



May 29, 2018

## TECHNICAL MEMORANDUM

To: Steve Clough  
Nevada Environmental Response Trust

From: John Pekala, CEM#2347, Expires 9/20/2018, Ramboll  
Jessica Donovan and Ross Russell, Ramboll

Re: **RI Phase 3 Modification No. 3  
Nevada Environmental Response Trust Site  
Henderson, Nevada  
Ramboll Project No. 1690006943-037**

This Technical Memorandum presents Ramboll's recommended Modification No. 3 to the scope of work for the Remedial Investigation (RI) Phase 3 Investigation currently in progress at the Nevada Environmental Response Trust Site (the "Site") located in Henderson, Nevada.

### Scope Modification – Nuclear Magnetic Resonance Logging

At the request of NDEP, the Trust will perform Nuclear Magnetic Resonance (NMR) logging in select wells. This technology can be used in open or PVC-cased wells to provide high-resolution downhole estimates of hydraulic conductivity, total water content, and relative pore-size distributions below the water table. Above the water table, NMR provides volumetric water content measurements. Ramboll will utilize the NMR Javelin system developed by Vista Clara, Inc. to collect these data. The specific Javelin tool used will depend on the diameter of the well, because larger diameter wells require a larger tool that has a larger radius of investigation. All tools will provide a measurement approximately every 1.5 feet of depth.

Ramboll has selected 139 monitoring wells along the operable unit (OU) boundaries of OU-1, OU-2, and OU-3 and in areas of interest such as the Interceptor Well Field (IWF), the Athens Road Well Field (AWF), and along the Las Vegas Wash. The OU boundaries are illustrated on Figure 1. The purpose of the NMR logging study is to obtain additional information on subsurface hydraulic properties to help identify potential continuous coarser-grained flow pathways, both within the saturated alluvium and in the Upper Muddy Creek formation (UMCf). The average depth of the 139 selected wells is 85 feet below ground surface (bgs) with the deepest well having a total depth of 290 feet bgs. The majority of the wells selected for NMR logging were installed as part of the NERT RI (Phases 1, 2, and 3) and upcoming Downgradient Study Area Investigation well installations. In addition, several existing shallow wells were selected to supplement older boring log data. At clustered well locations, the deepest well was selected. The NMR logging results will be compared with other data collected at these locations (e.g., slug tests, boring logs, and soil physical tests).

### OU-1, NERT Site

Fifty-five wells with an average depth of 104 feet bgs have been selected for NMR logging in OU-1. In order to provide comprehensive data across the NERT Site, particularly in the area between the Unit Buildings and the IWF and northern Site boundary, the selected wells are generally distributed evenly between the northern and southern portions of the Site. Selected OU-1 wells for NMR logging are presented in Table 1, and the well locations are shown on Figure 2.

### OU-2, NERT Off-Site Study Area and Eastside Sub-Area

Forty-nine wells with an average depth of 75 feet bgs have been selected for NMR logging in OU-2. The well selection is roughly divided between the NERT Off-Site Study area (22 wells) and the Eastside Sub-Area (27 wells). Selected OU-2 wells for NMR logging are presented in Table 2, and the well locations are shown on Figure 3.

### OU-3, NERT Off-Site Study Area, Downgradient Study Area, and Northeast Sub-Area

Twenty-five wells with an average depth of 70 feet bgs have been selected for NMR logging in OU-3. Over half of these wells are roughly evenly spaced along the Las Vegas Wash from the western to the eastern end of the Downgradient Study Area. Fifteen of the monitoring wells located in OU-3 are scheduled to be installed as part of the ongoing Downgradient Study Area investigation and the NERT Phase 3 RI (within the Tuscany development). These wells will be scheduled for NMR logging upon their completion. Selected OU-3 wells for NMR logging are presented in Table 3, and the well locations are shown on Figure 4.

### Schedule

Ramboll anticipates that the NMR logging field work will take approximately four weeks to complete.

Please contact us should you have any questions about this recommended scope modification to the RI Phase 3.

### **Attachments**

Table 1 OU-1 NMR Logging Monitoring Well Selections

Table 2 OU-2 NMR Logging Monitoring Well Selections

Table 3 OU-3 NMR Logging Monitoring Well Selections

Figure 1 Operable Unit and Study Area Overview

Figure 2 OU-1 NMR Logging Locations

Figure 3 OU-2 NMR Logging Locations

Figure 4 OU-3 NMR Logging Locations

**TABLE 1. OU-1 NMR LOGGING MONITORING WELL SELECTIONS**  
**RI Phase 3 Modification No. 3**  
**Nevada Environmental Response Trust Site; Henderson, Nevada**

Monitoring Well ID	Well Owner	Ground Surface Elevation (feet msl)	Well Total Depth (feet bgs)	Casing Diameter (inches)	Water Bearing Zone
<b>OU-1 (Figure 2, 55 Wells)</b>					
NERT Site					
M-117	NERT	1878.12	155	2	Middle
M-118	NERT	1874.46	163	2	Middle
M-125D	NERT	1767.60	70	4	Shallow
M-140D	NERT	1744.67	70	4	Shallow
M-14D	NERT	1758.39	80	4	Shallow
M-150	NERT	1756.45	145	2	Middle
M-153	NERT	1797.21	170	2	Middle
M-159	NERT	1752.91	75	2	Shallow
M-161D	NERT	1747.78	140	4	Middle
M-162D	NERT	1745.04	140	4	Middle
M-165	NERT	1741.62	120	2	Middle
M-181	NERT	1759.36	115	2	Middle
M-186D	NERT	1798.16	173	4	Middle
M-195	NERT	1798.65	110	4	Middle
M-196	NERT	1799.29	105	4	Middle
M-197	NERT	1798.72	115	4	Middle
M-198	NERT	1797.49	115	4	Middle
M-199	NERT	1783.84	105	4	Middle
M-200	NERT	1772.83	120	4	Middle
M-201	NERT	1782.21	72	4	Shallow
M-202	NERT	1765.32	55	4	Shallow
M-203	NERT	1728.39	50	4	Shallow
M-204	NERT	1732.57	110	4	Middle
M-205	NERT	1731.95	50	4	Shallow
M-206	NERT	1731.10	50	4	Shallow
M-207	NERT	1729.55	45	4	Shallow
M-210	NERT	1729.31	80	4	Shallow
M-213	NERT	1730.59	110	4	Middle
M-214	NERT	1741.19	50	4	Shallow
M-218	NERT	1732.04	110	4	Middle
M-21D	NERT	1787.89	55	4	Shallow
M-220	NERT	1747.34	70	4	Shallow
M-222	NERT	1752.57	110	4	Middle
M-22D	NERT	1756.90	65	4	Shallow
M-231	NERT	1757.48	120	4	Middle
M-232	NERT	1783.36	120	4	Middle
M-233	NERT	1779.40	120	4	Middle
M-234	NERT	1794.51	85	4	Shallow
M-235	NERT	1797.53	105	4	Middle
M-236	NERT	1797.85	105	4	Middle
M-238	NERT	1813.08	110	4	Middle
M-240	NERT	1813.53	115	4	Middle
M-244	NERT	1736.13	105	4	Middle
M-246	NERT	1736.63	70	4	Shallow

**TABLE 1. OU-1 NMR LOGGING MONITORING WELL SELECTIONS**  
**RI Phase 3 Modification No. 3**  
**Nevada Environmental Response Trust Site; Henderson, Nevada**

<b>Monitoring Well ID</b>	<b>Well Owner</b>	<b>Ground Surface Elevation (feet msl)</b>	<b>Well Total Depth (feet bgs)</b>	<b>Casing Diameter (inches)</b>	<b>Water Bearing Zone</b>
M-37	NERT	1757.98	35	2	Shallow
M-66D	NERT	1751.72	70	4	Shallow
M-72D	NERT	1745.60	70	4	Shallow
M-73	NERT	1742.15	36	2	Shallow
M-81D	NERT	1743.04	70	4	Shallow
M-83D	NERT	1738.86	70	4	Shallow
TR-2	NERT	1749.48	175	4	Middle
TR-4	NERT	1770.20	145	4	Middle
TR-6	NERT	1797.74	80	4	Shallow
TR-7	NERT	1826.71	290	4	Middle
TR-9	NERT	1851.85	250	4	Middle

**Notes:**

NERT = Nevada Environmental Response Trust

**TABLE 2. OU-2 NMR LOGGING MONITORING WELL SELECTIONS**  
**RI Phase 3 Modification No. 3**  
**Nevada Environmental Response Trust Site; Henderson, Nevada**

Monitoring Well ID	Well Owner	Ground Surface Elevation (feet msl)	Well Total Depth (feet bgs)	Casing Diameter (inches)	Water Bearing Zone
<b>OU-2 (Figure 3, 49 Wells)</b>					
NERT Off-Site Study Area					
M-152	NERT	1695.81	145	2	Middle
MC-MW-37R2	NERT	1709.13	63	4	Shallow
PC-134D	NERT	1618.82	90	4	Shallow
PC-137D	NERT	1618.79	90	4	Shallow
PC-162	NERT	1644.52	45	2	Shallow
PC-165	NERT	1660.46	38	2	Shallow
PC-168	NERT	1664.01	35	2	Shallow
PC-172D	NERT	1677.87	51	2	Shallow
PC-175	NERT	1693.07	39	2	Shallow
PC-176	NERT	1633.52	75	4	Shallow
PC-177	NERT	1628.09	60	4	Shallow
PC-179	NERT	1675.45	50	4	Shallow
PC-182	NERT	1696.45	85	4	Shallow
PC-187R	NERT	1703.72	55	4	Shallow
PC-188	NERT	1717.15	60	4	Shallow
PC-192	NERT	1674.04	50	4	Shallow
PC-193	NERT	1643.19	50	4	Shallow
PC-194	NERT	1634.85	58	4	Shallow
PC-195	NERT	1612.93	75	4	Shallow
PC-196	NERT	1612.93	75	4	Shallow
PC-197	NERT	1610.40	75	4	Shallow
PC-40R	NERT	1677.56	55	2	Shallow
Eastside Sub-Area					
ES-1	NERT	1753.54	110	4	Middle
ES-10	NERT	1621.27	65	4	Shallow
ES-12	NERT	1605.18	65	4	Shallow
ES-13	NERT	1630.62	105	4	Middle
ES-14B	NERT	1665.37	115	4	Middle
ES-15	NERT	1655.28	90	4	Shallow
ES-16	NERT	1660.84	100	4	Middle
ES-17	NERT	1666.55	100	4	Middle
ES-18	NERT	1679.58	110	4	Middle
ES-19	NERT	1685.46	177	4	Middle
ES-20	NERT	1716.20	110	4	Middle
ES-28	NERT	1758.96	85	4	Shallow
ES-29	NERT	1763.49	80	4	Shallow
ES-30	NERT	1665.33	93	4	Shallow
ES-31	NERT	1643.92	75	4	Shallow
ES-32	NERT	1695.93	92	4	Shallow
ES-33	NERT	(1)	33	4	Shallow
ES-34	NERT	(1)	41	4	Shallow
ES-35	NERT	(1)	45	4	Shallow
ES-36	NERT	(1)	45	4	Shallow
ES-37	NERT	(1)	40	4	Shallow

**TABLE 2. OU-2 NMR LOGGING MONITORING WELL SELECTIONS**  
**RI Phase 3 Modification No. 3**  
**Nevada Environmental Response Trust Site; Henderson, Nevada**

<b>Monitoring Well ID</b>	<b>Well Owner</b>	<b>Ground Surface Elevation (feet msl)</b>	<b>Well Total Depth (feet bgs)</b>	<b>Casing Diameter (inches)</b>	<b>Water Bearing Zone</b>
ES-38	NERT	(1)	41	4	Shallow
ES-39	NERT	(1)	46	4	Shallow
ES-4	NERT	1726.94	90	4	Shallow
ES-7	NERT	1678.43	80	4	Shallow
ES-8B	NERT	1716.60	110	4	Middle
ES-9	NERT	1681.57	100	4	Middle

**Notes:**

(1) As built well completions have not been surveyed. These wells are part of the ZVI Treatability Study.

NERT = Nevada Environmental Response Trust

**TABLE 3. OU-3 NMR LOGGING MONITORING WELL SELECTIONS**  
**RI Phase 3 Modification No. 3**  
**Nevada Environmental Response Trust Site; Henderson, Nevada**

Monitoring Well ID	Well Owner	Ground Surface Elevation (feet msl)	Well Total Depth (feet bgs)	Casing Diameter (inches)	Water Bearing Zone
<b>OU-3 (Figure 4, 25 Wells)</b>					
NERT Off-Site Study Area					
PC-178	NERT	1595.12	70	4	Shallow
PC-56	NERT	1573.53	55	2	Shallow
PC-156B	NERT	1547.12	45	2	Shallow
COH-2B	NA	1544.42	67	2	Shallow
Downgradient Study Area					
WMW6.9S	SNWA	1568.11	52	2.5	Shallow
WMW5.58SD	SNWA	1433.76	80	4	Shallow
NERT3.65S1*	NERT	NA	60	4	Shallow
NERT3.80S1*	NERT	NA	60	4	Shallow
NERT4.21N1*	NERT	NA	55	4	Shallow
NERT4.38N1*	NERT	NA	55	4	Shallow
NERT4.51S1*	NERT	NA	50	4	Shallow
NERT4.71S1*	NERT	NA	50	4	Shallow
NERT4.93S1*	NERT	NA	50	4	Shallow
NERT5.11S1*	NERT	NA	45	4	Shallow
NERT5.49S1*	NERT	NA	40	4	Shallow
NERT5.91S1*	NERT	NA	50	4	Shallow
LNDMW-1	NA	1510.68	60	NA	Shallow
Northeast Sub-Area					
ES-21B*	NERT	1539.94	80	4	Shallow
ES-22B*	NERT	NA	80	4	Middle
ES-23B*	NERT	NA	80	4	Middle
ES-24*	NERT	NA	80	4	Middle
ES-25B*	NERT	NA	80	4	Middle
ES-26	NERT	NA	80	4	Middle
ES-27	NERT	1539.94	80	4	Middle
MW-18	COH	1581.77	105	2	Middle

**Notes:**

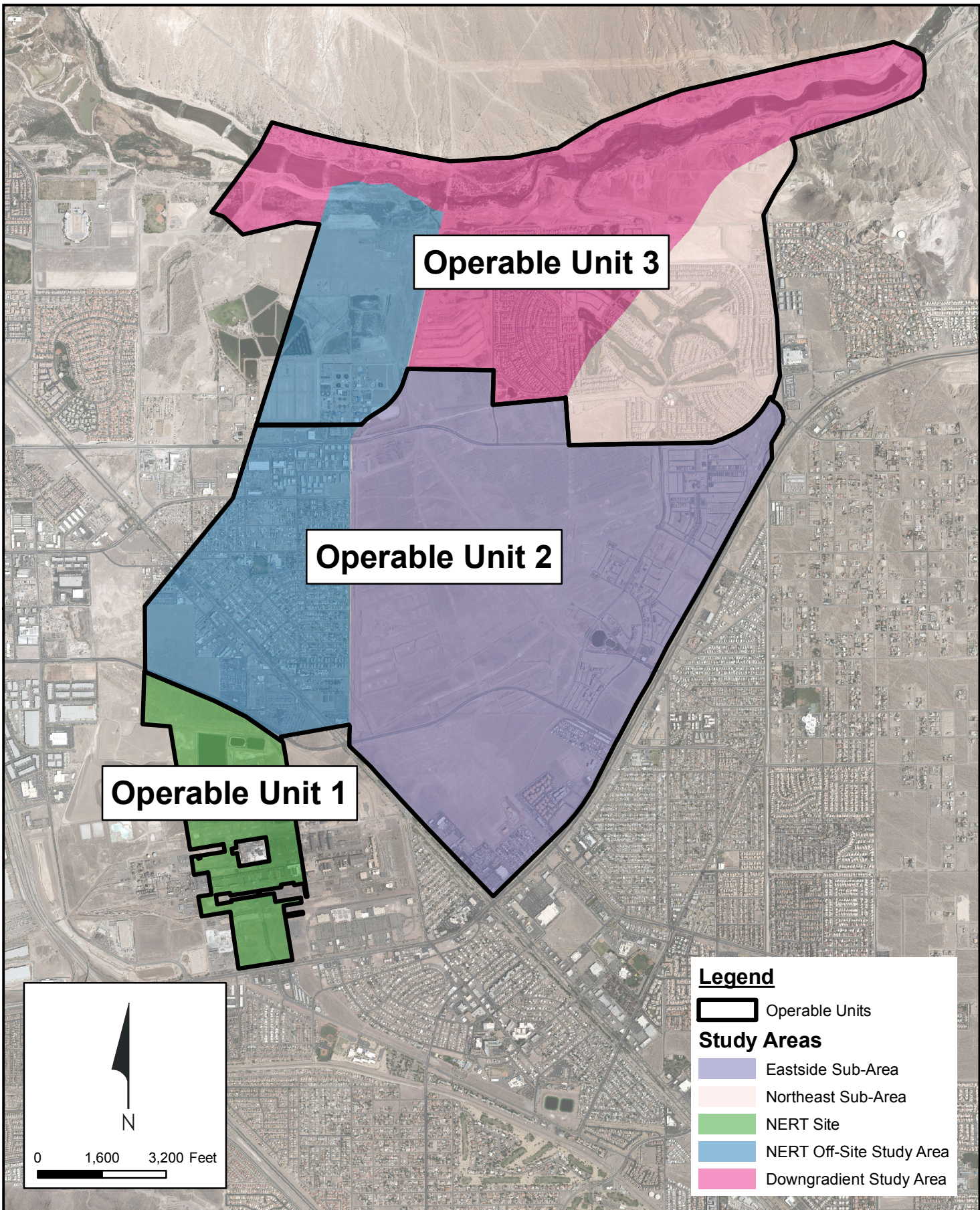
\* Monitoring well has not yet been installed.

NERT - Nevada Environmental Response Trust

NA - not available

SNWA - Southern Nevada Water Agency

COH - City of Henderson

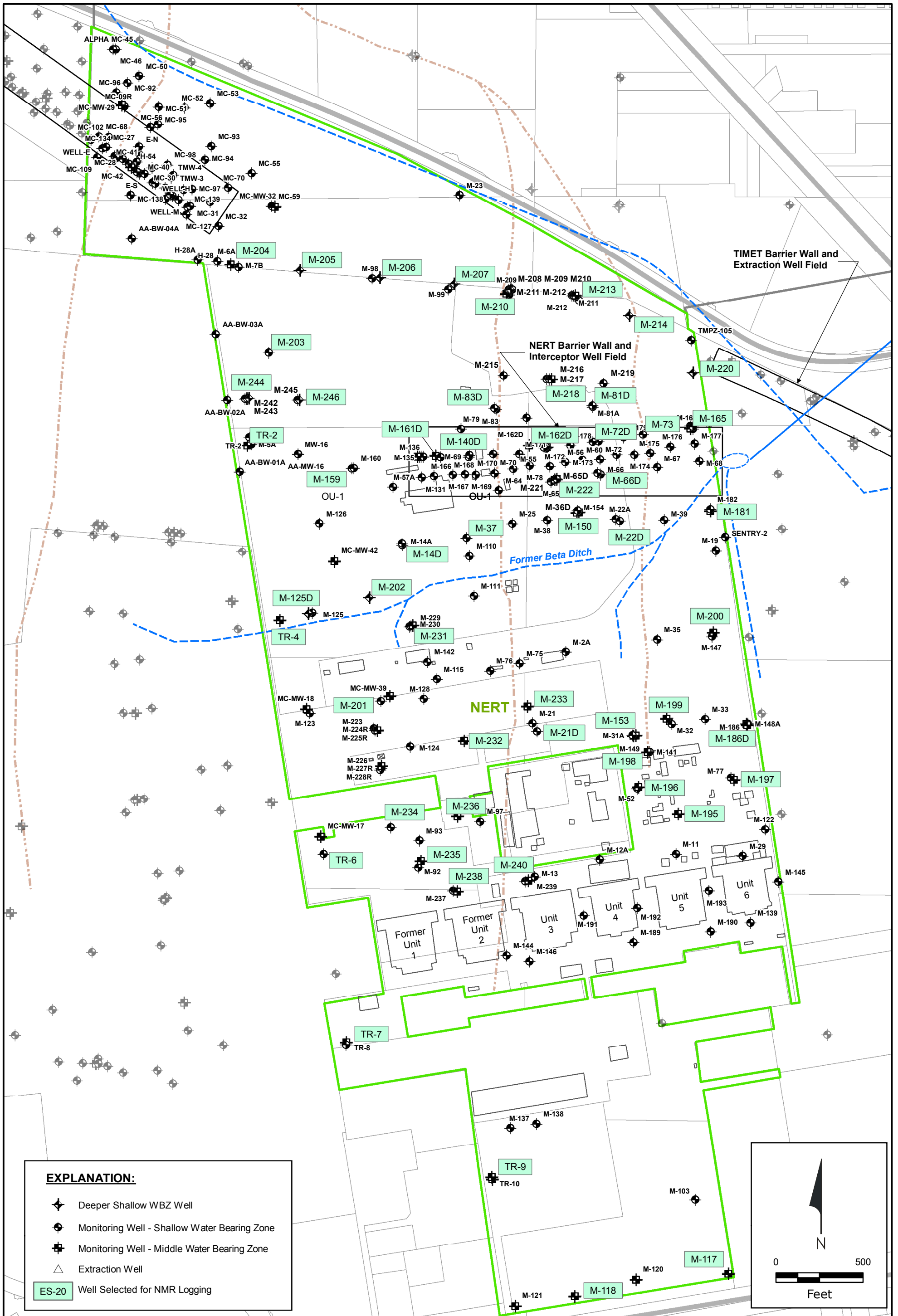


**Operable Unit and Study Area Overview**  
 Nevada Environmental Response Trust Site  
 Henderson, Nevada

Figure

**1**





**EXPLANATION:**

- ◆ Deeper Shallow WBZ Well
- Monitoring Well - Shallow Water Bearing Zone
- Monitoring Well - Middle Water Bearing Zone
- △ Extraction Well
- ES-20 Well Selected for NMR Logging

0 500  
Feet

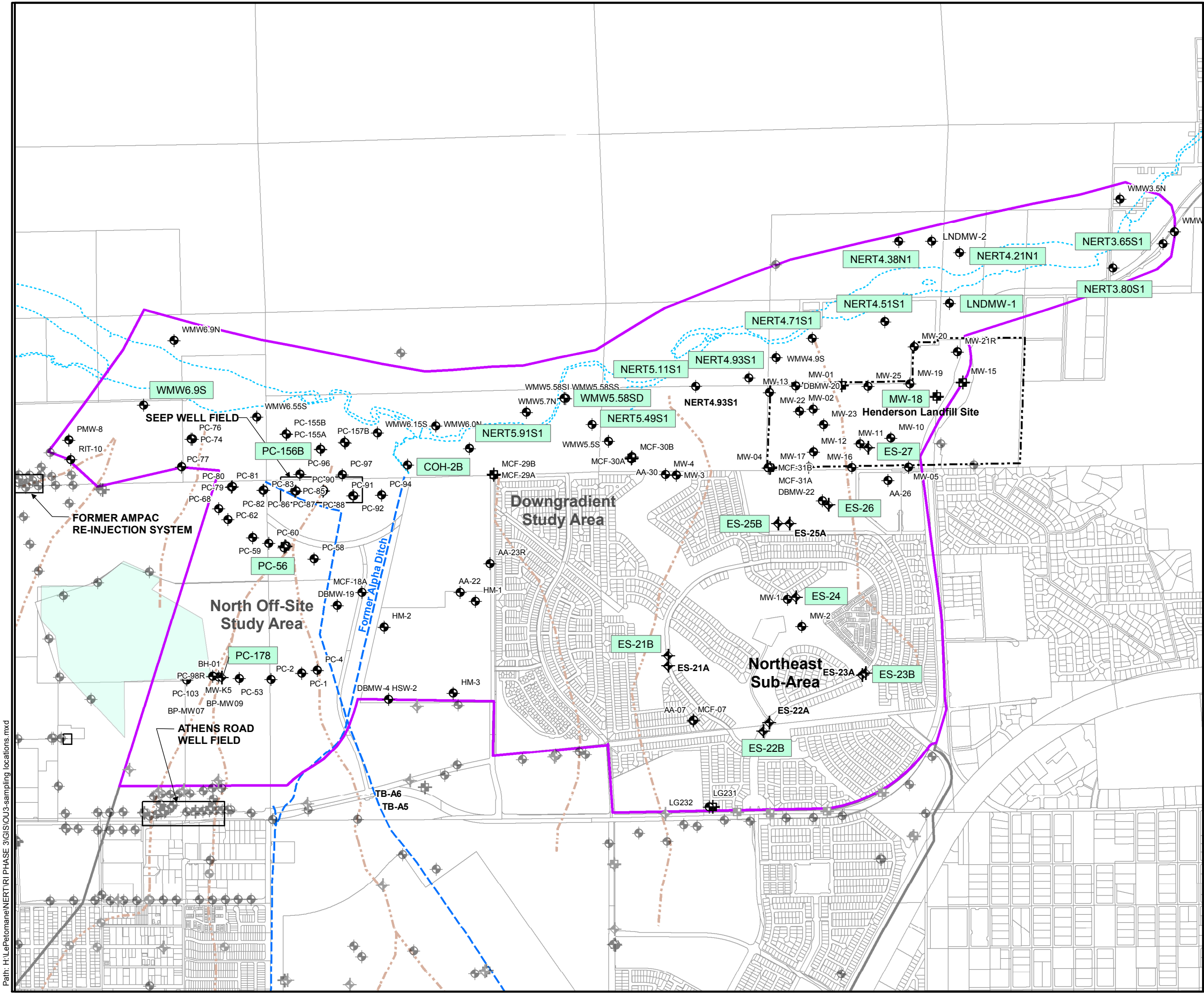


**OU-1 NMR Logging Locations**  
Nevada Environmental Response Trust Site  
Henderson, Nevada

Figure  
**2**

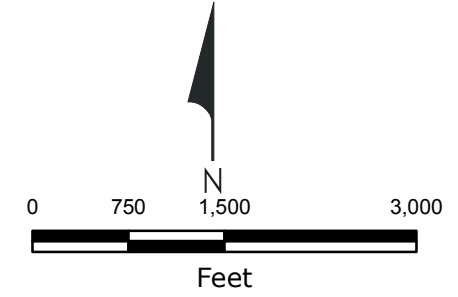
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**EXPLANATION:**

- ◆ Deeper Shallow WBZ Well
- Monitoring Well - Shallow Water Bearing Zone
- ⊕ Monitoring Well - Middle Water Bearing Zone
- △ Extraction Well
- ES-20 Well Selected for NMR Logging



**OU-3 NMR Logging Locations**  
Nevada Environmental Response Trust Site  
Henderson, Nevada

Date: 5/18/2018	Contract Number: 169000 6943-020	Figure <b>4</b>
Drafter: RS	Approved:	Revised:

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**RI Phase 3 Modification No. 3  
Nuclear Magnetic Resonance Logging**

**Nevada Environmental Response Trust  
(Former Tronox LLC Site)  
Henderson, Nevada**

**Nevada Environmental Response Trust (Trust) Representative Certification**

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of the Trust. Based on my own involvement and/or my inquiry of the person or persons who manage the system(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Signature:** Jay A. Steinberg, Pres. Le Pet *just individually, but solely as*, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

**Name:** Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

**Title:** Solely as President and not individually

**Company:** Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Date:** 5/20/18

**RI Phase 3 Modification No. 3  
Nuclear Magnetic Resonance Logging**

**Nevada Environmental Response Trust  
(Former Tronox LLC Site)  
Henderson, Nevada**

**Responsible Certified Environmental Manager (CEM) for this project**

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.



5/29/2018

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**John M. Pekala, PG  
Principal**

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**Date**

Certified Environmental Manager  
Ramboll US Corporation  
CEM Certificate Number: 2347  
CEM Expiration Date: September 20, 2018