

October 29, 2021

**TECHNICAL MEMORANDUM**

To: Steve Clough  
Nevada Environmental Response Trust

From: John Pekala, CEM#2347, Expires 9/20/2022, Ramboll  
Chris Stubbs, Anne Gates, and Elizabeth Miesner, Ramboll

Re: **BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater Modification #1 (Revision 1)**  
**Nevada Environmental Response Trust Site**  
**Henderson, Nevada**  
**Ramboll Project No. 1690020169-006**

This Technical Memorandum presents Ramboll's recommended Modification No. 1 to the Baseline Health Risk Assessment (BHRA) Work Plan for OU-1 and OU-2 Soil Gas and Groundwater for the Nevada Environmental Response Trust (NERT) Site (the "BHRA Work Plan").<sup>1</sup> The most recent version of the BHRA Work Plan is Revision 1, dated December 18, 2018 and approved by the Nevada Division of Environmental Protection (NDEP) on January 24, 2019. The BHRA Work Plan states that potential risks from vapor intrusion to indoor air will be evaluated based on estimated indoor air concentrations calculated using the most recent version of the United States Environmental Protection Agency's (USEPA's) Johnson and Ettinger (J&E) model spreadsheet.

Using this approach, estimates of vapor intrusion risk reported in the BHRA for OU-1 and OU-2 Soil Gas and Groundwater, dated July 23, 2021 (the "BHRA Report"), were determined by estimating indoor air concentrations from soil gas and groundwater data using the J&E model. While these two datasets were modeled and used as multiple lines of evidence, the soil gas dataset was used as the primary line of evidence because there are lower uncertainties when modeling soil gas data since there is no need to calculate the partitioning between water and soil gas. The estimated excess lifetime cancer risks for indoor residential air based on modeling from the soil gas data were within the acceptable risk range of  $10^{-4}$  to  $10^{-6}$ , and the estimated noncancer hazard indices (HI) were well below the threshold of 1. It is important to note that these cancer risk and noncancer hazard estimates are based on conservative assumptions which are likely to overestimate actual exposures and calculated risks.

The BHRA Report also indicated that >90% of risk associated with vapor intrusion in OU-2 is related to chloroform impacts. The distribution of chloroform in groundwater and soil gas within OU-2 is detailed in Section 8 of the Remedial Investigation Report of OU-1 and OU-2.

This Modification No. 1 to the BHRA Work Plan was developed in response to a letter from NDEP to NERT dated September 8, 2021 in response to the BHRA Report (the "NDEP

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<sup>1</sup> This is Revision 1 of Modification #1 that was revised in response to NDEP comments dated October 19, 2021.

Letter"). The NDEP Letter required NERT to modify the approved BHRA Work Plan to include a targeted indoor air investigation of chloroform in areas of OU-2 with elevated soil gas and groundwater concentrations within the eastern portion of the Pittman residential area. Therefore, and consistent with the requirements of the NDEP Letter, NERT will collect additional data, inclusive of indoor air, to "confirm that chloroform indoor air levels remain below long-term health-based thresholds and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements". In addition, the indoor air results of chloroform will be compared to the health-based screening level threshold of 12  $\mu\text{g}/\text{m}^3$  as defined in the attachment to the NDEP Letter to confirm that the vapor intrusion risk to residents is within the USEPA's acceptable risk range.

Consistent with the BHRA Work Plan, the modeling results presented in the BHRA Report were used to estimate indoor air concentrations from soil gas samples collected at approximately 5 and 15 feet below ground surface (ft bgs) and shallow groundwater. Since the indoor air concentrations estimated from groundwater were treated as a secondary line of evidence in the BHRA Report, the proposed investigation will focus on comparing direct measurements to the estimates derived through soil gas modeling. In contrast to measured indoor air concentrations, the indoor air concentrations estimated by the model only include subsurface chemical sources and do not include ambient or indoor chemical sources. Chloroform may be present in indoor air as a result of indoor sources such as household cleaning products. In addition, since chloroform is a trihalomethane and a byproduct of treatment (chlorination) of municipal water, chloroform is also likely to be present in both indoor and ambient air as a result of off gassing from water used in bathrooms, kitchens, swimming pools, and irrigation. Consistent with municipal water throughout the US, chloroform and other trihalomethanes have been detected in the water supply in the City of Henderson.<sup>2</sup> Thus, in addition to direct sampling of indoor air, the investigation proposed herein also includes sampling of sub-slab air and ambient air to quantify the effect of ambient and indoor chemical sources on indoor air concentrations. For the abovementioned reasons, these additional lines of direct measurements are necessary to ensure the accuracy of the comparisons to be performed between the modeled indoor air estimates and the direct indoor air measurements.

To perform the comparative analysis with the BHRA modeling results, all samples collected will be analyzed for a list of target volatile organic compounds (VOCs) that were widely detected at a frequency greater than 85% in previous deeper soil gas samples: chloroform, carbon tetrachloride, tetrachloroethene, and trichloroethene.<sup>3</sup> In addition to comparing the BHRA modeling and individual chemical results, the ratios of different chemical concentrations in the subsurface and indoor air will be compared if chloroform is detected in indoor air at greater concentrations than in ambient air. The analysis of chemical ratios is necessary to distinguish the effects of subsurface sources from indoor or ambient sources on indoor air concentrations. The samples will also be analyzed for the trihalomethanes to help identify the effects of water treatment byproducts on sample results.

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<sup>2</sup> City of Henderson drinking water quality report by the Environmental Working Group available at <https://www.ewg.org/tapwater/system.php?pws=Nv0000076>.

<sup>3</sup> The 85% detection frequency threshold was selected to include the chlorinated hydrocarbons with relatively higher median detected concentrations of at least 10  $\mu\text{g}/\text{m}^3$ , because these chemicals would be relatively more likely to be detected in both soil gas and indoor air.

The overall sampling program is described in the following subsections.

### **Selection of Sampling Locations**

Consistent with the NDEP Letter, "Targeted Indoor Air Sampling Areas" were selected based on the residential locations where chloroform concentrations in soil gas at depths of 10 to 15 feet exceeded 4,000 ug/m<sup>3</sup>. Two areas identified for sampling are shown with red outlines in Figure 1. As shown in Figure 1, the two Targeted Indoor Air Sampling Areas encompass two groups of soil gas locations within residential areas where chloroform concentrations at 15 feet below grade were greater than 4,000 ug/m<sup>3</sup> and generally extends outwards to the next sampling location where the chloroform concentrations are below 4,000 ug/m<sup>3</sup>. For purposes of data comparison, sampling will be performed at up to nine residential properties as follows: i) up to three residential properties from the northern sampling area; ii) up to three residential properties from the southern sampling area; and iii) up to three residential properties west of the Target Indoor Air Sampling Areas but within the OU-2 BHRA Area. The homes in each of these areas will be surveyed to identify properties where disruption to residents can be minimized (i.e., use of vacant homes or rental properties) and those that would provide conditions representative of the housing stock in the sampling areas, considering such factors as construction types, foundation types, home age and size, and heating, ventilation, and air conditioning (HVAC) system design, etc. Based on this assessment, specific homeowners will be contacted by the Trust with a letter from NDEP, requesting access to perform the sampling.

### **Sampling Approach**

At each of the up to 6 residential properties identified for sampling within the Target Indoor Air Sampling Areas, and for which access has been granted by the property owner, samples will be collected for the following purposes:

- Indoor air samples will be collected to determine if chloroform is present in indoor air of a residence.
- Sub-slab air and ambient air samples will be collected to quantify the effect of ambient and indoor chemical sources on indoor air concentrations.

Adjacent to each of the up to 6 residential properties within the Target Indoor Air Sampling Areas and in public rights of way:

- Soil gas samples will be collected to model the indoor concentrations which will then be used as the basis for the comparative analysis required by NDEP.<sup>4</sup>

At each of the up to 3 residential properties west of the Target Indoor Air Sampling Areas but within the OU-2 BHRA Area, and for which access has been granted by the property owner, samples will be collected for the following purposes:

- Indoor air to assess the levels of chloroform from use of chlorinated municipal water, use of household products (e.g., household cleaning products), and resulting from sources of chloroform other than the subject groundwater plume.

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<sup>4</sup> If existing soil gas probes are not accessible for sampling in the public right-of-way immediately abutting the residential property, a shallow and a deep soil gas probe will be installed at a single location in the public right-of-way adjacent to the property.

- Ambient air to assess the effect of outdoor chemical sources on indoor air concentrations.

The sampling approach, including pre-sampling activities, for indoor air, ambient air, sub-slab air, and soil gas are discussed in the following subsections.

### **Indoor Air Sampling**

In the event a subject property is occupied, the following activities will be conducted at each property once it has been temporarily vacated by its residents or tenants.

#### **Pre- Indoor Air Sampling Activities**

- To provide an estimate of the concentrations of trihalomethanes that may be present in the water supplying the home, a water sample will be collected from the kitchen or bathroom inside the home and from a faucet/hose bib outside the home. This water sample will be analyzed for trihalomethanes using USEPA Method 524.2.
- A residential home survey will be conducted to document construction characteristics and identify the location of potential preferential pathways to the subsurface, such as sinks, floor drains, and other utility penetrations and document the typical HVAC system use and the potential for the HVAC system to influence migration from the subsurface to indoor air. As part of the residential home survey, potential indoor sources of chloroform from water use and household cleaning products will be identified and potentially reduced. In addition, water to the home will be turned off.

#### **Indoor Air Sampling Procedures**

The following indoor air sampling activities will be initiated no more than 24 hours after completion of the pre-indoor air sampling activities:

- Three samples of indoor air will be collected through a 24-hour sample period from the inside of each home at an approximate height of three to five feet. In addition, one duplicate sample will be collected at one of the locations. During sampling, regardless of occupancy, the HVAC system (if present) will be operated normally.
- All samples will be collected into 6-liter, stainless-steel Summa™ canisters individually certified clean for the target analytes. Each Summa canister will be equipped with a flow-controller set to the appropriate rate for a 24-hour sample period.
- Indoor air samples will be analyzed for target VOCs and trihalomethanes that could be present in treated water. The samples will be analyzed using USEPA Method TO-15 in selected ion monitoring (SIM) mode.

### **Ambient Air Sampling**

Upwind and downwind ambient air sampling locations will be selected at each residential property based on the residential home survey and predominant wind direction. Ambient air samples will be collected on the same day as indoor air samples.

### Ambient Air Sampling Procedures

- Two ambient air samples (approximately upwind and downwind) will be collected from outside the home within the property boundary simultaneously with the indoor air samples.
- All samples will be collected into 6-liter stainless-steel Summa canisters individually certified clean for the target analytes. Each Summa canister will be equipped with a flow-controller set to the appropriate rate for a 24-hour sample period.
- Ambient air samples will be analyzed for target VOCs and trihalomethanes that could be present in treated water. The samples will be analyzed using USEPA Method TO-15 in SIM mode.

### **Sub-Slab Sampling**

Up to two sub-slab sampling locations will be identified near the indoor air samples. These locations will be selected in areas where carpets are in-place such that the sampling activity will not impact the aesthetics of the home. If tile or similar hard surface floors are only present the sampling locations will be adjusted to the least possible conspicuous location. Where possible, samples will be located within closets or other similar inconspicuous locations. In any case, the locations will be approved by the homeowner before any penetrations of the slab occur.

### Sub-Slab Sampling Procedures<sup>5</sup>

The following sub-slab sampling activities will be initiated no more than 24 hours after completion of the indoor and ambient air sampling activities:

- After temporarily pulling back a corner of carpet (if applicable), a small-diameter hole, approximately 5/8-inch in diameter, will be drilled through the concrete of the foundation slab. Sub-slab holes will be advanced three to four inches into the fill below the slab. The vapor pin assembly (which includes a silicone sleeve) will be gently hammered into the drilled hole such that the silicone sleeve seals the annular space between the pin and slab. Following placement of the pin, the protective cap will be secured on to the pin to prevent vapor loss prior to sampling.
- Sub-slab utilities, such as water, sewer, and electrical, will be located by a subcontracted utility locator professional and temporarily marked on the slab prior to drilling (e.g., using masking tape). No permanent markings will be made on finished flooring surfaces.
- Vapor probes will be constructed of approximately 1/4-inch diameter tubing with a permeable probe tip.
- Sampling will be conducted at least two hours following installation of a probe to allow for the subsurface to equilibrate.
- All samples will be collected into 6-liter stainless-steel Summa™ canisters individually certified clean for the target analytes. Purging and sampling rates will not exceed 200 milliliters per minute.

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<sup>5</sup> It is assumed that all homes which will be sampled have slab-on-grade foundations.

- Sub-slab air samples will be analyzed for target VOCs and trihalomethanes that could be present in treated water. The samples will be analyzed using USEPA Method TO-15 in SIM mode.
- Following completion of sub-slab sampling, the small-diameter sample holes will be filled with hydraulic cement or grout of a similar color to the surrounding floor slab. Any affected carpet will be reattached. The flooring restoration will be coordinated with the homeowner to restore the floor surfaces to the homeowner's satisfaction.

### **Soil Gas Sampling**

As discussed above, soil gas samples will be collected at locations adjacent to each residential location sampled to model the indoor concentrations which will then be used as the basis for the comparative analysis required by NDEP. If an existing soil gas probe is not accessible for sampling in the public right-of-way immediately abutting the residential property, a new location will be identified within the public right-of-way adjacent to the property.

#### **Soil Gas Sampling Procedures**

- Soil gas samples will be collected using the procedures specified in RI Phase 2 Modification No. 11, approved by NDEP on June 21, 2018. Consistent with the data collection effort of RI Phase 2 Modification 11, the drilling and sampling methods to be used will follow those provided in the Phase 1 RI Field Sampling Work Plan.<sup>6</sup> Soil gas probes will be installed at 5 and 15 ft bgs.
- Soil gas samples will be analyzed for target VOCs and trihalomethanes using USEPA Method TO-15. Soil gas samples will be collected following indoor and ambient air sampling and on the same day as sub-slab sampling is performed.

### **Quality Assurance / Quality Control**

An addendum to the Quality Assurance Project Plan (QAPP), Revision 6 will be prepared to incorporate the analytical methods for indoor air, ambient air, and sub-slab sampling. The QAPP addendum will be submitted to NDEP for approval within 30 days of approval of this BHRA Work Plan.

### **Reporting**

Following data collection, the analytical data collected will be validated and incorporated into the NERT project database. A Technical Memorandum will be prepared presenting the analytical results associated with the proposed sampling.

### **Anticipated Schedule**

The schedule will depend on obtaining access to residential properties for sampling. However, Ramboll anticipates that sample collection can begin within 2 weeks of gaining access of a property.

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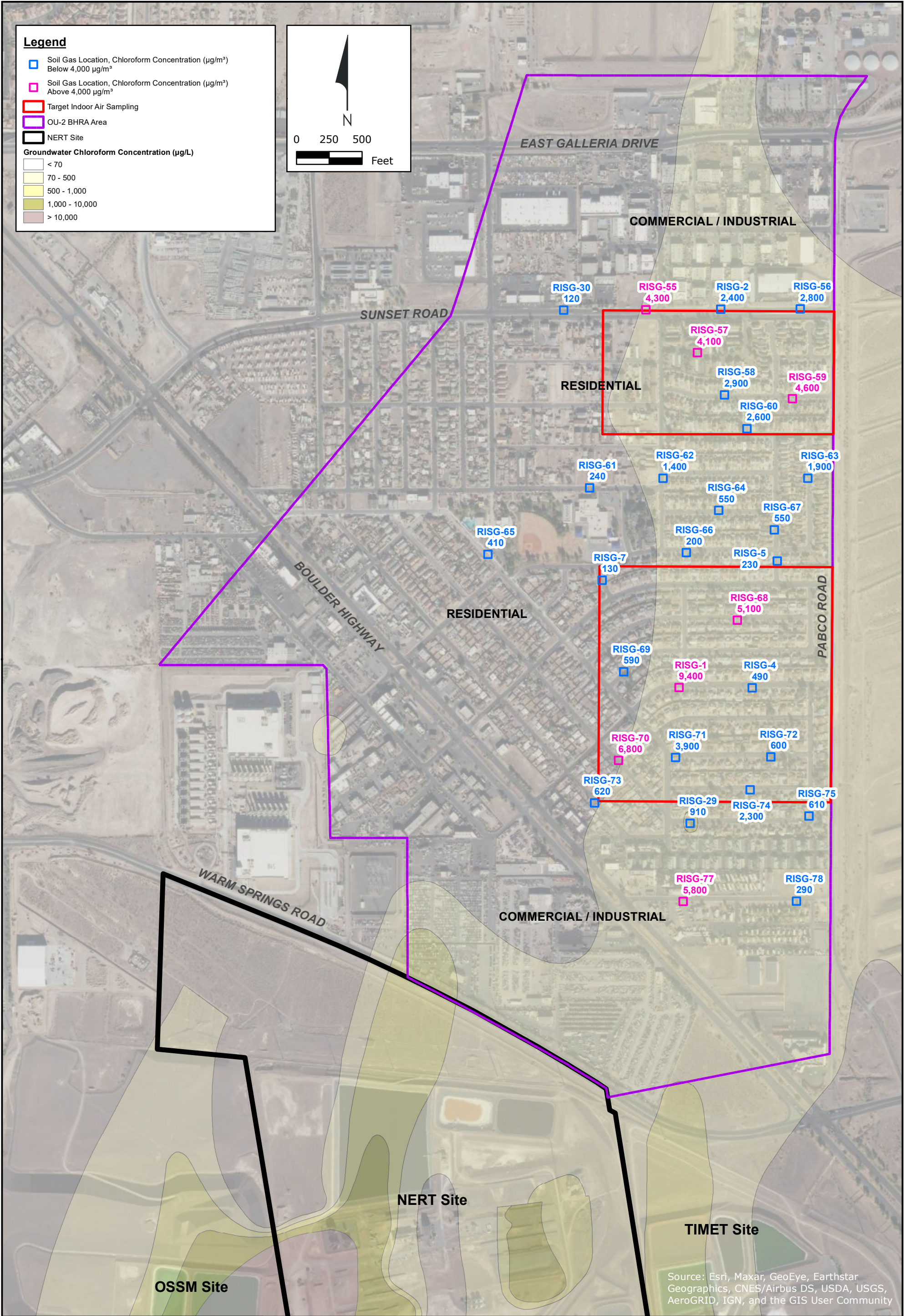
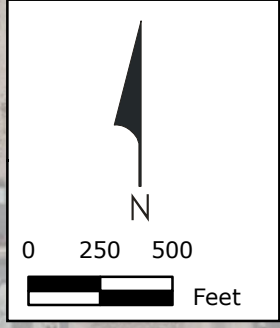
<sup>6</sup> ENVIRON. 2014. Field Sampling Plan, Revision 1, Nevada Environmental Response Trust Site, Henderson Nevada, July 18, 2014. NDEP approved August 1, 2014.

Please contact us should you have any questions about this Modification No. 1 of the BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater.



**Legend**

- Soil Gas Location, Chloroform Concentration ( $\mu\text{g}/\text{m}^3$ ) Below 4,000  $\mu\text{g}/\text{m}^3$
  - Soil Gas Location, Chloroform Concentration ( $\mu\text{g}/\text{m}^3$ ) Above 4,000  $\mu\text{g}/\text{m}^3$
  - Target Indoor Air Sampling
  - OU-2 BHRA Area
  - NERT Site
- Groundwater Chloroform Concentration ( $\mu\text{g}/\text{L}$ )**
- < 70
  - 70 - 500
  - 500 - 1,000
  - 1,000 - 10,000
  - > 10,000



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRAs\GIS\Figure 1 - Target Indoor Air Sampling Areas.mxd



**Target Indoor Air Sampling Areas and Soil Gas Concentrations (10-15 ft bgs)**  
 Nevada Environmental Response Trust Site  
 Henderson, Nevada

Figure  
**1**

Drafter: JC    Date: 2021-09-30    Contract Number: 1690020169-007    Approved by:    Revised:



**BHRA Work Plan for OU-1 and OU-2  
Soil Gas and Groundwater Modification #1 (Revision 1)**

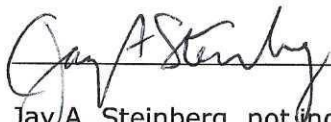
**Nevada Environmental Response Trust Site  
(Former Tronox LLC Site)  
Henderson, Nevada**

**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 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:**  Not Individually, but Solely  
as President of the 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:** 10/29/21

BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater Modification #1 (Revision 1)  
Nevada Environmental Response Trust Site  
Henderson, Nevada

**BHRA Work Plan for OU-1 and OU-2  
Soil Gas and Groundwater Modification #1 (Revision 1)**

**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 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.



**John M. Pekala, PG  
Principal**

October 29, 2021

**Date**

Certified Environmental Manager  
Ramboll US Consulting, Inc.  
CEM Certificate Number: 2347  
CEM Expiration Date: September 20, 2022