ecology and environment, inc.
International Specialists in the Environment
1940 Webster Street, Suite 100
Oakland, California 94612
Tel: (510) 893-6700, Fax: (510) 550-2760

August 6, 2012

Maggie Waldon, Federal On-Scene Coordinator
United States Environmental Protection Agency
Region 9, Emergency Response Section
75 Hawthorne Street
San Francisco, CA 94105

Subject: **April 2012 Cove Transfer Station 1 (TS1) Field Assessment; Addendum Letter Report to the *Cove Transfer Station Sites 1 and 2 Abandoned Uranium Mine Waste Removal Assessment Report; Cove, Apache County, Arizona; February 2012.***
TDD No.: TO2-09-11-10-0002; Project No.: EE-002693-2162

1.0 ADDENDUM SUMMARY

The Ecology and Environment, Inc. (E&E) Superfund Technical Assessment and Response Team (START) has been directed by the United States Environmental Protection Agency (U.S. EPA) to collect additional environmental data required to address critical data gaps identified during the November 2011 Cove Transfer Station 1 (TS1) Removal Assessment (RA).

Based on the conclusions from data collected at TS1 during November 2011, the U.S. EPA and START identified two critical data gaps that did not allow for complete assessment of site conditions at TS1. The following data gaps were identified from the November 2011 RA at TS1:

Data Gap 1: Scans of surface gamma radiation in soil above the site-specific Derived Concentration Guidance Level (DCGL) of 2 picocuries per gram (pCi/g) should be extended to the north, west, south and east of the November 2011 RA proposed excavation boundary to delineate elevated gamma activity concentrations in additional areas that may be susceptible to surface runoff and/or airborne deposition of residual uranium-bearing ore.

Data Gap 2: Interior gamma radiation dose rates should be determined from within the residence located on site at TS1 in order to completely identify all potential human health risks from exposure to uranium-bearing ore.

In order to further evaluate these data gaps, the U.S. EPA and START performed a subsequent field assessment at TS1 between April 17 and 19, 2012. This report is intended to serve as an addendum to the *Cove Transfer Station Sites 1 and 2 Abandoned Uranium Mine Removal Assessment Report, Cove, Apache County, Arizona* (E&E,

2012a), and documents the data collected at TS1 during April 2012.

The data collected at TS1 during April 2012 are provided in this addendum under Appendix A as Figure 2a Surface Gamma Activity and Excavation Boundaries; and, Figure 2b Residential Radiation Survey. A data summary table for the residential interior dose rate measurements and background dose rate measurements is provided under Appendix B as Table 1.

2.0 APRIL 2012 TS1 FIELD ASSESSMENT

The April 2012 TS1 field assessment was performed in accordance with the *Time-Critical Quality Assurance Sampling Plan (QASP) for Cove Transfer Stations 1 & 2 Abandoned Uranium Mine Waste, Radiation Removal Assessment and Sampling,* dated November 2011 (E&E, 2011); and *Time-Critical Quality Assurance Sampling Plan (QASP) for Cove Transfer Station 1, Residential Radiation Monitoring,* dated April 2012 (E&E, 2012b).

The following project objectives were completed at TS1 during April 2012 to address critical data gaps required for site characterization:

1. Surface gamma activity scans were extended to the north, east, south, and west of the November 2011 RA excavation boundary to further delineate the lateral ground surface boundary where radium-226 (Ra-226) concentrations are elevated above the site-specific DCGL of 2.0 pCi/g.

2. Interior gamma radiation dose rate measurements were collected from within the residence to determine whether or not the excess annual gamma radiation dose rates above background exceed the U.S. EPA-established excess cancer risk dose rate of 15 milliRoentgen equivalent man per year (mrem/yr).

3. Interior gamma activity scan measurements were collected from 100 percent of accessible floor space to determine if the residence foundation, flooring, or materials under the foundation are impacted by residual uranium-bearing ore at TS1.

4. Background concentrations were re-evaluated, from the same location as the November 2011 RA, in order to calculate the background gamma radiation dose rates and to provide quality control of the utilized gamma activity scan instruments.

The following sections document the additional April 2012 TS1 field assessment activities and the data collected. Photographs documenting the April 2012 field assessment are provided as Appendix C.

3.0 SURFACE GAMMA ACTIVITY SCAN

Between April 18 and 19, 2012, START completed an additional surface gamma activity scan at TS1 to further delineate the lateral ground surface boundary where Ra-226 concentrations are elevated above the site-specific DCGL of 2.0 pCi/g. The April 2012 surface gamma activity scan was performed in accordance with the site QASP (E&E, 2011). START performed the April 2012 surface gamma activity scan by utilizing the

U.S. EPA Rapid Assessment Tool (RAT) software, a Trimble® Geo XT global positioning system (GPS) unit, and a Ludlum® Model 2241 ratemeter and detector model 44-20 (s/n 198223) with 3-inch x 3-inch sodium iodide gamma scintillator (s/n 18BR9) (Ludlum 3x3) to identify additional excavation areas. During both the November 2011 and April 2012 TS1 field assessments all gamma activity scan measurements were collected utilizing the same Ludlum 3x3 instrument in order to provide a consistent correlation between gamma activity scan measurements and Ra-226 soil concentrations. Therefore, all surface gamma activity measurements collected from the Ludlum 3x3 during this April 2012 field assessment were correlated to the linear regression analysis data collected during the November 2011 RA comparing Ra-226 soil concentrations <10 pCi/g to one-minute surface gamma activity counts (E&E, 2012a; Section 4.5 and Figure 7).

START performed the April 2012 surface gamma activity scan by extending outwards to the north, east, south and west from the previously identified excavation boundary (E&E, 2012a). All surface gamma activity scan measurements were collected from approximately 6 inches above the ground surface. While performing the gamma activity scan, START personnel utilized RAT software and a portable laptop to display the previously identified excavation boundary (E&E, 2012a), which allowed the surveyor to extend outwards from this boundary by observing real-time color-coded dots on a laptop; the colors and threshold values for each color were programmed into the RAT software prior to the gamma activity scan. Green indicated that the gamma radiation measurement was below the DCGL (< 2 pCi/g), yellow indicated that the gamma radiation measurement was slightly elevated above the DCGL up to two times the DCGL (2.1 to 4.0 pCi/g), red indicated that the gamma radiation measurement was elevated from two times above the DCGL up to five times above the DCGL (4.1 to 10.0 pCi/g), and purple indicated that the gamma radiation measurement was greater than five times the DCGL (>10.1 pCi/g). Once the surveyor observed consecutive gamma activity measurements below the DCGL (2 pCi/g) in the direction of delineation (i.e., north), a stake was set as the extent of delineation in that direction, and recorded with a GPS unit.

Based on the additional gamma activity scan data collected at TS1 during April 2012, the estimated removal boundary of soil impacted by abandoned uranium mine waste above the DCGL of 2 pCi/g is approximately 339,087 square feet, with an estimated average depth of 1 foot below ground surface. The estimated volume of soil that will need to be removed from TS1 is approximately 12,559 cubic yards. The April 2012 gamma activity scan data and estimated removal boundaries for TS1 are presented as Figure 2a (Appendix A).

4.0 RESIDENTIAL GAMMA RADIATION SURVEY

On April 17, 2012, the U.S. EPA, Navajo Nation Environmental Protection Agency, and START personnel met with the residence property owner located within the site boundary of TS1. At this time Federal On-scene Coordinator Maggie Waldon received permission from the property owner to conduct a gamma radiation survey from the interior of his residence. The April 2012 residential gamma radiation survey at TS1 was performed in accordance with the QASP (E&E, 2012b).

Prior to initiation of the interior gamma radiation survey, START reviewed the residence

construction history with the property owner. At this time, the property owner indicated that prior to construction of his residence, he graded and leveled the land area where his residence is currently situated, and that topsoil material was pushed beyond the east edge of the residence foundation and to the west down the embankment towards Navajo Route 33. Following review of the construction history, structural characteristics were reviewed and recorded as the size, shape, layout, and construction materials used for the residence.

START then performed an interior gamma radiation survey by collecting two different types of radiation measurements from each room of the residence: interior gamma exposure dose rate measurements and interior gamma activity scan measurements. These measurements are discussed in the following sections.

4.1 Interior Gamma Exposure Dose Rate Measurements

Interior gamma exposure dose rate measurements were collected by utilizing a General Electric Rueters-Stokes High Pressurized Ion Chamber RSS-131 (HPIC). The HPIC was placed 1 meter above the floor in the center of each room, or closest location if obstructed, and recorded measurements for approximately five minutes. In order to collect the most accurate interior gamma exposure rate possible, assessment teams stayed out of a 10-foot radius surrounding the HPIC during data collection. To further ensure accuracy, data collected during the first 90 seconds and last 90 seconds of the five-minute HPIC sample were discarded to allow for an undisturbed two-minute sample average. The HPIC sampling method was designed after recommendations from the manufacturer to minimize movement around the instrument during sampling and to correct for instrument fluctuations at the beginning and end of a sampling period. The HPIC sampling method is designed to minimize outliers that would bias data sets.

The HPIC measurements, recorded in microRoentgen per hour (µR/hr), were collected to represent a statistically-based average exposure rate in each room. The measured exposure rate for each room was then used to estimate the excess dose rate beyond background to a resident from occupancy. A 1 to 1 (1:1) conversion was used when converting Roentgen to Roentgen equivalent man (rem).

In order to determine if there was an imminent and substantial threat to residents from gamma radiation, an exposure rate was calculated based on assessment data. According to U.S. EPA guidance, a 15 mrem/yr dose rate represents an excess cancer risk of 3×10^{-4} above background. This risk calculation utilizes a 30-year exposure period per lifetime and a 24-hour/day exposure. The risk calculation is based upon a risk conversion factor of 7 percent cancer incidence per 100 rem of exposure and is derived from the National Academy of Sciences report on the Biological Effects of Ionizing Radiation, 1990 (BIER V).

Assessment activities measured the gamma radiation exposure rate, and its associated risk, in a way that considers the risk from all sources of external gamma radiation, either anthropogenic or as a combination of anthropogenic and naturally occurring sources. In order to derive excess exposure rate beyond background, the natural background radiation exposure rate was subtracted from the total measured radiation exposure rate from each residential interior room.

Based on the April 2012 interior gamma exposure dose rate measurements, the average gamma exposure rate did not exceed the U.S. EPA excess cancer risk guidance of 15 mrem/yr above the background concentration within any of the nine rooms where measurements were collected. The collected April 2012 interior gamma exposure dose rate measurements are presented as Figure 2b (Appendix A) and a data summary table for the interior gamma exposure dose rate measurements is provided as Table 1 (Appendix B).

4.2 Interior Gamma Activity Scan Measurements

Interior gamma activity scan measurements were collected from 100 percent of accessible floor space using the Ludlum 3x3 to determine if the residence foundation, flooring, or materials under the foundation are impacted by residual uranium-bearing ore located at TS1. The same Ludlum 3x3 instrument used to perform the surface gamma activity scan at TS1 was utilized to collect interior gamma activity measurements in order to provide a consistent correlation between TS1 study locations and gamma activity measurements. The Ludlum 3x3 was minimally shielded to allow gamma activity measurements over the widest area possible (approximately 3 feet in diameter). Objects in the path of the survey were not moved; instead, the survey was conducted around the object. The Ludlum 3x3 detector was held 6 inches above the floor surface and moved in a serpentine motion at approximately 1 to 2 feet per second. The surveyor observed the measurements in kilo counts per minute (kcpm), and based on professional judgment, determined the average gamma activity measurement for each room. If a location was detected above the site-specific DCGL of 2 pCi/g (equivalent to approximately 36 kcpm), the extent of the elevated area was determined and recorded as a “hotspot”.

Based on the April 2012 interior gamma activity scan measurements, slightly elevated gamma radiation areas were identified from the residence within the Kitchen and Bathroom B at 37 kcpm, and within the Living Room and Bedroom B at 40 kcpm. These slightly elevated gamma activity measurements are most likely attributable to residual uranium-bearing dust being transported from outside at TS1 into the residence from common human activity (i.e., dust from shoes). The collected April 2012 interior gamma activity scan measurements are presented as Figure 2b (Appendix A).

5.0 BACKGROUND GAMMA EXPOSURE DOSE RATE MEASURMENTS

On April 17, 2012, the U.S. EPA and START personnel collected background gamma exposure dose rate measurements from the regional background site, located at the Cove Chapter House, which was identified and evaluated during the November 2011 RA (E&E, 2012a).

Background gamma exposure dose rate measurements were collected by utilizing the same HPIC as was used for the collection of interior gamma exposure dose rate measurements at TS1. The HPIC was placed 1 meter above the ground surface at three sample locations identified during the November 2011 RA and recorded measurements for approximately five minutes at each location. In order to collect the most accurate background gamma exposure rate possible, assessment teams stayed out of a 10-foot radius surrounding the HPIC during data collection. To further ensure accuracy, data collected during the first 90 seconds and last 90 seconds of the five-minute HPIC sample were discarded, to allow for an undisturbed two-minute sample average. An average two-

minute exposure rate was determined at each of the three background sample locations. An average of these three measurements was calculated and used as a single exposure rate for the background area.

The average two-minute background gamma exposure dose rate measurement determined based on the three background HPIC sample locations was 13.2 µR/hr. This background gamma exposure dose rate was used for calculation of the excess annual dose rate above background (Table 1, Appendix B).

6.0 SUMMARY AND CONCLUSION

This addendum report provides documentation of the Cove TS1 supplemental April 2012 field assessment in order to address critical data gaps identified from the November 2011 TS1 RA to allow for complete site characterization. This report and the associated data are intended to serve as an addendum to the ***Cove Transfer Station Sites 1 and 2 Abandoned Uranium Mine Waste Removal Assessment Report; Cove, Apache County, Arizona; February 2012.***

During the April 2012 TS1 field assessment, additional gamma radiation data were collected to further delineate the lateral ground surface boundary where Ra-226 concentrations are elevated above the site-specific DCGL of 2.0 pCi/g, and to determine whether or not residential interior gamma radiation dose rates exceed the U.S. EPA excess cancer risk guidance of 15 mrem/yr above the background concentration in order to completely identify all potential human health risks from exposure to uranium-bearing ore.

Data from the April 2012 field assessment indicate that:

- The estimated removal boundary of soil impacted by abandoned uranium mine waste above the site-specific DCGL of 2 pCi/g is approximately 339,087 square feet, with an estimated average depth of 1 foot below ground surface. The estimated volume of soil that will need to be removed from TS1 is approximately 12,559 cubic yards.

- Residential interior gamma exposure dose rate measurements did not exceed the U.S. EPA excess cancer risk guidance of 15 mrem/yr above the background concentration within any of the nine rooms where measurements were collected.

- Residential interior gamma activity scan measurements were slightly elevated within the Kitchen and Bathroom B at 37 kcpm, and within the Living Room and Bedroom B at 40 kcpm. These slightly elevated gamma activity scan measurements are most likely attributable to residual uranium-bearing dust being transported from outside at TS1 into the residence from common human activity.

If you have any questions regarding the START activities associated with this project, please contact me at 510/893-6700 x4805.

Respectfully,

David Neil Ellis
E & E START, Project Manager

cc: E & E START Project File

Appendix A: Figures
Figure 2a Transfer Station 1 Surface Gamma Activity and Excavation Boundaries
Figure 2b Transfer Station 1 Residential Radiation Survey

Appendix B: Data Summary Table
Table 1 Residential Interior Gamma Radiation Dose Rates

Appendix C: Photographic Documentation

REFERENCES:

Ecology and Environment, Inc., 2011. "*Time-Critical Quality Assurance Sampling Plan (QASP) for Cove Transfer Stations 1 & 2 Abandoned Uranium Mine Waste, Radiation Removal Assessment and Sampling,"* November 2011.

Ecology and Environment, Inc., 2012a. "*Cove Transfer Station Sites 1 and 2 Abandoned Uranium Mine Removal Assessment Report, Cove, Apache County, Arizona*," February 2012.

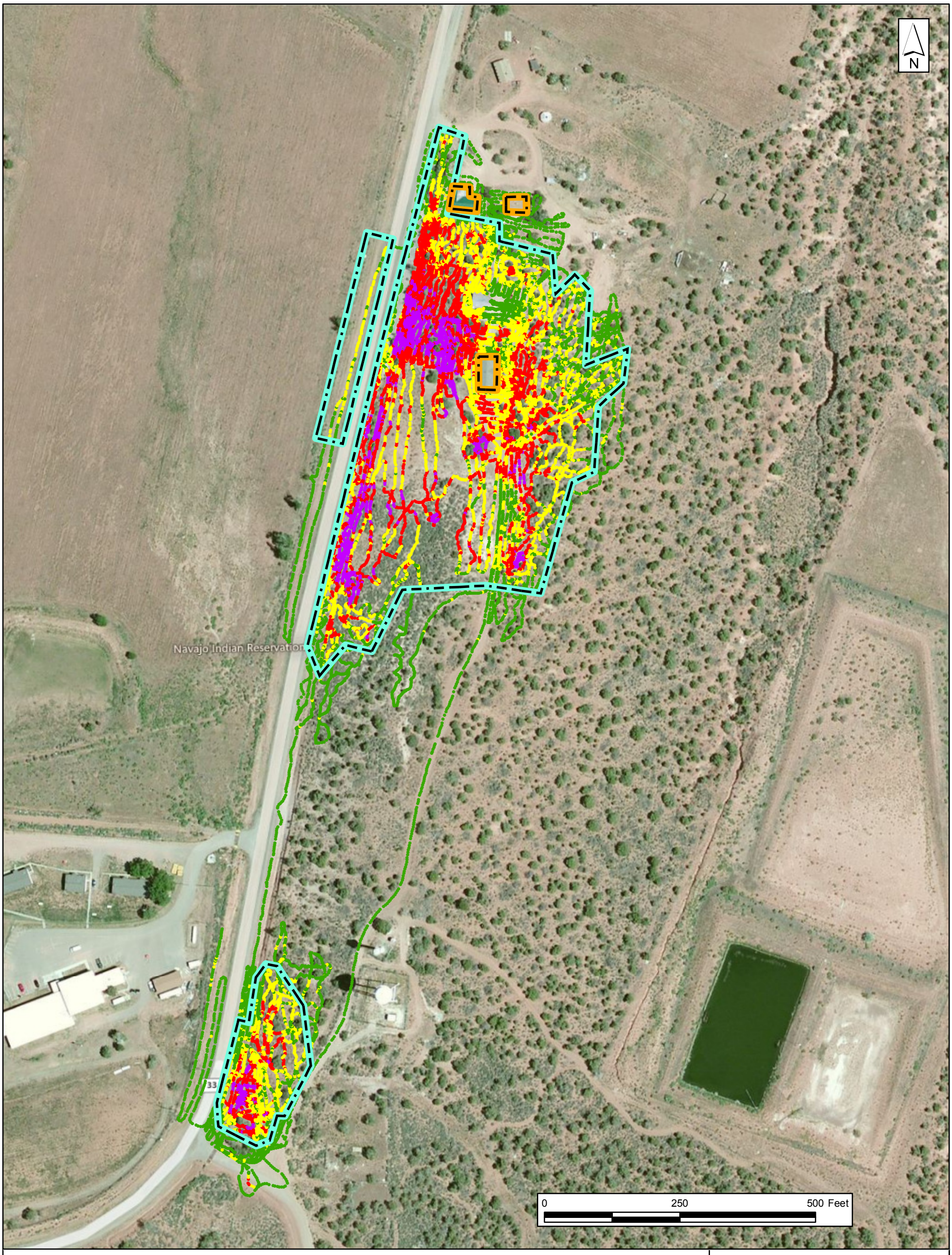
Ecology and Environment, Inc., 2012b. "*Time-Critical Quality Assurance Sampling Plan (QASP) for Cove Transfer Station 1, Residential Radiation Monitoring,"* April 2012.

Appendix A: Figures

Figure 2a Transfer Station 1 Surface Gamma Activity and Excavation Boundaries
Figure 2b Transfer Station 1 Residential Radiation Survey

TDD: TO-02-09-11-10-0002
Project# 002693.2162.01RA

Source: Aerial Photo: Bing Maps



LEGEND

Proposed excavation boundary

Residential Structure

Gamma Activity (cpm)

- 0 - 36,043
- 36,044 - 46,907
- 46,908 - 79,499
- >79,500

ABBREVIATIONS

cpm	counts per minute
pCi/g	picocuries per gram
Ra-226	Radium-226

Gamma Activity (cpm)	Correlated Ra-226 Concentration (pCi/g)
0-36,043	0-2.0
36,044-46,907	2.1-4.0
46,908-79,499	4.1-10.0
>79,500	>10.1

Figure 2a
Transfer Station 1
Surface Gamma Activity and Excavation Boundaries

Cove, Apache County, Arizona

ecology and environment, inc.
International Specialists in the Environment

Topo Source: ESRI National Geographic Society

LEGEND

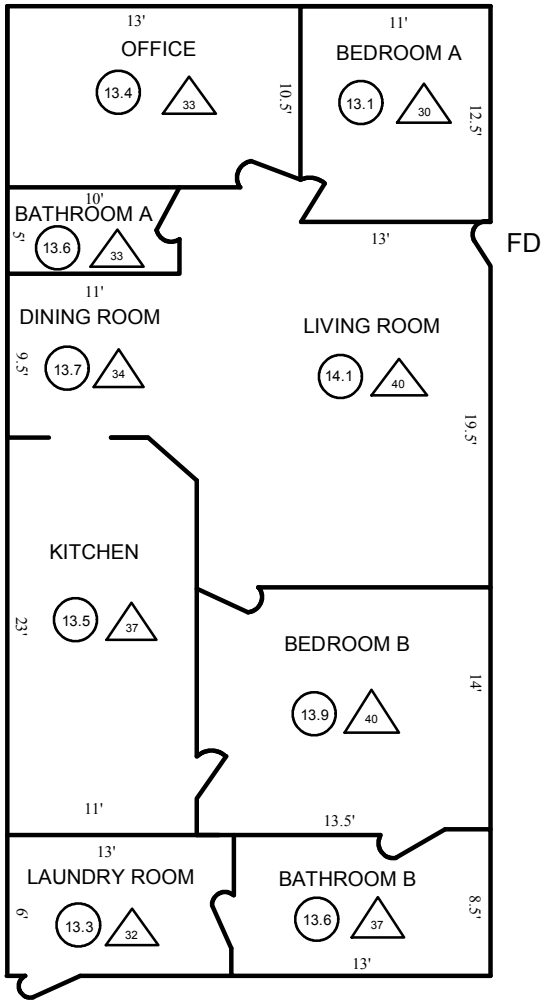
13.2 µR/HR Average at 1 meter above floor

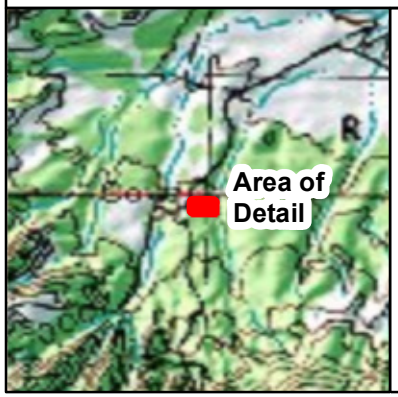
115.7 KCPM at 6 inches above floor

ABBREVIATIONS

15'	INSIDE WALL LENGTH (IN FEET)
FD	FRONT DOOR
KCPM	KILO COUNTS PER MINUTE
µR/HR	MICRO ROENTGEN PER HOUR

Ceiling Height = 8'
Exterior Dimensions = 28' X 56'
Structure built on 2.5' of cement block on top of concrete footers.





N

LOCATION
LATITUDE = 36.561807
LONGITUDE = -109.216247

Figure 2b
Transfer Station 1
Residential Radiation Survey

Cove, Apache County, Arizona

ecology and environment, inc.
International Specialists in the Environment

Attachment B:
Data Summary Table

Table 1 Residential Interior Gamma Radiation Dose Rates

Table 1. Residential Interior Gamma Radiation Dose Rates
Cove Transfer Station 1, Begay Homesite
Cove, Apache County, Arizona

Assumed daily duration of exposure to hazard	24	hours/day
Assumed lifetime duration of exposure to hazard	30	years/lifetime
Assumed fatal cancer risk per lifetime unit dose	7%	per Sievert
	7%	per 100 rem
Assumed excess fatal cancer risk per CERCLA annual dose	3.E-04	per 15 mrem/yr

Residence	Sample Location	Date	Interior Dose Measurement (µR/hr)	Background Dose Measurement (µR/hr)	Total Dose (mrem/yr[1])	Background Dose (mrem/yr[1])	**Excess Annual Dose Above Background (mrem/yr)**
T. Begay	OFFICE	4/17/2012	13.4	13.2	117.5	115.7	**1.8**
	BEDROOM A	4/17/2012	13.1	13.2	114.8	115.7	**-0.9**
	BATHROOM A	4/17/2012	13.6	13.2	119.2	115.7	**3.5**
	LIVING ROOM	4/17/2012	14.1	13.2	123.6	115.7	**7.9**
	DINING ROOM	4/17/2012	13.7	13.2	120.1	115.7	**4.4**
	KITCHEN	4/17/2012	13.5	13.2	118.3	115.7	**2.6**
	LAUNDRY	4/17/2012	13.3	13.2	116.6	115.7	**0.9**
	BEDROOM B	4/17/2012	13.9	13.2	121.8	115.7	**6.1**
	BATHROOM B	4/17/2012	13.6	13.2	119.2	115.7	**3.5**

Notes:
1. Assumes 1:1 conversion when converting Roentgen to rem
µR/hr = microRoentgen per hour
mrem/yr = milliRoentgen Equivalent Man units per year
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

Attachment C:
Photographic Documentation

APRIL 2012 FIELD ASSESSMENT
COVE TRANSFER STATION 1 (TS1)
Cove, Apache County, Arizona

E&E Project. No.: EE-002693-2162 TDD No: TO2-09-11-10-0002

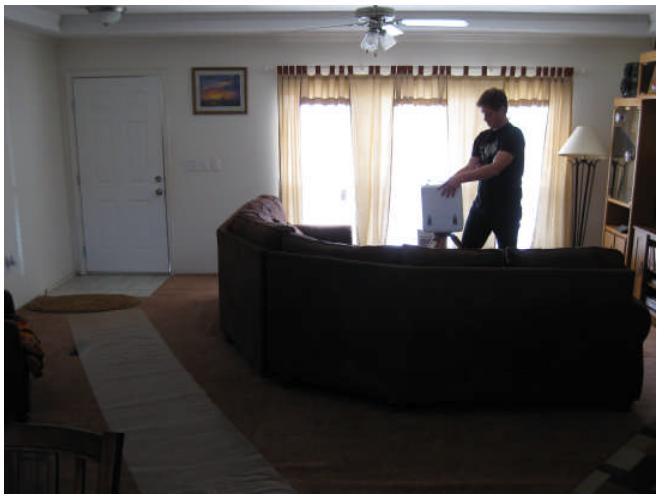
PHOTOGRAPH #1

Date: 04/17/2011

Direction: Down

Photographer: M. Diener

Description: View of the HPIC interior gamma exposure dose rate measurements within Bedroom A of the residence located at TS1.



PHOTOGRAPH #2

Date: 04/17/2012

Direction: East

Photographer: M. Diener

Description: View of the HPIC setup prior to collection of interior gamma exposure dose rate measurements within the Living Room of the residence located at TS1.

PHOTOGRAPH #3

Date: 04/17/2012

Direction: Northeast

Photographer: M. Diener

Description: Exterior view of residence located at TS1.

APRIL 2012 FIELD ASSESSMENT
COVE TRANSFER STATION 1 (TS1)
Cove, Apache County, Arizona

E&E Project. No.: EE-002693-2162 TDD No: TO2-09-11-10-0002

PHOTOGRAPH #4

Date: 04/17/2012

Direction: North

Photographer: M. Diener

Description: View of slope located north of residence at TS1 and neighboring residence located further north.

PHOTOGRAPH #5

Date: 04/17/2012

Direction: West

Photographer: M. Diener

Description: View of wood frame/metal roof structure located north of the residence at TS1.

PHOTOGRAPH #6

Date: 04/18/2012

Direction: South

Photographer: M. Diener

Description: View of gamma activity scan north of the residence located at TS1.