

**COVE TRANSFER STATION SITES 1 AND 2  
ABANDONED URANIUM MINE WASTE REMOVAL ASSESSMENT REPORT  
COVE, APACHE COUNTY, ARIZONA**



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## List of Abbreviations and Acronyms

μR/hr	micro roentgens per hour
AUMW	Abandoned Uranium Mine Waste
bgs	below ground surface
cpm	counts per minute
DCGL	Derived Concentration Guidance Level
DOE	United States Department of Energy
E & E	Ecology and Environment Inc.
EPA	United States Environmental Protection Agency
FOSC	Federal On-Scene Coordinator
GPS	Global Positioning System
Kerr-McGee	Kerr-McGee Oil Industries, Inc.
Ludlum 3 x 3	Ludlum® Model 2241 ratemeter and detector model 44-20 with 3-inch x 3-inch sodium iodide gamma scintillator
MARRSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NAMLRP	Navajo Abandoned Mine Land Reclamation Program
NNEPA	Navajo Nation Environmental Protection Agency
NRC	United States Nuclear Regulatory Commission
PA	Preliminary Assessment
pCi/g	picocuries per gram
PRG	Preliminary Remediation Goal
QA/QC	Quality Assurance and Quality Control
QASP	Quality Assurance and Sampling Plan
Ra-226	Radium-226
Ra-226+d	Radium-226 plus daughter progeny
RAT	Rapid Assessment Tool
START	Superfund Technical Assessment and Response Team
TS1	Transfer Station 1
TS2	Transfer Station 2

# 1 Introduction

In November 2011, the United States Environmental Protection Agency (EPA) Region 9 Federal On-Scene Coordinator (FOSC) Maggie Waldon tasked Ecology and Environment, Inc.'s (E & E) Superfund Technical Assessment and Response Team (START) to provide technical support for the EPA-funded removal assessment at Cove Transfer Station 1 (TS1) and Cove Transfer Station 2 (TS2) located in Cove, Apache County, Arizona (Figure 1). TS1 and TS2 belong to the Cove Chapter of the Navajo Nation Native American Reservation (Navajo).

This removal assessment was initiated in response to regulatory concern over potential radioactive contamination at TS1 and TS2 from historical uranium ore mining practices throughout the nearby Lukachukai Mountains that may pose an “imminent and substantial endangerment to human health or the environment.” During the most recent site inspection at TS1 on July 9, 2004, and during a site inspection at TS2 on October 19, 2005, both performed by the Navajo Nation Environmental Protection Agency (NNEPA), gamma radiation activity (gamma activity) counts greater than two times the NNEPA-referenced background level of 14 microroentgens per hour ( $\mu\text{R/hr}$ ) were detected at multiple locations throughout each transfer station site. Based on these results, the NNEPA requested assistance from the EPA in performing a removal assessment of TS1 and TS2 to determine the nature and extent of the contamination for the purpose of mitigating any potential impacts to human health and/or the environment.

This report documents the results of the field assessment conducted by START between November 16 and 18, 2011, to characterize site conditions and to determine whether previously detected elevated gamma activity at TS1 and TS2 pose “imminent and substantial endangerment to human health or the environment.” As appropriate, the EPA will use data acquired during the removal assessment to evaluate the potential for a removal action at the site(s) and identify alternatives to mitigate environmental hazards that meet endangerment criteria.

## 2 Site Information

### 2.1 Site Location

The sites evaluated in this report were TS1 and TS2. A background site was also evaluated to determine naturally-occurring gamma activity levels within the region of TS1 and TS2. The locations of TS1, TS2, and the regional background site are shown in Figure 1 and described below.

#### 2.1.1 Transfer Station 1

TS1 is located immediately east of Navajo Route 33 and 0.15 miles north of the Cove Day School in Cove, Apache County, Arizona. The geographic coordinates for the approximate center of the area of concern are 36° 33' 41.00" North latitude and 109° 13' 00.00" West longitude. The ground surface elevation at the site is 6,442 feet above sea level (Google™ Earth, aerial imagery, 2012).

#### 2.1.2 Transfer Station 2

TS2 is located immediately west of Navajo Route 33 and approximately 2.2 miles north of the Cove Day School in Cove, Apache County, Arizona. The geographic coordinates for the approximate center of the area of concern are 36° 35' 03.00" North latitude and 109° 12' 04.00" West longitude. The ground surface elevation at the site is 6,112 feet above sea level (Google™ Earth, aerial imagery, 2012).

#### 2.1.3 Regional Background Site

The regional background site is located approximately 1,300 feet southwest of Navajo Route 33 on the Navajo Cove Chapter House property, approximately 275 feet south of the Chapter House and immediately south of the Chapter House entrance road. The geographic coordinates for the approximate center of the regional background site are 36° 35' 03.35" North latitude and 109° 11' 20.5" West longitude, with a ground surface elevation of 6,053 feet above sea level (Google™ Earth, aerial imagery, 2012).

### 2.2 Site Description

The site features, land use, approximate size, and field observations for TS1, TS2 and the regional background site are described below. Site feature and location maps are presented in Appendix A.

#### 2.2.1 Transfer Station 1

TS1 occupies approximately 4 acres of land consisting primarily of undeveloped, open grazing land bordered by an immediately adjacent single-family residence to the north and northeast, with vacant land and a second single-family residence approximately 200 feet farther to the north. To the west is Navajo Route 33 with agricultural fields beyond, vacant land is to the south, and an unpaved residential access road is located to the east with vacant land beyond. Based on field observation, TS1 is likely used by local residents as pastureland for grazing sheep and cattle. According to NNEPA personnel, water wells utilized for human consumption or agricultural application are not present on TS1.

TS1 is characterized by an approximately 2/1 and 3/1 slope beginning on the eastern portion of the site and running downward to the west, then leveling in areas ranging in length between approximately 100 feet and 50 feet before reaching Navajo Route 33. The site is largely covered by sagebrush except for a level area located in the center of the site, which has been historically impacted by mining operations and underwent a Navajo Abandoned Mine Land Reclamation Program (NAMLRP) Abandoned Uranium Mine Waste (AUMW) removal action between July 2003 and July 2004 (see Section 2.4). Portions of the western-facing slope are covered with waste rock and/or waste ore that were apparently pushed up slope or deposited along the slope during mining operations. Waste rock and/or waste ore was also identified on the level portion of the western site boundary, running north to south along the existing barbed wire fence and west into the drainage culvert bordering Navajo Route 33.

The single-family residence located on the north and northeast portion of the TS1 site occupies approximately 1,600 square feet. This residential property is primarily situated upgradient from the identified abandoned mine waste; therefore, surface runoff from portions of the TS1 site that are impacted by AUMW does not flow directly through the property. Although surface runoff does not appear to flow directly through the residential property, AUMW was identified on western portions of the residential property, along the slope. From visual observation and reports by NNEPA the residence was established within the last five to eight years. The structure consists of a pre-manufactured home situated on a raised foundation approximately one to two feet above ground surface. At this time it cannot be determined whether soil excavation occurred prior to construction of the residence. One single-family residence is located north of the boundary of contamination identified during this removal assessment. This residence is potentially located in an area downgradient from identified AUMW at TS1; therefore, surface runoff from portions of the site that are impacted could potentially flow directly through the property. This residence was not included within the removal assessment, and additional investigation at the property may be warranted.

### **2.2.2 Transfer Station 2**

TS2 occupies approximately 2.5 acres of land consisting exclusively of undeveloped, open grazing land bordered by Navajo Route 33 to the immediate southeast and vacant land in all surrounding directions. Based on field observations, TS2 is likely used by local residents as pastureland for grazing sheep and cattle. As of November 2011, no residential homesites were identified near TS2. According to NNEPA personnel, water wells utilized for human consumption or agricultural application are not present on TS2.

TS2 is characterized as level land and largely covered by sagebrush. Portions of TS2 considered to be historically impacted by mining operations are covered with residual waste rock and/or waste ore.

### **2.2.3 Regional Background Site**

The regional background site occupies approximately 2 acres of land consisting exclusively of undeveloped, open land bordered by the Cove Chapter House access road to the north and vacant land to the west, south, and east.

The regional background site was selected based on guidelines set forth by the EPA and NNEPA, and documented in the *Background Location Selection Criteria, Prepared by U.S. EPA and NNEPA*, dated April 1, 2010 (U.S. EPA and NNEPA 2010).

### **2.3 Site Background**

Information regarding the site background was compiled from the Preliminary Assessment (PA) Report for the TS1 site, *Preliminary Assessment Report, Cove Transfer Station, Cove, Arizona*, prepared by Weston Solutions, Inc. (Weston) dated August 2007 (Weston, 2007). Historical operations at TS1 and TS2 included stockpiling of uranium-bearing ore from mines located in the nearby Lukachukai Mountains, housing of mining personnel, and administration of mining operations. In May 1952, Kerr-McGee Oil Industries, Inc. (Kerr-McGee) acquired property in the Lukachukai Mountains for construction of their Navajo Uranium Division and began to actively mine uranium-bearing ore in the region. In October 1954, the Kerr-McGee field camp was moved from the Mesa No. 1 mine to TS1. The Kerr-McGee mining operations field camp included several prefabricated structures that were used for field administrative offices to house and service employees during the week and to maintain fleet vehicles. During this period, uranium-bearing ore deposits from the company-run Lukachukai mines were brought down the mountain and stockpiled at TS1 and TS2. The ore was then loaded from stockpiles at TS1 and TS2 and shipped approximately 40 miles to the Shiprock Mill for processing. The ore stockpiled at TS1 primarily came from the Mesa No. 2 mine, which produced approximately 5,000 tons of high-vanadium carnotite-tyuyamunite ore per month and was the most productive mine in the region. It is assumed that operations at TS1 and TS2 ceased no later than 1968 since the final shipments of ore were removed from the Lukachukai Mountains in May 1968.

### **2.4 Previous Investigations**

According to the PA report (Weston, 2007), the EPA Region 9 began its Abandoned Uranium Mine Project in 1994 to determine if the former uranium mining activities at the Navajo Nation posed a threat to human health or the environment. Over the course of this investigation, which lasted through January 2000, aerial radiation surveys were conducted over 1,194 square miles. In addition, over 200 water sources used for human consumption were identified and analyzed for radiation and related metal concentrations. The aerial radiation survey of the Lukachukai region identified the Cove Transfer Station sites as having elevated radiation levels.

A radiological survey was conducted at the TS1 site by NNEPA personnel on July 23, 2003. One hundred thirty-four measurements were collected across the site from one meter above ground surface using a hand-held radiation survey meter. Approximately 72 percent of these readings were at least two times greater than the established background level of 14  $\mu\text{R/hr}$  (Weston, 2007). The highest recorded value at the site was 400  $\mu\text{R/hr}$ , which was collected from an unvegetated, discolored area at the central portion of the site.

The NAMLRP conducted a removal action at the TS1 site between July 2003 and July 2004. The NAMLRP staff surveyed the site prior to conducting the removal action to determine areas of elevated radiation. These areas, which totaled between 1 and 2 acres, were then excavated and the soils were transported back to the Lukachukai mines. Additional details of this removal action are unknown.

## **2. Site Information**

NNEPA staff returned to the TS1 site on July 9, 2004, to conduct an additional radiological survey following the removal action conducted by the NAMLRP. Radiological readings collected during this survey, which was conducted using the same radiation meter as the previous NNEPA survey to prevent as little variance in gamma activity readings as possible, ranged from 15 to 30  $\mu\text{R/hr}$ . Two areas, each less than 3 square feet, were identified as having elevated levels of radiation (100 and 150  $\mu\text{R/hr}$ ). These areas were located at the western portion of the property along the highway right-of-way fence line associated with Navajo Route 33 and were not included in the NAMLRP removal action conducted between July 2003 and July 2004.

A tabulated data set of a previous investigation at TS2 was provided by NNEPA to E & E during the November 2011 field assessment phase of this removal assessment. According to this data set, a radiological survey was conducted at TS2 by NNEPA personnel on October 19, 2005. Two hundred eighty-eight measurements were collected across the site from 1 meter above ground surface using a hand-held radiation survey meter. Approximately 67 percent of these readings were at least two times greater than the established background level of 14  $\mu\text{R/hr}$ . The highest recorded value at the site was 330  $\mu\text{R/hr}$ , which was collected from an unvegetated, discolored area at the central portion of the site.

### 3 Field Assessment

Field activities for this removal assessment were conducted from November 16 through 18, 2011, under the authority of FOSC Maggie Waldon. E & E START performed field assessment activities 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, November 2011* (E & E 2011), with the following exceptions:

- Subsurface soil samples were collected at 1-foot intervals to a depth of 36 inches (3 feet) below ground surface (bgs) rather than 60 inches (5 feet) bgs as stated in the QASP. Subsurface soil samples were only collected to a total depth of 3 feet bgs because visual observations suggest surface deposition is the source of AUMW and subsurface contamination to 5 feet bgs is not expected.
- Field duplicate soil samples were collected at a total frequency of approximately 3 percent rather than 10 percent as stated in the QASP.

Prior to the field assessment on November 16, 2011, EPA and START met with NNEPA representative Eugene Esplain and traveled to the Cove Chapter House of the Navajo Nation to inform the Chapter Administration of the EPA and NNEPA intent to perform a removal assessment at the TS1 and TS2 sites and to explain the nature of the removal assessment work.

During the field assessment, a total of 13 surface soil samples and 8 shallow subsurface soil samples were collected from TS1; a total of 13 surface soil samples and 15 shallow subsurface soil samples were collected from TS2; and a total of 11 surface soil samples were collected from the regional background site. The field assessment activities are discussed in Sections 3.1 through 3.5. Photographs documenting the field assessment are provided in Appendix B.

The site-specific QASP described the sampling rationale, sampling methodology, analytical procedures, and scope of sampling to meet the following project objectives:

1. Determine concentrations of radium-226 (Ra-226) and gamma radiation activity in soils to evaluate the potential threat to human health or the environment from AUMW at TS1 and TS2;
2. Determine the lateral ground surface boundaries where gamma radiation activity corresponding to Ra-226 concentrations elevated above the proposed action level are present at the Cove TS1 and TS2 sites;
3. Evaluate the vertical subsurface extent where gamma radiation activity corresponding to Ra-226 concentrations elevated above the proposed action level are present at the Cove TS1 and TS2 sites; and
4. Evaluate the typical background levels for gamma radiation activity in a regionalized area surrounding the Cove TS1 and TS2 sites.



### **3.1 Transfer Station 1**

All surface gamma activity scans and soil sampling conducted at TS1 were performed according to the QASP (E & E 2011) unless otherwise noted. An initial surface gamma activity scan was conducted at TS1 by using the EPA's 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 (EPA serial no. 198223) with 3-inch x 3-inch sodium iodide gamma scintillator (EPA serial no. 18BR9) (Ludlum 3x3) to identify the area of concern. Following the surface gamma activity scan, soil samples were collected using an 80-foot by 80-foot triangular grid with a total of 13 grid sample points in the area of concern at TS1 to provide a correlation between the gamma activity measurements and the Ra-226 concentrations in soil.

Before collecting surface soil samples, a one-minute surface gamma activity count was collected at each soil sample location. The Ludlum 3x3 probe was held 6 inches above the soil surface during the measurement. The geographic coordinates of each sample location were recorded using a GPS unit. One surface soil sample was collected between 0 and 6 inches bgs into a 9-ounce (oz) laboratory-supplied sample jar using a clean stainless steel trowel from each of the 13 grid points.

For subsurface soil samples, five of the 13 surface grid points were selected from locations where gamma activity levels were elevated above the background gamma activity levels during the one-minute surface gamma activity counts. A hand auger with a 2 ¾-inch stainless steel bit was then advanced at each of the five selected grid points to a depth of 12 inches bgs, 24 inches bgs, and 36 inches bgs or when refusal was met. Refusal of the hand auger was encountered at 12 inches bgs at sample locations COVE1-SS-01, COVE1-SS-11, and COVE1-SS-13, and therefore only one subsurface soil sample was collected from each of these locations at 12 inches bgs. Refusal of the hand auger was encountered 24 inches bgs at sample location COVE1-SS-07, and therefore only two subsurface soil samples were collected from 12 inches and 24 inches bgs at this location. Subsurface soil samples were collected from all three intervals to 36 inches bgs at sample location COVE1-SS-05. One shallow subsurface soil sample was collected into a 9-oz laboratory-supplied sample jar at each identified soil depth interval.

After collection, all soil samples were placed in coolers and kept chilled on ice for storage and laboratory for analysis of Ra-226. All field decontamination, sample quality assurance/quality control (QA/QC), labeling, documentation, chain of custody, and shipping standard operating procedures (SOPs) were followed as described in the QASP unless otherwise noted.

### **3.2 Transfer Station 2**

All surface gamma activity scans and soil sampling conducted at the TS2 site were performed according to the QASP (E & E 2011) unless otherwise noted. An initial surface gamma activity scan was conducted at TS2 by using the EPA's RAT software, a GPS unit, and a Ludlum 3x3 to identify the area of concern. Following the surface gamma activity scan, soil samples were collected using an 80-foot by 80-foot triangular grid with a total of 13 grid sample points in the area of concern at TS2 to provide a correlation between the gamma activity measurements and the Ra-226 concentrations in soil.

Before collecting surface soil samples, a one-minute surface gamma activity count was collected at each soil sample location. The Ludlum 3x3 probe was held 6 inches above the soil surface

### 3. Summary of Field Activities

during the measurement. The geographic coordinates of each sample location were recorded using a GPS unit. One surface soil sample was collected between 0 and 6 bgs into a 9-ounce (oz) laboratory-supplied sample jar using a clean stainless steel trowel from each of the 13 grid points.

For subsurface soil samples, five of the 13 surface grid points were selected from locations where elevated gamma activity was observed during the one-minute surface gamma activity counts. A hand auger with a 2 3/4-inch stainless steel bit was then advanced at each of the five selected grid points to a depth of 12 inches bgs, 24 inches bgs, and 36 inches bgs. One shallow subsurface soil sample was collected into a 9-oz laboratory-supplied sample jar at each soil depth interval.

After collection, all soil samples were placed in coolers and kept chilled on ice for storage and laboratory shipment for analysis of Ra-226. All field decontamination, sample QA/QC, labeling, documentation, chain of custody, and shipping SOPs were followed as described in the QASP unless otherwise noted.

#### 3.3 Regional Background Site

All surface gamma activity scans and soil sampling conducted at the regional background site were performed according to the QASP (E & E 2011) unless otherwise noted. An initial surface gamma activity scan was conducted at the background site by using the EPA's RAT software, a GPS unit, and a Ludlum 3x3 to determine whether or not elevated gamma activity levels were present at the background site. Following the surface gamma activity scan, soil samples were collected using an 80-foot by 80-foot triangular grid with a total of 11 grid sample points within the regional background site to provide a correlation between the gamma activity measurements and the Ra-226 concentrations in soil.

Before collecting surface soil samples, a one-minute surface gamma activity count was collected at each soil sample location. The Ludlum 3x3 probe was held 6 inches above the soil surface during the measurement. The geographic coordinates of each sample location were recorded using a GPS unit. One surface soil sample was collected between 0 and 6 bgs into a 9-ounce (oz) laboratory-supplied sample jar using a clean stainless steel trowel from each of the 11 grid points.

Subsurface soil samples were not collected from the regional background site because the area has not been impacted by AUMW and estimation of removal volumes is not required at the background site. Data from the regional background site is only intended for use as correlation between typical background Ra-226 soil concentrations and soil gamma activities and the Ra-226 soil concentrations and gamma activities detected at TS1 and TS2, which have been impacted by AUMW.

After collection, all soil samples were placed in coolers and kept chilled on ice for storage and laboratory shipment for analysis of Ra-226. All field decontamination, sample QC, labeling, documentation, chain of custody, and shipping SOPs were followed as described in the QASP unless otherwise noted.

### **3.4 QA/QC of Field Sampling**

Two QC field duplicate soil samples (COVE1-S-113 and COVE2-S-106) were collected at locations randomly selected in the field. According to the QASP, field duplicate samples were collected to determine a relative percent difference between homogenized split duplicate soil samples collected as a double volume from one location. Field duplicate soil samples consisted of one sample aliquot collected as double volume, homogenized, and then split into two sample jars and assigned a unique sample ID for analysis of Ra-226.

Two laboratory QC soil samples (COVE1-S-01 and COVE2-S-01), referred to as matrix duplicates, were randomly selected for additional Ra-226 laboratory QC analyses.

Two QC equipment rinsate samples (RB-111711 and RB-111811) were collected from non-dedicated sampling instruments (i.e., hand auger, trowel) used during the assessment to evaluate field decontamination procedures. In accordance with the QASP, equipment rinsate samples were collected following decontamination of the sampling equipment at a rate of once per day. Rinsate samples were collected by pouring distilled water over the decontaminated sampling instrument and collecting the water into a certified clean, nitric acid-preserved 2-liter polyethylene sample container for analysis of Ra-226.

### **3.5 QA/QC of Field Gamma Activity Measurements**

The Ludlum 3 x 3 field screening instrument utilized during this removal assessment was evaluated to document that the equipment was within annual calibration and operating within daily QC parameters according to the QASP. To minimize the potential for measurement variability, the Ludlum Model 2241 ratemeter was matched with the same Ludlum Model 44-20 detector with 3-inch x 3-inch sodium iodide gamma scintillator throughout the assessment period. Prior to the assessment, the high voltage settings for the matched ratemeter-detector combinations were adjusted so that the detectors had similar gamma radiation responses to a certified Ra-226 source. Data were collected within a voltage window on the matched ratemeter-detector that was specific to Ra-226.

Prior to performing any surface field measurements, a one-minute gamma activity count was performed for the matched ratemeter-detectors using a certified Ra-226 source. Immediately before or after the one-minute count was performed with the Ra-226 check source, an additional one-minute count was performed without a check source. A  $\pm 20\%$  variation from this initial measurement value was set as the QC tolerance limit during subsequent daily QC checks.

Daily QC checks were performed at the end of each day of assessment activity. To minimize variance during each daily QC check, the check was performed with the Ra-226 source and ratemeter-detector combinations in the same location and orientation as those used during the initial calibration measurement described above. The ratemeter-detector combination used during this removal assessment did not fail QC limits (i.e., within 20 percent of the initially measured values). Calibration sheets and annual calibration certificates are located in the project files.

## 4 Presentation and Discussion of Analytical Results and Gamma Activity Measurement Data

Surface soil samples, shallow subsurface soil samples, and equipment rinsate samples collected during the November 2011 removal assessment were analyzed for the following contaminant of concern:

- Ra-226 gamma spectroscopy with in-growth, by method HASL 300, 4.5.2.3.

Soil samples and equipment rinse blank samples collected during the November 2011 removal assessment to be analyzed for Ra-226 gamma spectroscopy (method HASL 300, 4.5.2.3) were submitted to GEL Laboratories LLC (GEL), located in Charleston, South Carolina.

Surface gamma activity scans (RAT scan) and one-minute surface gamma activity counts conducted during the November 2011 removal assessment were collected utilizing:

- Ludlum® Model 2241 ratemeter and detector model 44-20 (U.S. EPA serial : 198223) with 3-inch x 3-inch NaI (sodium iodide) gamma scintillator (U.S. EPA S/N: 18BR9)

All laboratory analytical results were provided by GEL with Tier 1 data validation. A START chemist then conducted Tier 2 data validation for all laboratory-generated data in accordance with the EPA guidance *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (EPA/540/G-90/004 OSWER Directive 9360.4-01, dated April 1990) (EPA, 1990). Tier 2 data validation included evaluation of criteria such as laboratory QA/QC summaries, holding times, and matrix-related recoveries. Data qualifiers were applied by START according to the *U.S. EPA CLP National Functional Guidelines for Inorganic Data Review* (OSWER 9240.1-45, EPA 540-R-04-004, dated October 2004) (EPA, October 2004). All data were found to be acceptable for use as definitive data. A summary of analytical laboratory results and gamma activity measurements are presented in Appendix C. Laboratory Analytical Data Validation Reports are presented in Appendix D.

### 4.1 Derived Concentration Guidance Level

The DCGL was used to screen the risk to human health from Ra-226 concentrations in soil at the TS1 and TS2 sites. The DCGL is defined by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) as *a radionuclide-specific surface or volume residual radioactivity level that is related to a concentration dose or risk criterion* (MARSSIM, 2000). MARSSIM was composed under the EPA, the Nuclear Regulatory Commission (NRC), and the Department of Energy (DOE), who are responsible agencies for the release of radioactive sites following their cleanup; it is intended to provide a nationally consistent consensus approach for conducting radiation surveys and investigations at potentially contaminated sites for federal, state, and local agencies. DCGLs may be developed with EPA guidance using default modeling input parameters, such as the current EPA Preliminary Remediation Goals (PRGs); or by using site-specific modeling parameters (e.g., exposure pathways, contamination zones, and land-use).

## **4. Discussion of Analytical Results and Gamma Activity Measurement Data**

The DCGLs for both TS1 and TS2 were established by using the baseline EPA excess risk level for Ra-226 and daughter progeny (Ra-226+d) for residential soils. To establish the site-specific DCGLs, the EPA PRG for residential soil at a  $10^{-4}$  excess risk level for Ra-226+d of 1.21 picocuries per gram (pCi/g) was added to the average detected background soil concentration for Ra-226 of 0.79 pCi/g (see Section 4.4) to produce a DCGL of 2.0 pCi/g at both TS1 and TS2.

Analytical data collected during this removal assessment were compared to the EPA-established DCGL of 2.0 pCi/g to identify specific areas of concern where elevated Ra-226 and gamma activity levels are present within soils.

### **4.2 Transfer Station 1**

On November 18, 2011, the START performed a surface gamma activity scan and collected surface and subsurface soil samples and co-located one-minute surface gamma activity counts at TS1 (Figure 2, Appendix A). A summary of the Ra-226 analytical data for surface and subsurface soil samples and the co-located one-minute surface gamma activity counts is presented in Table 1 (Appendix C).

#### **4.2.1 TS1 Surface Soil Sampling and Gamma Activity Measurements**

Thirteen surface soil samples (COVE1-S-01 through COVE1-S-13) were collected to identify whether concentrations of Ra-226 in surface soil exceeded the site-specific action level at TS1 and to provide a correlation factor between surface gamma activity measurements and Ra-226 surface concentrations at TS1.

Ra-226 concentrations in 13 surface soil samples collected from TS1 ranged from 1.05 pCi/g to 54.9 pCi/g. Of these 13 surface samples, Ra-226 levels in 12 samples exceeded the Ra-226 DCGL of 2.0 pCi/g. The average Ra-226 surface concentration detected in the sample set was 10.2 pCi/g, which significantly exceeds the DCGL. Co-located one-minute surface gamma activity counts collected from these 13 soil sample locations ranged from 34,464 counts per minute (cpm) to 95,383 cpm and had an average of 50,781 cpm. The correlation between the detected Ra-226 surface concentrations and the one-minute surface gamma activity counts in co-located soil samples at TS1 is discussed in Section 4.5.

#### **4.2.2 TS1 Subsurface Soil Sampling**

Eight subsurface soil samples were collected to evaluate the vertical extent of soil impacted by AUMW and to estimate potential soil removal volumes at TS1.

Ra-226 concentrations in subsurface soil samples collected at 12 inches bgs ranged from 0.632 pCi/g to 1.64 pCi/g. Ra-226 concentrations in subsurface soil samples collected at 24-inches bgs were detected at 0.850 pCi/g from sample location COVE1-SS-05 and at 14.7 pCi/g from sample location COVE1-SS-07. Ra-226 was detected at a concentration of 0.852 pCi/g at 36-inches bgs from sample location COVE1-SS-05. Except for sample location COVE1-SS-07, collected from the 24 inches bgs depth interval, detected concentrations of Ra-226 in the subsurface soil samples were all below the DCGL of 2.0 pCi/g. The lack of highly impacted soils at depth strongly suggests surface deposition of AUMW is the source of the radioactivity and indicates that the vertical extent of elevated Ra-226 concentrations is primarily confined within the upper 12 inches of soil.

## **4. Discussion of Analytical Results and Gamma Activity Measurement Data**

### **4.3 Transfer Station 2 Surface and Subsurface Soil Sampling and Gamma Activity Measurements**

On November 17, 2011, the START performed a surface gamma activity scan and collected surface and subsurface soil samples and co-located one-minute surface gamma activity counts at TS2 (Figure 3, Appendix A). A summary of the Ra-226 analytical data for surface and subsurface soil samples and co-located one-minute surface gamma activity counts is presented in Table 2 (Appendix C).

#### **4.3.1 TS2 Surface Soil Sampling and Gamma Activity Measurements**

Thirteen surface soil samples (COVE2-S-01 through COVE2-S-13) were collected to identify whether concentrations of Ra-226 in surface soil exceeded the site-specific action level at TS2 and to provide a correlation factor between surface gamma activity measurements and Ra-226 surface concentrations at TS2.

Ra-226 concentrations in 13 surface soil samples collected from TS2 ranged from 1.58 pCi/g to 92.7 pCi/g. Of these 13 surface samples, Ra-226 levels in 12 samples exceeded the Ra-226 DCGL of 2.0 pCi/g. The average Ra-226 surface concentration detected in the sample set was 26.9 pCi/g, which significantly exceeds the DCGL. Co-located one-minute surface gamma activity counts collected from these 13 soil sample locations ranged from 39,215 cpm to 263,561 cpm, with an average of 120,959 cpm. The correlation between the detected Ra-226 surface concentrations and the one-minute surface gamma activity counts in co-located soil samples at TS2 is discussed in Section 4.5.

#### **4.3.2 TS2 Subsurface Soil Sampling**

Fifteen subsurface soil samples were collected to evaluate the vertical extent of soil impacted by AUMW and to estimate potential soil removal volumes at TS2.

Ra-226 concentrations in soil samples collected at 12 inches bgs ranged from 0.681 pCi/g to 1.09 pCi/g. Ra-226 concentrations in soil samples collected at 24 inches bgs ranged from 0.643 pCi/g to 0.890 pCi/g. Ra-226 concentrations in subsurface soil samples collected at 36 inches bgs ranged from 0.691 pCi/g to 0.948 pCi/g. Detected concentrations of Ra-226 were below the DCGL of 2.0 pCi/g in for all subsurface soil samples collected at TS2. The lack of highly impacted soils at depth strongly suggests surface deposition of AUMW is the source of radioactivity and indicates that the vertical extent of elevated Ra-226 concentrations is primarily confined within the upper 12 inches of soil.

### **4.4 Regional Background Site Surface Soil Sampling and Gamma Activity Measurements**

On November 17, 2011, the START performed a surface gamma activity scan and collected surface soil samples and co-located one-minute surface gamma activity counts at the regional background site (Figure 4, Appendix A). A summary of Ra-226 analytical data for surface soil samples and co-located one-minute surface gamma activity counts is presented in Table 3 (Appendix C).

Eleven surface soil samples (COVE-BKG-01 through COVE-BKG-11, locations 01-11) were collected to identify the range and average of regional Ra-226 background concentrations and to



#### 4. Discussion of Analytical Results and Gamma Activity Measurement Data

provide a correlation factor between background surface gamma activity measurements and surface Ra-226 background concentrations. For the purpose of this removal assessment, the “regional background site” is defined as ***a site regionally located near the identified waste site, but which is not influenced by site activities or releases.*** The regional background site for this removal assessment was selected based on guidelines set forth by the EPA and NNEPA (NNEPA 2010), and meet background location selection criteria such as: similar evaluation, similar geology, within an undisturbed area, and within an area not influenced by drainage or flooding.

Ra-226 concentrations in surface soil samples collected from the background site ranged from 0.539 pCi/g to 0.987 pCi/g. In the 11 surface samples, all detected Ra-226 concentrations were below the DCGL of 2.0 pCi/g. Co-located one-minute surface gamma activity counts collected from these 11 soil sample locations ranged from 26,990 cpm to 29,744 cpm and had an average of 27,978 cpm. The correlation between the detected Ra-226 surface concentrations and the one-minute surface gamma activity counts in co-located soil samples in the regional background area is discussed in Section 4.5.

Results from the regional background site were used in developing the DCGL to evaluate the typical Ra-226 background concentrations and indicate that background concentrations of Ra-226 in soils are less than 1 pCi/g.

### 4.5 Correlation Between Surface Soil Sampling and Gamma Activity Measurements

#### 4.5.1 Transfer Station 1 and Transfer Station 2

The detected Ra-226 surface concentrations and one-minute surface gamma activity counts in co-located soil samples at TS1 were correlated to determine the gamma activity level equivalent to a DCGL of 2.0 pCi/g. Using linear regression analysis, the coefficient of determination ( $R^2$ ) value between Ra-226 surface concentrations and one-minute surface gamma activity counts in corresponding samples was greater than 75 percent (Table 1, Appendix C). A graphical comparison of the TS1 Ra-226 surface soil concentrations and corresponding one-minute surface gamma activity counts is presented in Figure 5 (Appendix A).

The detected Ra-226 surface concentrations and one-minute surface gamma activity count in co-located soil samples at TS2 were correlated to determine the gamma activity level equivalent to a DCGL of 2.0 pCi/g. Using linear regression analysis, the  $R^2$  value between Ra-226 surface concentrations and one-minute surface gamma activity counts in corresponding samples was 33 percent (Table 2, Appendix C). A graphical comparison of the TS2 Ra-226 surface soil concentrations and corresponding one-minute surface gamma activity counts is presented in Figure 6 (Appendix A).

Although a correlation value was established between the detected Ra-226 surface concentration and one-minute surface gamma activity count in co-located soil samples at TS1 and TS2 individually, the actual  $R^2$  value used to evaluate the correlation between Ra-226 surface concentrations and the surface gamma activity scan for the purposes of this removal assessment is based on sample location data from both TS1 and TS2 where Ra-226 surface concentrations are less than 10 pCi/g (<10 pCi/g). A total of eight sample locations from TS1 with Ra-226 surface concentrations <10 pCi/g and a total of four sample locations from TS2 with Ra-226

#### **4. Discussion of Analytical Results and Gamma Activity Measurement Data**

surface concentrations <10 pCi/g were used to establish this  $R^2$  value (Table 4, Appendix C). The use of this more conservative  $R^2$  value for correlating measurements collected during the surface gamma activity scan and the surface Ra-226 concentrations is intended to more accurately represent Ra-226 concentrations near the proposed EPA DCGL of 2.0 pCi/g to be protective of human health exposure risks. The  $R^2$  value between Ra-226 surface concentrations <10 pCi/g and one-minute surface gamma activity counts in corresponding samples (collected from TS1 and TS2) was greater than 75 percent. Therefore, gamma activity scanning data correlated to Ra-226 surface concentrations <10 pCi/g collected during this assessment meets the EPA criterion for use as screening level data ( $R^2 = >70$  percent) at TS1 and TS2. A graphical comparison of the TS1 and TS2 Ra-226 surface soil concentrations <10 pCi/g and the corresponding one-minute surface gamma activity counts is presented in Figure 7 (Appendix A).

Results from the gamma activity scan at TS1 provide evidence that slightly elevated gamma activity measurements between 36,044 cpm and 49,907 cpm (corresponding to Ra-226 surface soil concentrations between 2 pCi/g and 4 pCi/g) are present to the west, south, and east of the on-site residence and in areas near residual uranium-bearing ore throughout the TS1 site (Figure 2, Appendix A). These slightly elevated gamma activity measurements are likely attributable to wind dispersion and surface runoff of soils containing gamma-emitting radioisotopes from the residual uranium-bearing ore identified at TS1. Elevated gamma activity measurements between 46,908 cpm and 79,499 cpm (corresponding to Ra-226 surface soil concentrations between 4 pCi/g and 10 pCi/g) and greater than 79,500 cpm (corresponding to Ra-226 surface soil concentrations >10 pCi/g) are primarily located along the western facing slope of TS1; immediately adjacent to, west of, and south of the on-site residence; in the northern portion of the study area; and near the western site boundary along the existing barbed wire fence and within the Navajo Route 33 drainage culvert. Elevated gamma activity measurements are likely attributable to residual uranium-bearing ore identified at these locations. Results of the gamma activity scan for TS1 are shown in Figure 2 (Appendix A).

Results from the gamma activity scan at TS2 provide evidence that slightly elevated gamma activity measurements between 36,044 cpm and 49,907 cpm (corresponding to Ra-226 surface soil concentrations between 2 pCi/g and 4 pCi/g) are present in perimeter areas of the TS2 site and within the east and west drainage culverts located along Navajo Route 33 (Figure 3, Appendix A). These slightly elevated gamma activity measurements are likely attributable to wind dispersion and surface runoff of soils containing gamma-emitting radioisotopes from the residual uranium-bearing ore identified at TS2. Elevated gamma activity measurements between 46,908 cpm and 79,499 cpm (corresponding to Ra-226 surface soil concentrations between 4 pCi/g and 10 pCi/g) and greater than 79,500 cpm (corresponding to Ra-226 surface soil concentrations >10 pCi/g) are primarily located in the central portion of the TS2 site. Elevated gamma activity measurements are likely attributable to residual uranium-bearing ore identified at these locations. Results of the gamma activity scan for TS2 are shown as Figure 3 (Appendix A).

##### **4.5.2 Regional Background Site**

The detected Ra-226 surface concentrations and one-minute surface gamma activity counts in co-located soil samples at the background site were compared to establish a correlation between the two. Using linear regression analysis, the  $R^2$  value between Ra-226 surface concentrations and one-minute surface gamma activity counts in corresponding samples at was 6.7 percent (Table 3, Appendix C). A graphical comparison of the background area Ra-226 surface soil





#### ***4. Discussion of Analytical Results and Gamma Activity Measurement Data***

concentrations and corresponding one-minute surface gamma activity counts is presented in Figure 8 (Appendix A).

In general, Ra-226 concentrations in surface soil samples correlated poorly with measured one-minute surface gamma activity counts at the background sampling locations. The poor correlation is likely due to the relatively low Ra-226 soil concentrations and gamma activity counts in the background area. At relatively low activity counts, natural variation in the measurements due to surface topography, instrument geometry, instrument drift (noise), and sampling error (e.g., small variations in distance from the detector to ground surface) have a greater relative impact on the activity count in comparison to locations where elevated activity counts and Ra-226 concentrations are present.

## 5 Conclusions and Recommendations

The following conclusions and recommendations were made based on START's review of the existing data and on START's knowledge of existing site conditions.

Results from TS1 indicate that surface soils with gamma activity measurements corresponding to Ra-226 surface soil concentrations elevated slightly above the site-specific action level are present to the west, south, and east of the on-site residence and in areas near residual uranium-bearing ore throughout the TS1 site. Surface soils with gamma activity measurements corresponding to Ra-226 surface soil concentrations greater than twice the site-specific action level are primarily located along the western facing slope of TS1; immediately adjacent to, west of, and south of the on-site residence; in the northern portion of the study area; and near the western site boundary along the existing barbed wire fence and within the Navajo Route 33 drainage culvert. Based on the lack of highly impacted subsurface soils at TS1, the data strongly suggest that surface deposition of AUMW is the source of the radioactivity and indicate that the vertical extent of elevated Ra-226 soil concentrations is primarily confined within the upper 12 inches of soil.

Additional recommendations at TS1 include further evaluation of indoor radon and gamma activity concentrations at both the on-site residence and the residence located north of the current site boundary to completely identify all exposure pathways and human health exposure risks. Gamma activity scans should be extended north, west, and east of the current site boundary to primarily incorporate the single-family residence to the north and the drainage culvert located west of Navajo Route 33, which may be susceptible to surface runoff of soils containing gamma-emitting radioisotopes from residual uranium-bearing ore.

Based on the EPA-established DCGL of 2.0 pCi/g, START estimates the initial removal boundary impacted by AUMW at TS1 is approximately 252,995 square feet, with an estimated average depth of 1 foot. It should be noted that this is the current approximate extent of soil with gamma activity counts exceeding 36,044 cpm, which corresponds to the DCGL of 2.0 pCi/g, and is based on observed correlations between Ra-226 concentrations <10 pCi/g and one-minute gamma activity counts in co-located surface soil samples at TS1 and TS2. The estimated volume of soil that will need to be removed from the TS1, based on the DCGL of 2 pCi/g is approximately 9,370 cubic yards (yd<sup>3</sup>). Due to the recommended additional assessment of gamma activity levels at TS1 outside the current site boundary, this soil removal volume is estimated and will likely increase with new data.

Results from TS2 indicate that surface soils with gamma activity measurements corresponding to Ra-226 surface soil concentrations elevated slightly above the site-specific action level are present in areas surrounding the central portion of the TS2 site and within the east and west drainage culverts located along Navajo Route 33. Surface soils with gamma activity measurements corresponding to Ra-226 surface soil concentrations greater than twice the site-specific action level are primarily located in the central portion of the TS2 site. Based on the lack of highly impacted subsurface soils at TS2, the data strongly suggest that surface deposition of AUMW is the source of radioactivity and indicate that the vertical extent of elevated Ra-226 concentrations is primarily confined within the upper 12 inches of soil.

## **5. Conclusions and Recommendations**

Additional recommendations at TS2 include extending gamma activity scans to the east of the Navajo Route 33 drainage culvert and north of current site boundary where slightly elevated gamma activity measurements were identified to delineate areas potentially susceptible to surface runoff of soils containing gamma-emitting radioisotopes from residual uranium-bearing ore.

Based on the EPA-established DCGL of 2.0 pCi/g, START estimates the initial removal boundary impacted by AUMW at TS2 is approximately 275,761 square feet, with an estimated average depth of 1 foot. It should be noted that this is the current approximate extent of soil with gamma activity counts exceeding 36,044 cpm, which equates to the DCGL of 2.0 pCi/g, and is based on observed correlations between Ra-226 concentrations <10 pCi/g and one-minute gamma activity counts in co-located surface soil samples at TS1 and TS2. The estimated volume of soil that will need to be removed from the TS2, based on the DCGL of 2 pCi/g is approximately 10,213 yd<sup>3</sup>. Due to the recommended additional assessment of gamma activity levels at TS2 outside the current site boundary, this soil removal volume is estimated and will likely increase with new data.

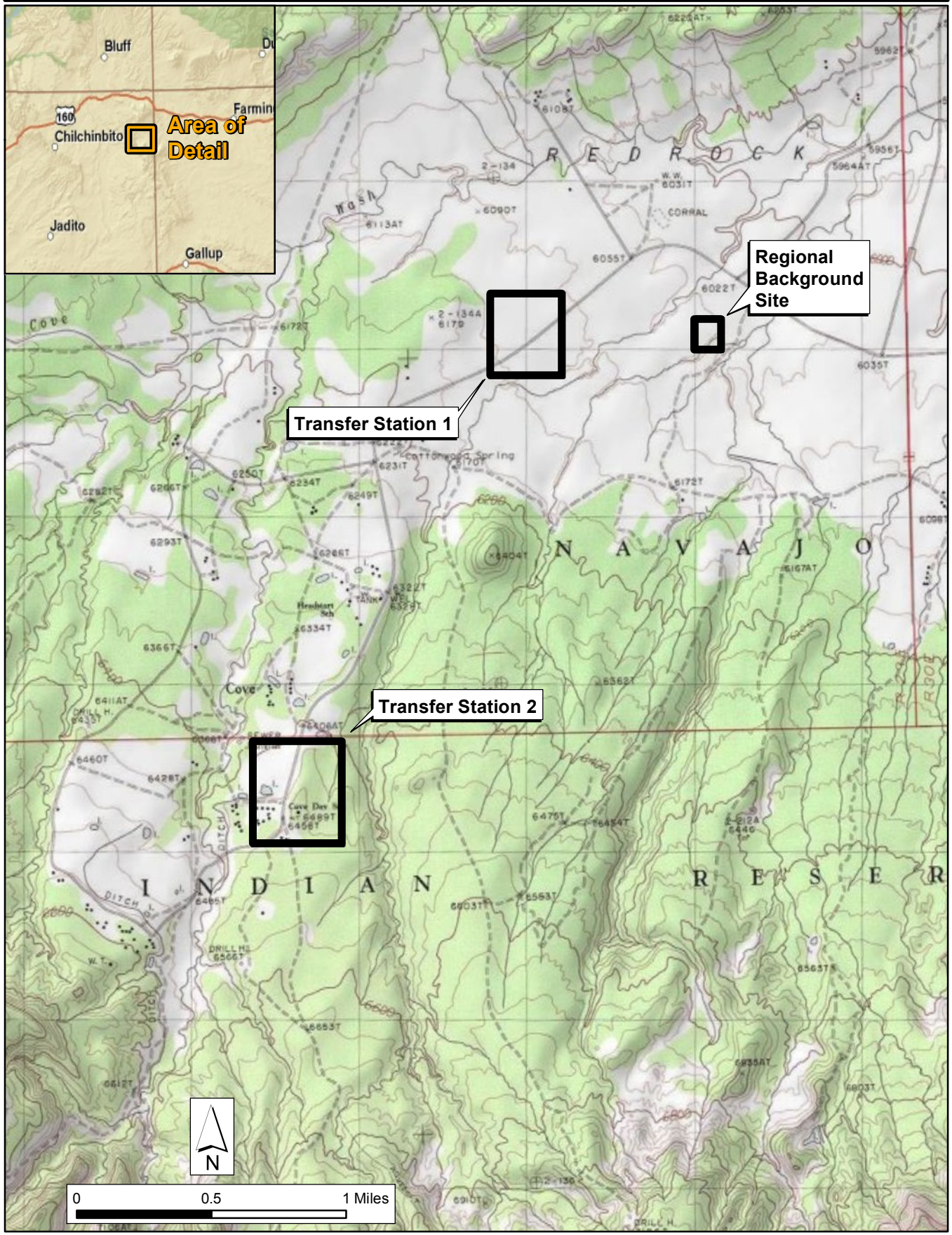
In addition, START recommends an evaluation of feasible disposal alternatives to determine the most effective method of disposing of impacted soils. The feasibility study should include evaluating the use of existing mines, contaminated areas, and/or soil repositories. The evaluation should include input from NNEPA personnel and local residents who might be impacted by the presence of a new or modified existing soil repository.

## 6 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.
- MARSSIM, 2000. “*Multi-Agency Radiation Survey and Site Investigation Manual*,” August 2000.
- EPA, 1990. “*Quality Assurance/Quality Control guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures*,” (EPA/540/G-90/004 OSWER Directive 9360.4-01), April 1990.
- EPA, 2004. “*U.S. EPA CLP National Functional Guidelines for Inorganic Data Review*,” (OSWER 9240.1-45, EPA 540-R-04-004), October 2004.
- EPA and NNEPA, 2010. “*Background Location Selection Criteria, Prepared by NNEPA and EPA*,” April 2010.
- Weston Solutions, Inc., 2007. “*Preliminary Assessment Report for Cove Transfer Station, Cove, Arizona, prepared for the U.S. EPA Region 9 EPA ID No.: NNN000906016*,” August 2007.

# Appendix A: Figures

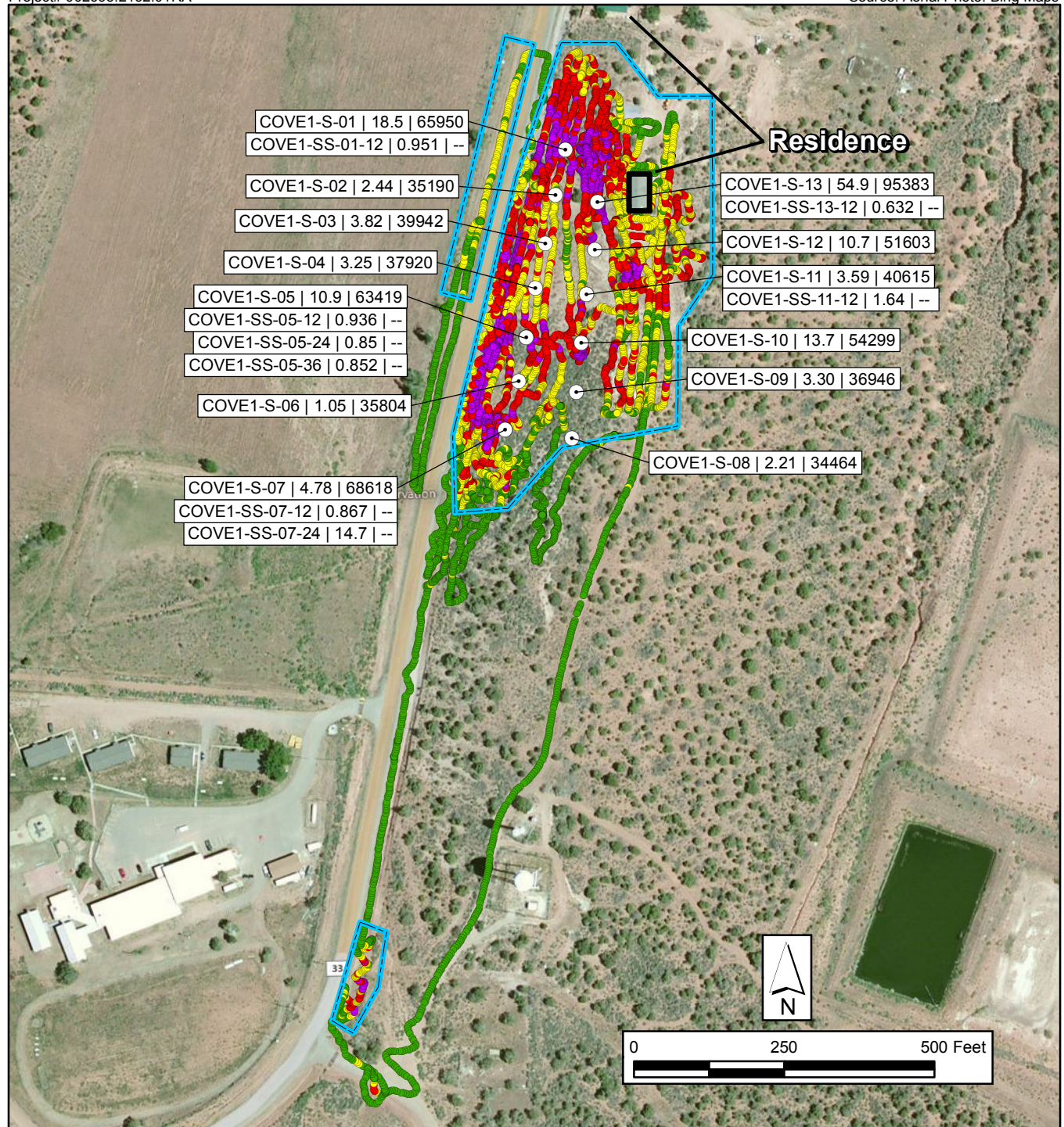




**Figure 1**  
**Site Location Map**

**Cove, Apache County, Arizona**





## LEGEND

- Proposed excavation boundary
- Ra-226 soil sample location

## Gamma Activity (cpm)

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

## ABBREVIATIONS

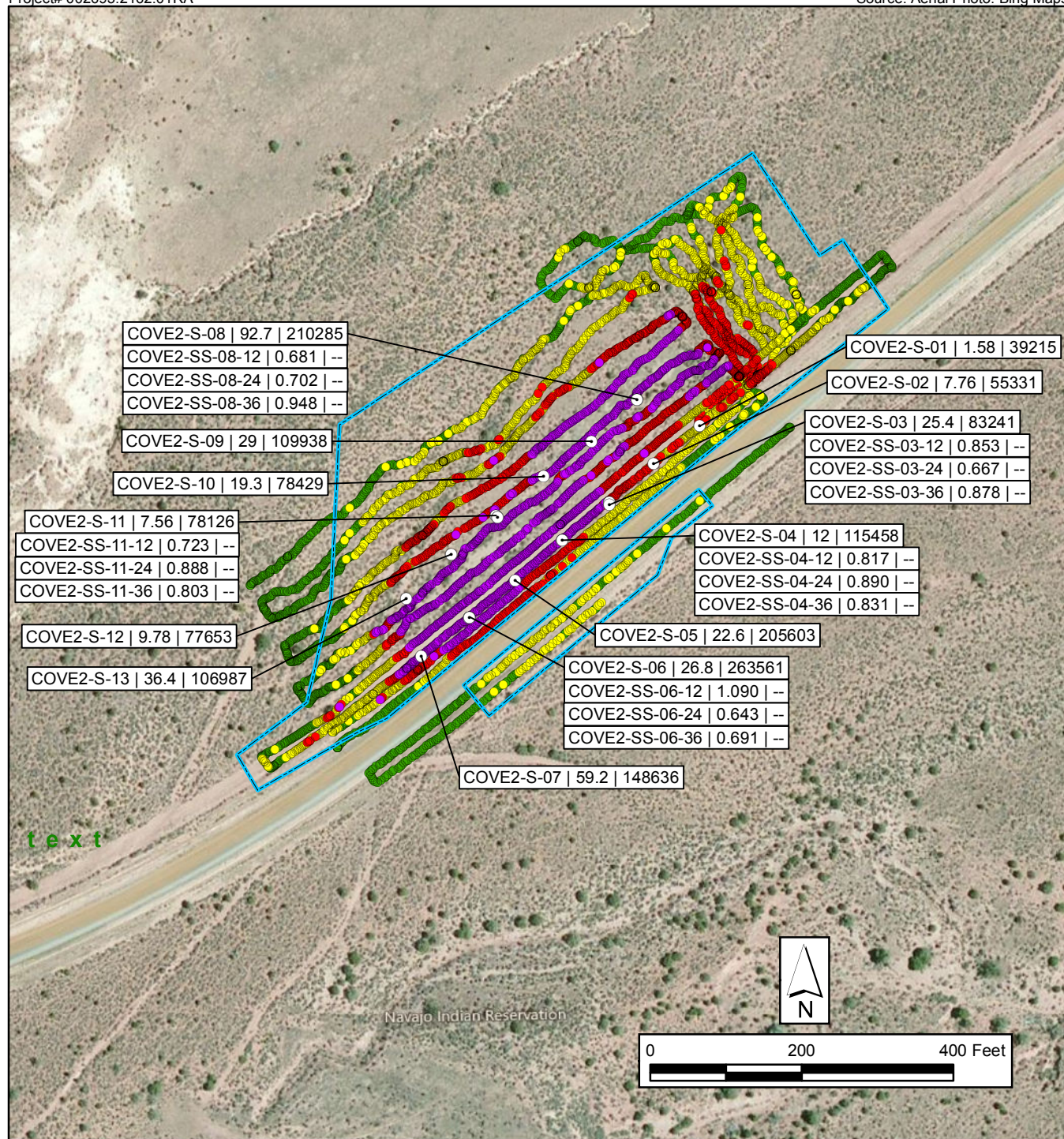
- cpm counts per minute
- pCi/g picocuries per gram
- Ra-226 Radium-226

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

Depth	Sample ID	Ra - 226 (pCi/g)	One Minute Gamma Activity Count (cpm)
Surface	COVE1-S-01	0.305	65,950
Subsurface	COVE1-SS-01-12	0.951	--

**Figure 2**  
**Transfer Station 1**  
**Surface Gamma Activity and**  
**Ra-226 Soil Sampling Locations**  
**Cove, Apache County, Arizona**





### LEGEND

- Proposed excavation boundary
- Ra-226 soil sample location

### 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

Depth	Sample ID	Ra - 226 (pCi/g)	One Minute Gamma Activity Count (cpm)
Surface	COVE2-S-08	92.7	210,285
Subsurface	COVE2-SS-08-24	0.702	--

**Figure 3**  
**Transfer Station 2**  
**Surface Gamma Activity and**  
**Ra-226 Soil Sampling Locations**  
**Cove, Apache County, Arizona**





### LEGEND

- Ra-226 soil sample location

### Gamma Activity (cpm)

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

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

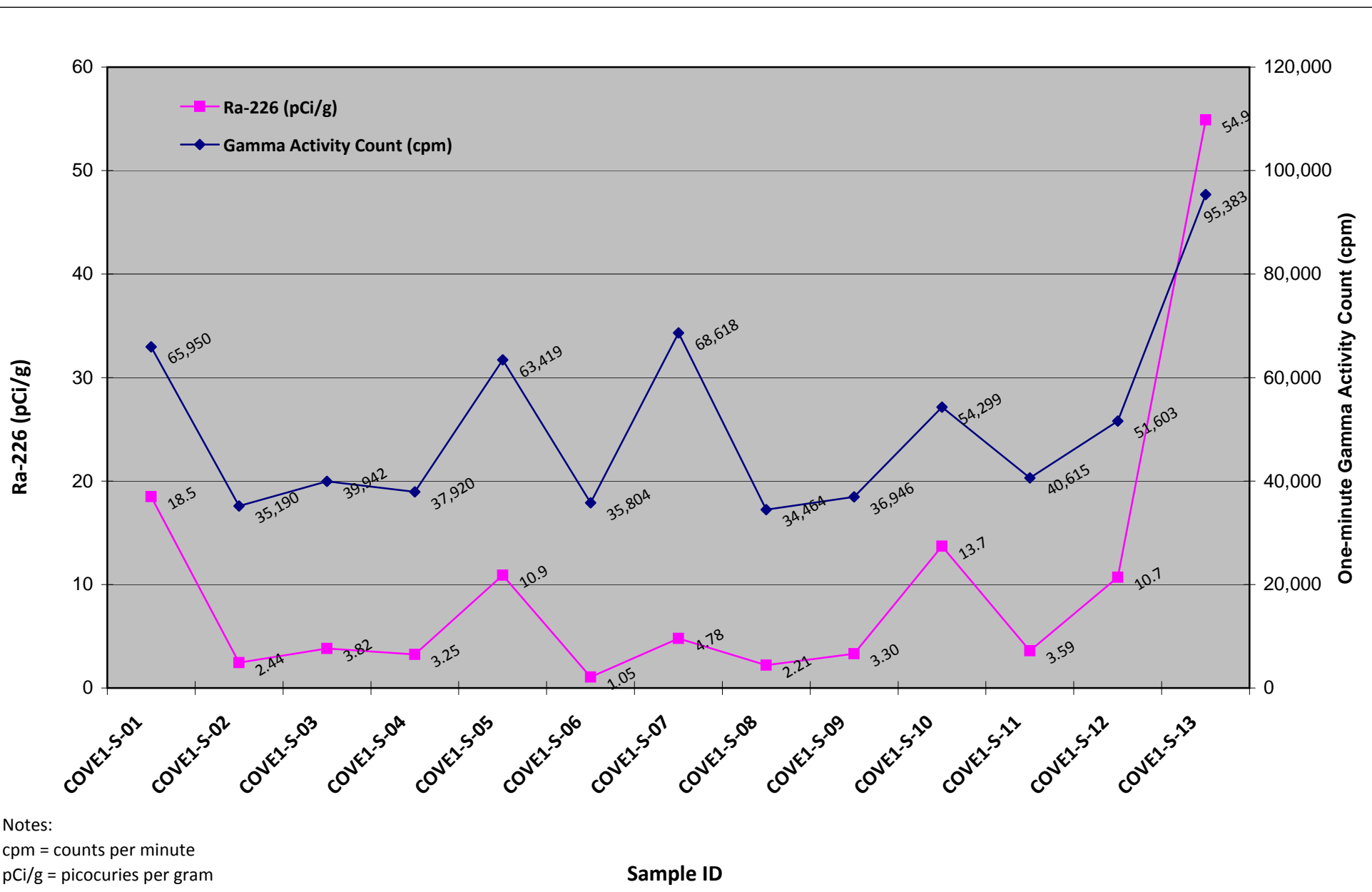
### ABBREVIATIONS

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

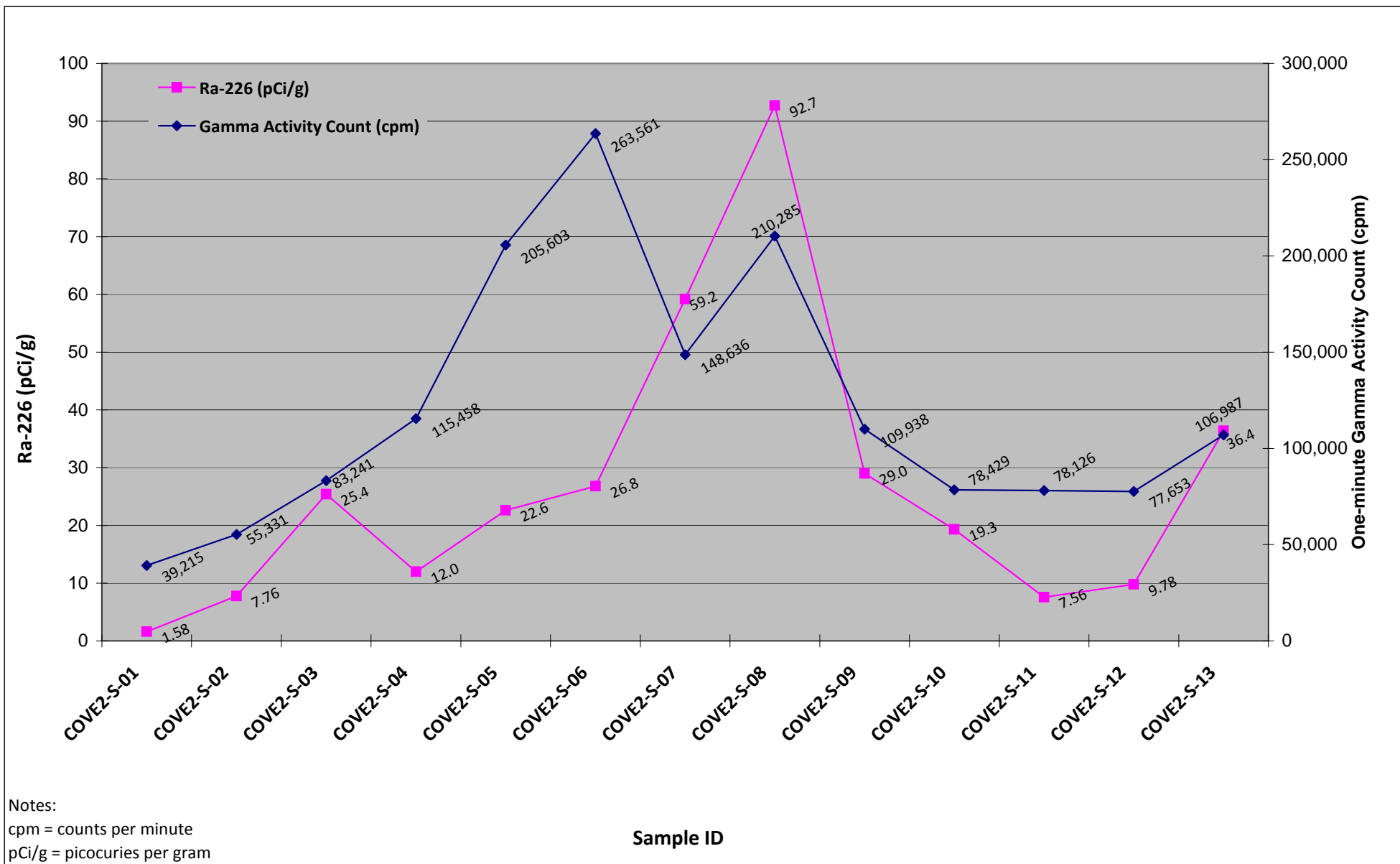
Sample ID	Ra - 226 (pCi/g)	One Minute Gamma Activity Count (cpm)
COVE-BKG-01	0.987	27,063

**Figure 4**  
**Regional Background Site**  
**Surface Gamma Activity and**  
**Ra-226 Soil Sampling Locations**  
**Cove, Apache County, Arizona**

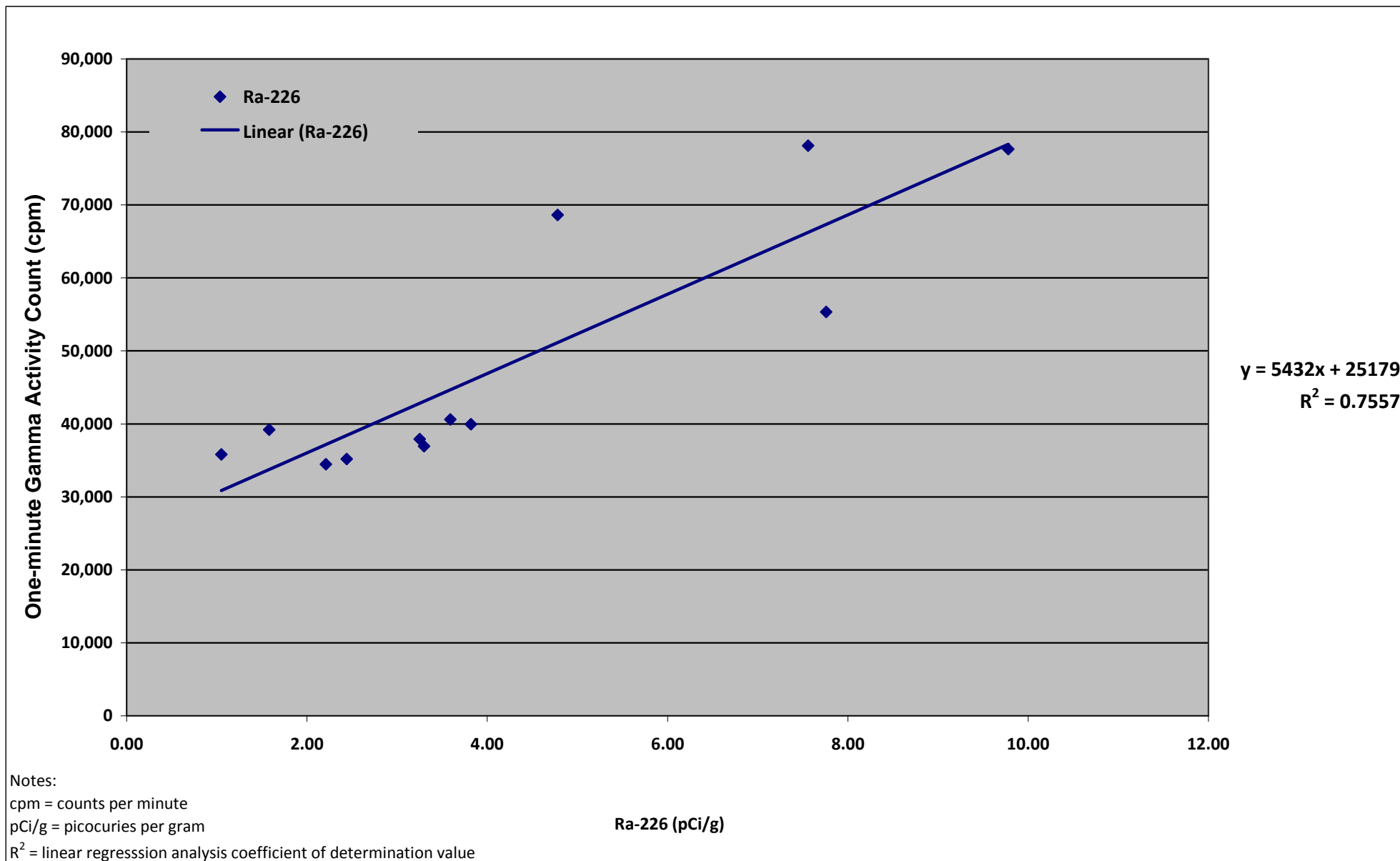
**Figure 5. Transfer Station 1**  
**Ra-226 in Surface Soil and Associated One-minute Gamma Activity Count**  
**Abandoned Uranium Mine Waste Removal Assessment**  
**Cove, Apache County, Arizona**



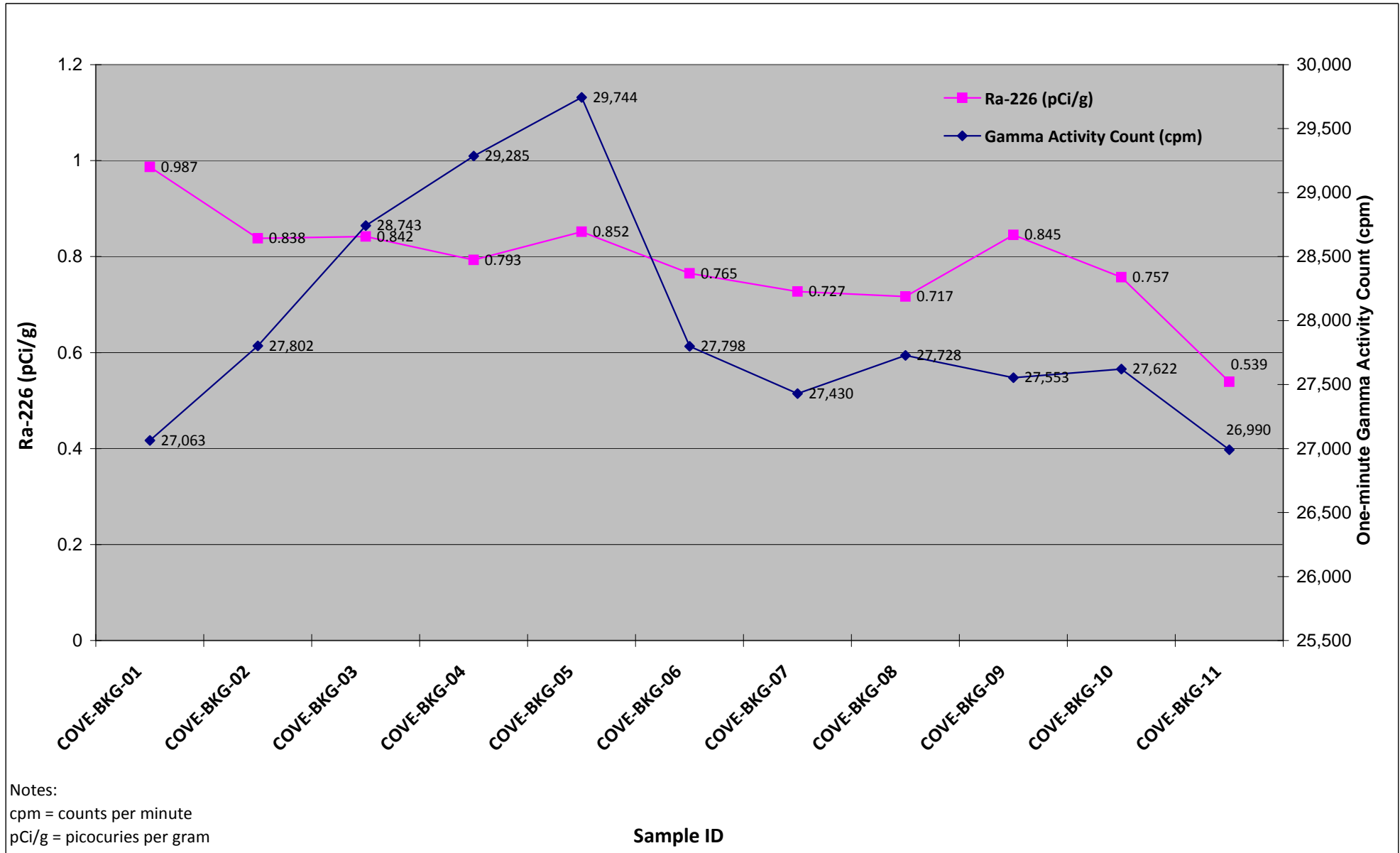
**Figure 6. Transfer Station 2**  
**Ra-226 in Surface Soil and Associated One-minute Gamma Activity Count**  
**Abandoned Uranium Mine Waste Removal Assessment**  
**Cove, Apache County, Arizona**



**Figure 7. Transfer Stations 1 and 2, Gamma Activity Correlation Study,  
Ra-226 Concentrations <10 pCi/g versus One-minute Gamma Activity Count  
Abandoned Uranium Mine Removal Assessment  
Cove, Apache County, Arizona**



**Figure 8. Regional Background Site**  
**Ra-226 in Surface Soil and Associated One-minute Gamma Activity Count**  
**Abandoned Uranium Mine Waste Removal Assessment**  
**Cove, Apache County, Arizona**



## **Appendix B: Site Photographs**





**COVE TRANSFER STATION SITES 1 AND 2**  
**Abandoned Uranium Mine Waste Removal Assessment**  
Cove, Apache County, Arizona

E&E Project. No.: 002693.2162.01RA

TDD No: TO2-09-11-10-0002



**PHOTO 1**

**Date:** 11/16/2011

**Direction:** Southwest

**Photographer:** N. Ellis

**Description:** Transfer Station Site 1 - Site overview extending south and west to Route 33



**PHOTO 2**

**Date:** 11/16/2011

**Direction:** Northwest

**Photographer:** N. Ellis

**Description:** Transfer Station Site 1 - View of impacted slope located west of the residential structure



**PHOTO 3**

**Date:** 11/16/2011

**Direction:** North

**Photographer:** N. Ellis

**Description:** Transfer Station Site 1 - View of residential structure and impacted slope to the west

**COVE TRANSFER STATION SITES 1 AND 2**  
**Abandoned Uranium Mine Waste Removal Assessment**  
Cove, Apache County, Arizona

E&E Project. No.: 002693.2162.01RA

TDD No: TO2-09-11-10-0002



**PHOTO 4**

**Date:** 11/16/2011

**Direction:** North-northeast

**Photographer:** N. Ellis

**Description:** Transfer Station Site 2 - Site overview and soil berm extending north



**PHOTO 5**

**Date:** 11/16/2011

**Direction:** South-southwest

**Photographer:** N. Ellis

**Description:** Transfer Station Site 2 - Site overview and soil berm extending south



**PHOTO 6**

**Date:** 11/17/2011

**Direction:** North

**Photographer:** N. Ellis

**Description:** Background Location - Site overview extending north



# **Appendix C: Summary of Analytical Laboratory Results and Gamma Activity Measurements**



**Table 1. Transfer Station 1**  
**Summary of Soil Sample Results for Ra-226 and Associated One-minute Gamma Activity Count**  
**Abandoned Uranium Mine Waste Removal Assessment**  
**Cove, Apache County, Arizona**

Sample ID	Ra-226 (pCi/g)	Method Detection Limit (pCi/g)	One-minute Gamma Activity Count (cpm)
Surface Soil Samples			
COVE1-S-01	18.5	0.305	65,950
COVE1-S-02	2.44	0.132	35,190
COVE1-S-03	3.82	0.217	39,942
COVE1-S-04	3.25	0.126	37,920
COVE1-S-05	10.9	0.172	63,419
COVE1-S-06	1.05	0.119	35,804
COVE1-S-07	4.78	0.175	68,618
COVE1-S-08	2.21	0.155	34,464
COVE1-S-09	3.30	0.175	36,946
COVE1-S-10	13.7	0.264	54,299
COVE1-S-11	3.59	0.188	40,615
COVE1-S-12	10.7	0.226	51,603
COVE1-S-13	54.9	0.499	95,383
COVE1-S-113*	78.2	0.542	92,643
MINIMUM	1.05	0.119	34,464
MAXIMUM	54.9	0.499	95,383
AVERAGE	10.24	0.21	50,781
STANDARD DEVIATION	14.4	0.1	18,307
R <sup>2</sup> COEFFICIENT VALUE	0.76		
DCGL VALUE	2.0		
Subsurface Soil Samples			
COVE1-SS-01-12	0.951	0.116	NA
COVE1-SS-05-12	0.936	0.166	NA
COVE1-SS-05-24	0.850	0.157	NA
COVE1-SS-05-36	0.852	0.156	NA
COVE1-SS-07-12	0.867	0.127	NA
COVE1-SS-07-24	14.7	0.203	NA
COVE1-SS-11-12	1.64	0.136	NA
COVE1-SS-13-12	0.632	0.146	NA

**Notes:**

- 1) Soil samples analyzed for Radium 226 by EML HASL 300, 4.5.2.3
- 2) One-minute Gamma activity counts measured by Ludlum Measurements Inc. Model 2241 Ratemeter & Detector Model 44-20 3"x3" NaI Gamma Scintillator
- 3) (\*) indicates field duplicate sample not included within statistical analysis
- 4) cpm = counts per minute
- 5) DCGL = Derived Concentration Guidance Level
- 6) pCi/g = picocuries per gram
- 7) R<sup>2</sup> = linear regression analysis coefficient of determination value
- 8) bold/shade indicates that the Ra-226 sample concentration exceeds the established DCGL value
- 9) NA = Not Applicable

Table 2. Transfer Station 2			
Summary of Soil Sample Results for Ra-226 and Associated One-minute Gamma Activity Count			
Abandoned Uranium Mine Waste Removal Assessment			
Cove, Apache County, Arizona			
Sample ID	Ra-226 (pCi/g)	Method Detection Limit (pCi/g)	One-minute Gamma Activity Count (cpm)
Surface Soil Samples			
COVE2-S-01	1.58	0.106	39,215
COVE2-S-02	7.76	0.170	55,331
COVE2-S-03	25.4	0.265	83,241
COVE2-S-04	12.0	0.185	115,458
COVE2-S-05	22.6	0.274	205,603
COVE2-S-06	26.8	0.336	263,561
COVE2-S-07	59.2	0.477	148,636
COVE2-S-08	92.7	0.541	210,285
COVE2-S-09	29.0	0.282	109,938
COVE2-S-10	19.3	0.209	78,429
COVE2-S-11	7.56	0.166	78,126
COVE2-S-12	9.78	0.171	77,653
COVE2-S-13	36.4	0.327	106,987
COVE2-S-106*	23.3	0.251	260,884
MINIMUM	1.58	0.106	39,215
MAXIMUM	92.7	0.541	263,561
AVERAGE	26.93	0.27	120,959
STANDARD DEVIATION	24.90	0.13	67,406
R <sup>2</sup> COEFFICIENT VALUE	0.33		
DCGL VALUE	2.0		
Subsurface Soil Samples			
COVE2-SS-03-12	0.853	0.122	NA
COVE2-SS-03-24	0.667	0.132	NA
COVE2-SS-03-36	0.878	0.166	NA
COVE2-SS-04-12	0.817	0.110	NA
COVE2-SS-04-24	0.890	0.134	NA
COVE2-SS-04-36	0.831	0.150	NA
COVE2-SS-06-12	1.09	0.153	NA
COVE2-SS-06-24	0.643	0.127	NA
COVE2-SS-06-36	0.691	0.147	NA
COVE2-SS-08-12	0.681	0.123	NA
COVE2-SS-08-24	0.702	0.132	NA
COVE2-SS-08-36	0.948	0.172	NA
COVE2-SS-11-12	0.723	0.105	NA
COVE2-SS-11-24	0.888	0.123	NA
COVE2-SS-11-36	0.803	0.145	NA

**Notes:**

- 1) Soil samples analyzed for Radium 226 by EML HASL 300, 4.5.2.3
- 2) One-minute Gamma activity counts measured by Ludlum Measurements Inc. Model 2241 Ratemeter & Detector Model 44-20 3"x3" NaI Gamma Scintillator
- 3) (\*) indicates field duplicate sample not included within statistical analysis
- 4) cpm = counts per minute
- 5) DCGL = Derived Concentration Guidance Level
- 6) pCi/g = picocuries per gram
- 7) R<sup>2</sup> = linear regression analysis coefficient of determination value
- 8) bold/shade indicates that the Ra-226 sample concentration exceeds the established DCGL value
- 9) NA = Not Applicable

**Table 3. Regional Background Site  
Summary of Soil Sample Results for Ra-226 and Associated One-minute Gamma Activity Count  
Abandoned Uranium Mine Waste Removal Assessment  
Cove, Apache County, Arizona**

Sample ID	Ra-226 (pCi/g)	Method Detection Limit (pCi/g)	One-minute Gamma Activity Count (cpm)
COVE-BKG-01	0.987	0.120	27,063
COVE-BKG-02	0.838	0.183	27,802
COVE-BKG-03	0.842	0.146	28,743
COVE-BKG-04	0.793	0.174	29,285
COVE-BKG-05	0.852	0.107	29,744
COVE-BKG-06	0.765	0.159	27,798
COVE-BKG-07	0.727	0.137	27,430
COVE-BKG-08	0.717	0.111	27,728
COVE-BKG-09	0.845	0.139	27,553
COVE-BKG-10	0.757	0.115	27,622
COVE-BKG-11	0.539	0.132	26,990
<b>MINIMUM</b>	<b>0.539</b>	<b>0.107</b>	<b>26,990</b>
<b>MAXIMUM</b>	<b>0.987</b>	<b>0.183</b>	<b>29,744</b>
<b>AVERAGE</b>	<b>0.787</b>	<b>0.138</b>	<b>27,978</b>
<b>STANDARD DEVIATION</b>	<b>0.112</b>	<b>0.025</b>	<b>892</b>
<b>R<sup>2</sup> COEFFICIENT VALUE</b>	<b>0.07</b>		
<b>DCGL VALUE</b>	<b>2.0</b>		

**Notes:**

- 1) Soil samples analyzed for Radium 226 by EML HASL 300, 4.5.2.3
- 2) One-minute Gamma activity counts measured by Ludlum Measurements Inc. Model 2241 Ratemeter & Detector Model 44-20 3"x3" NaI Gamma Scintillator
- 3) cpm = counts per minute
- 4) DCGL = Derived Concentration Guidance Level
- 5) pCi/g = picocuries per gram
- 6) R<sup>2</sup> = linear regression analysis coefficient of determination value

**Table 4. Transfer Stations 1 and 2 Gamma Activity Correlation Study,  
Summary of Soil Sample Results for Ra-226 Surface Concentrations <10 pCi/g and  
Associated One-minute Gamma Activity Count  
Abandoned Uranium Mine Waste Removal Assessment  
Cove, Apache County, Arizona**

Sample ID	Ra-226 (pCi/g)	One-minute Gamma Activity Count (cpm)
COVE1-S-06	1.05	35,804
COVE2-S-01	1.58	39,215
COVE1-S-08	<b>2.21</b>	34,464
COVE1-S-02	<b>2.44</b>	35,190
COVE1-S-04	<b>3.25</b>	37,920
COVE1-S-09	<b>3.30</b>	36,946
COVE1-S-11	<b>3.59</b>	40,615
COVE1-S-03	<b>3.82</b>	39,942
COVE1-S-07	<b>4.78</b>	68,618
COVE2-S-11	<b>7.56</b>	78,126
COVE2-S-02	<b>7.76</b>	55,331
COVE2-S-12	<b>9.78</b>	77,653
<b>MINIMUM</b>	<b>1.05</b>	<b>34,464</b>
<b>MAXIMUM</b>	<b>9.78</b>	<b>78,126</b>
<b>AVERAGE</b>	<b>4.260</b>	<b>48,319</b>
<b>STANDARD DEVIATION</b>	<b>2.721</b>	<b>17,005</b>
<b>R<sup>2</sup> COEFFICIENT VALUE</b>	<b>0.76</b>	
<b>DCGL VALUE</b>	<b>2.0</b>	

**Notes:**

- 1) Soil samples analyzed for Radium 226 by EML HASL 300, 4.5.2.3
- 2) One-minute Gamma activity counts measured by Ludlum Measurements Inc. Model 2241 Ratemeter & Detector Model 44-20 3"x3" NaI Gamma Scintillator
- 3) cpm = counts per minute
- 4) DCGL = Derived Concentration Guidance Level
- 5) pCi/g = picocuries per gram
- 6) R<sup>2</sup> = linear regression analysis coefficient of determination value
- 7) bold/shade indicates that the Ra-226 sample concentration exceeds the established DCGL value

# **Appendix D: Laboratory Analytical Data Validation Reports**



# ANALYTICAL DATA REVIEW SUMMARY

## Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

<b>Laboratory:</b> GEL Laboratories	<b>Lab Project Number:</b> 290716
<b>Sampling Dates:</b> November 18, 2011	<b>Sample Matrix:</b> Soil
<b>Analytical Method:</b> Radium-226 (EML HASL 300 4.5.2.3/Ga-01-R)	<b>Data Reviewer:</b> Joanna Christopher

### REVIEW AND APPROVAL:

**Data Reviewer:** Joanna Christopher  
**Technical QA Reviewer:** \_\_\_\_\_  
**Project Manager:** \_\_\_\_\_

**Date:** 1/26/12  
**Date:** \_\_\_\_\_  
**Date:** \_\_\_\_\_

### SAMPLE IDENTIFICATION:

Sample No.	Sample I.D.	Laboratory I.D.
1	COVE1-S-01	290716001
2	COVE1-S-02	290716002
3	COVE1-S-03	290716003
4	COVE1-S-04	290716004
5	COVE1-S-05	290716005
6	COVE1-S-06	290716006
7	COVE1-S-07	290716007
8	COVE1-S-08	290716008
9	COVE1-S-09	290716009
10	COVE1-S-10	290716010
11	COVE1-S-11	290716011
12	COVE1-S-12	290716012
13	COVE1-S-13	290716013
14	COVE1-S-113	290716014
15	COVE1-SS-13-12"	290716015
16	COVE1-SS-01-12"	290716016
17	COVE1-SS-11-12"	290716017
18	COVE1-SS-05-12"	290716018
19	COVE1-SS-05-24"	290716019
20	COVE1-SS-05-36"	290716020
21	COVE1-SS-07-12"	290716021
22	COVE1-SS-07-24"	290716022
23	RB-111811	290716023

# ANALYTICAL DATA REVIEW SUMMARY

## Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### DATA PACKAGE COMPLETENESS CHECKLIST:

#### Checklist Code:

- ☒ **X** Included: no problems
- ☐ **\*** Included: problems noted in review
- ☐ **O** Not Included and/or Not Available
- ☐ **NR** Not Required
- ☐ **RS** Provided As Re-submission

#### Case Narrative:

- ☒ **X** Case Narrative present

#### Quality Control Summary Package:

- ☒ **X** Data Summary sheets
- ☒ **X** Initial and Continuing Calibration results
- ☒ **X** Detector Background Control Charts
- ☐ **NR** Matrix Spike recoveries
- ☒ **X** Matrix Duplicate results
- ☒ **X** Laboratory Control Sample recoveries
- ☒ **X** Analysis Detection Limits
- ☒ **X** Preparation Log
- ☒ **X** Analysis Run Log

#### Raw QC Data Package Section

- ☒ **X** Chain-of-Custody Records
- ☒ **X** Instrument Printouts
- ☒ **X** Sample Preparation Notebook Pages
- ☐ **NR** Logbook and Worksheet Pages
- ☐ **NR** Percent Solids Determination



## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### DATA VALIDATION SUMMARY

The data were reviewed following procedures and limits specified in the EPA OSWER directive, *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (EPA/540/G-90/004, OSWER Directive 9360.4-01, dated April 1990).

Indicate with a YES or NO whether each item is acceptable without qualification:

1	Holding Times	Yes
2	Initial and Continuing Calibrations	Yes
3	Laboratory Control Sample	Yes
4	Matrix Spike	Not Required for Gamma Spec Analysis
5	Blanks and Background Samples	Yes
6	Duplicate Analyses	Yes (Field and Matrix Duplicates)
7	Analyte Quantitation	Yes
8	Overall Assessment of Data	Yes
9	Usability of Data	Yes

**Comments:** One field duplicate sample pair was collected for this SDG, consisting of samples COVE1-S-13/ COVE1-S-113.

# ANALYTICAL DATA REVIEW SUMMARY

## Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 1. HOLDING TIMES

☒ **Acceptable**  
☐ **Acceptable with qualification**  
☐ **Unacceptable**

Samples were extracted and analyzed within required holding times except as noted under Comments. In addition, no problems were identified with regard to sample preservation or custody unless specified. For those samples analyzed outside holding time requirements, the detected results have been qualified as estimated (J), and the nondetected results have been qualified either as estimated (UJ) or rejected (R) based on the reviewer's judgement.

#### **All Sample Matrices:**

Radiochemistry analyses: 6 months from collection to analysis.

**Comments:** For this analysis there was a minimum 7-day time period for radon gas to decay for analysis. The laboratory ingrowth period was 21 days. The samples were analyzed 26 days after collection, which is acceptable.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 1</i>	<b>Location:</b> <i>CoveTS1</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 2. INITIAL AND CONTINUING CALIBRATION VERIFICATION

☒ **Acceptable**  
☐ **Acceptable with qualification**  
☐ **Unacceptable**

Unless flagged below, an initial calibration verification (ICV), background, and efficiency check were performed for each gamma spec detector at the beginning of the run, and were within the laboratory acceptance limits.

#### Comments:

All gamma spec detectors used for these analyses were operating within acceptance criteria.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 1</i>	<b>Location:</b> <i>CoveTS1</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 3. LABORATORY CONTROL SAMPLE

- ☒ **Acceptable**  
☐ **Acceptable with qualification**  
☐ **Unacceptable**  
☐ **No Laboratory Control Samples Analyzed**

Laboratory control sample recoveries are used for a qualitative indication of accuracy (bias) independent of matrix effects. LCS recovery limits should either be specified in the Sampling and Analysis Plan or can be established by the laboratory. For analytes which exceeded these control limits, associated detected results are qualified as estimated (J). In cases where the recovery was below 30%, all associated nondetected results are rejected (R) and detected results are qualified as estimated (J).

#### Comments:

All gamma spec LCS recoveries associated with these analyses were within laboratory acceptance criteria for accuracy.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

#### 4. MATRIX SPIKE

☐ Acceptable  
☐ Acceptable with qualification  
☐ Unacceptable  
☒ **NR** No Matrix Spikes Analyzed

Matrix spike recoveries are used for a qualitative indication of accuracy (bias) due to matrix effects. Unless flagged below, one laboratory control sample was analyzed at a rate of one per batch or one per 20 samples. Recoveries were within a range of 75-125%. For analytes which exceeded these control limits, associated detected results are qualified as estimated (J). In cases where the recovery was below 30%, all associated nondetected results are rejected (R) and detected results are qualified as estimated (J).

#### Comments:

Matrix spike analyses are not required for gamma spec analysis.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 5. BLANKS AND BACKGROUND SAMPLES

☒ Acceptable  
☐ Detection Limits Adjusted

The following blanks were analyzed:

☒ Method (preparation) Blanks  
☐ Field Blanks  
☒ Calibration Blanks (instrument background check)  
☐ Rinsate Blanks  
☐ Background Samples

Preparation (method) blanks were prepared for each batch of samples extracted. A preparation blank was analyzed after every continuing calibration standard, prior to sample analysis unless noted below. Any compound detected in the sample and also detected in any associated blank, must be qualified as non-detect (U) when the sample concentration is less than 5x the blank concentration.

#### Comments:

All gamma spec background counts and method blanks associated with these analyses were within laboratory acceptance criteria.

# ANALYTICAL DATA REVIEW SUMMARY

## Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 6. DUPLICATE ANALYSES

☐ Acceptable  
☒ Acceptable with qualification  
☐ Unacceptable  
☐ No Duplicates Analyzed

Type of duplicates analyzed:

☒ Field Duplicates  
☒ Laboratory Duplicates

Calculate the relative Percent Difference (RPD) between the members of duplicate pairs using the equation indicated below. Qualify the detected results as estimated (J) for any analyte whose RPD in a laboratory duplicate exceeds 20% for water samples or 35% for soil samples.

$$RPD = \frac{2(\text{Value 1} - \text{Value 2})}{\text{Value 1} + \text{Value 2}} \times 100\%$$

For radiological analyses calculate the normalized absolute difference (NAD; also known as relative error ratio) between the members of duplicate pairs using the equation indicated below. Qualify the detected results as estimated (J) for any analyte whose NAD in a laboratory duplicate exceeds 3 for water samples or soil samples.

$$NAD = \frac{|x_1 - x_2|}{\sqrt{u_c(x_1)^2 + u_c(x_2)^2}}$$

Where:

**NAD** = statistical difference between two radioanalytical results  
 **$|x_1 - x_2|$**  = absolute value of the difference between result 1 and result 2  
 **$x_1$**  = measured activity of result 1  
 **$x_2$**  = measured activity of result 2  
 **$u_c(x_1)$**  = combined standard uncertainty for result 1  
 **$u_c(x_2)$**  = combined standard uncertainty for result 2

**Warning limit for NAD is 2.**  
**Control limit for NAD is 3.**

#### Comments:

The RPD and NAD calculated for the laboratory duplicate sample pair analyses performed for gamma spec analysis of radium-226 were within acceptance limits for precision. The RPD (45.6) and NAD (8.71) calculated for the field duplicate sample pair analyses performed for gamma spec analysis of radium-226 were outside acceptance limits for precision; therefore the results for the field duplicate sample pair were qualified with J as estimated.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 1</i>	<b>Location:</b> <i>CoveTS1</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 7. ANALYTE QUANTITATION

Confirm that analyte quantitation was performed correctly using the following formula:

$$\text{Ra-226 (pCi/g)} = \frac{\text{net peak area} \times \text{decay factor}}{2.22 \times \text{counting efficiency} \times \text{sample mass} \times \text{isotopic abundance} \times \text{count time} \times \text{ingrowth factor}}$$

**Comments:**

10% of the results were checked with reproducibility within 10%. The gamma spec result calculations were performed correctly.



## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 1	<b>Location:</b> CoveTS1
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 8. OVERALL ASSESSMENT OF DATA

On the basis of this review, the following determination has been made with regard to the overall data usability for the specified level.

☐ Acceptable  
☒ Acceptable with Qualification  
☐ Rejected

Accepted data meet the minimum requirements for the following EPA data category:

☐ ERS Screening  
☐ Non-definitive with 10 % Conformation by Definitive Methodology  
☐ Definitive, Comprehensive Statistical Error Determination was performed.  
☒ Definitive, Comprehensive Statistical Error Determination was not performed.

Any qualifications to individual sample analysis results are detailed in the appropriate section above or appear under the comments section below. In cases where several QC criteria are out of specification, it may be appropriate to further qualify the data usability. The data reviewer must use professional judgment and express concerns and comments on the data validity for each specific data package.

#### Comments:

All reported results are usable without qualification except those for the field duplicate sample pair, which were qualified with J as estimated because precision was outside acceptance criteria.

Ra-228 was detected in 12 samples in this SDG at levels ranging from 0.51 to 1.02 pCi/g, likely due to radioactive decay of naturally occurring Th-232. Cs-137 was detected in 10 samples in this SDG at levels ranging from 0.055 to 0.81 pCi/g, likely due to atmospheric radioactive fallout.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 1</i>	<b>Location:</b> <i>CoveTS1</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 9. DOCUMENTATION OF LABORATORY CORRECTIVE ACTION

**Problem:** None.

**Resolution:** N/A

**Attached are copies of all data summary sheets, with data qualifiers indicated, and a copy of the chain of custody for the samples.**

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-01  
Sample ID: 290716001  
Matrix: Soil  
Collect Date: 18-NOV-11 09:00  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		18.5	+/-2.12	0.305	1.00	pCi/g		MXR1	12/14/11	1121	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*gchristopher 1/26/12*

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Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-02  
Sample ID: 290716002  
Matrix: Soil  
Collect Date: 18-NOV-11 09:05  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		2.44	+/-0.311	0.132	1.00	pCi/g		MXR1	12/14/11	1122	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R		

*Chris Foster 11/26/12*

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Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-03  
Sample ID: 290716003  
Matrix: Soil  
Collect Date: 18-NOV-11 09:10  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		3.82	+/-0.546	0.217	1.00	pCi/g		MXR1	12/14/11	1122	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher* 1/26/12



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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-04 Project: ECOL00716  
Sample ID: 290716004 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 09:15  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		3.25	+/-0.422	0.126	1.00	pCi/g		MXR1	12/14/11	1127	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J. Christopher* 1/26/12

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## Certificate of Analysis

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-05  
Sample ID: 290716005  
Matrix: Soil  
Collect Date: 18-NOV-11 09:20  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		10.9	+/-1.19	0.172	1.00	pCi/g		MXR1	12/14/11	1222	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-06 Project: ECOL00716  
Sample ID: 290716006 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 09:25  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		1.05	+/-0.200	0.119	1.00	pCi/g		MXR1	12/14/11	1223	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J. Christopher 1/26/12*

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-07 Project: ECOL00716  
Sample ID: 290716007 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 09:30  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		4.78	+/-0.586	0.175	1.00	pCi/g		MXR1	12/14/11	1224	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*jjchristopher 1/26/12*

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-08  
Sample ID: 290716008  
Matrix: Soil  
Collect Date: 18-NOV-11 09:35  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		2.21	+/-0.348	0.155	1.00	pCi/g		MXR1	12/14/11	1316	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-09  
Sample ID: 290716009  
Matrix: Soil  
Collect Date: 18-NOV-11 09:40  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		3.30	+/-0.465	0.175	1.00	pCi/g		MXR1	12/14/11	1316	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-10 Project: ECOL00716  
Sample ID: 290716010 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 09:45  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		13.7	+/-1.49	0.264	1.00	pCi/g		MXR1	12/14/11	1317	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JJ Christopher 1/26/12*

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## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-11 Project: ECOL00716  
Sample ID: 290716011 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 09:50  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		3.59	+/-0.476	0.188	1.00	pCi/g		MXR1	12/14/11	1317	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-12  
Sample ID: 290716012  
Matrix: Soil  
Collect Date: 18-NOV-11 09:55  
Receive Date: 19-NOV-11  
Collector: Client  
Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		10.7	+/-1.16	0.226	1.00	pCi/g		MXR1	12/14/11	1318	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-13 Project: ECOL00716  
Sample ID: 290716013 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 10:00  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		54.9	+/-5.43	0.499	1.00	pCi/g		MXR1	12/14/11	1318	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-S-113 Project: ECOL00716  
Sample ID: 290716014 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 10:02  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		78.2	+/-8.64	0.542	1.00	pCi/g		MXR1	12/14/11	1319	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-13-12" Project: ECOL00716  
Sample ID: 290716015 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 10:30  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.632	+/-0.171	0.146	1.00	pCi/g		MXR1	12/14/11	1319	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-01-12" Project: ECOL00716  
Sample ID: 290716016 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 10:50  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.951	+/-0.191	0.116	1.00	pCi/g		MXR1	12/14/11	1319	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-11-12" Project: ECOL00716  
Sample ID: 290716017 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 10:40  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		1.64	+/-0.292	0.136	1.00	pCi/g		MXR1	12/14/11	1320	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-05-12" Project: ECOL00716  
Sample ID: 290716018 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 11:00  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.936	+/-0.255	0.166	1.00	pCi/g		MXR1	12/14/11	1320	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-05-24" Project: ECOL00716  
Sample ID: 290716019 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 11:05  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.850	+/-0.233	0.157	1.00	pCi/g		MXR1	12/14/11	1320	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-05-36" Project: ECOL00716  
Sample ID: 290716020 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 11:10  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.852	+/-0.222	0.156	1.00	pCi/g		MXR1	12/14/11	1331	1165665	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1446	1163320

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*jjchristopher 1/26/12*

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## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-07-12" Project: ECOL00716  
Sample ID: 290716021 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 11:15  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.867	+/-0.187	0.127	1.00	pCi/g		MXR1	12/14/11	1109	1165666	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1629	1163321

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE1-SS-07-24" Project: ECOL00716  
Sample ID: 290716022 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 18-NOV-11 11:20  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		14.7	+/-1.54	0.203	1.00	pCi/g		MXR1	12/14/11	1109	1165666	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1629	1163321

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JZ Christopher 1/26/12*



# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 15, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: RB-111811 Project: ECOL00716  
Sample ID: 290716023 Client ID: ECOL007  
Matrix: Water  
Collect Date: 18-NOV-11 11:30  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra228, liquid "As Received"												
Radium-226	U	9.01	+/-110	138		pCi/L		KXG3	12/14/11	1124	1169840	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J. Christopher* 1/26/12

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Page: 1 of 3  
Project #: 002693.2162.01RA  
GEL Quote #: \_\_\_\_\_  
COC Number (1): \_\_\_\_\_  
PO Number: \_\_\_\_\_

**GEL Chain of Custody and Analytical Request**

GEL Work Order Number: 290916

GEL Laboratories, LLC  
2040 Savage Road  
Charleston, SC 29407  
Phone: (843) 556-8171  
Fax: (843) 766-1178

Client Name: Ecology & Environment Phone #: 510/893-6700  
Project/Site Name: COVE TRANSFER STATION Fax #: 142  
Address: 1940 WILKESBORO ST. #100 OAKLAND, CA  
Collected by: WILLIE ELLIS Send Results To: MIRY SONG

Sample ID	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (a)	Field Filtered (b)	Sample Matrix (c)	Sample Analysis Requested (5) (Fill in the number of containers for each test)					Total number of containers	Should this sample be considered:	TSCA Regulated Radioactive	Preservative Type (6)	Comments Note: extra sample is required for sample specific QC
						1	2	3	4	5					
COVE1-S-01	11/18/11	0900	N		SO						1	X			
COVE1-S-02		0905	N								1	X			
COVE1-S-03		0910	N								1	X			
COVE1-S-04		0915	N								1	X			
COVE1-S-05		0920	N								1	X			
COVE1-S-06		0925	N								1	X			
COVE1-S-07		0930	N								1	X			
COVE1-S-08		0935	N								1	X			
COVE1-S-09		0940	N								1	X			
COVE1-S-10		0945	N								1	X			

TAT Requested: Normal: X Rush: \_\_\_\_\_ Specify: \_\_\_\_\_ (Subject to Surcharge) Fax Results: Yes / No  
Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: Are there any known hazards applicable to these samples? If so, please list the hazards

RADIOACTIVE

Sample Collection Time Zone  
Eastern Central Mountain Pacific Other

Chain of Custody Signatures

Relinquished By (Signed)	Date	Received by (signed)	Date	Time
<u>Willie Ellis</u>	<u>11/18/11</u>	<u>WILLIE ELLIS</u>	<u>11/19/11</u>	<u>915</u>

GEL PM: \_\_\_\_\_  
Method of Shipment: \_\_\_\_\_  
Date Shipped: \_\_\_\_\_  
Airbill #: \_\_\_\_\_  
Airbill #: \_\_\_\_\_

1) Chain of Custody Number = Client Determined  
2) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite  
3) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.  
4) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal  
5) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B -3, 6010B/7470A -1)  
6) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

For Lab Receiving Use Only  
Custody Seal Intact? YES NO  
Cooler Temp: C

WHITE = LABORATORY YELLOW = FILE PINK = CLIENT

La copy & Christopher 1/26/12

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Page 3 of 3

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

**GEL**

Laboratories LLC

## SAMPLE RECEIPT &amp; REVIEW FORM

&lt; a copy &gt; 1/26/12 J. Christopher

Client: <b>ECOL</b>		SDG/AR/COC/Work Order: <b>290707/290716</b>
Received By: <b>JP</b>		Date Received: <b>11-21-11</b>
Suspected Hazard Information	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation. <b>Net Counts: 0 cpm</b>
COC/Samples marked as radioactive?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Maximum Net Counts Observed* (Observed Counts - Area Background Counts):
Classified Radioactive II or III by RSO?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
COC/Samples marked containing PCBs?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Shipped as a DOT Hazardous?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Hazard Class Shipped: UN#:
Samples identified as Foreign Soil?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	

Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1 Shipping containers received intact and sealed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2 Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Preservation Method: Ice bags Blue ice Dry ice <u>None</u> Other (describe) *all temperatures are recorded in Celsius
2a Daily check performed and passed on IR temperature gun?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Temperature Device Serial #: <b>41502209</b> Secondary Temperature Device Serial # (If Applicable):
3 Chain of custody documents included with shipment?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4 Sample containers intact and sealed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
5 Samples requiring chemical preservation at proper pH?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's, containers affected and observed pH: If Preservation added, Lot#:
6 VOA vials free of headspace (defined as < 6mm bubble)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's and containers affected:
7 Are Encore containers present?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	(If yes, immediately deliver to Volatiles laboratory)
8 Samples received within holding time?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ID's and tests affected:
9 Sample ID's on COC match ID's on bottles?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's and containers affected:
10 Date & time on COC match date & time on bottles?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's affected: <b>time on container RB-111811 is 11:45</b>
11 Number of containers received match number indicated on COC?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's affected:
12 Are sample containers identifiable as GEL provided?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13 COC form is properly signed in relinquished/received sections?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14 Carrier and tracking number.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: <u>FedEx Air</u> FedEx Ground UPS Field Services Courier Other  <b>8710 1056 8337</b> <b>8710 1056 8348</b>

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials **JP**Date **11/21/11**Page **1** of **1**

# ANALYTICAL DATA REVIEW SUMMARY

## Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

<b>Laboratory:</b> GEL Laboratories	<b>Lab Project Number:</b> 290707
<b>Sampling Dates:</b> November 17, 2011	<b>Sample Matrix:</b> Soil
<b>Analytical Method:</b> Radium-226 (EML HASL 300 4.5.2.3/Ga-01-R)	<b>Data Reviewer:</b> Joanna Christopher

### REVIEW AND APPROVAL:

**Data Reviewer:** Joanna Christopher  
**Technical QA Reviewer:** \_\_\_\_\_  
**Project Manager:** \_\_\_\_\_

**Date:** 1/26/12  
**Date:** \_\_\_\_\_  
**Date:** \_\_\_\_\_

### SAMPLE IDENTIFICATION:

Sample No.	Sample I.D.	Laboratory I.D.
1	COVE2-S-01	290707001
2	COVE2-S-02	290707002
3	COVE2-S-03	290707003
4	COVE2-S-04	290707004
5	COVE2-S-05	290707005
6	COVE2-S-06	290707006
7	COVE2-S-07	290707007
8	COVE2-S-08	290707008
9	COVE2-S-09	290707009
10	COVE2-S-10	290707010
11	COVE2-S-11	290707011
12	COVE2-S-12	290707012
13	COVE2-S-13	290707013
14	COVE2-S-106	290707014
15	COVE2-SS-03-12"	290707015
16	COVE2-SS-03-24"	290707016
17	COVE2-SS-03-36"	290707017
18	COVE2-SS-04-12"	290707018
19	COVE2-SS-04-24"	290707019
20	COVE2-SS-04-36"	290707020
21	COVE2-SS-06-12"	290707021
22	COVE2-SS-06-24"	290707022
23	COVE2-SS-06-36"	290707023
24	COVE2-SS-08-12"	290707024
25	COVE2-SS-08-24"	290707025
26	COVE2-SS-08-36"	290707026
27	COVE2-SS-11-12"	290707027

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 2</i>	<b>Location:</b> <i>CoveTS2</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

Sample No.	Sample I.D.	Laboratory I.D.
28	COVE2-SS-11-24"	290707028
29	COVE2-SS-11-36"	290707029
30	RB-111711	290707030
31	COVE-BKG-01	290707031
32	COVE-BKG-02	290707032
33	COVE-BKG-03	290707033
34	COVE-BKG-04	290707034
35	COVE-BKG-05	290707035
36	COVE-BKG-06	290707036
37	COVE-BKG-07	290707037
38	COVE-BKG-08	290707038
39	COVE-BKG-09	290707039
40	COVE-BKG-10	290707040
41	COVE-BKG-11	290707041

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### DATA PACKAGE COMPLETENESS CHECKLIST:

#### Checklist Code:

<u>  X  </u>	Included: no problems
<u>  *  </u>	Included: problems noted in review
<u>  O  </u>	Not Included and/or Not Available
<u> NR </u>	Not Required
<u> RS </u>	Provided As Re-submission

#### Case Narrative:

<u>  X  </u>	Case Narrative present
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#### Quality Control Summary Package:

<u>  X  </u>	Data Summary sheets
<u>  X  </u>	Initial and Continuing Calibration results
<u>  X  </u>	Detector Background Control Charts
<u> NR </u>	Matrix Spike recoveries
<u>  X  </u>	Matrix Duplicate results
<u>  X  </u>	Laboratory Control Sample recoveries
<u>  X  </u>	Analysis Detection Limits
<u>  X  </u>	Preparation Log
<u>  X  </u>	Analysis Run Log

#### Raw QC Data Package Section

<u>  X  </u>	Chain-of-Custody Records
<u>  X  </u>	Instrument Printouts
<u>  X  </u>	Sample Preparation Notebook Pages
<u> NR </u>	Logbook and Worksheet Pages
<u> NR </u>	Percent Solids Determination



## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### DATA VALIDATION SUMMARY

The data were reviewed following procedures and limits specified in the EPA OSWER directive, *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (EPA/540/G-90/004, OSWER Directive 9360.4-01, dated April 1990).

Indicate with a YES or NO whether each item is acceptable without qualification:

1	Holding Times	Yes
2	Initial and Continuing Calibrations	Yes
3	Laboratory Control Sample	Yes
4	Matrix Spike	Not Required for Gamma Spec Analysis
5	Blanks and Background Samples	Yes
6	Duplicate Analyses	Yes (Field and Matrix Duplicates)
7	Analyte Quantitation	Yes
8	Overall Assessment of Data	Yes
9	Usability of Data	Yes

**Comments:** One field duplicate sample pair was collected for this SDG, consisting of samples COVE2-S-06/ COVE2-S-106.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

#### 1. HOLDING TIMES

☒ **Acceptable**  
☐ **Acceptable with qualification**  
☐ **Unacceptable**

Samples were extracted and analyzed within required holding times except as noted under Comments. In addition, no problems were identified with regard to sample preservation or custody unless specified. For those samples analyzed outside holding time requirements, the detected results have been qualified as estimated (J), and the nondetected results have been qualified either as estimated (UJ) or rejected (R) based on the reviewer's judgement.

#### **All Sample Matrices:**

Radiochemistry analyses: 6 months from collection to analysis.

**Comments:** For this analysis there was a minimum 7-day time period for radon gas to decay for analysis. The laboratory ingrowth period was 21 days. The samples were analyzed 27 to 28 days after collection, which is acceptable.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 2</i>	<b>Location:</b> <i>CoveTS2</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 2. INITIAL AND CONTINUING CALIBRATION VERIFICATION

☒ **Acceptable**  
☐ **Acceptable with qualification**  
☐ **Unacceptable**

Unless flagged below, an initial calibration verification (ICV), background, and efficiency check were performed for each gamma spec detector at the beginning of the run, and were within the laboratory acceptance limits.

#### Comments:

All gamma spec detectors used for these analyses were operating within acceptance criteria.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 2</i>	<b>Location:</b> <i>CoveTS2</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 3. LABORATORY CONTROL SAMPLE

☒ **Acceptable**  
☐ **Acceptable with qualification**  
☐ **Unacceptable**  
☐ **No Laboratory Control Samples Analyzed**

Laboratory control sample recoveries are used for a qualitative indication of accuracy (bias) independent of matrix effects. LCS recovery limits should either be specified in the Sampling and Analysis Plan or can be established by the laboratory. For analytes which exceeded these control limits, associated detected results are qualified as estimated (J). In cases where the recovery was below 30%, all associated nondetected results are rejected (R) and detected results are qualified as estimated (J).

#### Comments:

All gamma spec LCS recoveries associated with these analyses were within laboratory acceptance criteria for accuracy.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 2</i>	<b>Location:</b> <i>CoveTS2</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

#### 4. MATRIX SPIKE

\_\_\_\_\_ **Acceptable**  
\_\_\_\_\_ **Acceptable with qualification**  
\_\_\_\_\_ **Unacceptable**  
NR **No Matrix Spikes Analyzed**

Matrix spike recoveries are used for a qualitative indication of accuracy (bias) due to matrix effects. Unless flagged below, one laboratory control sample was analyzed at a rate of one per batch or one per 20 samples. Recoveries were within a range of 75-125%.

For analytes which exceeded these control limits, associated detected results are qualified as estimated (J). In cases where the recovery was below 30%, all associated nondetected results are rejected (R) and detected results are qualified as estimated (J).

#### Comments:

Matrix spike analyses are not required for gamma spec analysis.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 5. BLANKS AND BACKGROUND SAMPLES

☒ Acceptable  
☐ Detection Limits Adjusted

The following blanks were analyzed:

☒ Method (preparation) Blanks  
☐ Field Blanks  
☒ Calibration Blanks (instrument background check)  
☐ Rinsate Blanks  
☒ Background Samples

Preparation (method) blanks were prepared for each batch of samples extracted. A preparation blank was analyzed after every continuing calibration standard, prior to sample analysis unless noted below. Any compound detected in the sample and also detected in any associated blank, must be qualified as non-detect (U) when the sample concentration is less than 5x the blank concentration.

#### Comments:

All gamma spec background counts and method blanks associated with these analyses were within laboratory acceptance criteria.

# ANALYTICAL DATA REVIEW SUMMARY

## Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 6. DUPLICATE ANALYSES

- ☒ Acceptable  
☐ Acceptable with qualification  
☐ Unacceptable  
☐ No Duplicates Analyzed

Type of duplicates analyzed:

- ☒ Field Duplicates  
☒ Laboratory Duplicates

Calculate the relative Percent Difference (RPD) between the members of duplicate pairs using the equation indicated below. Qualify the detected results as estimated (J) for any analyte whose RPD in a laboratory duplicate exceeds 20% for water samples or 35% for soil samples.

$$RPD = \frac{2(\text{Value 1} - \text{Value 2})}{\text{Value 1} + \text{Value 2}} \times 100\%$$

For radiological analyses calculate the normalized absolute difference (NAD; also known as relative error ratio) between the members of duplicate pairs using the equation indicated below. Qualify the detected results as estimated (J) for any analyte whose NAD in a laboratory duplicate exceeds 3 for water samples or soil samples.

$$NAD = \frac{|x_1 - x_2|}{\sqrt{u_c(x_1)^2 + u_c(x_2)^2}}$$

Where:

- NAD** = statistical difference between two radioanalytical results  
 **$|x_1 - x_2|$**  = absolute value of the difference between result 1 and result 2  
 **$x_1$**  = measured activity of result 1  
 **$x_2$**  = measured activity of result 2  
 **$u_c(x_1)$**  = combined standard uncertainty for result 1  
 **$u_c(x_2)$**  = combined standard uncertainty for result 2

Warning limit for NAD is 2.

Control limit for NAD is 3.

### Comments:

The NAD calculated for the laboratory duplicate and field duplicate sample pair analyses performed for gamma spec analysis of radium-226 were within acceptance limits for precision.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> Cove Transfer Station 2	<b>Location:</b> CoveTS2
<b>Project TDD Number:</b> 09-11-10-0002	<b>PAN:</b> 002693.2162.01RA

### 7. ANALYTE QUANTITATION

Confirm that analyte quantitation was performed correctly using the following formula:

$$\text{Ra-226 (pCi/g)} = \frac{\text{net peak area} \times \text{decay factor}}{2.22 \times \text{counting efficiency} \times \text{sample mass} \times \text{isotopic abundance} \times \text{count time} \times \text{ingrowth factor}}$$

**Comments:**

10% of the results were checked with reproducibility within 10%. The gamma spec result calculations were performed correctly.



## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 2</i>	<b>Location:</b> <i>CoveTS2</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 8. OVERALL ASSESSMENT OF DATA

On the basis of this review, the following determination has been made with regard to the overall data usability for the specified level.

☒ **Acceptable**  
☐ **Acceptable with Qualification**  
☐ **Rejected**

Accepted data meet the minimum requirements for the following EPA data category:

☐ **ERS Screening**  
☐ **Non-definitive with 10 % Conformation by Definitive Methodology**  
☐ **Definitive, Comprehensive Statistical Error Determination was performed.**  
☒ **Definitive, Comprehensive Statistical Error Determination was not performed.**

Any qualifications to individual sample analysis results are detailed in the appropriate section above or appear under the comments section below. In cases where several QC criteria are out of specification, it may be appropriate to further qualify the data usability. The data reviewer must use professional judgment and express concerns and comments on the data validity for each specific data package.

#### Comments:

All reported results are usable without qualification.

Ra-228 was detected in 29 samples in this SDG at levels ranging from 0.63 to 7.76 pCi/g, likely due to radioactive decay of naturally occurring Th-232. Cs-137 was detected in 16 samples in this SDG at levels ranging from 0.13 to 0.76 pCi/g, likely due to atmospheric radioactive fallout.

## ANALYTICAL DATA REVIEW SUMMARY

### Tier 2 Validation

<b>Site Name:</b> <i>Cove Transfer Station 2</i>	<b>Location:</b> <i>CoveTS2</i>
<b>Project TDD Number:</b> <i>09-11-10-0002</i>	<b>PAN:</b> <i>002693.2162.01RA</i>

### 9. DOCUMENTATION OF LABORATORY CORRECTIVE ACTION

**Problem:** None.

**Resolution:** N/A

Attached are copies of all data summary sheets, with data qualifiers indicated, and a copy of the chain of custody for the samples.

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-01  
Sample ID: 290707001  
Matrix: Soil  
Collect Date: 17-NOV-11 09:45  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		1.58	+/-0.230	0.106	1.00	pCi/g		MXR1	12/14/11	1341	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R		

*Christopher* 1/26/12

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-02  
Sample ID: 290707002  
Matrix: Soil  
Collect Date: 17-NOV-11 09:50  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		7.76	+/-0.861	0.170	1.00	pCi/g		MXR1	12/14/11	1341	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

# GEL LABORATORIES LLC

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Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-03  
Sample ID: 290707003  
Matrix: Soil  
Collect Date: 17-NOV-11 09:55  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		25.4	+/-2.69	0.265	1.00	pCi/g		MXR1	12/14/11	1342	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-04  
Sample ID: 290707004  
Matrix: Soil  
Collect Date: 17-NOV-11 10:00  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		12.0	+/-1.33	0.185	1.00	pCi/g		MXR1	12/14/11	1343	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*gchristopher 1/26/12*

# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-05  
Sample ID: 290707005  
Matrix: Soil  
Collect Date: 17-NOV-11 10:05  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		22.6	+/-2.36	0.274	1.00	pCi/g		MXR1	12/15/11	0535	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID:	COVE2-S-06	Project:	ECOL00716
Sample ID:	290707006	Client ID:	ECOL007
Matrix:	Soil		
Collect Date:	17-NOV-11 10:10		
Receive Date:	19-NOV-11		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		26.8	+/-2.80	0.336	1.00	pCi/g		MXR1	12/15/11	0536	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*



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## Certificate of Analysis

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-07  
Sample ID: 290707007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:15  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		59.2	+/-6.64	0.477	1.00	pCi/g		MXR1	12/15/11	0544	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*jj Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-08 Project: ECOL00716  
Sample ID: 290707008 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:40  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		92.7	+/-9.25	0.541	1.00	pCi/g		MXR1	12/15/11	0544	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JP Christopher* 1/26/12

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-09  
Sample ID: 290707009  
Matrix: Soil  
Collect Date: 17-NOV-11 10:45  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		29.0	+/-2.97	0.282	1.00	pCi/g		MXR1	12/15/11	0545	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Joanna Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-10 Project: ECOL00716  
Sample ID: 290707010 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:50  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		19.3	+/-1.96	0.209	1.00	pCi/g		MXR1	12/15/11	0616	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*gchristophe 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-11  
Sample ID: 290707011  
Matrix: Soil  
Collect Date: 17-NOV-11 10:55  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		7.56	+/-0.843	0.166	1.00	pCi/g		MXR1	12/15/11	0617	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*jjchristopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-12  
Sample ID: 290707012  
Matrix: Soil  
Collect Date: 17-NOV-11 11:00  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		9.78	+/-1.06	0.171	1.00	pCi/g		MXR1	12/15/11	0617	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*g7Chris Toher 1/26/12*

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Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-13  
Sample ID: 290707013  
Matrix: Soil  
Collect Date: 17-NOV-11 11:05  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		36.4	+/-3.70	0.327	1.00	pCi/g		MXR1	12/15/11	0618	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

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Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-S-106 Project: ECOL00716  
Sample ID: 290707014 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:12  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		23.3	+/-2.38	0.251	1.00	pCi/g		MXR1	12/15/11	0619	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Chris Tocher 1/26/12*



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Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-03-12" Project: ECOL00716  
Sample ID: 290707015 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:05  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.853	+/-0.195	0.122	1.00	pCi/g		MXR1	12/15/11	0619	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-03-24" Project: ECOL00716  
Sample ID: 290707016 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:10  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.667	+/-0.205	0.132	1.00	pCi/g		MXR1	12/15/11	0620	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXCI	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*gchristopher 1/26/12*

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## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-03-36" Project: ECOL00716  
Sample ID: 290707017 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:00  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.878	+/-0.247	0.166	1.00	pCi/g		MXR1	12/15/11	0620	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*gchristopher 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-04-12" Project: ECOL00716  
Sample ID: 290707018 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:30  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.817	+/-0.174	0.110	1.00	pCi/g		MXR1	12/15/11	0621	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*jj Christopher 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-04-24" Project: ECOL00716  
Sample ID: 290707019 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:25  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.890	+/-0.201	0.134	1.00	pCi/g		MXR1	12/15/11	0656	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-04-36" Project: ECOL00716  
Sample ID: 290707020 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:20  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.831	+/-0.216	0.150	1.00	pCi/g		MXR1	12/15/11	0656	1165661	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1614	1163318

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JJ Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-06-12" Project: ECOL00716  
Sample ID: 290707021 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:40  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		1.09	+/-0.224	0.153	1.00	pCi/g		MXR1	12/16/11	0538	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Jz Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-06-24" Project: ECOL00716  
Sample ID: 290707022 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:45  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.643	+/-0.197	0.127	1.00	pCi/g		MXR1	12/16/11	0539	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J Christopher 1/26/12*



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#102  
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Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-06-36" Project: ECOL00716  
Sample ID: 290707023 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 10:50  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.691	+/-0.163	0.147	1.00	pCi/g		MXR1	12/16/11	0539	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JP Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-08-12" Project: ECOL00716  
Sample ID: 290707024 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 11:20  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.681	+/-0.156	0.123	1.00	pCi/g		MXR1	12/16/11	0540	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JF Christopher 1/26/12*

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-08-24" Project: ECOL00716  
Sample ID: 290707025 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 11:25  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.702	+/-0.197	0.132	1.00	pCi/g		MXR1	12/16/11	0551	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J. Christopher* 1/26/12

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Report Date: December 16, 2011

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-08-36" Project: ECOL00716  
Sample ID: 290707026 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 11:30  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.948	+/-0.251	0.172	1.00	pCi/g		MXR1	12/16/11	0556	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-11-12" Project: ECOL00716  
Sample ID: 290707027 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 11:00  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.723	+/-0.154	0.105	1.00	pCi/g		MXR1	12/16/11	0557	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JG Christopher 1/26/12*

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Report Date: December 16, 2011

Company : Ecology & Environment, Inc.  
Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-11-24" Project: ECOL00716  
Sample ID: 290707028 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 11:05  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.888	+/-0.206	0.123	1.00	pCi/g		MXR1	12/16/11	0559	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JJ Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE2-SS-11-36" Project: ECOL00716  
Sample ID: 290707029 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 11:10  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.803	+/-0.191	0.145	1.00	pCi/g		MXR1	12/16/11	0559	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: RB-111711 Project: ECOL00716  
Sample ID: 290707030 Client ID: ECOL007  
Matrix: Water  
Collect Date: 17-NOV-11 11:30  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra228, liquid "As Received"												
Radium-226	U	-29.6	+/-70.7	120		pCi/L		KXG3	12/14/11	1123	1169840	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*jj Christopher 1/26/12*



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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-01  
Sample ID: 290707031  
Matrix: Soil  
Collect Date: 17-NOV-11 13:10  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.987	+/-0.183	0.120	1.00	pCi/g		MXR1	12/16/11	0600	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-02 Project: ECOL00716  
Sample ID: 290707032 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 13:15  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.838	+/-0.228	0.183	1.00	pCi/g		MXR1	12/16/11	0601	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-03  
Sample ID: 290707033  
Matrix: Soil  
Collect Date: 17-NOV-11 13:20  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.842	+/-0.200	0.146	1.00	pCi/g		MXR1	12/16/11	0601	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JJ Christopher 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-04  
Sample ID: 290707034  
Matrix: Soil  
Collect Date: 17-NOV-11 13:25  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.793	+/-0.231	0.174	1.00	pCi/g		MXR1	12/16/11	0602	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JJ Christopher 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-05  
Sample ID: 290707035  
Matrix: Soil  
Collect Date: 17-NOV-11 13:30  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.852	+/-0.158	0.107	1.00	pCi/g		MXR1	12/16/11	0602	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-06 Project: ECOL00716  
Sample ID: 290707036 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 13:35  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.765	+/-0.193	0.159	1.00	pCi/g		MXR1	12/16/11	0606	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher 1/26/12*

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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-07 Project: ECOL00716  
Sample ID: 290707037 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 13:40  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.727	+/-0.200	0.137	1.00	pCi/g		MXR1	12/16/11	0648	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J. Christopher* 1/26/12

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#102  
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Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-08 Project: ECOL00716  
Sample ID: 290707038 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 13:45  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.717	+/-0.204	0.111	1.00	pCi/g		MXR1	12/16/11	0649	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Josephine 1/26/12*



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#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-09 Project: ECOL00716  
Sample ID: 290707039 Client ID: ECOL007  
Matrix: Soil  
Collect Date: 17-NOV-11 13:50  
Receive Date: 19-NOV-11  
Collector: Client

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.845	+/-0.190	0.139	1.00	pCi/g		MXR1	12/16/11	0649	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*J. Christensen* 1/26/12

# GEL LABORATORIES LLC

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Report Date: December 16, 2011

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-10  
Sample ID: 290707040  
Matrix: Soil  
Collect Date: 17-NOV-11 13:55  
Receive Date: 19-NOV-11  
Collector: Client

Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.757	+/-0.165	0.115	1.00	pCi/g		MXR1	12/16/11	0650	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*JJ Christopher 1/26/12*

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Address : 3700 Industry Ave.  
#102  
Lakewood, California 90712  
Contact: Ms. Mindy Song  
Project: 002693.2162.01RA06 Cove Transfer Stations 1&2 Assessment

Client Sample ID: COVE-BKG-11  
Sample ID: 290707041  
Matrix: Soil  
Collect Date: 17-NOV-11 14:00  
Receive Date: 19-NOV-11  
Collector: Client  
Project: ECOL00716  
Client ID: ECOL007

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis												
Gamma, Ra226, Solid "Dry Weight Corrected"												
Radium-226		0.539	+/-0.159	0.132	1.00	pCi/g		MXR1	12/16/11	0700	1165663	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	11/22/11	1625	1163319

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	

*Christopher* 1/26/12

<b>GEL Chain of Custody and Analytical Request</b>		GEL Laboratories, LLC 2040 Savage Road Charleston, SC 29407 Phone: (843) 556-8171 Fax: (843) 766-1178										
<b>GEL Work Order Number:</b>	<b>290707%</b>											
<b>Client Name:</b>	<b>EcoLogix &amp; ENVIRONMENTAL</b>	<b>Phone #:</b>	<b>(570) 893-6700</b>									
<b>Project/Site Name:</b>	<b>COVE TRANSFER STATIONS</b>	<b>Fax #:</b>	<b>#2</b>									
<b>Address:</b>	<b>1940 WALKER STREET ST. #100 OAKLAND, CA.</b>											
<b>Collected by:</b>	<b>Nen Ficus</b>	<b>Send Results To:</b>	<b>MICRO SONG</b>									
Sample ID		*Date Collected (mm-dd-yy)	*Time Collected (Military) (hh:mm)	QC Code (a)	Field Filtered (b)	Sample Matrix (c)	TSCA Regulated	Should this sample be considered:	Total number of containers	Sample Analysis Requested <sup>(d)</sup> (Fill in the number of containers for each test)	<- Preservative Type (6)	Comments
*For composites - indicate start and stop date/time												Note: extra sample is required for sample specific QC
COVE2-S-01		11/12/2011	0945	A		S	X		1	HASL RA-226		
COVE2-S-02			0950	A		I	X		1			
COVE2-S-03			0955	A		I	X		1			
COVE2-S-04			1000	A		I	X		1			
COVE2-S-05			1005	A		I	X		1			
COVE2-S-06			1010	A		I	X		1			
COVE2-S-07			1013	A		I	X		1			
COVE2-S-08			1040	A		I	X		1			
COVE2-S-09			1045	A		I	X		1			
COVE2-S-10			1050	A		I	X		1			
TAT Requested: Normal: X Rush:		Specify: (Subject to Surcharge)		Yes / No		Circle Deliverable: C of A / QC Summary		Level 1 / Level 2 / Level 3 / Level 4				
Remarks: Are there any known hazards applicable to these samples? If so, please list the hazards												
RADIOACTIVE												
Chain of Custody Signatures							Sample Shipping and Delivery Details					
Relinquished By (Signed)	Date	Received by (signed)	Date	Time	GEL PM:	Method of Shipment:						
[Signature]	11/18/11	[Signature]	11-20-11	0915		Airbill #: _____ Date Shipped: _____						
						Airbill #: _____						
						Airbill #: _____						

1.) Chain of Custody Number = Client Determined  
 2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Duplicate Sample, G = Grab, C = Composite  
 3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.  
 4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W-Water, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O-Oil, P-Paper, U-Urine, F-Fecal, N=Nasal  
 5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/470A - 1).  
 6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, BX = Hexams, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

For Lab Receiving Use Only  
Custody Seal Intact?  
YES NO  
Cooler Temp:  
19 C

*La copy > J. Christensen 1/26/12*

<h2 style="margin: 0;">GEL Chain of Custody and Analytical Request</h2>		GEL Laboratories, LLC 2040 Savage Road Charleston, SC 29407 Phone: (843) 556-8171 Fax: (843) 766-1178	
Page: <u>2</u> of <u>5</u> Project #: _____ GEL Quote #: _____ COC Number (1): _____ PO Number: _____		GEL Work Order Number: _____ Client Name: <u>Ecology &amp; Environment</u> Phone #: <u>510/893-6700</u> Project/Site Name: <u>TRANSFER STATIONS 1 &amp; 2</u> Fax #: _____ Address: <u>1940 WILBERSTEN ST. #100 OAKLAND, CA.</u> Collected by: <u>ALLEN KELIC</u> Send Results To: <u>MIRIAM SAGG</u>	
Sample ID * For composites - indicate start and stop date/time		* Date Collected (mm-dd-yy) * Time Collected (Military) (hh:mm) QC Code (2) Field Filtered (3) Sample Matrix (4)	Should this sample be considered: Radioactive TSCA Regulated Total number of containers Sample Analysis Requested (5) (Fill in the number of containers for each test) <-- Preservative Type (6) Comments Note: extra sample is required for sample specific QC
<u>COVER-5-11</u> <u>COVER-5-12</u> <u>COVER-5-13</u> <u>COVER-5-106</u> <u>COVER-55-03-12"</u> <u>COVER-55-03-24"</u> <u>COVER-55-03-36"</u> <u>COVER-55-04-12"</u> <u>COVER-55-04-24"</u> <u>COVER-55-04-36"</u>		<u>11/17/2011</u> <u>1100</u> <u>1105</u> <u>1012</u> <u>1005</u> <u>1010</u> <u>1000</u> <u>1030</u> <u>1025</u> <u>1020</u>	<u>50</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>
TAT Requested: Normal: <input checked="" type="checkbox"/> Rush: _____ Specify: _____ (Subject to Surcharge) Remarks: Are there any known hazards applicable to these samples? If so, please list the hazards		Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4 Sample Collection Time Zone Eastern Pacific Other <u>Mountain</u>	
<h3>Chain of Custody Signatures</h3>			
Relinquished By (Signed)	Date	Received by (signed)	Date
<u>Melvin</u>	<u>11/14/11</u>	<u>J.P. Pin</u>	<u>11-19-11</u>
1		2	
2		3	
Sample Shipping and Delivery Details GEL PM: _____ Method of Shipment: _____ Date Shipped: _____ Airbill #: _____ Airbill #: _____			
For Lab Receiving Use Only Custody Seal Intact? YES NO Cooler Temp: <u>110</u> C			

1.) Chain of Custody Number = Client Determined  
 2.) QC Codes: N = Normal Sample, TB = Trip Blank, FB = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite  
 3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.  
 4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal  
 5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).  
 6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank  
**WHITE = LABORATORY      YELLOW = FILE      PINK = CLIENT**

GEL Chain of Custody and Analytical Request						GEL Laboratories, LLC 2040 Savage Road Charleston, SC 29407 Phone: (843) 556-8171 Fax: (843) 766-1178	
GEL Work Order Number:			Client Name: Ecology & Environmental				
			Project/Site Name: COVE TRANSFER STATIONS / #2				
			Address:				
			Send Results To: MARY SONG				
Sample ID			Date Collected (mm-dd-yy)	*Time Collected (Military) (hh:mm)	QC Code (N)	Field Filtered (Y/N)	Sample Matrix (S/L/W)
* For composites - indicate start and stop date/time							
Cove 2 - SS - 06 - 12"			11/17/2011	1040	N		S
Cove 2 - SS - 06 - 24"				1245	N		S
Cove 2 - SS - 06 - 36"				1250	N		S
Cove 2 - SS - 08 - 12"				1120	N		S
Cove 2 - SS - 08 - 24"				1125	N		S
Cove 2 - SS - 08 - 36"				1130	N		S
Cove 2 - SS - 11 - 12"				1100	N		S
Cove 2 - SS - 11 - 24"				1105	N		S
Cove 2 - SS - 11 - 36"				1110	N		S
RB - 11711				1130	EB	N	W

TAT Requested: Normal: X Rush:	Specify:	(Subject to Surcharge)	Fax Results:	Yes	No	Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4
Remarks: Are there any known hazards applicable to these samples? If so, please list the hazards.						
RADIOACTIVE						

Chain of Custody Signatures			Sample Shipping and Delivery Details		
Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
M. Song	11/18/11	0600	J. P. Jones	11-19-11	0915

GEL PM:		Method of Shipment:		Date Shipped:	
Airbill #:		Airbill #:			

For Lab Receiving Use Only	
Custody Seal Intact?	YES NO
Cooler Temp:	10 °C

1.) Chain of Custody Number = Client Determined  
2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite  
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5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).  
6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, if no preservative is added = leave field blank  
WHITE = LABORATORY

WHITE = LABORATORY  
YELLOW = FILE  
PINK = CLIENT





## SAMPLE RECEIPT &amp; REVIEW FORM

*La copy*  
*Christopher 1/26/12*

Client: <b>ECOL</b>		SDG/AR/COC/Work Order: <b>290767/290716</b>	
Received By: <b>JP</b>		Date Received: <b>11-21-11</b>	
Suspected Hazard Information	Yes <input checked="" type="checkbox"/> No <input checked="" type="checkbox"/>	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation. <i>Net counts 0 cpm 11/21/11</i>	
COC/Samples marked as radioactive?	<input checked="" type="checkbox"/>	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): <b>0 cpm</b>	
Classified Radioactive II or III by RSO?	<input checked="" type="checkbox"/>		
COC/Samples marked containing PCBs?	<input checked="" type="checkbox"/>		
Shipped as a DOT Hazardous?	<input checked="" type="checkbox"/>	Hazard Class Shipped: UN#:	
Samples identified as Foreign Soil?	<input checked="" type="checkbox"/>		

Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1 Shipping containers received intact and sealed?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: Seals broken Damaged container Leaking container Other (describe):
2 Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Preservation Method: Ice bags Blue ice Dry ice <u>None</u> Other (describe): <i>*all temperatures are recorded in Celsius</i> <b>16</b>
2a Daily check performed and passed on IR temperature gun?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Temperature Device Serial #: <b>4150220 9</b> Secondary Temperature Device Serial # (If Applicable):
3 Chain of custody documents included with shipment?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
4 Sample containers intact and sealed?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: Seals broken Damaged container Leaking container Other (describe):
5 Samples requiring chemical preservation at proper pH?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sample ID's, containers affected and observed pH: If Preservation added, Lot#:
6 VOA vials free of headspace (defined as < 6mm bubble)?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sample ID's and containers affected:
7 Are Encore containers present?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	(If yes, immediately deliver to Volatiles laboratory)
8 Samples received within holding time?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	ID's and tests affected:
9 Sample ID's on COC match ID's on bottles?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sample ID's and containers affected:
10 Date & time on COC match date & time on bottles?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sample ID's affected: <i>time on container RB-111811 is 11:45</i>
11 Number of containers received match number indicated on COC?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sample ID's affected:
12 Are sample containers identifiable as GEL provided?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
13 COC form is properly signed in relinquished/received sections?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
14 Carrier and tracking number.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: <u>FedEx Air</u> FedEx Ground UPS Field Services Courier Other <b>8716 1056 8337</b> <b>8710 1056 8348</b>

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials

*JP*

Date

*11/21/11*

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of

*1*