

MEMO

Date **October 22, 2018**

To **Nevada Environmental Response Trust**

From **John Pekala, Scott Warner, and Chris Ritchie**Copy to **Nevada Division of Environmental Protection**

United States Environmental Protection Agency

Subject Galleria Drive ZVI-Enhanced Bioremediation Treatability

Study Monthly Progress Report

TASK PROGRESS UPDATE: AUGUST 2018

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Ramboll US Corporation (Ramboll) has prepared this memorandum which summarizes Ramboll's progress during August 2018 toward successfully implementing the Galleria Drive ZVI-Enhanced Bioremediation Treatability Study.

TASK M18 – GALLERIA DRIVE ZVI-ENHANCED BIOREMEDIATION TREATABILITY STUDY

- Task Leaders Scott Warner / Chris Ritchie
- Current Status
 - Phase 1 of the treatability study is underway. The pre-design field investigation as specified in the work plan is complete; bench-scale testing is in progress. Phase 2 (design and implementation of a field test) will be proposed in early 2019 as part of a forthcoming Work Plan Addendum.
 - Data from the pre-design field investigation are being evaluated. Preliminary draft data have been attached to this task progress update (see Tables 1 through 4 and Figures 1 through 3).
 - The depth to the contact between the alluvium and UMCf varied between 14 and 25 feet below ground surface (bgs).
 - Depth to first encountered groundwater ranged between 25 and 38 feet bgs.
 Saturated alluvium was not encountered.
 - Horizontal gradient indicates the groundwater flows in a north-northeasterly direction.
 - Perchlorate concentrations in groundwater ranged from 3.3-7.0 milligrams per liter (mg/l). Chlorate concentration ranged from 8.7-52 mg/l.
 - Batch microcosm tests with soil, groundwater, and ZVI are in progress and are expected to be completed in September 2018.



- Column testing is underway. Two initial test columns have been packed and are currently operating to test flow rates under varying influent pressures. Additional columns are being packed and are expected to begin operation by 10/5 to test ZVI under dynamic, site-simulated conditions.
- Schedule and Progress Updates
 - Field work related to the pre-design field investigation as specified in the work plan is complete. Additional deeper investigation is being considered and may be proposed as a work plan modification.
 - Bench-scale testing is expected to continue through November 2018.
 - This task initially had a work plan addendum scheduled for submittal at the end of August 2018. To allow for additional time necessary for the completion of column tests, we now anticipate submittal of a work plan addendum in early 2019.
- Health and Safety
 - There were no safety incidents during August 2018.

ATTACHMENTS

- Table 1 Pre-Design Field Investigation Location Information (Preliminary Information)
- Table 2 Pre-Design Field Investigation Groundwater Elevations (Preliminary Information)
- Table 3 Pre-Design Field Investigation Groundwater Sampling Results (Preliminary Information)
- Table 4 Pre-Design Field Investigation Soil Sampling Results (Preliminary Information)
- Figure 1 Pre-Design Field Investigation UMCf Contact (Preliminary Information)
- Figure 2 Pre-Design Field Investigation Groundwater Elevations (Preliminary Information)
- Figure 3 Pre-Design Field Investigation Groundwater Sampling Results (Preliminary Information)



Galleria Drive ZVI-Enhanced Bioremediation Treatability Study Progress Update

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

Nevada Environmental Response Trust (NERT) 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 NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the systems(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, not individually, but solely in its representative capacity as the Nevada
Environmenta	al Response Trust Trustee
Signature:	and Stember , not individually, but solely in his
(Trepresentative 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:	10/12/18



Galleria Drive ZVI-Enhanced Bioremediation Treatability Study Progress Update

Nevada Environmental Response Trust Site (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 prepared 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. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

Description of Services Provided: Prepared Galleria Drive ZVI-Enhanced Bioremediation Treatability Study Progress Update, Nevada Environmental Response Trust Site, Henderson, Nevada

John M. Pekala, PG

Principal

Certified Environmental Manager Ramboll Environ US Corporation CEM Certificate Number: 2347

CEM Expiration Date: September 20, 2020

October 22, 2018

Date

TABLE 1: PRE-DESIGN FIELD INVESTIGATION LOCATION INFORMATION

ZVI-Enhanced Bioremediation Treatability Study Work Plan Addendum Nevada Environmental Response Trust Site Henderson, Nevada

Location Name	Location Type	Installation Date	Easting	Northing	Top of Casing Elevation (ft amsl)	Ground Elevation (ft amsl)	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Screen Size	Casing Diameter (in)	Casing Material
ES-33	Monitoring Well	04/14/2018	830688.49	26727819.66	1626.39	1623.97	35.0	33.0	18.0	33.0	0.01	4.0	PVC
ES-34	Monitoring Well	04/17/2018	831294.61	26727878.6	1630.03	1627.42	42.0	41.0	26.0	41.0	0.01	4.0	PVC
ES-35	Monitoring Well	04/15/2018	831812.43	26727994.68	1628.35	1625.92	47.0	45.0	30.0	45.0	0.01	4.0	PVC
ES-36	Monitoring Well	04/16/2018	832531.15	26728075.74	1630.83	1628.61	47.0	45.0	30.0	45.0	0.01	4.0	PVC
ES-37	Monitoring Well	04/27/2018	830634.29	26727252.08	1634.21	1631.56	40.0	37.0	22.0	37.0	0.01	4.0	PVC
ES-38	Monitoring Well	04/27/2018	831828.2	26727641.1	1628.11	1625.48	41.0	40.0	25.0	40.0	0.01	4.0	PVC
ES-39	Monitoring Well	04/30/2018	832407.53	26727422.09	1637.87	1635.06	46.0	45.0	30.0	45.0	0.01	4.0	PVC
ESB-19	Boring	04/11/2018	830639.12	26727257.32	NA	1631.71	35.0	NA	NA	NA	NA	NA	NA
ESB-20	Boring	04/10/2018	831210.53	26727506.15	NA	1631.17	40.0	NA	NA	NA	NA	NA	NA
ESB-21	Boring	04/10/2018	831823.35	26727636.29	NA	1625.57	40.0	NA	NA	NA	NA	NA	NA
ESB-22	Boring	04/10/2018	832411.01	26727434.77	NA	1634.96	45.0	NA	NA	NA	NA	NA	NA
ESB-23	Boring	04/13/2018	832183.02	26728135.68	NA	1627.26	45.0	NA	NA	NA	NA	NA	NA

Notes:

ft amsl = feet above mean sea level ft bgs = feet below ground surface in = inches

TABLE 2: PRE-DESIGN FIELD INVESTIGATION GROUNDWATER ELEVATIONS

ZVI-Enhanced Bioremediation Treatability Study Work Plan Addendum Nevada Environmental Response Trust Site Henderson, Nevada

Location Name	Measurement Date	Top of Casing Elevation (ft amsl)	Water Level Depth (ft bTOC)	Groundwater Level Elevation (ft amsl)
ES-33	05/23/2018	1626.39	27.68	1598.71
ES-34	05/23/2018	1630.03	32.55	1597.48
ES-35	05/22/2018	1628.35	30.72	1597.63
ES-36	05/22/2018	1630.83	36.27	1594.56
ES-37	05/22/2018	1634.21	29.74	1604.47
ES-38	05/23/2018	1628.11	28.35	1599.76
ES-39	05/23/2018	1637.87	41.24	1596.63

Notes:

ft amsl = feet above mean sea level ft bTOC = feet below top of casing

TABLE 3: PRE-DESIGN FIELD INVESTIGATION GROUNDWATER SAMPLING RESULTS

ZVI-Enhanced Bioremediation Treatability Study Work Plan Addendum

Nevada Environmental Response Trust Site

Henderson, Nevada

Location Name	Sample Date	Bicarbonate as HCO3 (mg/L)	Calcium (mg/L)	Carbon (mg/L)	Carbonate as CO3 (mg/L)	Chlorate (mg/L)	Chloride (mg/L)	Chromium VI (mg/L)	Dissolved Solids (total) (mg/L)	Hydroxide (mg/L)	Iron (mg/L)	Iron, Ferric (mg/L)	Iron, Ferrous (mg/L)	Magnesium (mg/L)	Perchlorate (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)	Total Alkalinity as CaCO3 (mg/L)
ES-33	05/23/2018	130	570	0.87	<2.4	15	890	0.0085	6,000	<1.4	<0.25	<0.10	<0.10	320	3.5	75	860	2,700	110
ES-34	05/23/2018	74	630	<0.65	<2.4	52	1,400	0.064	8,400	<1.4	<0.25	<0.10	<0.10	630	7.0	230	1,300	3,900	60
	(FD)	73	590	0.67	<2.4	52	1,400	0.064	8,400	<1.4	<0.25	<0.10	<0.10	580	6.9	210	1,200	3,800	60
ES-35	05/22/2018	90	540	0.89	<2.4	25	860	0.028	5,900	<1.4	<0.050	<0.10	<0.10	230	3.3	40	620	2,500	74
ES-36	05/22/2018	76	530	2.1	<2.4	44	1,200	0.060	6,800	<1.4	<0.050	<0.10	<0.10	270	5.2	280	760	2,700	62
ES-37	05/22/2018	76	500	<0.65	<2.4	18	890	0.017	6,400	<1.4	0.15	0.15	<0.10	290	3.9	110	750	3,000	62
ES-38	05/23/2018	91	630	0.75	<2.4	29	880	0.027	5,900	<1.4	<0.25	<0.10	<0.10	290	3.3	54	780	2,600	75
ES-39	05/23/2018	110	670	0.90	<2.4	8.7	920	0.060	5,700	<1.4	<0.25	<0.10	<0.10	260	4.5	41	760	2,300	87

Notes:

mg/L = milligrams per Liter

TABLE 4: PRE-DESIGN FIELD INVESTIGATION SOIL SAMPLING RESULTS

Location Name	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Chlorate (mg/kg)	Nitrate as N (mg/kg)	Nitrate as NO3 (mg/kg)	Perchlorate (mg/kg)
ES-33	04/11/2018	10.0	10.5	8.2	1.3	5.8	0.72
		11.0	11.5	5.8	1.1	4.7	0.64
		12.0	12.5	2.1	<0.91	<4.0	0.37
		13.0	13.5	9.5	1.9	8.5	1.2
		14.0	14.5	9.5	2.7	12	1.1
		15.0	15.5	17	3.2	14	1.6
		16.0	16.5	23	4.4	20	2.9
		17.0	17.5	18	4.1	18	2.5
		18.0	18.5	15	2.4	11	1.9
		(FD)	(FD)	15	2.3	10	1.5
		19.0	19.5	14	2.1	9.4	1.8
		20.0	20.5	8.2	1.9	8.5	1.0
		21.0	21.5	7.8	1.7	7.4	1.1
		22.0	22.5	6.0	1.2	5.4	0.95
		23.0	23.5	5.7	1.3	5.9	0.94
		24.0	24.5	6.0	1.3	5.6	1.3
		25.0	25.5	9.1	2.6	11	1.5
		26.0	26.5	6.1	1.7	7.6	1.2
		27.0	27.5	8.1	1.9	8.6	1.4
		28.0	28.5	16	4.1	18	2.2
		29.0	29.5	14	3.3	15	1.8
		30.0	30.5	11	2.4	11	1.6
		31.0	31.5	11	2.7	12	1.8
		32.0	32.5	8.4	2.8	12	2.1
		33.0	33.5	7.6	1.9	8.3	1.5
		40.0	40.5	9.3	2.4	11	2.3
		50.0	50.5	8.5	2.0	8.8	1.6
		(FD)	(FD)	8.0	1.9	8.3	1.6
		60.0	60.5	2.0	<1.4	<5.9	0.54
		70.0	70.5	0.14	<1.1	<4.6	<0.013
		80.0	80.5	<0.074	<1.2	<5.1	<0.070
		90.0	90.5	<0.078	<1.2	<5.5	<0.015
		100.0	100.5	<0.080	<1.3	<5.5	<0.015
		110.0	110.5	2.0	<1.1	<4.9	<0.013
		(FD)	(FD)	2.0	<1.1	<4.9	<0.013
		120.0	120.5	<0.067	<1.1	<4.7	<0.013
ES-34	04/12/2018	10.0	10.5	10	1.3	5.8	1.3

TABLE 4: PRE-DESIGN FIELD INVESTIGATION SOIL SAMPLING RESULTS

Location Name	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Chlorate (mg/kg)	Nitrate as N (mg/kg)	Nitrate as NO3 (mg/kg)	Perchlorate (mg/kg)
ES-34	04/12/2018	20.0	20.5	17	2.8	12	1.4
		15.0	15.5	2.1	1.7	7.7	2.1
		16.0	16.5	3.6	1.0	4.6	0.53
		17.0	17.5	3.5	<0.86	3.8	0.24
		18.0	18.5	14	1.8	7.9	0.82
		19.0	19.5	13	2.4	11	0.73
		25.0	25.5	14	2.7	12	0.94
		26.0	26.5	17	2.5	11	1.6
		27.0	27.5	12	3.4	15	1.5
		28.0	28.5	17	3.9	17	1.8
		29.0	29.5	19	3.9	17	1.8
		30.0	30.5	20	3.6	16	1.9
		(FD)	(FD)	19	3.6	16	1.8
		31.0	31.5	21	3.9	17	1.4
		32.0	32.5	29	5.8	26	1.3
		33.0	33.5	20	3.6	16	1.8
		34.0	34.5	17	3.5	16	1.2
		35.0	35.5	39	7.3	32	5.6
		36.0	36.5	51	11	50	6.4
		37.0	37.5	16	3.7	16	2.9
		38.0	38.5	25	5.8	26	4.3
		40.0	40.5	32	8.4	37	6.7
		50.0	50.5	8.7	1.7	7.7	1.0
		60.0	60.5	0.39	<1.3	<5.7	0.12
		(FD)	(FD)	0.39	<1.2	<5.4	0.093
		70.0	70.5	0.80	<1.4	<6.1	<0.083
		80.0	80.5	0.37	<1.1	<5.0	<0.069
		90.0	90.5	0.16	<1.0	<4.6	<0.062
		100.0	100.5	<0.32	<1.0	<4.4	<0.061
		(FD)	(FD)	<0.31	<1.0	<4.4	<0.059
		110.0	110.5	0.084	<1.1	<4.7	<0.064
		120.0	120.5	0.30	<1.3	<5.5	<0.074
	04/17/2018	20.0	20.5	26	4.4	19	2.1
		21.0	21.5	24	5.2	23	2.2
		22.0	22.5	27	5.8	26	2.5
		23.0	23.5	24	5.8	25	3.1
		24.0	24.5	24	5.8	26	2.3

TABLE 4: PRE-DESIGN FIELD INVESTIGATION SOIL SAMPLING RESULTS

Location Name	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Chlorate (mg/kg)	Nitrate as N (mg/kg)	Nitrate as NO3 (mg/kg)	Perchlorate (mg/kg)
ES-35	04/12/2018	10.0	10.5	7.2	2.0	9.1	0.75
		20.0	20.5	3.3	1.2	5.2	0.36
		22.0	22.5	4.7	0.87	3.9	0.20
		23.0	23.5	3.9	0.98	4.3	0.098
		24.0	24.5	6.6	1.4	6.1	0.11
		25.0	25.5	21	4.4	20	1.7
		26.0	26.5	11	3.2	14	1.4
		30.0	30.5	7.5	2.1	9.4	0.88
		(FD)	(FD)	11	3.0	13	1.3
		27.0	27.5	9.1	2.6	12	0.55
		28.0	28.5	12	2.6	12	1.2
		29.0	29.5	7.3	2.7	12	1.2
		31.0	31.5	9.8	1.7	7.6	0.75
		32.0	32.5	9.5	2.0	8.9	0.47
		33.0	33.5	7.7	1.7	7.6	0.61
		34.0	34.5	9.4	1.7	7.6	0.52
		35.0	35.5	18	3.6	16	1.9
		36.0	36.5	9.1	1.5	6.7	0.91
		37.0	37.5	6.7	1.7	7.4	0.70
		38.0	38.5	18	3.1	14	1.3
		39.0	39.5	17	3.4	15	1.2
		40.0	40.5	18	2.9	13	<0.071
		(FD)	(FD)	17	3.1	14	<0.069
		41.0	41.5	8.8	1.7	7.5	<0.064
		42.0	42.5	8.9	2.1	9.2	<0.063
		43.0	43.5	12	2.1	9.2	<0.063
		44.0	44.5	16	2.7	12	<0.067
		45.0	45.5	15	2.6	11	<0.062
		50.0	50.5	2.7	<1.0	<4.5	0.98
		60.0	60.5	<0.086	<1.4	<5.9	<0.016
		(FD)	(FD)	<0.081	<1.3	<5.7	<0.015
		70.0	70.5	0.098	<1.2	<5.4	<0.015
	04/13/2018	80.0	80.5	1.0	<1.1	<4.9	<0.066
		(FD)	(FD)	1.1	<1.2	<5.1	<0.014
		90.0	90.5	0.45	<1.3	<5.8	<0.078
		100.0	100.5	0.078	<1.1	<4.8	<0.065
		110.0	110.5	<0.34	<1.1	<4.8	<0.064

TABLE 4: PRE-DESIGN FIELD INVESTIGATION SOIL SAMPLING RESULTS

Location Name	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Chlorate (mg/kg)	Nitrate as N (mg/kg)	Nitrate as NO3 (mg/kg)	Perchlorate (mg/kg)
ES-35	04/13/2018	120.0	120.5	<0.34	<1.1	<4.9	<0.013
ES-36	04/16/2018	10.0	10.5	4.4	5.8	26	2.0
		20.0	20.5	1.5	2.7	12	0.77
		19.0	19.5	1.1	1.9	8.6	0.55
		21.0	21.5	0.22	1.4	6.3	0.68
		22.0	22.5	0.73	2.0	8.9	0.20
		23.0	23.5	4.3	8.9	40	0.95
		24.0	24.5	4.1	6.8	30	0.85
		25.0	25.5	4.0	5.8	26	0.62
		26.0	26.5	11	8.7	39	1.1
		27.0	27.5	13	7.4	33	1.1
		28.0	28.5	20	7.2	32	1.1
		29.0	29.5	17	9.3	41	1.3
		30.0	30.5	29	8.4	37	1.8
		(FD)	(FD)	29	8.1	36	2.0
		31.0	31.5	40	11	50	2.4
		32.0	32.5	27	5.5	25	1.9
		33.0	33.5	31	7.0	31	2.4
		34.0	34.5	9.9	4.1	18	1.3
		35.0	35.5	10	2.5	11	0.90
		36.0	36.5	39	8.8	39	3.1
		37.0	37.5	32	5.6	25	1.7
		38.0	38.5	27	7.4	33	3.0
		39.0	39.5	48	12	52	3.4
		40.0	40.5	24	12	53	3.7
		(FD)	(FD)	24	11	49	3.8
		41.0	41.5	11	5.9	26	1.9
		42.0	42.5	16	4.8	21	1.8
		50.0	50.5	2.6	1.3	5.8	0.83
		60.0	60.5	0.097	<1.0	<4.5	<0.060
		(FD)	(FD)	0.079	<1.0	<4.4	<0.060
		70.0	70.5	<0.071	<1.1	<4.9	<0.067
		80.0	80.5	<0.070	<1.1	<4.9	<0.066
		90.0	90.5	0.18	<1.1	<4.9	<0.065
		(FD)	(FD)	0.24	<1.1	<4.8	<0.065
		100.0	100.5	0.40	<1.2	<5.3	<0.072
		110.0	110.5	<0.33	<1.1	<4.6	<0.063

TABLE 4: PRE-DESIGN FIELD INVESTIGATION SOIL SAMPLING RESULTS

Location Name	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Chlorate (mg/kg)	Nitrate as N (mg/kg)	Nitrate as NO3 (mg/kg)	Perchlorate (mg/kg)
ES-36	04/16/2018	120.0	120.5	<0.064	<1.0	<4.5	<0.061
ESB-19	04/11/2018	10.0	10.5	1.8	<0.89	<3.9	2.3
		20.0	20.5	6.1	1.2	5.4	2.0
		30.0	30.5	4.0	<1.0	<4.4	0.18
ESB-20	04/10/2018	10.0	10.5	26	3.0	13	5.8
		20.0	20.5	20	3.1	14	1.6
		30.0	30.5	11	3.5	16	1.4
		40.0	40.5	15	2.7	12	1.3
ESB-21	04/10/2018	10.0	10.5	3.7	2.1	9.1	0.62
		20.0	20.5	18	3.4	15	1.1
		30.0	30.5	8.6	1.8	8.1	1.0
		40.0	40.5	4.1	1.2	5.5	0.81
ESB-22	04/10/2018	10.0	10.5	0.75	3.9	17	2.0
		20.0	20.5	2.9	1.9	8.5	2.8
		(FD)	(FD)	2.8	1.8	8.1	3.3
		30.0	30.5	5.2	8.5	38	6.4
		40.0	40.5	13	1.7	7.4	0.52
ESB-23	04/13/2018	10.0	10.5	3.4	1.9	8.6	1.5
		20.0	20.5	1.5	0.90	4.0	0.24
		(FD)	(FD)	1.5	0.87	3.9	0.27
		30.0	30.5	16	2.6	12	0.97
		40.0	40.5	18	3.9	17	1.5

Notes:

ft bgs = feet below ground surface mg/kg = milligrams per kilogram





