RAMBOLL

ENVIRONMENT
& HEALTH

August 29, 2022

## TECHNICAL MEMORANDUM

To: Steve Clough
Nevada Environmental Response Trust

From: Beth Richter, Chris Stubbs, and Elizabeth Miesner, Ramboll

**Re: OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**
**Ramboll Project No. 1690025040-011**

This Technical Memorandum presents the results of an indoor air sampling program conducted at the direction of the Nevada Division of Environmental Protection (NDEP) to evaluate potential vapor migration of chloroform from groundwater to indoor air within the eastern portion of the Pittman Neighborhood, located in Henderson, Nevada. The sampling was conducted on behalf of the Nevada Environmental Response Trust (NERT). The indoor air results for chloroform were compared to the health-based screening level threshold of 12 micrograms per cubic meter ($\mu g/m^3$) to confirm that the vapor intrusion risk to residents is within the United States Environmental Protection Agency's (USEPA's) acceptable risk range. The data demonstrate the validity of the modeled results as presented in the BHRA for OU-2 Soil Gas and Groundwater (Ramboll 2021a) and that there is no unacceptable human health risk due to vapor intrusion associated with the groundwater plume in the Pittman Neighborhood.

The indoor air sampling program was implemented consistent with Modification No. 1 to the Baseline Health Risk Assessment (BHRA) Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Revision 1 (the "BHRA Work Plan"). This Technical Memorandum includes the following:

- Identification of target sample areas,
- Selection of homes to sample,
- Description of field investigation methodology, and
- Summary of sample results compared to background, health-based screening levels and model predicted indoor air concentrations.

### BACKGROUND

NERT is currently completing a Remedial Investigation and Feasibility Study (RI/FS) of 5,200 acres in Henderson, Nevada, which is broken down into three Operable Units (OUs). OU-1 consists primarily of the property used by Kerr-McGee Chemical Corporation and Tronox, LLC for historical manufacturing activities. OU-2 comprises the Eastside Sub-Area to the east of Pabco Road and the southern portion of the NERT Off-Site Study Area to the west of Pabco Road, and OU-3 is located to the north of OU-2. (See Figure 1). Chemicals

present in groundwater in OU-1 have migrated offsite beneath portions of OU-2. The NERT Off-Site Study Area in OU-2 is primarily residential, known as the Pittman Neighborhood, with commercial operations adjacent to major roadways.

The BHRA Work Plan Revision 1, prepared by Ramboll US Consulting, Inc. (Ramboll) in 2018, presented the methodology for evaluating potential human health risks due to the migration of volatile chemicals present in groundwater to indoor and outdoor air. The Work Plan proposed evaluating the potential health risks using OU-2 soil gas and groundwater data and the most recent version of the USEPA's Johnson and Ettinger (J&E) model spreadsheet to estimate indoor air concentrations. NDEP approved the BHRA Work Plan on January 24, 2019.

Using the approach in the NDEP-approved Work Plan, estimates of vapor intrusion risk for OU-2 were determined by estimating indoor air concentrations from OU-2 soil gas and groundwater data using the J&E model (USEPA 2017). The results of this evaluation were reported in the BHRA for OU-2 Soil Gas and Groundwater, dated July 23, 2021 (the "BHRA Report"; Ramboll 2021a), which is currently under NDEP review. While soil gas and groundwater 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 calculating the partitioning between water and soil gas is not necessary. As reported in the BHRA Report, the maximum estimated excess lifetime cancer risk for indoor residential air based on modeling from the RI soil gas data was at $2 \times 10^{-5}$, which is within the acceptable risk range of $10^{-4}$ to $10^{-6}$. The estimated noncancer hazard indices (HI) were well below the threshold of 1. The BHRA Report indicated that the major chemical contributor to risk associated with vapor intrusion (>90%) was chloroform (Ramboll 2021a).

On September 8, 2021, NERT received a letter from NDEP (the "NDEP Letter") requiring NERT to modify the approved BHRA Work Plan to include a targeted indoor air sampling investigation of chloroform in areas of OU-2 with elevated soil gas and groundwater concentrations within the eastern portion of the Pittman Neighborhood. In the NDEP Letter, NERT was required 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, NERT was directed to compare the indoor air results of chloroform to the health-based screening level threshold of 12 $\mu g/m^3$, as defined in the USEPA letter (the "USEPA Letter") attached to the NDEP Letter to confirm that the vapor intrusion risk to residents is within the USEPA's acceptable risk range.

In response to the NDEP Letter, NERT prepared Modification No. 1 to the BHRA Work Plan Revision 1, dated October 29, 2021 (the "BHRA Modification"; Ramboll 2021b), which was approved by NDEP on November 10, 2021. Implementation of the BHRA Modification began immediately following the "Pittman Indoor Air Sampling Virtual Community Information Meeting" hosted by NDEP on December 9, 2021.

**IDENTIFICATION OF TARGET SAMPLING AREAS**

Consistent with the USEPA Letter, "Target 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 µg/m$^3$. The two areas identified for sampling are shown with red outlines in Figure 2. As shown in Figure 2, the two Targeted Indoor Air Sampling Areas encompass two groups of soil gas locations within residential areas where chloroform concentrations at 10 to 15 feet below ground surface (bgs) were greater than 4,000 µg/m$^3$ and generally extend outwards to the next sampling location where the chloroform concentrations are below 4,000 µg/m$^3$. The two areas are referred to as the northern sampling area and the southern sampling area.

For purposes of data comparison, the BHRA Modification specified sampling for 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, referred to as the background sampling area.

In order to determine representative housing stock in the sampling areas, information was reviewed from the Clark County Assessor's Office[1] parcel database for homes in the Pittman Neighborhood. Information in the parcel database relevant to housing stock included:

- Type Description (one-story, split level, two story, etc.)
- Construction year
- House square footage
- Parcel square footage
- Number of bedrooms
- Number of bathrooms
- Pool/hot tub (yes/no)
- Basement (yes/no)

Because many pools/hot tubs use chlorine, which can be an ambient source of chloroform, homes were designated in the following categories (pool here refers to pool or hot tub):

- Category 1: Has a pool
- Category 2: Shares a boundary with a parcel with a pool
- Category 3: Shares a corner with a parcel with a pool
- Category 4: Does not have a pool or share a boundary or corner with a parcel with a pool

Only Category 4 homes were targeted for sampling.

[1] The parcel database used for the evaluation is from October 2021. The most current up-to-date version can be seen on the Clark County website: https://maps.clarkcountynv.gov/ow/?@828360,26734205,5

## SELECTION OF SAMPLING LOCATIONS

Selection of homes in the northern and southern sampling areas was based upon proximity to soil gas locations RISG-59 and RISG-1, respectively, which had the highest chloroform results (>4,000 µg/m$^3$ at 15 ft bgs) from the November 2019 soil gas sampling event. The homes in the background sampling area were selected near soil gas location RISG-65, which had chloroform results from the November 2019 sampling event almost 10 times below the targeted areas. Contacting and identifying interested homeowners was an iterative process completed over the course of approximately five months. Ultimately, seven interested property owners were identified and sampling activities at all seven locations were completed between late March and May 2022, as shown in the table below.

| SAMPLING AREA | SAMPLE LOCATIONS[2] | ADJACENT SOIL GAS PROBE AND NOVEMBER 2019 CHLOROFORM CONCENTRATION |
|---|---|---|
| North | H5<br>H13 | RISG-59<br>4,600 µg/m$^3$ |
| South | H1<br>H2<br>H3 | RISG-1<br>9,400 µg/m$^3$ |
| Background | H6<br>H7 | RISG-65<br>410 µg/m$^3$ |

## FIELD INVESTIGATION METHODOLOGY

At each residential property identified for sampling within the Target Indoor Air Sampling Areas, samples were collected for the following purposes:

- Indoor air samples were collected to determine if chloroform and other target VOCs are present in indoor air of a residence.
- Sub-slab air and ambient air samples were collected to quantify the effect of ambient and indoor chemical sources on indoor air concentrations.

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

- Soil gas samples were collected to model the indoor air concentrations to use as the basis for the comparative analysis directed in the USEPA Letter.

At each residential property identified within the background sampling area, samples were collected for the following purposes:

[2] A total of 27 homes (H1 through H27) were targeted for sampling. Of these homes, the seven listed ultimately agreed to the sampling program.

- Indoor air samples were collected 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.
- Ambient air samples were collected to assess the effect of outdoor chemical sources on indoor air concentrations.

At all properties, tap water samples were collected to determine the presence of trihalomethanes, including chloroform.

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 and Ambient Air Sampling**

**Pre-Indoor Air Sampling Activities**

Prior to collecting indoor air samples, the following activities were completed:

- A residential home survey was 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. As part of the residential home survey, potential indoor sources of chloroform, such as household cleaning products or solvents were identified and asked to be removed from the home. The air and vapors were field screened for total organic vapors using a calibrated photoionization detector (PID).
- To provide an estimate of the concentrations of trihalomethanes that may be present in the water supply to the home, a water sample was collected from the kitchen or bathroom inside the home and from a faucet/hose bib outside the home.
- Prior to sampling, the valve at each location was fully opened for at least three minutes. The kitchen sink was run and sampled using cold water. If a hose was attached to the exterior spigot, the hose was removed, or water was run through the hose for an additional 5 seconds. The water samples collected during the investigation were submitted following standard chain of custody procedures to Eurofins Test America for laboratory analyses of trihalomethanes following USEPA Method 524.2.
- After water sample collection was complete and approximately 12 to 24 hours prior to the start of indoor air sampling, the water supply to the house was turned off at the street valve and the remaining water was drained from all exterior and interior locations (i.e., spigots, faucets, showers, etc.). All interior drains (i.e., sinks, showers, toilets, etc.) were flushed with deionized water. Approximately 0.5-1 gallon of water was used for each sink and shower drain. The toilets were fully flushed of original water and deionized water was used to fill the tank. At each toilet several tank fills and flushes were completed to ensure the removal of all municipal water. Approximately 2.5-3 gallons of water was used to flush each toilet.

**Indoor Air Sampling Procedures**

The following indoor air sampling activities were initiated no more than 24 hours after completion of the pre-indoor air sampling activities as described above and after the residents of the home had relocated for the duration of the sampling program:

Three samples of indoor air were collected over a 24-hour sample period from the inside of each home at an approximate height of three to five feet. The three target locations in each home were:

- a primary living space, such as the living room area,
- an area with drains/pipes present through the slab, such as a bathroom or kitchen, and
- a secondary living space, such as a bedroom or office.

A quality assurance/quality control (QA/QC) duplicate sample was paired with the drain-area sample location. The doors to the bathroom and bedroom were closed where samples were placed. During sampling, the HVAC system (if present) was operated normally as it would be by the homeowner for the time of year.

**Ambient Air Sampling**

Two outdoor ambient air samples were collected at each residence to evaluate the air quality surrounding the property. To the extent practical, one outdoor air sample was placed in an upwind location, and one was placed in a downwind location. Ambient air samples were collected concurrently with indoor air samples.

**Air Sampling Analytical Procedures**

All indoor and ambient air samples were collected into 6-liter, stainless-steel Summa™ canisters individually certified clean for the target analytes. Each canister was equipped with a flow-controller set to the appropriate rate for a 24-hour sample period.

The air canisters were checked multiple times throughout the day to confirm appropriate pressure drop. Indoor and ambient air samples were retrieved after a 24-hour sampling period. Indoor and ambient air samples were submitted to Eurofins Air Toxics of Folsom, California for analysis of target VOCs (chloroform, carbon tetrachloride, trichloroethene, tetrachloroethene)[3] and trihalomethanes (bromodichloromethane, dibromochloromethane, bromoform) using USEPA Method TO-15 in SIM mode.

**Sub-Slab Sampling**

For homes located in the north and south target sampling areas, two sub-slab sampling locations were identified. The sub-slab vapor sampling locations were selected to be near the center of the residence or garage and away from exterior walls to the extent

[3] As stated in the BHRA Modification, in order to perform the comparative analysis with the BHRA modeling results, all samples collected were 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. The 85% detection frequency threshold was selected to include the chlorinated hydrocarbons with relatively higher median detected concentrations of at least 10 µg/m$^3$, because these chemicals would be relatively more likely to be detected in both soil gas and indoor air.

practicable. The sample locations were spaced to be representative of vapors beneath separate areas of the residence. In all cases, the locations were approved by the homeowner before any penetrations of the slab occurred.

Sub-slab utilities, such as water, sewer, and electrical, were located by a subcontracted utility location professional and temporarily marked on the slab prior to drilling (e.g., using masking tape).

**Sub-Slab Sampling Procedures**

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

- A licensed driller, BC2 Environmental, was contracted to drill and install the sub-slab sample points. To facilitate collection of sub-slab vapor samples from just beneath the concrete slab floor, Vapor Pins™ sub-slab vapor sampling probes were installed at the selected and preapproved locations. After temporarily pulling back a corner of carpet (if applicable), the Vapor Pin was installed by drilling a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void, inserting the lower end of the Vapor Pin assembly into the drilled hole, and driving the Vapor Pin into the hole. The lower end of the Vapor Pin consists of a barbed end fitted with a silicone sleeve that creates an airtight seal when inserted into the concrete. The vapor pin assembly, consisting of a barbed end fitted with a silicone sleeve, was gently hammered into the drilled hole such that the silicone sleeve seals the annular space between the pin and slab and a protective cap was secured on to the pin to prevent vapor loss prior to sampling.
- Vapor probes were constructed of 1/4-inch diameter tubing with a permeable probe tip.
- Sampling was conducted at least two hours following installation of a probe to allow for the subsurface to equilibrate.
- When the sub-slab sampling activities were complete, the entire Vapor Pin assembly was removed, and the hole was filled with hydraulic cement and topped with a quick setting epoxy. Flooring repairs to indoor locations (i.e., reattachment of carpet) was completed by a qualified contractor, as needed.

**Sub-Slab Sampling Analytical Procedures**

All samples were collected into 6-liter stainless-steel Summa™ canisters individually certified clean for the target analytes. Purging and sampling rates did not exceed 200 milliliters per minute.

Sub-slab air samples were submitted to Eurofins Air Toxics of Folsom, California for analysis of target VOCs (chloroform, carbon tetrachloride, trichloroethene, tetrachloroethene) and trihalomethanes (bromodichloromethane, dibromochloromethane, bromoform) using USEPA Method TO-15 in SIM mode.

## Soil Gas Sampling

As indicated above, soil gas samples were collected at locations within the public right-of-way adjacent to each residential location within the Target Indoor Air Sampling Areas. The soil gas probes were installed a minimum of approximately 48 hours prior to sampling to allow for the subsurface to equilibrate. Soil gas samples were collected following indoor and ambient air sampling and on the same day as sub-slab sampling was performed.

### Soil Gas Sampling Procedures

The following sampling procedures were implemented for the collection of soil gas samples:

- Soil gas samples were 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 No. 11, the drilling and sampling methods used followed those provided in the Phase 1 RI Field Sampling Work Plan (ENVIRON 2014). Sample collection was completed consistent with prior soil gas sampling in OU-2. Soil gas probes were installed at 5 and 15 ft bgs.
- Prior to soil gas sample collection, a QA/QC shut-in test and sampling was conducted utilizing a helium shroud. The shut-in test verified the sampling train was leak-free. The helium shroud signified no leaks were present in the sampling train. The helium shroud was filled approximately 15-20% with helium and maintained throughout purging and sampling by monitoring with a helium detector. Several samples were collected to confirm that helium was not pulled downhole into the soil gas probe.

### Soil Gas Analytical Procedures

Soil gas samples were submitted to Eurofins Air Toxics of Folsom, California for analysis of target VOCs (chloroform, carbon tetrachloride, trichloroethene, tetrachloroethene) and trihalomethanes (bromodichloromethane, dibromochloromethane, bromoform) using USEPA Method TO-15 in SIM mode.

## Quality Assurance / Quality Control

The November 16, 2021 addendum to the Quality Assurance Project Plan (QAPP), Revision 6 (Ramboll 2021a) was prepared to incorporate the analytical methods for indoor air, ambient air, and sub-slab sampling. The QAPP addendum was submitted to NDEP and approved on December 8, 2021. All field investigations conducted through the implementation of the BHRA Modification were performed consistent with the QAPP.

## Data Validation and Management

The analytical laboratory data packages were submitted to LDC, Inc. for data validation. Data validation was completed in accordance with the QAPP, Revision 6 consistent with prior data collected as part of the Remedial Investigation of OU-2. A Data Validation Summary Report (DVSR) and associated Electronic Data Deliverable (EDD) is under preparation and will be submitted to NDEP upon completion.

## CHLOROFORM INDOOR AIR AND SOIL GAS SAMPLING RESULTS AND EVALUATION

The chloroform sampling results for each home are shown on Table 1. Consistent with the BHRA Modification, the indoor air results for chloroform were compared to a threshold of 12 µg/m$^3$ as defined in the USEPA Letter. The analytical results associated with other VOCs that were analyzed, as well as the evaluation of human health risk, will be presented in the revised BHRA for OU-2 Soil Gas and Groundwater following receipt of NDEP's comments on the report.

The measured indoor air results for chloroform were:

- Background area measured indoor air concentrations ranged from 0.40 to 1.1 µg/m$^3$.
- Target area measured indoor air concentrations ranged from 0.31 to 3.4 µg/m$^3$.

The measured soil gas sample results are also shown in Table 1 for homes in the Target Indoor Air Sampling Areas. All soil gas results show lower concentrations than the November 2019 soil gas sampling event.

Table 2 compares the model predicted chloroform indoor air concentrations to the measured concentrations. The predicted concentrations were calculated by multiplying the measured soil gas concentrations at 5 and 15 feet bgs (as listed in Table 1) by the corresponding soil gas-to-indoor air attenuation factors previously calculated in the BHRA Report. As described in the BHRA Report, the attenuation factors representing the ratio between indoor air concentrations and soil gas concentrations were calculated using the J&E model (USEPA 2017) based on site-specific soil parameters. The previously modeled attenuation factors for soil gas at 5 and 15 ft bgs are also included in Table 2.

Indoor air concentrations were calculated as the product of measured soil gas concentrations and the previously modeled attenuation factor for that soil gas depth. Since the J&E model does not account for indoor or ambient sources of chloroform, the range of predicted indoor air concentrations for each house was calculated by adding the range of chloroform concentrations found in the indoor air of background area houses to the modeled indoor air concentrations.

## CONCLUSIONS

In September 2021, NDEP directed NERT to modify the approved BHRA Work Plan to include a targeted indoor air investigation of chloroform in residential areas of OU-2 with elevated soil gas and groundwater concentrations within the eastern portion of the Pittman Neighborhood. Consistent with the requirements of the NDEP request, NERT prepared and submitted Modification No. 1 to the BHRA Work Plan Revision 1 (Ramboll 2021b) which was approved by NDEP on November 10, 2021. Subsequent to NDEP hosting a public meeting, seven properties were identified with owners willing to participate in the program. The field implementation of the BHRA Modification was completed between late March and May 2022.

The indoor air results for chloroform were compared to the threshold of 12 µg/m$^3$ as defined in the USEPA Letter to confirm that the vapor intrusion risk to residents is within the USEPA's acceptable risk range. The concentrations of chloroform in indoor air within the

seven houses sampled in the Pittman Neighborhood were well below the screening level of 12 µg/$m^3$.

All other data collected through the implementation of the BHRA Modification will be presented in the revised BHRA for OU-2 Soil Gas and Groundwater once comments have been received from NDEP.

## REFERENCES

ENVIRON (ENVIRON International Corporation). 2014. Field Sampling Plan, Revision 1, Nevada Environmental Response Trust Site, Henderson, Nevada. July 18. NDEP approved August 1, 2014.

NDEP (Nevada Division of Environmental Protection). 2020. NDEP Basic Comparison Levels. August.

NDEP. 2021. Nevada Division of Environmental Protection Response to: Quality Assurance Project Plan Addendum: BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater Modification #1. Nevada Environmental Response Trust Site, Henderson, Nevada. December 8.

Ramboll (Ramboll US Consulting, Inc). 2018. Baseline Health Risk Assessment Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Revision 1. December 18. NDEP approved January 24, 2019.

Ramboll. 2021a. Quality Assurance Project Plan, Revision 6. Nevada Environmental Response Trust Site, Henderson, Nevada. Revised February 24, 2021.

Ramboll. 2021a. Baseline Health Risk Assessment for OU-1 and OU-2 Soil Gas and Groundwater. Nevada Environmental Response Trust Site, Henderson, Nevada. Revised July 23.

Ramboll. 2021b. BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Modification #1 (Revision 1). Nevada Environmental Response Trust Site, Henderson, Nevada. Revised October 29.

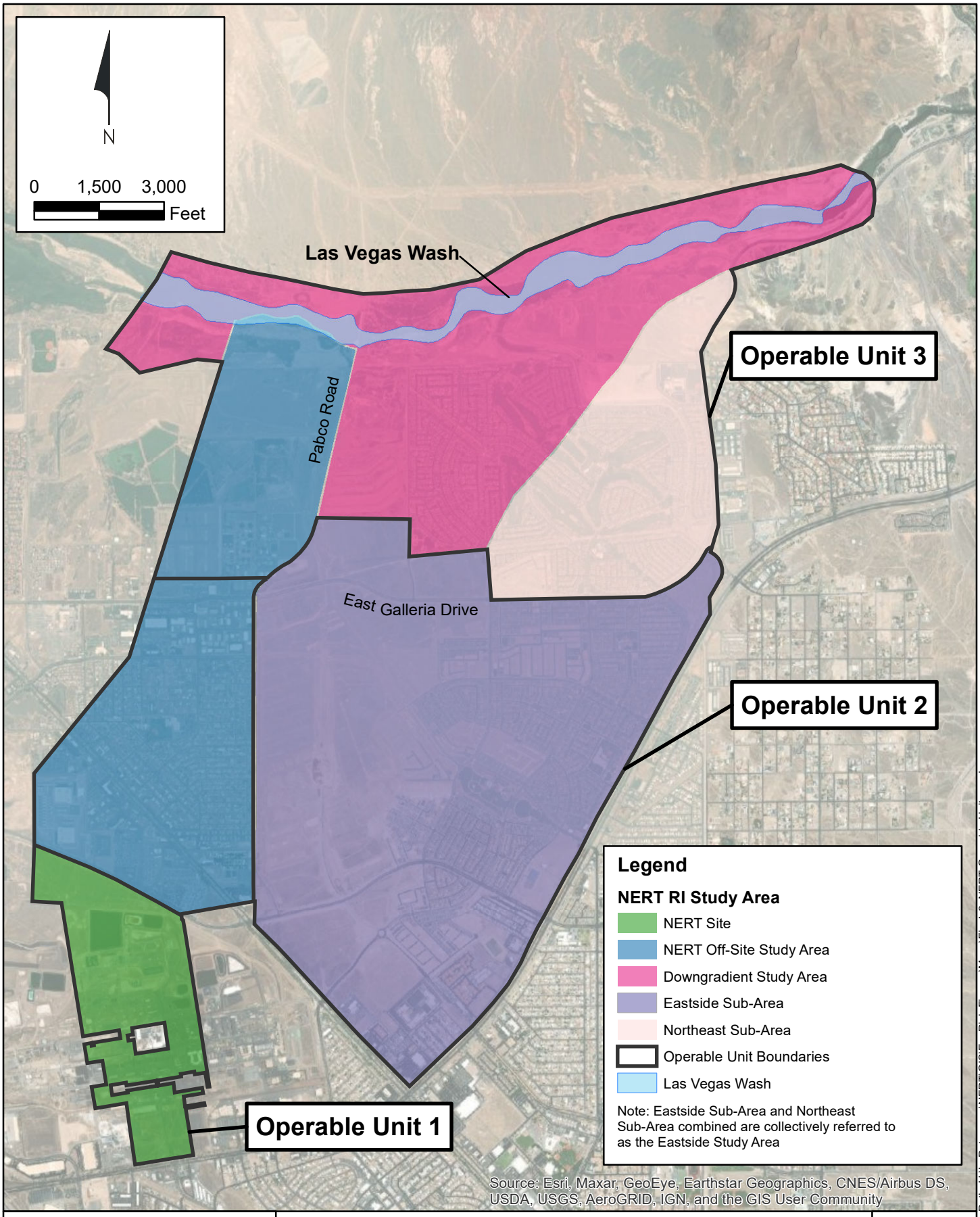
Ramboll. 2021c. Quality Assurance Project Plan Addendum, Modification #1 (Revision 1). Nevada Environmental Response Trust Site, Henderson, Nevada. Revised November 16.

USEPA (United States Environmental Protection Agency). 2017. EPA Spreadsheet Modeling Subsurface Vapor Intrusion. Version 6. September.

## ATTACHMENTS

Table 1 and 2

Figure 1 and 2




Path: H:\LePetomane\NERT\GIS\EcoRisk Figures\Maps\Fig 1-2. NERT Operable Units.mxd

RAMBOLL

**NERT Operable Units and RI Study Areas**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure 1

Drafter: RS Date: 8/16/2022 Contract Number: 1690011200-032 Approved by: Revised:

## Legend

- Soil Gas Location, Chloroform Concentration (µg/m³) Below 4,000 µg/m³
- Soil Gas Location, Chloroform Concentration (µg/m³) Above 4,000 µg/m³
- Target Indoor Air Sampling
- OU-2 BHRA Area
- NERT Site

**November 2019 Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

N

0 250 500

Feet

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

COMMERCIAL / INDUSTRIAL

RESIDENTIAL

RESIDENTIAL

COMMERCIAL / INDUSTRIAL

NERT Site

TIMET Site

OSSM Site

RISG-30 120
RISG-55 4,300
RISG-2 2,400
RISG-56 2,800
RISG-57 4,100
RISG-58 2,900
RISG-59 4,600
RISG-60 2,600
RISG-61 240
RISG-62 1,400
RISG-63 1,900
RISG-64 550
RISG-67 550
RISG-65 410
RISG-66 200
RISG-7 130
RISG-5 230
RISG-68 5,100
RISG-69 590
RISG-1 9,400
RISG-4 490
RISG-70 6,800
RISG-71 3,900
RISG-72 600
RISG-73 620
RISG-29 910
RISG-74 2,300
RISG-75 610
RISG-77 5,800
RISG-78 290



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

RAMBOLL

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

Figure 2

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

**Table 1. Chloroform Sampling Results Summary**

| Chloroform | | H1 (South) | H2 (South) | H3 (South) | H5 (North) | H6 (Background) | H7 (Background) | H13 (North) |
|---|---|---|---|---|---|---|---|---|
| Residential Air Health-based Screening Level (µg/m$^3$) [1] | | 12 | | | | | | |
| Indoor Air Samples (µg/m$^3$) | IA1 | 2.2 | 0.50 | 3.0 | 0.43 | 0.40 | 0.72 | 0.31 |
| | IA2 | 3.4 | 0.99 | 3.3 | 0.47 | 0.40 | 1.0 | 0.41 |
| | IA2-FD | 3.4 | 0.96 | 3.4 | 0.47 | 0.41 | 1.1 | 0.47 |
| | IA3 | 2.5 | 0.72 | 3.0 | 0.54 | 0.40 | 0.73 | 0.31 |
| Soil Gas Samples (µg/m$^3$) | SG-5 | 3,800 | 440 | 2,200 | 410 | -- | -- | 280 |
| | SG-15 | 5,600 | 760 | 3,600 | 650 | -- | -- | 560 |

**Notes:**

-- = Not applicable

µg/m$^3$ = microgram per cubic meter

[1] As directed by USEPA, chloroform is compared to the health-based screening level of 12 µg/m$^3$ (USEPA 2020).

**Source:**

USEPA. 2020. Letter from Nicole Moutoux/USEPA to James Dotchin/NDEP. Re: Justification for Focused Indoor Air Investigation for Chloroform at Nevada Environmenal Response Trust Site, Operable Unit 2. September 11.

**Table 2. Comparison of Predicted and Measured Concentrations of Chloroform in Indoor Air**
**Northern and Southern Sampling Areas**

| | H1 | H2 | H3 | H5 | H13 |
|---|---|---|---|---|---|
| Measured indoor air concentration in background area houses (µg/m$^3$) | 0.40 - 1.1 | | | | |
| Model attenuation factor for soil gas at 5 ft bgs [1] | 4.74E-04 | | | | |
| Model attenuation factor for soil gas at 15 ft bgs [1] | 1.43E-04 | | | | |
| Predicted indoor air concentration (µg/m$^3$) [2] | 1.2 - 2.9 | 0.51 - 1.3 | 0.91 - 2.1 | 0.49 - 1.3 | 0.48 - 1.2 |
| Measured indoor air concentration (µg/m$^3$) | 2.2 - 3.4 | 0.50 - 1.0 | 3.0 - 3.4 | 0.43 - 0.5 | 0.31 - 0.47 |

**Notes:**

[1] Calculated using the Johnson and Ettinger model (USEPA 2017) based on parameters described in Ramboll (2021).

[2] Calculated by adding the background area house concentration to the product of the attenuation factor and measured soil gas concentration.

**Sources:**

Ramboll. 2021. Baseline Health Risk Assessment for OU-2 Soil Gas and Groundwater. July 23.

USEPA . 2017. EPA Spreadsheet Modeling Subsurface Vapor Intrusion. Version 6.0. September.

# OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum
## 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:** Jay A Steinberg 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:** 8/29/22

# OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum
## 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.

Kimberly Kuwabara

**Kimberly Kuwabara, M.S.**
**Senior Managing Consultant**

August 29, 2022
**Date**

Nevada Certified Environmental Manager
Ramboll US Consulting, Inc.
CEM Certificate Number: 2353
CEM Expiration Date: March 20, 2023