction data and potentiometric readings for all monitoring wells included in the survey.

3.2 POTENTIOMETRIC MAP DEVELOPMENT

A facility-wide potentiometric surface map was constructed using the water-level measurements taken during the August 2001 survey ([Plate 1](#)). Monitoring wells from which data were obtained are all

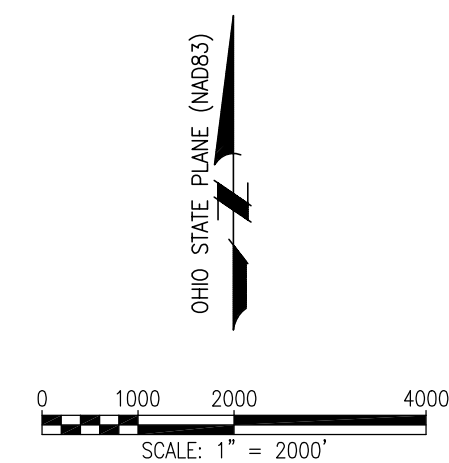



- LEGEND**
-PRIMARY BUILDING
 -SECONDARY BUILDING
 -GRAVEL ROAD
 -RAILROAD TRACKS
 -FENCE LINE
 -STREAM
 -POND
 -MONITORING WELL LOCATION
 -RVAAP FACILITY BOUNDARY
 -POTENTIOMETRIC SURFACE
 -INFERRED POTENTIOMETRIC SURFACE
 - 1093.79.....POTENTIOMETRIC SURFACE ELEVATION

NOTES:

POTENTIOMETRIC MAP BASED ON FACILITY WIDE WATER LEVEL MEASUREMENTS COLLECTED AUGUST 27/28, 2001. CONTOUR INTERVAL IS 10 FEET.

POTENTIOMETRIC SURFACE ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.



 U.S. Army Corps of Engineers Louisville District	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS LOUISVILLE, KENTUCKY	
	RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO	
	PLATE I RVAAP FACILITY-WIDE POTENTIOMETRIC SURFACE MAP AUGUST, 2001	
DRAWN BY: R.B. / S.D.	REV. NO./DATE: C / 12-09-02	CAD FILE: /02030/DWGS/0475TE03

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screened within the uppermost groundwater interval at RVAAP; either at the water table or immediately below it. Both unconsolidated and bedrock zone wells are represented in the water level data set. The many streams, creeks, and ponds present at RVAAP are expressions of the water table. To augment the water level data in areas that did not have adequate well coverage, elevations of ponds and perennial streams were used to infer water table elevations. Elevations of ponds and perennial streams were estimated from the U.S. Army Corps of Engineers 1997 base map for RVAAP, which was created using a 0.6-m (2-ft) topographic contour interval. Topographic controls from base map files were also used to guide placement of water table isopleths.

The facility-wide potentiometric map shows the water table surface is generally a subdued expression of the surface topography of the region. The predominant groundwater flow direction across RVAAP is to the east, with table elevations decreasing from a high of about 1,136 ft above mean sea level (amsl) at well BKGmw-005 in the northwest portion of the facility, to a low of about 928 ft amsl southeast of Load Line 1 (well LL1mw-065). A significant potentiometric high, centered around Load Line 2, is indicated in the southeastern portion of RVAAP. This potentiometric high results in localized radial flow vectors in this particular portion of the facility. A groundwater divide is also inferred in the western portion of the facility based on surface stream elevations and topography, although little potentiometric data exist in this region to confirm its presence.

At the watershed scale (i.e., Sand Creek, Hinkley Creek, Eagle Creek), groundwater flow directions generally mirror surface drainage patterns and are quite variable. Regional drainage patterns along Sand Creek in the northeast portion of RVAAP result in a localized perturbation in the overall flow direction to the north-northeast. In several locations along the southern boundary of RVAAP, south-southeast perturbations in the overall observed groundwater flow patterns are observed as follows:

- a south-southeasterly flow component from the potentiometric high area centered around Load Lines 1, 2, and 3 toward the facility boundary;
- a southerly flow component toward the facility boundary from the southeastern portion of Load Line 4 and the southernmost portion of Load Line 12;
- a southerly flow component toward the facility boundary from Load Line 4 mirroring the direction of surface water flow in the unnamed tributary that drains this load line; and
- groundwater flow to the south in association with Hinkley Creek in the southwest portion of the site (i.e., National Advisory Committee for Aeronautics Test Area and Demolition Area 1 vicinity).

The potentiometric surface may be interpreted with a higher degree of confidence in the southeastern portion of RVAAP than in many other areas of the facility because of the density of monitoring wells present (i.e., vicinity of Cobb's Pond; Ramsdell Quarry; and Load Lines 1 through 4 and 12). The potentiometric surface and water table gradients in the vicinity of Cobb's Pond, and Load Lines 12 and 4 are subdued when compared to other portions of RVAAP, and they appear to be influenced by the abundant large surface water features and wetlands present in these areas. Additionally, potential subsurface geologic heterogeneities in the vicinity of Load Line 12 create a complex potentiometric surface that is difficult to interpret with existing data. An apparent narrow potentiometric low, oriented in a north-south direction, extends along the axis of Load Line 12 from South Service Road towards Cobb's Pond (see [Plate 1](#)). This potentiometric low was also evident from water table data collected during 2000, as presented in the Load Line 12 Phase II RI Report (USACE 2001c).

4.0 REFERENCES

USACE (U. S. Army Corps of Engineers) 2001a. Sampling and Analysis Plan Addendum No. 1 for the Phase II Remedial Investigation of Load Lines 2, 3, and 4, Ravenna Army Ammunition Plant Ravenna, Ohio, F44650-99-0007, DO CY01, July.

USACE 2001b. Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio, DACA62-00-D-0001, DO CY02, March.

USACE 2001c. Phase II Remedial Investigation Report for Load Line 12 at the Ravenna Army Ammunition Plant, Ravenna, Ohio, DACA62-00-D-0001, DO CY06, July.