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DOE/NV/03624--0752

NEVADA NATIONAL SECURITY SITE

2019 DATA REPORT: GROUNDWATER MONITORING PROGRAM AREA 5 RADIOACTIVE WASTE MANAGEMENT SITE

March 2020

Prepared for:

U.S. Department of Energy

National Nuclear Security Administration

Nevada Field Office

Prepared by:

Mission Support and Test Services, LLC

Las Vegas, Nevada

DISCLAIMER

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Ag	silver
AMSL	above mean sea level
As	arsenic
Ba	barium
bgs	below ground surface
BN	Bechtel Nevada
°C	degree(s) Celsius
Ca^{+2}	calcium
Cd	cadmium
CFR	Code of Federal Regulations
Cl^{-}	chloride
cm	centimeter(s)
Cr	chromium
D M S.ds	degrees minutes seconds, decimal seconds
DOE	U.S. Department of Energy
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
F^{-}	fluoride
FB	field blank
FD	field duplicate
Fe	iron
ft	foot (feet)
HCO_3^{-}	bicarbonate
HDPE	high-density polyethylene
Hg	mercury
HNO_3	nitric acid
H_2SO_4	sulfuric acid
IL	investigation level
in.	inch(es)
K^{+}	potassium
LCS	laboratory control sample
LR	laboratory replicate
m	meter(s)
MB	method blank
MCL	maximum contaminant level
MDL	method detection limit
Mg^{+}	magnesium

mg/l	milligram(s) per liter
ml	milliliter(s)
mmho/cm	millimho(s) per centimeter
Mn	manganese
M&O	Management and Operations
MS	matrix spike
MSTS	Mission Support and Test Services, LLC
Na^{+}	sodium
NDEP	Nevada Division of Environmental Protection
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
Pb	lead
PCB	polychlorinated biphenyl
pCi/l	picocurie(s) per liter
POC	Point of Compliance
QA	quality assurance
QAP	Quality Assurance Program
QC	quality control
QSAS	Quality Systems for Analytical Services
RCRA	*Resource Conservation and Recovery Act*
REECo	Reynolds Electrical and Engineering Company, Inc.
RL	reporting limit
RPD	relative percent difference
RWMS	Radioactive Waste Management Site
SAP	Sampling and Analysis Plan
SC	specific conductance
SDG	sample delivery group
Se	selenium
SiO_4^{-4}	silicate
SO_4^{-2}	sulfate
SVOA	semivolatile organic analyte
TB	trip blank
TOC	total organic carbon
TOX	total organic halides
UGTA	Underground Test Area
VOA	volatile organic analyte

EXECUTIVE SUMMARY

This report presents groundwater and leachate sample results from the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada National Security Site in Nye County, Nevada. Since 1993, groundwater samples have been collected and static water levels have been measured from the aquifer immediately below the Area 5 RWMS. The data are evaluated for evidence of effects on the aquifer related to the Area 5 RWMS. Leachate from the Cell 18 lined mixed waste cell has been sampled since 2011, and leachate from the Cell 25 lined mixed waste cell was first sampled in 2019 after it began receiving waste in August 2018. Leachate data are analyzed for hazardous contaminants to determine appropriate leachate handling and disposal. This report includes five years of data from 2015 through 2019.

In 2019, groundwater samples were collected and static water levels were measured at three wells near the Area 5 RWMS. Groundwater samples were collected at wells UE5PW-1 and UE5PW-3 on March 5 and August 6, 2019, and at well UE5PW-2 on March 12 and August 6, 2019. Static water levels were measured at wells UE5PW-1 and UE5PW-3 on March 4, June 10, August 5, and October 7, 2019, and at well UE5PW-2 on March 6, June 10, August 5, and October 7, 2019. Groundwater monitoring at the Area 5 RWMS complies with Title 40 Code of Federal Regulations (CFR) Part 264.97, *General ground-water monitoring requirements*, and 40 CFR 264.98, *Detection monitoring program*. Groundwater samples were analyzed for indicators of contamination (pH, specific conductance [SC], total organic carbon, total organic halides, and tritium) and toxicity characteristic metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). General water chemistry parameters (major cations [calcium, magnesium, potassium, and sodium], major anions [bicarbonate, chloride, and sulfate], iron, fluoride, manganese, and silicate) were also measured. Results from samples collected in 2019 were within the limits for each parameter established by the Nevada Division of Environmental Protection in *Resource Conservation and Recovery Act* (RCRA) Permit NEV HW0101, Revision 6. Data from the shallow aquifer indicate there has been no measurable impact to the uppermost aquifer from the Area 5 RWMS, and there were no significant changes in measured groundwater parameters compared to previous years.

Leachate from two lined mixed waste cells drains into sumps and is pumped into aboveground tanks at each cell. Samples are collected from the tanks at least annually or when the leachate volume approaches the 3,000-gallon tank capacity at Cell 18 or the 10,000-gallon tank capacity at Cell 25. In 2019, leachate samples were collected at Cell 18 on March 14, May 29, and December 11, 2019, and at Cell 25 on August 1, 2019. All leachate analytical results are below the regulatory levels for toxicity characteristic contaminants (40 CFR 261.24) and below the investigation levels for polychlorinated biphenyls (PCBs), tritium, pH, and SC specified in RCRA Permit NEV HW0101, Revision 6. No quantifiable PCB levels were detected in any leachate sample. Based on the leachate analytical results, leachate was pumped from the collection tanks and used for dust control at the cell that generated the leachate.

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1.0 INTRODUCTION

This report presents groundwater and leachate monitoring results from the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada National Security Site (NNSS) in Nye County, Nevada. The data include new results collected during calendar year 2019 and previous results from 2015 through 2018.

Title 40 Code of Federal Regulation (CFR) Part 264.91, *Required programs*, specifies groundwater monitoring for waste treatment, storage, and disposal facilities, and *Resource Conservation and Recovery Act* (RCRA) Permit NEV HW0101, Revision 6, defines the groundwater and leachate monitoring requirements for the Area 5 RWMS. Area 5 RWMS groundwater monitoring is in the detection monitoring phase described in 40 CFR 264.98, *Detection monitoring program*. Groundwater elevation, indicator parameters, toxicity characteristic metals, and general water chemistry parameters are monitored to provide a reliable indication of the presence of hazardous constituents in uppermost aquifer below the Area 5 RWMS.

Leachate data from the lined mixed waste cells (Cell 18 and Cell 25) at the Area 5 RWMS are used to characterize, classify, and identify the regulated properties of the leachate to determine the disposal method for collected leachate. RCRA Permit NEV HW0101, Revision 6, defines the leachate monitoring requirements. Leachate is monitored for the toxicity characteristic contaminants listed in Table 1 of 40 CFR 261.24, polychlorinated biphenyls (PCBs), tritium, pH, and specific conductance (SC). RCRA Permit NEV HW0101, Revision 6, allows leachate to be used for dust control on the cell that generated the leachate provided no regulatory levels for toxicity characteristic contaminants are exceeded.

1.1 PURPOSE AND SCOPE

This report satisfies the 2019 annual analytical and field data reporting requirements for groundwater and leachate monitoring at the Area 5 RWMS as required by RCRA Permit NEV HW0101, Revision 6. Data from 2015 through 2019 are provided. These data are evaluated to determine whether the Area 5 RWMS has affected the uppermost aquifer below the Area 5 RWMS and to determine the disposal method for leachate collected from the Area 5 mixed waste disposal unit, which comprises Cell 18 and Cell 25.

1.2 SITE CHARACTERISTICS

The Area 5 RWMS is located in Frenchman Flat at the NNSS, approximately 105 kilometers (65 miles) northwest of Las Vegas, Nevada (Figure 1-1). The region is one of the least populous in the U.S. due to lack of water resources. Ecologic and hydrogeologic conditions have been previously summarized for the NNSS (U.S. Department of Energy [DOE] 1997, Shott et al. 1998, Ostler et al. 2000, and Bechtel Nevada [BN] 2006) and the Area 5 RWMS (Reynolds Electrical and Engineering Company, Inc. [REECo] 1993 and 1994, Istok et al. 1994, and Blout et al. 1995). Frenchman Flat is a closed basin filled with 360 to 460 meters (m) (1,200 to 1,500 feet [ft]) of alluvial sediments in the Basin and Range Province. Permanent surface waters do not occur within the basin. The uppermost aquifer is found in the alluvial sediments approximately 244 m (801 ft) below the Area 5 RWMS. Frenchman Flat receives an average of 12 centimeters (cm) (4.7 inches [in.]) of precipitation per year, and potential evapotranspiration is approximately 150 cm (59 in.) per year. The plant community surrounding the site is a creosote bush (*Larrea tridentata*) shrubland characteristic of the Mojave Desert. Aboveground net primary productivity is comparatively low (approximately 300 kilograms per hectare per year), and there are few plant roots below the percolation depth of infiltrated precipitation (approximately 2.5 m [8.2 ft]).

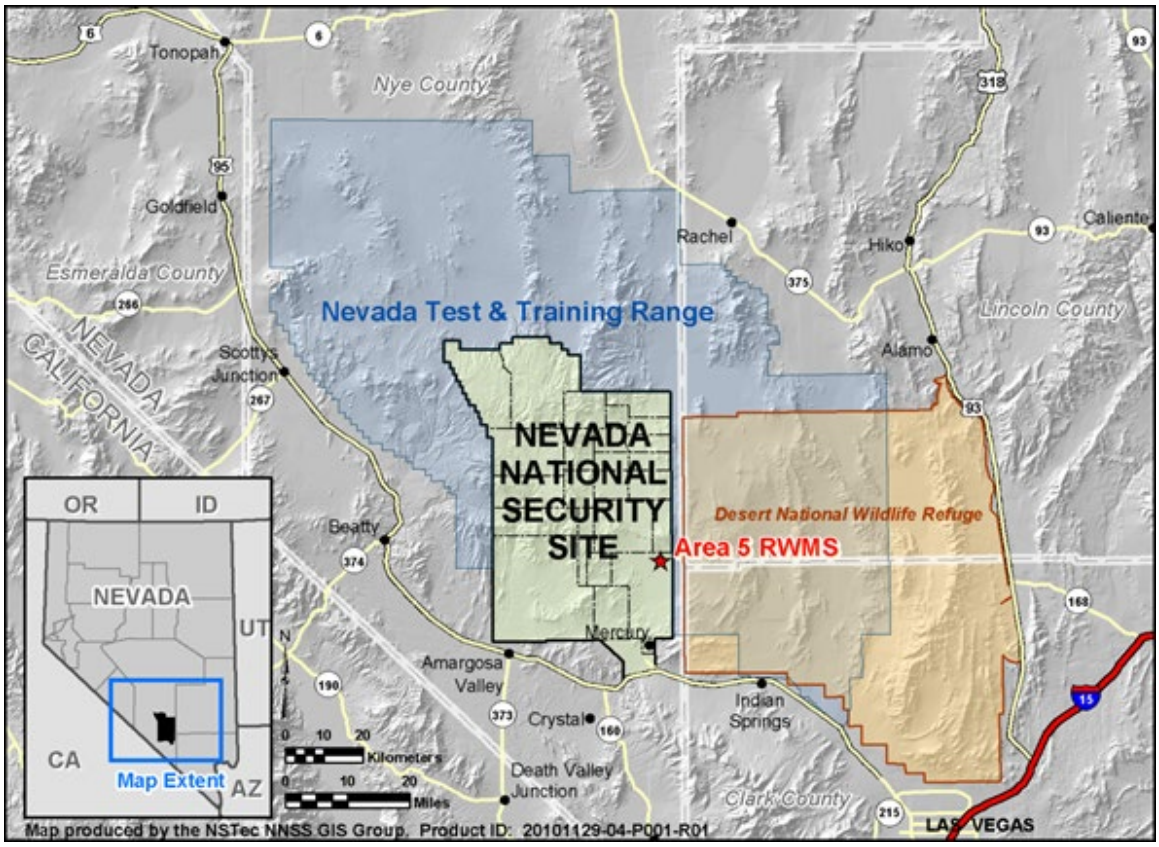


Figure 1-1. Location of the Area 5 Radioactive Waste Management Site

Site characterization studies indicate that infiltrated precipitation does not percolate below the depth of the plant root zone, and local aquifer recharge is negligible or absent under current climatic conditions. The chloride accumulation observed at approximately 2.5 m (8.2 ft) in the alluvial sediments indicates the percolation depth of infiltrated precipitation. The quantity of accumulated chloride indicates recharge to the aquifer ceased 10,000 to 15,000 years ago (Tyler et al. 1996 and Scanlon et al. 2003). Weighing lysimeters, in operation since 1994, have not detected drainage below a depth of 2.0 m (6.6 ft) in a vegetated lysimeter. Water potential measurements indicate that vadose zone moisture flows upwards in the upper 35.0 m (115 ft) of the vadose zone (Shott et al. 1998). Similar conclusions of negligible recharge have been made by other investigations of arid intermountain valleys of the southwestern U.S. desert (Andraski 1997, Walvoord et al. 2002, and Scanlon et al. 2003).

1.2.1 Site Hydrology

1.2.1.1 Saturated Zone

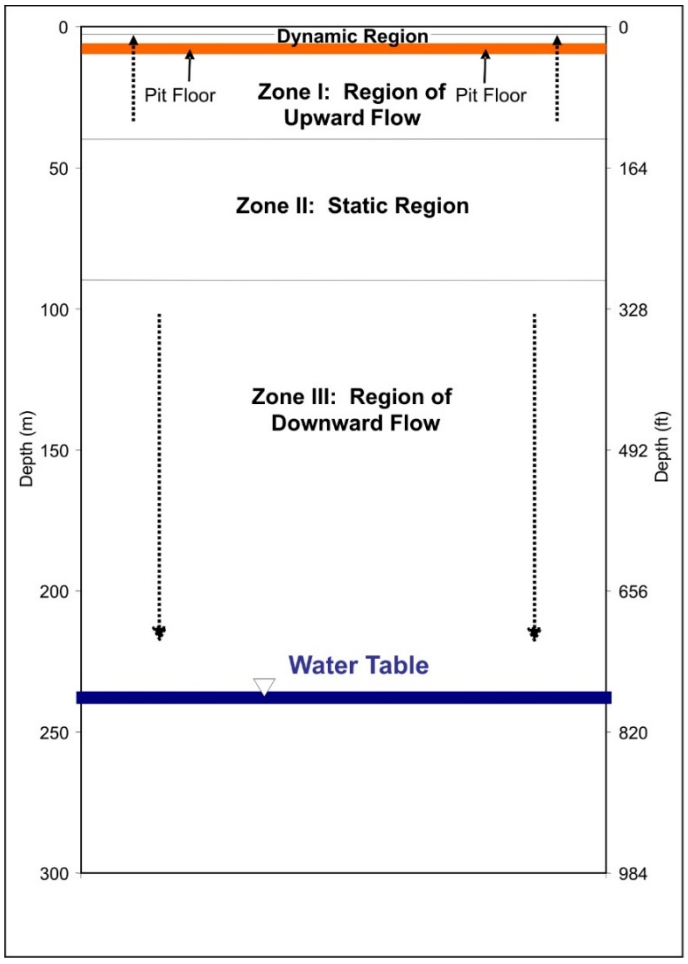
The water table in the uppermost aquifer is nearly flat with very little flow. At three monitoring wells near the Area 5 RWMS, the aquifer elevation varied between 733.36 m (2,406.0 ft) and 733.75 m (2,407.3 ft) above mean sea level (AMSL) from 2015 through 2019. During this period, the average water level elevation was 733.57 m (2,406.7 ft), the average hydraulic gradient was 0.000103 m/m to the south-southeast, and the average calculated flow velocity was 9.6 cm (3.8 in.) per year. The Underground Test Area (UGTA) program conceptualized a slow (less than 1.0 m [3.3 ft] per year) southeast groundwater flow in the central Frenchman Flat basin (DOE 2016).

1.2.1.2 Vadose Zone

Climate and vegetation strongly control the movement of water in the upper 2 m (7 ft) of alluvium at the Area 5 RWMS. Except for periods following precipitation events, water content in this near-surface region is low. Below the near-surface region, relatively steady upward movement of water is occurring. In this region of slow upward water movement, stable isotope compositions of soil pore water show evaporation is the dominant process (Tyler et al. 1996). This region extends from approximately 3 to 40 m (10 to 130 ft) below ground surface (bgs). Below this region, constant total water potentials with depth indicate a static region located between approximately 40 and 90 m (130 and 300 ft) bgs (Shott et al. 1998). In this static region, essentially no vertical liquid flow occurs because there is no potential gradient. Gravitational potential is balanced by matrix potential. Below this static region, flow is steady and downward due to gravity (Figure 1-2). If contaminants were to migrate below the current static region, movement to the groundwater would be extremely slow due to the low water content of the alluvium. Conservative estimates of travel time from beneath the static region to the groundwater are in excess of 50,000 years (Shott et al. 1998).

Based on research, field studies, modeling, and monitoring data, which are summarized in the Area 3 and Area 5 RWMS Performance Assessments (Shott et al. 1998 and 2000) and in Levitt and Sully (1998), there is no groundwater recharge under current climatic conditions at the Area 5 RWMS. Recent studies indicate that under bare-soil conditions such as those found at the operational waste unit covers, some drainage may occur through the covers into the waste zone. This drainage is estimated to be about 1 percent of annual rainfall based on conservative modeling results (Levitt et al. 1999). In addition, monitoring data from a bare-soil weighing lysimeter located in Area 5 show varying soil-water contents and soil-water potentials at depths of 1 to 2 m (3 to 7 ft) that are correlated to rainfall, while data from a vegetated lysimeter located at Area 5 show fairly constant soil-water contents and soil-water potentials at these depths. This indicates that precipitation is percolating to these depths in the bare-soil lysimeter but is not percolating to these depths in the vegetated lysimeter. Drainage through the waste covers should not be confused with groundwater recharge because the final closure covers will be vegetated, eliminating the downward pathway. Deep drainage and potential groundwater recharge appear to be occurring primarily along mountain fronts, but also in isolated valley locations at the NNSS where soil permeability is high, soil is thin, and vegetation is sparse.

Water content and water depth profiles are measured with time-domain reflectometry and heat dissipation probes in the upper 1.8 m (5.9 ft) of the waste covers to detect the percolation depth of infiltrated precipitation above the waste. This is detected by an increase in water content or the matrix potential increasing toward zero. Water potential measurements are also used to indicate the direction of flow through the waste cover. Vadose zone monitoring is used to identify water that has percolated below the root zone.



Dynamic Region: Magnitude and direction of liquid fluxes are variable and determined by episodic infiltration, evapotranspiration, and processes of biotic transport. The boundary is located at mean depth of 6 ft.

Zone I, Region of Slow Upward Flow: Region where the combination of low precipitation and high potential evapotranspiration leads to a dry zone, inducing upward flow of pore water in the unsaturated zone from as deep as 100 ft. Mean upward flux is 0.004 mm/yr.

Waste zone located in region of upward flow.

Zone II, Static Region: Region of no vertical liquid flow (balance of matric suction and gravitational forces). The thickness and the depth below the surface of this region changes with the physical/textural properties of alluvium and in situ water content.

Zone III, Region of Slow Downward Flow: Region of steady downward flow (increased water content allows downward drainage). Water in the vadose zone is currently recharging the water table most likely infiltrated during past pluvial climate cycles.

There is no aerially distributed recharge to the groundwater table under current conditions.

Figure 1-2. Conceptual Model of Vadose Zone Flow

1.2.2 Regional and Site Geology

The sequence of rocks at the NNSS consists of Proterozoic and Paleozoic rocks (primarily marine, sedimentary, and metasedimentary), locally intrusive Cretaceous granitic rocks, Miocene volcanic rocks, and post-volcanic sand and gravel. This sequence would be approximately 10,500 m (35,000 ft) thick if stacked at one location according to age (Frizzell and Shulters 1990).

The mountain ranges surrounding Frenchman Flat consist primarily of Tertiary volcanic rocks and underlying Paleozoic sedimentary and metasedimentary rocks. These ranges bound rotated and downdropped blocks in the basin. Erosion of the mountain ranges has resulted in deposition of a significant thickness of alluvium. The stratigraphy of rocks within Frenchman Flat to intermediate depths is known to a reasonable degree based on boreholes drilled for water wells and underground nuclear testing. On the basis of 3-D seismic reflection data (BN 2005), the upper surface of the underlying carbonate rocks is about 2,100 m (6,900 ft) bgs and may be as deep as 2,740 m (9,000 ft) near the center of the basin.

2.0 GROUNDWATER MONITORING

Groundwater monitoring at the Area 5 RWMS complies with 40 CFR 264.97, *General ground-water monitoring requirements*, and 40 CFR 264.98, *Detection monitoring program*, to provide a reliable indication of hazardous constituents in the uppermost aquifer underlying the Area 5 RWMS. 40 CFR 264.98 requires monitoring for indicator parameters and waste constituents or reaction products to provide an indication of the presence of hazardous constituents in groundwater.

The groundwater monitoring strategy for the Area 5 RWMS is described in the Sampling and Analysis Plan (SAP) in the RCRA Part B Permit Application for the mixed waste disposal unit (DOE 2017); *Sampling and Analysis Plan, Nevada National Security Site, Area 5 Groundwater Monitoring* (National Security Technologies, LLC [NSTec] 2016a); and *Sampling and/or Analysis Plan-Data Quality Objectives, Area 5 RWMS Groundwater Monitoring* (Mission Support and Test Services, LLC [MSTS] 2018a).

Monitoring for indicator parameters has been conducted since 1993 at the Area 5 RWMS, and there has been no indication of contaminants in the aquifer, so the more rigorous requirements of 40 CFR 264.99, *Compliance monitoring program*, or 40 CFR 264.100, *Corrective action program*, are not applicable.

2.1 GROUNDWATER MONITORING WELLS

Pilot Well 1 (UE5PW-1), Pilot Well 2 (UE5PW-2), and Pilot Well 3 (UE5PW-3) are used to monitor the groundwater in the uppermost aquifer below the Area 5 RWMS. RCRA Permit NEV HW0101, Revision 6, designates UE5PW-1 as the Point of Compliance (POC) and UE5PW-2 and UE5PW-3 as background wells. The POC is defined as a vertical surface located at the down-gradient limit of the waste management area that extends down into the uppermost aquifer underlying regulated units. Although the initial purposes of the pilot wells were to characterize water quality and hydrologic properties of the uppermost aquifer and to characterize the hydrologic properties, stratigraphy, and lithology of the thick vadose zone above this aquifer, these wells meet design, construction, and development criteria specified in 40 CFR 264.98. Construction of a fourth monitoring well (UE5MW-4) began in 2019. No groundwater samples were collected during 2019 at this new well.

The pilot wells were drilled between March and November 1992, and the groundwater has been monitored since 1993. The wells were drilled using a casing-advance underreaming drilling system with air as the only drilling fluid. Drilled borehole diameters ranged from 30.6 cm (12.0 in.) at ground level to 23.7 cm (9.33 in.) at the bottom of UE5PW-1 and UE5PW-2 and 20.0 cm (7.87 in.) at the bottom of UE5PW-3. UE5PW-1 is drilled in alluvium from ground level to 256 m (839 ft). UEPW-2 is drilled in alluvium from ground level to 280 m (920 ft). UE5PW-3 is drilled in alluvium from ground level to 188 m (617 ft), welded tuff to 280 m (919 ft), and bedded tuff to 291 m (955 ft). Each well is completed with a centralized 6.35-cm (2.50-in.) diameter stainless steel casing with an 18.3-m (60.0-ft) dual-screen filter pack attached to the bottom of the casing. The borehole annulus below and around the screen is filled with 6/12 coarse mesh sand. Above the screen to approximately 24 m (79 ft) bgs, the annulus is sealed with a dry mix seal material of 60% Overton sand, 25% bentonite powder, and 15% silica flour. This zone is interspersed with five 6.1-m (20-ft) long and four 0.9-m (3-ft) long vadose monitoring locations where the annulus is filled with 6/12 coarse mesh sand. Above 24 m (79 ft), the borehole annulus is sealed with cement grout. A steel transport container over the wellhead and a 3-by-3 m (10-by-10 ft) concrete pad around the wellhead provide weather protection, surface seal, and lockable access to each well (REECo 1994). Well locations, elevations, and characteristics are summarized in Table 2-1 and Figure 2-1.

Table 2-1. Pilot Well Locations and Properties

	UE5PW-1[1]		UE5PW-2[2]		UE5PW-3[1]	
Latitude (D M S.ds[3])[4]	36° 51′ 05.50023″ N		36° 51′ 51.90872″ N		36° 52′ 01.22808″ N	
Longitude (D M S.ds)[4]	115° 56′ 58.14564″ W		115° 56′ 56.95404″ W		115° 58′ 16.04553″ W	
Northing (ft)[5]	765,702.32		770,396.15		771,291.03	
Easting (ft)[5]	709,832.53		709,894.12		703,460.32	
	ft	**m**	**ft**	**m**	**ft**	**m**
Land-Surface Elevation[6]	3,178.4	968.78	3,246.1	989.41	3,295.64	1,004.51
Measuring Point Elevation[6]	3,180.4	969.39	3,248.3	990.08	3,298.20	1,005.29
Borehole Depth (bgs)[7]	839.01	255.73	920.01	280.42	954.99	291.08
Well Depth (bgs)[7]	822.01	250.55	890.00	271.27	937.99	285.90
Deviation at Water Table[7]	0.27	0.082	0.68	0.20	0.07	0.02
Water Table Depth (bgs)[8]	772.05	235.32	839.34	255.83	888.54	270.83
Water Level Elevation[8]	2,406.3	733.45	2,406.8	733.59	2,407.1	733.68

[1] Included in Frenchman Flat 2013 – 2014 re-survey
[2] BN survey, 2001
[3] D M S.ds: degrees minutes seconds, decimal seconds
[4] 1927 North American Datum
[5] Nevada State Plan Central Zone 1927 North American Datum
[6] 1929 National Geodetic Vertical Datum
[7] REECo 1994
[8] Average 2015 through 2019 measurements

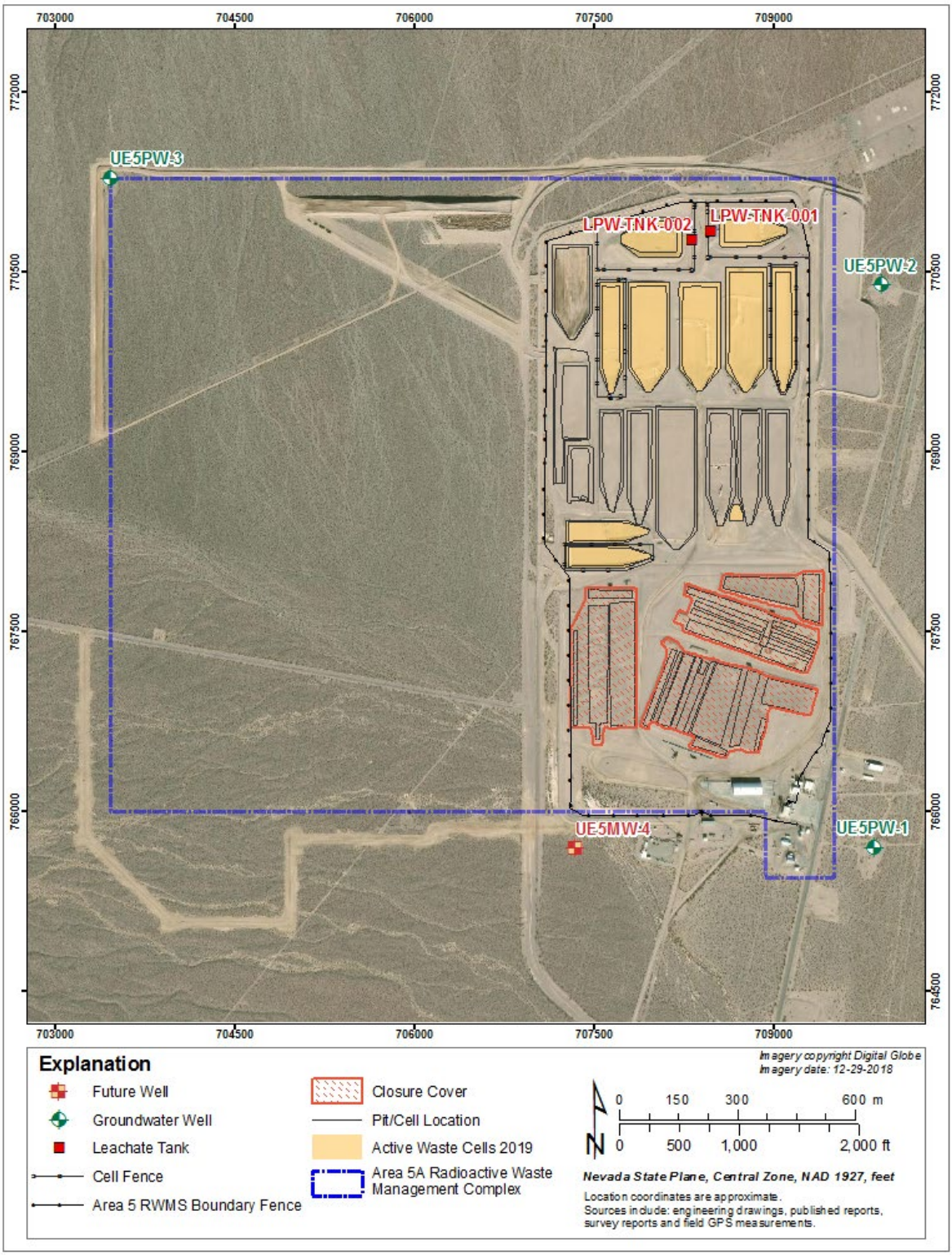


Figure 2-1. Locations of Wells and Leachate Collection Tanks

2.2 GROUNDWATER PARAMETERS AND SAMPLING FREQUENCY

Groundwater samples are collected semiannually and analyzed for the parameters listed below. Water levels are measured quarterly. The groundwater parameters are divided into categories representing indicators of contamination, toxicity characteristic metals, and general water chemistry.

Indicator parameters:

- pH
- SC
- total organic carbon (TOC)
- total organic halides (TOX)
- tritium

Toxicity characteristic metals:

- arsenic (As)
- barium (Ba)
- cadmium (Cd)
- chromium (Cr)
- lead (Pb)
- mercury (Hg)
- selenium (Se)
- silver (Ag)

General water chemistry:

- Major cations:
  - calcium (Ca^{+2})
  - magnesium (Mg^{+2})
  - potassium (K^{+})
  - sodium (Na^{+})
- Major anions:
  - bicarbonate (HCO_3^{-})
  - chloride (Cl^{-})
  - sulfate (SO_4^{-2})
- Trace elements:
  - fluoride (F^{-})
  - iron (Fe)
  - manganese (Mn)
  - silicate (SiO_4^{-4})

Investigation levels (ILs) for indicator parameters with quantifiable results (i.e., pH, SC) are based on historical measurements. Results for some indicator parameters (i.e., TOC, TOX, and tritium) are mostly below method reporting limits (RLs) and often below method detection limits (MDLs). ILs are set at double the RLs for these indicator parameters. The ILs for toxicity characteristic metals are set at the maximum concentrations of parameters for groundwater protection in 40 CFR 264.94, Table 1.

ILs are listed in Table 2-2. For parameters with quantifiable results and defined ILs, a control chart is used to evaluate the data to determine if the facility has a significant effect on groundwater. If results are less than ILs, the groundwater is assumed to be unaffected by the facility.

Table 2-2. Investigation Levels

Parameter	Investigation Level
pH	<7.6 or >9.2
SC	0.440 mmho/cm
TOC	2 mg/l
TOX	0.1 mg/l
tritium	2,000 pCi/l
As	0.05 mg/l
Ba	1 mg/l
Cd	0.01 mg/l
Cr	0.05 mg/l
Pb	0.05 mg/l
Hg	0.002 mg/l
Se	0.01 mg/l
Ag	0.05 mg/l

mg/l: milligram(s) per liter
mmho/cm: millimho(s) per centimeter
pCi/l: picocurie(s) per liter

General water chemistry parameters characterize the groundwater geochemistry and are evaluated with Piper diagrams. Changes in groundwater geochemistry could indicate a change in groundwater source or flow path. Water levels are measured and used with aquifer characteristics to calculate groundwater flux and flow velocity in the uppermost aquifer.

2.3 GROUNDWATER SAMPLING METHODS

The standard operating procedure SOP-2151.104, *Instructions for Area 5 RWMS Groundwater Well Preparation and Groundwater Sampling* (NSTec 2016b and MSTS 2019a), is followed for water level measurements, field measurements of groundwater parameters, and sample collection.

2.3.1 Water Level Measurements

Static groundwater depths at UE5PW-1, UE5PW-2, and UE5PW-3 are measured quarterly using a calibrated electronic water level tape. Groundwater depths are measured twice per year prior to groundwater sample collection and twice per year between groundwater sampling events. Groundwater depth measurements are collected before a sample pump is put into the well and before any water is pumped from the well. Groundwater depth at each well is measured by lowering a water level tape into the well until the water level sensor is activated and recording the water level depth from the well reference point to the nearest 0.01 ft (0.3 cm). Each depth measurement is corrected for borehole deviation by subtracting the well deviation log measurement at the measured depth from the measured depth and then normalized to depth measurements collected with a calibrated steel tape. Groundwater elevation (AMSL) is calculated by subtracting the measured groundwater depth from the reference point elevation. Groundwater depth is calculated by subtracting the groundwater elevation from the ground surface elevation. Starting with this report, all reported water level measurements are normalized to correspond to measurements collected with a calibrated steel tape. Replacing the water level tape in 2019 made this normalization process necessary.

2.3.2 Groundwater Sample Collection

Upon completion of water level measurements, a pneumatic pump is lowered into each well to approximately 1.5 m (5.0 ft) below the water level, and at least three well volumes are purged from each well. Three well volumes is approximately 950 liters (250 gallons). Stable pH, SC, and turbidity values measured after well purging indicate the well is ready for sampling.

A calibrated handheld meter measures the pH and SC of the pump outflow prior to sampling. Groundwater samples are collected from the pump outflow in new, certified clean sample bottles. A unique number is assigned and affixed to each sample bottle. Required preservatives are added to samples, sample bottles are sealed, and tamper-evident tape is applied to the sealed bottles. Sealed samples are placed in ice chests and remain cooled through shipment to Nevada-certified contract laboratories for analysis. Chain of custody protocols are followed for all samples, beginning with sample collection through final analysis. All samples are approved for release from the NNSS and for shipment to Nevada-certified contract laboratories for analysis by the Radiological Control Department.

Sampling and Analysis Plan, Nevada National Security Site, Area 5 Groundwater Monitoring (NSTec 2016a) and *Sampling and/or Analysis Plan-Data Quality Objectives, Area 5 RWMS Groundwater Monitoring* (MSTS 2018a) identify sample types (i.e., grab, field duplicate [FD], field blank [FB]), number of samples, sample volumes, and sample preservative for each groundwater sample. A grab sample and two replicate samples are collected consecutively from each well for TOC, TOX, and tritium analyses. Also, replicate samples for all other laboratory analyses were collected at one well during each 2019 sampling event. Field replicate samples provide additional data in case any sample result is above the IL and provide an estimate of sample result variability.

In 2019, groundwater depths were measured on March 4 and 6, June 10, August 5, and October 14, and groundwater samples were collected on March 5 and 12, and August 6. Field measurements of pH and SC were collected using a calibrated handheld meter, and field measurements of groundwater depths were collected using a calibrated electronic water level tape. Table 2-3 summarizes the type of sample bottles, preservative, and number of samples collected at UE5PW-1, UE5PW-2, and UE5PW-3 in 2019 for each analysis performed.

Table 2-3. Number of Groundwater Samples Collected

Parameter	Sample Bottle	Preservative	03/05/2019 and 03/12/2019			08/06/2019		
			Grab	FD	FB	Grab	FD	FB
Tritium	250-ml HDPE	<6°C	3	6	-	3	6	-
TOC	250-ml amber glass	pH<2 (H_2SO_4), <6°C	3	6	3	3	6	3
TOX[1]	500-ml amber glass	pH<2 (H_2SO_4), <6°C	3	6	3	3	6	3
Toxicity characteristic metals	500-ml HDPE	pH<2 (HNO_3), <6°C	3	1	-	3	1	-
General water chemistry	500-ml HDPE	pH<2 (HNO_3), <6°C	3	1	-	3	1	-
pH, SC, Cl^-, F^-, SO_4^{-2}	500-ml HDPE	<6°C	3	1	-	3	1	-

°C: degree(s) Celsius
HNO_3: nitric acid
H_2SO_4: sulfuric acid
HDPE: high-density polyethylene
ml: milliliter(s)
[1] No headspace for TOX sample bottles

2.4 GROUNDWATER SAMPLE RESULTS

Sampling and Analysis Plan, Nevada National Security Site, Area 5 Groundwater Monitoring (NSTec 2016a) and *Sampling and/or Analysis Plan-Data Quality Objectives, Area 5 RWMS Groundwater Monitoring* (MSTS 2018a) identify parameters and analytical methods. Most laboratory analytical methods are standard methods from *SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (U.S. Environmental Protection Agency [EPA] 1996). In 2019, laboratory analyses were performed by GEL Laboratories following standard contractual protocols and procedures. Table 2-4 summarizes the analytical methods used in 2019.

Table 2-4. Groundwater Sample Parameters, Laboratories, and Analytical Methods

Parameter	Laboratory	Method	Method Description
Groundwater level	Field	SOP-2151.104	Electronic Tape
pH	Field	SM 4500-H+ B	Potentiometric
SC	Field	EPA 120.1	Conductivity bridge
pH	GEL	SM 4500-H+ B	Potentiometric
SC	GEL	SW 9050A	Conductivity bridge
Tritium	GEL	EPA 906.0	Liquid scintillation
TOC	GEL	SM 5310B	Oxidation to carbon dioxide
TOX	GEL	SW 9020B	Carbon adsorption
Toxicity characteristic metals (As, Ba, Cd, Cr, Pb, Se, Ag)	GEL	SW 6010C	Inductively coupled plasma atomic emission spectroscopy
Hg	GEL	SW 7470A	Manual cold-vapor technique
General water chemistry (Ca^{+2}, Mg^{+2}, K^{+}, Na^{+}, Mn, Fe, Si)	GEL	SW 6010C	Inductively coupled plasma atomic emission spectroscopy
Cl^{-}, F^{-}, SiO_4^{-4}	GEL	EPA 300.0	Ion chromatography
Alkalinity	GEL	SM 2320B	Titration

No groundwater results exceeded ILs in 2019. If a specific result had exceeded an IL, the well would have been resampled and the analysis repeated within one month of receiving the result. Prior to resampling, sampling equipment would be cleaned and decontaminated, or other remedial corrective actions related to sampling and analyses would be completed. Individual pumps and sample tubing are dedicated to each well, and pumps are not moved from well to well without being decontaminated. Decontamination is only done when results indicate possible equipment contamination.

If detection monitoring results provide a statistically significant increase for chemical parameters or hazardous constituents in the groundwater, then actions specified in 40 CFR 264.98 would be implemented, including notifying the Nevada Division of Environmental Protection (NDEP), immediately resampling all wells, and, if contaminants are verified, submitting a permit modification request for a compliance monitoring program per 40 CFR 264.99.

2.4.1 Groundwater Elevation

Static groundwater depths from the well reference elevation were measured on March 4 and 6, June 10, August 5, and October 7, 2019. The 2019 average groundwater elevations AMSL were 733.41 m (2,406.2 ft) at UE5PW-1, 733.54 m (2,406.6 ft) at UE5PW-2, and 733.66 m (2,407.0 ft) at UE5PW-3. The corresponding 2019 average depths bgs were 235.37 m (772.2 ft) at UE5PW-1, 255.88 m (839.5 ft) at UE5PW-2, and 270.85 m (888.6 ft) at UE5PW-3. Measured groundwater depths bgs and groundwater elevations AMSL since 2015 and five-year averages of these values are provided in Table 2-5. Groundwater elevation measurements from the last five years are provided in Figure 2-2.

Table 2-5. Groundwater Depths and Elevations

	UE5PW-1				UE5PW-2				UE5PW-3			
	Depth (bgs)		Elevation		Depth (bgs)		Elevation		Depth (bgs)		Elevation	
Date	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
03/16/15	771.77	235.24	2,406.62	733.54	839.22	255.79	2,406.89	733.62	888.38	270.78	2,407.25	733.73
06/08/15	772.05	235.32	2,406.34	733.45	839.38	255.84	2,406.73	733.57	888.53	270.82	2,407.10	733.68
08/10/15	771.90	235.28	2,406.49	733.50	839.11	255.76	2,407.00	733.65	888.44	270.80	2,407.19	733.71
10/20/15	771.86	235.26	2,406.53	733.51	839.11	255.76	2,407.00	733.65	888.40	270.78	2,407.23	733.72
03/07/16	771.74	235.23	2,406.65	733.55	838.87	255.69	2,407.24	733.73	888.30	270.75	2,407.33	733.75
06/06/16	771.83	235.25	2,406.56	733.52	839.15	255.77	2,406.96	733.64	888.37	270.78	2,407.26	733.73
08/15/16	771.96	235.29	2,406.43	733.48	839.29	255.82	2,406.82	733.60	888.43	270.79	2,407.20	733.71
10/24/16	772.07	235.33	2,406.32	733.45	839.43	255.86	2,406.68	733.56	888.60	270.85	2,407.03	733.66
03/06/17	772.17	235.36	2,406.22	733.42	839.43	255.86	2,406.68	733.56	888.61	270.85	2,407.02	733.66
06/05/17	772.04	235.32	2,406.35	733.46	839.33	255.83	2,406.78	733.59	888.54	270.83	2,407.09	733.68
08/14/17	771.87	235.27	2,406.52	733.51	839.15	255.77	2,406.96	733.64	888.47	270.81	2,407.16	733.70
10/23/17	772.34	235.41	2,406.05	733.36	839.70	255.94	2,406.41	733.47	888.78	270.90	2,406.85	733.61
03/05/18	772.34	235.41	2,406.05	733.36	839.53	255.89	2,406.58	733.53	888.76	270.89	2,406.87	733.61
06/04/18	772.10	235.34	2,406.29	733.44	839.40	255.85	2,406.71	733.57	888.48	270.81	2,407.15	733.70
08/13/18	772.11	235.34	2,406.28	733.43	839.31	255.82	2,406.80	733.59	888.59	270.84	2,407.04	733.67
10/25/18	772.09	235.33	2,406.30	733.44	839.39	255.85	2,406.72	733.57	888.67	270.87	2,406.96	733.64
03/04/19	772.08	235.33	2,406.31	733.44	—	—	—	—	888.60	270.85	2,407.03	733.66
03/06/19	—	—	—	—	839.26	255.81	2,406.85	733.61	—	—	—	—
06/10/19	772.35	235.41	2,406.04	733.36	839.69	255.94	2,406.42	733.48	888.71	270.88	2,406.92	733.63
08/05/19	772.11	235.34	2,406.28	733.43	839.39	255.85	2,406.72	733.57	888.60	270.85	2,407.03	733.66
10/07/19	772.25	235.38	2,406.14	733.39	839.63	255.92	2,406.48	733.50	888.48	270.81	2,407.15	733.70
2019 Average	772.20	235.37	2,406.19	733.41	839.49	255.88	2,406.62	733.54	888.60	270.85	2,407.03	733.66
5-year Average	772.05	235.32	2,406.34	733.45	839.34	255.83	2,406.77	733.59	888.54	270.83	2,407.09	733.68

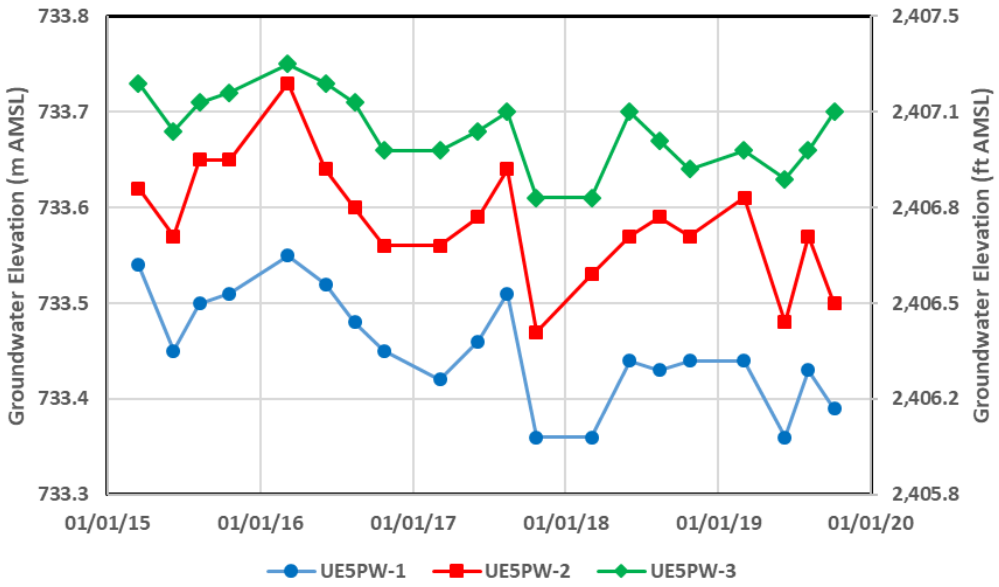


Figure 2-2. Groundwater Elevations

Well locations (Table 2-1) and groundwater elevations (Table 2-5) are used to calculate the magnitude and direction of the hydraulic gradient using a simple plane approximation. The three pilot well measurement points define a plane containing the water level points. The cross product of two vectors connecting the water level point at one well to the water level points at the other two wells is the aquifer hydraulic gradient. Groundwater flux and groundwater velocity in the uppermost aquifer are calculated for each set of elevation measurements in 2019 (Table 2-6). The average calculated groundwater flux in 2019 was 1.3E-09 m^3/m^2 per second, and the average velocity was 10.4 cm per year. The flow direction is south-southeast. The groundwater is essentially flat with negligible flow.

Table 2-6. Aquifer Flow Calculations

Date	Gradient Magnitude (m/m)	Gradient Direction (degrees east of north)	Groundwater Flux[1] (m^3/m^2 per second)	Groundwater Velocity[2] (m per year)
03/04/2019	1.19E-04	176	1.34E-09	0.111
06/10/2019	1.07E-04	143	1.19E-09	0.099
08/05/2019	1.03E-04	162	1.16E-09	0.096
10/07/2019	1.20E-04	131	1.34E-09	0.112

[1] Hydraulic conductivity = 1.12E-03 cm per second (3.67E-05 ft per second) (REECo 1994)

[2] Effective porosity = 0.38 (REECo 1994)

2.4.2 Groundwater pH

The pH at each well remained within the IL bounds of 7.6 and 9.2 in 2019. Prior to 2017, only field pH measurements were collected. Since 2017, samples for laboratory analysis were also collected. The 2019 average field measurement was 8.17 and ranged from 8.08 to 8.29. The 2019 average laboratory measurement was 8.38 and ranged from 8.31 to 8.47. The 2019 average pH was 8.33 at UE5PW-1, 8.24 at UE5PW-2, and 8.25 at UE5PW-3. These averages do not include laboratory measurements of FDs. pH remained stable and within the IL bounds of 7.6 and 9.2 for the last five years (Figure 2-3 and Table 2-7). No groundwater contamination is indicated by pH monitoring results.

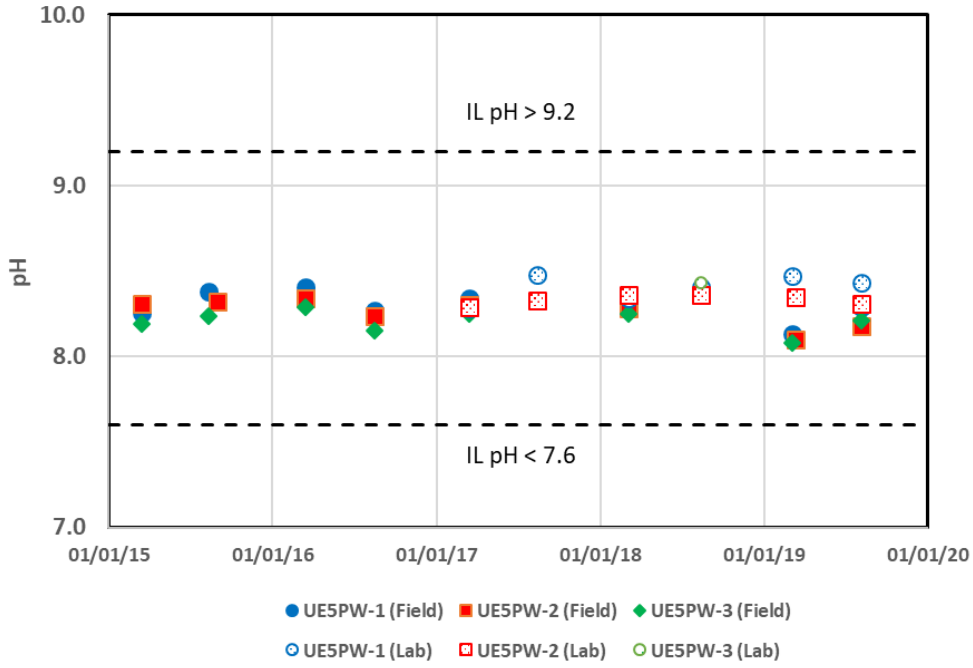


Figure 2-3. Groundwater pH

Table 2-7. Groundwater pH

Date	pH (IL <7.6 or >9.2)								
	UE5PW-1			UE5PW-2			UE5PS-3		
	Field	Grab	FD	Field	Grab	FD	Field	Grab	FD
03/17/2015	8.26	—	—	8.31	—	—	8.19	—	—
08/11/2015	8.38	—	—		—	—	8.24	—	—
09/01/2015		—	—	8.32	—	—	—	—	—
03/15/2016	8.41	—	—	8.34	—	—	8.29	—	—
08/16/2016	8.27	—	—	—	—	—	8.15	—	—
08/17/2016	—	—	—	8.24	—	—	—	—	—
03/15/2017	8.34	8.28	—	8.30	8.29	—	8.25	8.28	—
08/15/2017	—	8.48	8.48	—	8.33	—	—	8.35	—
03/06/2018	8.32	8.34	—	8.28	8.36	8.31	8.25	8.30	—
08/14/2018	—	8.41	—	—	8.36	—	—	8.39	8.43
03/05/2019	8.13	8.47	8.46	—	—	—	8.08	8.34	—
03/12/2019	—	—	—	8.10	8.35	—	—	—	—
08/06/2019	8.29	8.43	—	8.18	8.31	8.33	8.21	8.35	—

2.4.3 Groundwater Specific Conductance

All SC values were below the IL of 0.440 mmho/cm in 2019. Prior to 2018, only field SC measurements were collected. Since 2018, samples for laboratory analysis were also collected. The 2019 field values ranged from 0.357 to 0.381 mmho/cm, and the 2019 laboratory values ranged from 0.359 to 0.383 mmho/cm. The 2019 average SC values were 0.380 mmho/cm at UE5PW-1, 0.363 mmho/cm at UE5PW-2, and 0.375 mmho/cm at UE5PW-3. The five-year average SC values were 0.378 mmho/cm at UE5PW-1, 0.360 mmho/cm at UE5PW-2, and 0.373 mmho/cm at UE5PW-3. These averages do not include laboratory measurements of FDs. SC remained stable, constant, and below the IL for the last five years (Figure 2-4 and Table 2-8). No groundwater contamination is indicated by SC monitoring results.

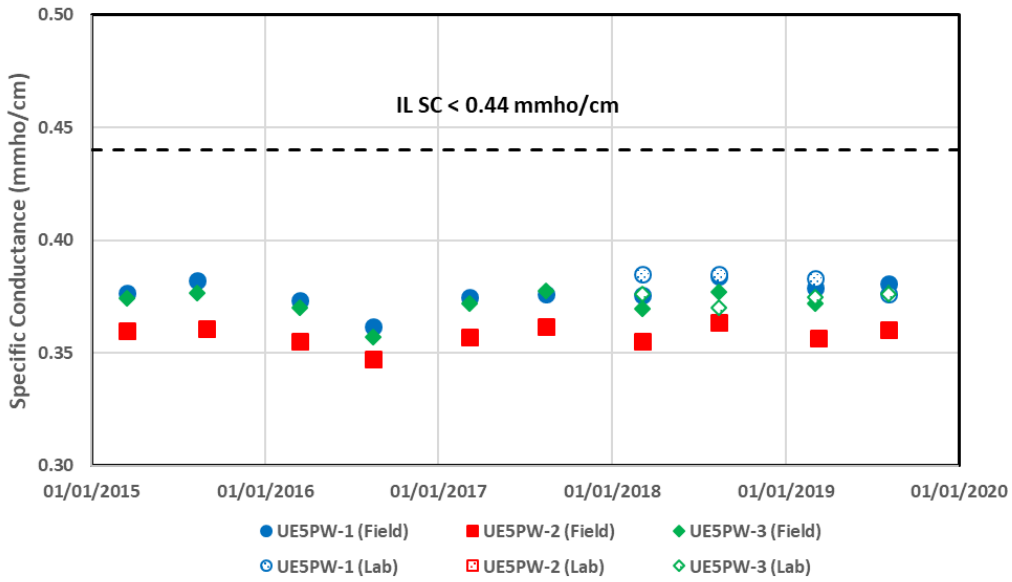


Figure 2-4. Groundwater Specific Conductance

Table 2-8. Groundwater Specific Conductance

Date	Specific Conductance (mmhos/cm) (IL = 0.440 mmhos/cm)								
	UE5PW-1			UE5PW-2			UE5PW-3		
	Field	Grab	FD	Field	Grab	FD	Field	Grab	FD
03/17/2015	0.377	—	—	0.360	—	—	0.374	—	—
08/11/2015	0.382	—	—	—	—	—	0.377	—	—
09/01/2015	—	—	—	0.361	—	—	—	—	—
03/15/2016	0.374	—	—	0.355	—	—	0.370	—	—
08/16/2016	0.362	—	—	—	—	—	0.357	—	—
08/17/2016	—	—	—	0.348	—	—	—	—	—
03/07/2017	0.375	—	—	—	—	—	—	—	—
03/08/2017	—	—	—	0.357	—	—	0.372	—	—
08/15/2017	0.376	—	—	0.362	—	—	0.378	—	—
03/06/2018	0.376	0.385	—	0.355	0.365	0.362	0.370	0.376	—
08/14/2018	0.384	0.385	—	0.364	0.362	—	0.377	0.370	0.373
03/05/2019	0.379	0.383	0.379	—	—	—	0.372	0.375	—
03/12/2019	—	—	—	0.357	0.359	—	—	—	—
08/06/2019	0.381	0.376	—	0.360	0.376	0.360	0.377	0.376	—
5-year Average	0.376	0.382	0.379	0.358	0.366	0.361	0.372	0.374	0.373

2.4.4 Groundwater Tritium

Three samples were collected consecutively at each well during each sampling event for tritium analysis. Because tritium concentrations are very low or not present, FDs provide additional data for evaluating possible false positive results when a single analysis may exceed the MDL. They also provide data for estimating experimental error associated with these measurements.

All 2019 tritium results were below the IL of 2,000 pCi/l and below the RL. Only one 2019 result from UE5PW-3 was above the MDL. During the last five years most tritium results were below the MDL (Table 2-9). No groundwater contamination is indicated by tritium monitoring results.

Table 2-9. Groundwater Tritium

	Tritium (pCi/l) (IL = 2,000 pCi/l)								
	UE5PW-1			UE5PW-2			UE5PW-3		
Date	Grab	FD	FD	Grab	FD	FD	Grab	FD	FD
03/17/2015	<245	<246	U	<246	U	U	U	<243	U
08/11/2015	U	U	U	—	—	—	U	U	U
09/01/2015	—	—	—	<238	U	U	—	—	—
03/15/2016	U	U	U	U	U	<253	U	U	U
08/16/2016	U	U	U	—	—	—	U	<221	U
08/17/2016	—	—	—	<252	<221	<216	—	—	—
03/07/2017	U	U	U	—	—	—	—	—	—
03/08/2017	—	—	—	U	U	<225	U	U	U
08/15/2017	U	U	U	U	U	U	U	U	U
03/06/2018	U	U	U	U	U	U	U	U	U
08/14/2018	U	U	U	<197	U	U	U	U	U
03/05/2019	U	U	U	—	—	—	U	U	U
03/12/2019	—	—	—	U	U	U	—	—	—
08/06/2019	U	U	U	U	U	U	<206	U	U

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

2.4.5 Groundwater Total Organic Carbon and Total Organic Halides

Three samples were collected consecutively at each well during each sampling event for TOC and TOX analysis. Because TOC and TOX concentrations are very low, FDs provide additional data for evaluating possible false positive results when a single analysis may exceed the MDL. They also provide data for estimating the experimental error associated with these measurements.

All 2019 TOC results were below the IL of 2 mg/l and below the RL of 1 mg/l. One FD from UE5PW-1 exceeded the MDL of 0.33 mg/l. No TOC concentration greater than the IL or the RL was detected in any groundwater sample during the last five years (Table 2-10). Estimated TOC results greater than the MDL but less than the RL are reported in Table 2-10 as <1.0 mg/l. Results less than or equal to the MDL are reported as “U.”

All 2019 TOX results were below the IL of 0.1 mg/l and below the RL of 0.01 mg/l. Two grab samples and three FDs from UE5PW-3 exceeded the MDL of 0.003 mg/l. During the last five years, all TOX results were less than the IL and the RL (Table 2-11). Estimated TOX results greater than the MDL but less than RL are reported in Table 2-11 as <0.01 mg/l. Results less than or equal to the MDL are reported as “U.”

No groundwater contamination is indicated by TOC and TOX monitoring results.

Table 2-10. Groundwater Total Organic Carbon

Date	Total Organic Carbon (mg/l) (IL = 2.0 mg/l)								
	UE5PW-1			UE5PW-2			UE5PW-3		
	Grab	FD	FD	Grab	FD	FD	Grab	FD	FD
03/17/2015	<1	<1	<1	<1	<1	<1	<1	<1	<1
08/11/2015	U	U	U	—	—	—	U	U	U
09/01/2015	—	—	—	U	U	U	—	—	—
03/15/2016	U	U	U	U	U	U	U	U	U
08/16/2016	U	U	U	—	—	—	U	U	U
08/17/2016	—	—	—	U	U	U	—	—	—
03/07/2017	U	U	U	—	—	—	—	—	—
03/08/2017	—	—	—	U	U	U	U	U	U
08/15/2017	U	U	U	U	U	U	U	U	U
03/06/2018	U	U	U	U	U	U	U	U	U
08/14/2018	U	U	U	U	U	U	U	U	U
03/05/2019	U	U	U	—	—	—	U	U	U
03/12/2019	—	—	—	U	U	U	—	—	—
08/06/2019	U	U	<1	U	U	U	U	U	U

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

Table 2-11. Groundwater Total Organic Halides

Date	Total Organic Halides (mg/l) (IL = 0.1 mg/L)								
	UE5PW-1			UE5PW-2			UE5PW-3		
	Grab	FD	FD	Grab	FD	FD	Grab	FD	FD
03/17/2015	U	U	U	U	U	U	U	U	U
08/11/2015	U	U	U	—	—	—	U	U	U
09/01/2015	—	—	—	U	U	U	—	—	—
03/15/2016	U	U	U	U	U	U	U	U	U
08/16/2016	U	U	U	—	—	—	U	U	U
08/17/2016	—	—	—	U	U	U	—	—	—
03/07/2017	U	U	U	—	—	—	—	—	—
03/08/2017	—	—	—	U	U	U	U	U	U
08/15/2017	U	<0.01	U	U	U	U	U	U	U
03/06/2018	U	U	U	U	<0.01	U	U	U	<0.01
08/14/2018	U	<0.01	U	U	<0.01	U	U	U	U
03/05/2019	U	U	U	—	—	—	<0.01	<0.01	<0.01
03/12/2019	—	—	—	U	U	U	—	—	—
08/06/2019	U	U	U	U	U	U	<0.01	U	<0.01

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

2.4.6 Groundwater Toxicity Characteristic Metals

The Area 5 RWMS groundwater monitoring plan (DOE 2017) identifies toxicity characteristic metals as indicators of groundwater contamination. Monitoring of these parameters began in 2017. ILs were set at the maximum concentration for groundwater protection listed in 40 CFR 264.94, Table 1 (Table 2-2).

In March 2017, samples were prepared following waste liquid protocols, including dilution by a factor of 10 before analysis, but subsequent samples were not diluted before analysis. Consequently, the MDL and RL were 10 times higher for the March 2017 samples. After the March 2017 samples, the ILs for all toxicity characteristic metal contaminants except Se were greater than the respective RLs. The IL for Se was between the MDL and RL.

All 2019 groundwater results for toxicity characteristic metals were below ILs. Results greater than the RL are reported in Table 2-12, and results greater than the MDL but less than the RL are reported as <RL in Table 2-12. Results less than or equal to the MDL are reported as "U." No groundwater contamination is indicated by the toxicity characteristic metals monitoring results.

Table 2-12. Groundwater Toxicity Characteristic Metals

	As (mg/l)	Ba (mg/l)	Cd (mg/l)	Cr (mg/l)	Pb (mg/l)	Se (mg/l)	Ag (mg/l)	Hg (mg/l)
	Investigation Level (mg/l)							
Date	0.05	1	0.01	0.05	0.05	0.01	0.05	0.002
UE5PW-1								
03/07/2017	U[1]	<0.05	U[1]	U[2]	U[3]	U[4]	U[2]	U[2]
08/15/2017	<0.03	0.014	U	<0.005	U	U[3]	U	U
08/15/2017 (FD)	<0.03	0.014	U	<0.005	U	U[3]	U	U
03/06/2018	<0.03	0.014	U	<0.005	U	U[3]	U	U
08/14/2018	<0.03	0.014	U	<0.005	U	U[3]	U	U
03/05/2019	U	0.014	U	<0.005	<0.01	U[3]	U	U
03/05/2019 (FD)	<0.03	0.014	U	<0.005	<0.01	U[3]	U	U
08/06/2019	U	0.015	U	<0.01	U	<0.03	U	U
UE5PW-2								
03/08/2017	U[1]	U	U[1]	U[2]	U[3]	U[4]	U[2]	U[2]
08/15/2017	<0.03	<0.005	U	0.007	U	U[3]	U	U
03/06/2018	<0.03	0.006	U	0.007	U	U[3]	U	U
03/06/2018 (FD)	<0.03	0.006	U	0.008	U	U[3]	U	U
08/14/2018	<0.03	<0.005	U	0.006	U	U[3]	U	U
03/12/2019	<0.03	<0.005	U	0.007	U	U[3]	U	U
08/06/2019	<0.03	<0.005	U	<0.01	U	<0.03	U	U
08/06/2019 (FD)	<0.03	0.005	U	<0.01	U	<0.03	U	U
UE5PW-3								
03/08/2017	U[1]	<0.05	U[1]	U[2]	U[3]	U[4]	U[2]	U[2]
08/15/2017	<0.03	0.010	U	<0.005	U	U[3]	U	U
03/06/2018	<0.03	0.010	U	<0.005	U	U[3]	U	U
08/14/2018	<0.03	0.010	U	<0.005	U	U[3]	U	U
08/14/2018 (FD)	<0.03	0.010	U	<0.005	U	U[3]	<0.005	U
03/05/2019	<0.03	0.009	U	<0.005	U	U[3]	U	U
08/06/2019	<0.03	0.011	U	<0.01	U	U[3]	U	U

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value
[1] IL = MDL
[2] IL = RL
[3] MDL<IL<RL
[4] IL<MDL

2.4.7 Groundwater General Water Chemistry Parameters

General water chemistry analyses for cations (Ca^{+2}, Mg^{+2}, K^{+}, and Na^{+}), anions (HCO_3^{-}, Cl^{-}, and SO_4^{-2}), and trace elements (F^{-}, Fe, Mn, and SiO_4^{-4}) show similar groundwater in all three wells and stable chemistry since 2015. The groundwater type in all three wells is sodium bicarbonate (Table 2-13). A Piper diagram with a data point for each sampling event from 2015 through 2019 summarizes the groundwater chemistry data for each well (Figure 2-5, Figure 2-6, and Figure 2-7). No groundwater contamination or changes in groundwater chemistry are indicated by the general water chemistry monitoring results.

Table 2-13. Groundwater General Water Chemistry Parameters

Date	Ca^{+2}	Mg^{+2}	K^{+}	Na^{+}	Mn	Fe	HCO_3^{-}	SO_4^{-2}	Cl^{-}	F^{-}	SiO_4^{-4}
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
UE5PW-1											
03/17/2015	14.4	6.96	6.31	49.4	U	U	154	34.2	9.7	1.1	61.9
08/11/2015	14.1	5.81	6.08	60.6	U	U	146	36.4	9.8	1.1	60.5
03/15/2016	14.1	5.61	6.35	55.6	U	U	154	35.0	9.8	1.1	59.3
08/16/2016	13.5	5.34	5.57	56.1	U	U	156	36.3	9.8	1.0	60.0
03/07/2017	13.1	5.16	5.71	57.9	U	U	160	35.2	9.7	1.1	57.1
08/15/2017	13.9	5.33	5.86	55.3	U	U	152	36.6	9.7	1.2	56.2
08/15/2017 (FD)	13.5	5.20	5.85	53.5	U	U	149	36.6	9.7	1.1	55.0
03/06/2018	13.0	4.98	5.73	55.4	U	U	110	35.0	10.0	1.3	57.5
08/14/2018	13.9	5.40	5.61	54.9	U	U	156	34.2	9.6	1.2	59.2
03/05/2019	15.3	5.35	5.72	54.8	U	U	155	34.4	9.8	1.3	64.5
03/05/2019 (FD)	14.9	5.07	5.46	52.9	U	U	156	34.3	9.8	1.3	63.0
08/06/2019	14.7	5.64	5.82	56.6	U	U	155	36.2	9.9	1.2	61.6
UE5PW-2											
03/17/2015	16.4	5.68	5.40	57.4	U	<0.1	157	27.7	8.0	1.0	60.3
09/01/2015	16.2	7.26	5.29	51.6	U	U	155	29.7	8.6	1.0	60.1
03/15/2016	15.4	6.70	5.20	46.2	U	U	159	28.1	8.0	0.9	56.3
08/17/2016	14.6	6.46	4.93	47.0	U	U	161	28.8	8.1	0.8	57.0
03/08/2017	15.1	6.18	4.71	48.5	U	U	163	28.2	8.0	0.9	55.3
08/15/2017	15.6	6.46	4.97	47.6	U	U	160	29.1	8.0	1.0	54.2
03/06/2018	15.3	6.60	5.00	49.0	U	U	160	29.0	8.2	1.1	57.2
03/06/2018 (FD)	15.4	6.67	5.19	50.8	U	U	161	29.2	8.2	1.1	58.2
08/14/2018	15.9	6.93	4.93	49.0	U	U	160	27.6	7.9	1.0	59.0
03/12/2019	15.6	7.09	5.20	50.7	U	U	162	27.5	8.0	1.2	60.4
08/06/2019	16.0	6.59	4.77	48.2	U	U	167	29.5	8.3	1.1	59.7
08/06/2019 (FD)	16.4	6.73	4.86	49.1	U	U	165	29.0	8.1	1.1	60.3
UE5PW-3											
03/17/2015	16.4	5.96	3.95	53.4	U	U	154	30.8	8.5	1.0	57.3
08/11/2015	16.3	6.31	4.21	59.1	U	U	151	32.2	8.7	1.0	58.2
03/15/2016	15.8	5.92	4.03	50.6	U	U	156	31.5	8.7	1.0	55.4
08/16/2016	15.2	5.78	3.84	52.6	U	U	160	32.4	8.6	0.9	56.3
03/08/2017	15.0	5.47	3.79	52.1	U	U	162	31.6	8.6	1.0	53.0
08/15/2017	15.9	5.74	4.03	52.7	U	U	161	32.2	8.5	1.0	53.7
03/06/2018	14.4	5.39	3.94	52.5	U	U	157	30.7	8.7	1.1	53.0
08/14/2018	14.9	5.75	3.86	51.3	U	U	155	30.0	8.4	1.1	54.8
08/14/2018 (FD)	14.9	5.87	3.81	51.1	U	U	156	30.8	8.4	1.0	54.1
03/05/2019	16.5	5.11	3.64	48.2	U	U	160	30.7	8.6	1.2	60.5
08/06/2019	14.7	5.64	5.82	56.6	U	U	155	36.2	9.9	1.2	61.6

Result<MDL reported as "U"

UE5PW-1

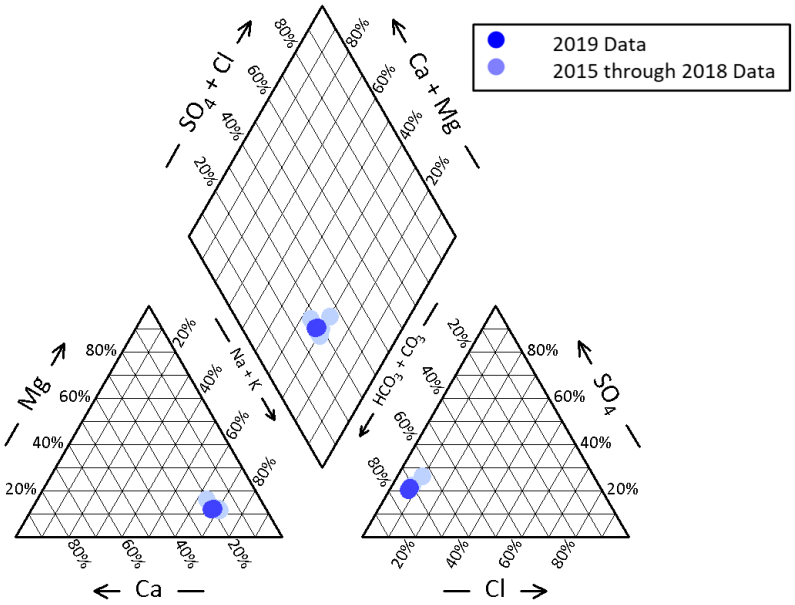


Figure 2-5. Piper Diagram for UE5PW-1

UE5PW-2

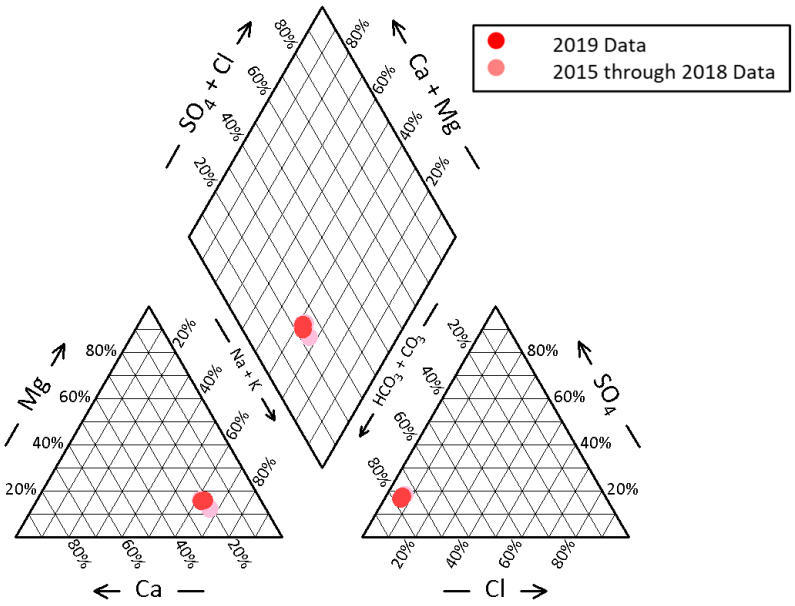


Figure 2-6. Piper Diagram for UE5PW-2

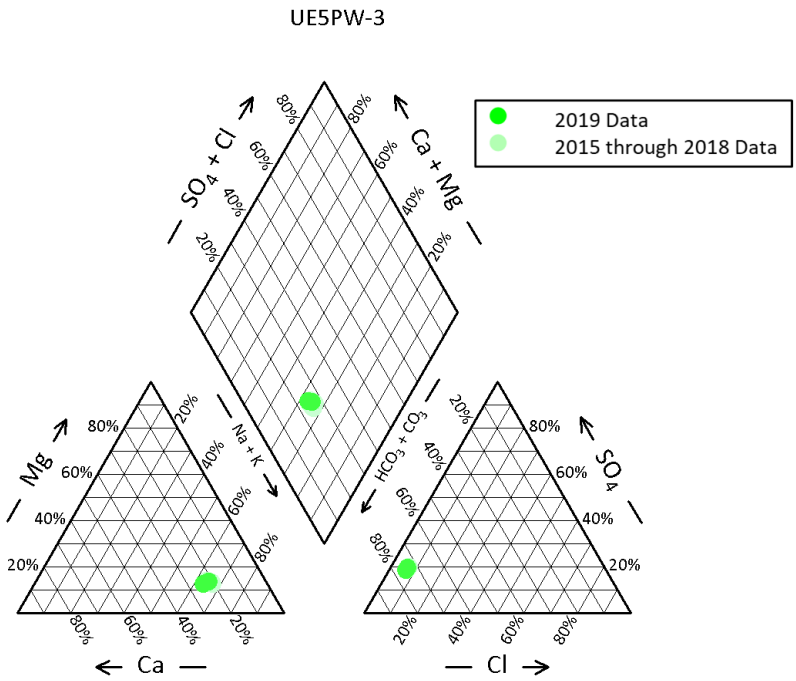


Figure 2-7. Piper Diagram for UE5PW-3

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3.0 LEACHATE MONITORING

Leachate monitoring data from the mixed waste disposal unit at the Area 5 RWMS are used to determine the disposal fate of collected leachate. According to 40 CFR 261.3(c)(2)(i), leachate is a hazardous waste. However, RCRA Permit NEV HW0101, Revision 6, contains a provision that collected leachate may be used for dust suppression within the cell of origin provided the leachate does not exceed any regulatory level for toxicity characteristic contaminants identified in 40 CFR 261.24, Table 1, and the tritium concentration does not exceed 1,330,000 pCi/l. If the leachate composition exceeds any regulatory level, the leachate is managed as hazardous waste in accordance with applicable regulations, and NDEP is notified within 10 days of this determination.

The leachate monitoring strategy is described in the SAP in the RCRA Part B Permit Application for the mixed waste disposal unit (DOE 2017); *Sampling and Analysis Plan, Nevada National Security Site, Mixed Waste Disposal Unit Leachate* (NSTec 2017a); and *Sampling and/or Analysis Plan-Data Quality Objectives, MWDU Leachate* (NSTec 2017b). Leachate monitoring for Cell 18 began in 2011. Leachate monitoring for Cell 25 began in 2019.

3.1 LEACHATE COLLECTION SYSTEM

Cell 18 and Cell 25 are lined mixed waste cells at the Area 5 RWMS. Cell 18 was constructed in 2010 and began receiving waste in January 2011. Cell 18 received its last waste package 2019, and preparation for closure of Cell 18 began. Cell 25 was constructed in 2017 and began receiving waste in August 2018. Each cell has a RCRA-compliant double liner with a leachate collection and leak detection system over a geosynthetic clay liner. The double liner is covered by approximately 61 cm (24 in.) of compacted soil and an additional 15 cm (6 in.) of aggregate material covering the compacted soil on the cell floor. The primary liner is 80-millimeter textured HDPE, and the secondary liner is 60-millimeter textured HDPE. The primary liner is directly below a double-sided geocomposite drainage layer, and a second double-sided geocomposite drainage layer separates the primary liner from the secondary liner.

Precipitation or other water applied to the area that is not removed by evapotranspiration infiltrates into the soil above the liner, percolates through the soil and any waste above the primary liner to the liner, flows through the geocomposite drainage layer above the liner, and drains into the primary sump in the cell floor. Any water leaking through the primary liner would percolate to the secondary liner, flow through the geocomposite drainage layer above the secondary liner, and drain into the secondary sump. Water collected in the primary sump is pumped to a double-walled leachate collection tank on the surface adjacent to the cell. Cell 18 has a 3,000-gallon storage tank (LPW-TNK-001), and Cell 25 has a 10,000-gallon storage tank (LPW-TNK-002) (Figure 2-1).

Pressure transducers monitor leachate levels in the leachate collection tanks, primary sumps, and secondary sumps. Totalizing flow meters measure the leachate volume pumped from each primary sump into its associated leachate collection tank. Pressure transducer measurements are recorded at the beginning of most workdays, and flow meter measurements are recorded at approximately one-week intervals. Cell 18 leachate volumes are calculated from the change in leachate tank level following pumping from the primary sump into the collection tank. These leachate volume measurements are more reliable than the corresponding flow meter measurements from Cell 18. Due to a pressure transducer failure, the Cell 25 leachate volume was measured by the totalizing flowmeter between the primary sump and the leachate collection tank. This value was verified with a sounding rod inserted into the top of the tank when the tank was emptied on August 15, 2019. No additional leachate was pumped from the primary sump into the leachate tank through December 31, 2019.

During the period of Cell 18 operation from January 2011 through December 2019, the cumulative leachate volume pumped from Cell 18 was approximately 388,243 liters (102,563 gallons), and the cumulative precipitation was 108.45 cm (42.71 in.) at the Area 5 RWMS. The equivalent depth of the collected leachate distributed over the 1.35-hectare (3.33-acre) area covered by the Cell 18 liner was 2.91 cm (1.14 in.). The cumulative leachate was 2.7 percent of the cumulative precipitation. The precipitation at the Area 5 RWMS during 2019 was 20.42 cm (8.03 in.), and the leachate volume collected from Cell 18 during 2019 was 28,028 liters (7,404 gallons). The 2019 leachate depth equivalent was 0.21 cm (0.08 in.), and the 2019 Cell 18 leachate amount was 1 percent of the 2019 precipitation.

Although the Cell 25 leachate tank was not full, it was sampled on August 1, 2019, and emptied on August 15, 2019, to meet the regulatory requirement for annual sampling. The total Cell 25 leachate volume was 22,660 liters (5,986 gallons). The equivalent depth of the leachate distributed over the 1.41-hectare (3.48-acre) area covered by the Cell 25 liner was 0.16 cm (0.06 in.). The Cell 25 leachate amount was 0.8 percent of 20.42 cm (8.03 in.) of precipitation at the Area 5 RWMS during 2019.

3.2 LEACHATE PARAMETERS AND SAMPLING FREQUENCY

At least annually or when the leachate collection tank approaches its capacity, samples are collected from the leachate and analyzed for toxicity characteristic contaminants, PCBs, pH, SC, and tritium.

Leachate samples are analyzed for the following contaminants:

- Toxicity characteristic contaminants:
  - Metals: As, Ba, Cd, Cr, Pb, Hg, Se, and Ag
  - Semivolatile organic analytes (SVOAs): o-, m-, and p-cresol; 1,4-dichlorobenzene; 2,4-dinitrotoluene; hexachlorobenzene; hexachlorobutadiene; hexachloroethane; nitrobenzene; pentachlorophenol; pyridine; 2,4,5-trichlorophenol; and 2,4,6-trichlorophenol
  - Volatile organic analytes (VOAs): benzene, carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichloroethane, 1,1-dichloroethylene, methyl ethyl ketone, tetrachloroethylene, trichloroethylene, and vinyl chloride
  - Pesticides: chlordane, endrin, heptachlor, lindane, methoxychlor, toxaphene, 2,4,5-TP (Silvex), and 2,4-D
- PCBs
- pH
- SC
- Tritium

Regulatory levels and ILs for leachate parameters are provided in RCRA Permit NEV HW0101, Revision 6. Regulatory levels for toxicity characteristic contaminants are set at the maximum concentration for each contaminant listed in 40 CFR 261.24, Table 1. These maximum concentrations are provided in Table 3-1. The National Primary Drinking Water Regulations identify the EPA maximum contaminant levels (MCLs) in public drinking water systems. The MCL for PCBs in public water systems is 0.0005 mg/l, and the IL for PCBs in leachate is 0.0005 mg/l. The IL for tritium is set at 400,000 pCi/l. This tritium concentration is the action level that requires UGTA drilling operations at the NNSS to discharge drilling fluid into lined sumps rather than unlined sumps (DOE 2009). A conservative dose assessment calculation for workers spraying leachate on a cell surface for dust control determined that a tritium concentration of 1,330,000 pCi/l would expose a worker to less than 10 percent of the DOE NNSS Administrative Control Level for a radiation dose of 500 millirems per year (NSTec 2017c). The ILs for pH and SC were revised in RCRA Permit NEV HW0101, Revision 6, based on the distribution of previous measurements. The IL for pH is <6.0 or >9.0, and the IL for SC is 10.0 mmho/cm (Table 3-2).

Table 3-1. Regulatory Levels for Toxicity Characteristic Contaminants in Leachate

Contaminant	Regulatory Level (mg/l)	Contaminant	Regulatory Level (mg/l)
Metals			
As	5	Pb	5
Ba	100	Se	1
Cd	1	Ag	5
Cr	5	Hg	0.2
Semivolatile Organic Analytes			
o-cresol	200	Hexachloroethane	3
m- and p-cresol	200	Nitrobenzene	2
1,4-dichlorobenzene	7.5	Pentachlorophenol	100
2,4-dinitrotoluene	0.13	Pyridine	5
Hexachlorobenzene	0.13	2,4,5-trichlorophenol	400
Hexachlorobutadiene	0.5	2,4,6-trichlorophenol	2
Volatile Organic Analytes			
Benzene	0.5	1,1-Dichloroethylene	0.7
Carbon tetrachloride	0.5	Methyl ethyl ketone	200
Chlorobenzene	100	Tetrachloroethylene	0.7
Chloroform	6	Trichloroethylene	0.5
1,2-Dichloroethane	0.5	Vinyl chloride	0.2
Pesticides			
Chlordane	0.03	Methoxychlor	10
Endrin	0.02	Toxaphene	0.5
Heptachlor	0.008	2,4,5-TP (Silvex)	1
Lindane	0.4	2,4-D	10

Table 3-2. Investigation Levels for Leachate

Contaminant	Investigation Level
PCBs	0.0005 mg/l
Tritium	400,000 pCi/l
SC	10.0 mmho/cm
pH	<6.0 or >9.0

3.3 LEACHATE SAMPLING METHODS

The standard operating procedure SOP-2151.456, *Resource Conservation and Recovery Act (RCRA) Cell 18 Leachate System Management* (NSTec 2017d and MSTS 2019b) was followed for sample collection at Cell 18, and the standard operating procedure SOP-2151.459, *Resource Conservation and Recovery Act (RCRA) Cell 25 Leachate System Management* (MSTS 2018b) was followed for sample collection at Cell 25. Liquid recirculation systems in each tank circulate the leachate in the tank for at least 20 minutes to thoroughly mix the tank contents. A valve in the recirculation system opens the flow to a sample port. A calibrated handheld meter measures the pH and SC of the leachate outflow just prior to sampling. Samples are collected in new, certified clean sample bottles appropriate for the required analyses. Required preservatives are added to samples, sample bottles are sealed, and tamper-evident tape is applied to the sealed bottles. Sealed samples are cooled in ice chests and remain cooled through shipment to Nevada-certified contract laboratories for analysis. Chain of custody protocols are followed for all samples beginning with sample collection to final analysis. All samples are approved for release from the NNSS to Nevada-certified contract laboratories for analysis by the Radiological Control Department. Samples were collected from the Cell 18 leachate tank on March 14, May 29, and December 11, 2019, and samples were collected from the Cell 25 leachate tank on August 1, 2019. A grab sample and a trip blank (TB) sample for VOA analysis were collected on each sample date.

Table 3-3. Number of Leachate Samples Collected

Parameter	Sample Bottle	Preservative	Cell 18						Cell 25	
			3/14/2019		5/29/2019		12/11/2019		8/1/2019	
			Grab	TB	Grab	TB	Grab	TB	Grab	TB
Specific Conductance	125-ml HDPE	<6°C	1	-	1	-	1	-	1	-
Tritium	125-ml HDPE	<6°C	1	-	1	-	1	-	1	-
Toxicity Characteristic Metals	500-ml glass	<6°C	1	-	1	-	1	-	1	-
Toxicity Characteristic SVOAs and Pesticides	1,000-ml amber glass	<6°C	3	-	3	-	3	-	3	-
Toxicity Characteristic VOAs[1]	40-ml VOA	<6°C	2	-	2	-	2	-	2	-
Total VOAs[1]	40-ml VOA	pH<2 (H_2SO_4), <6°C	-	3		3	-	3		3

[1] No headspace for VOA sample bottles

3.4 LEACHATE SAMPLE RESULTS

After sample results were evaluated, the leachate tanks were emptied and the leachate was used for dust control on the cell where the leachate was collected. The Cell 18 leachate tank was emptied on April 11, 2019, July 11, 2019, and January 16, 2020. The Cell 25 leachate tank was emptied on August 15, 2019. All Cell 18 laboratory analyses were performed by ALS. Cell 25 VOA analyses were performed by ALS, and all other Cell 25 laboratory analyses were performed by GEL. Laboratory analysis followed standard contractual protocols and procedures using standard methods from SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (EPA 1996). *Sampling and/or Analysis Plan-Data Quality Objectives, MWDU Leachate* (NSTec 2017b) provides the laboratory analysis procedures for the analyses summarized in Table 3-4.

Table 3-4. Leachate Sample Parameters, Laboratories, and Analytical Methods

Analysis	Cell 18 Laboratory	Cell 25 Laboratory	Method	Method Description
pH	Field	Field	SOP-2151.104	Potentiometric
Toxicity characteristic metals	ALS	GEL	SW 6010	Inductively coupled plasma atomic emission
Toxicity characteristic Hg	ALS	GEL	SW 7470	Manual cold-vapor technique
Toxicity characteristic SVOAs	ALS	GEL	SW 8270	Gas chromatography/mass spectrometry
Toxicity characteristic VOAs	ALS	ALS	SW 8260	gas chromatography/mass spectrometry
Toxicity characteristic pesticides	ALS	GEL	SW 8081	Gas chromatography
Toxicity characteristic herbicides	ALS	GEL	SW 8151	Gas chromatography
PCBs	ALS	GEL	SW 8082	Gas chromatography
Tritium	ALS	GEL	EPA 906.0	Liquid scintillation
SC	ALS	GEL	EPA 120.1	Conductivity bridge

3.4.1 Leachate Toxicity Characteristic Contaminants

Regulatory levels for toxicity characteristic contaminants are defined as the maximum concentration for each contaminant listed in 40 CFR 261.24, Table 1, and provided in Table 3-1. All 2019 toxicity characteristic contaminant results were below the regulatory levels (Table 3-5, Table 3-6, Table 3-7, and Table 3-8). If the laboratory result was less than or equal to the MDL, the result in the table was reported as "U," and if the laboratory result was greater than the MDL and less than or equal to the RL, the result in the table was reported as "<RL."

All leachate toxicity characteristic contaminant results are below regulatory levels for toxicity characteristic contaminants identified in RCRA Permit NEV HW0101, Revision 6. Exceeding any of these limits would prohibit use of collected leachate for dust suppression within the cell of origin.

Table 3-5. Leachate Toxicity Characteristic Metals

	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
	Regulatory Level (mg/l)							
	5.0	100	1.0	5.0	5.0	1.0	5.0	0.2
	Maximum and Minimum Method Detection Limit (mg/l)							
	0.057	0.3	0.015	0.03	0.033	0.067	0.03	0.001
	0.009	0.0021	0.0014	0.0066	0.0029	0.0042	0.0062	0.00006
Date	Cell 18 Leachate Tank							
01/28/2015	<0.1	<1	U	U	U	U	U	U
03/31/2015	U	<1	U	U	U	U	U	U
06/09/2015	U	<1	U	U	U	U	<0.1	U
10/28/2015	U	<1	U	U	U	U	U	U
12/01/2015	U	<1	U	U	<0.03	U	U	U
01/13/2016	U	<1	U	U	U	U	U	U
02/09/2016	U	<1	U	U	U	U	U	U
03/09/2016	<0.1	<1	U	U	U	U	U	U
03/29/2016	<0.1	<1	U	U	U	U	U	U
04/18/2016	<0.1	<1	U	U	U	U	U	U
05/10/2016	U	<1	U	U	U	U	U	U
06/15/2016	U	<1	U	U	U	U	U	U
07/13/2016	U	<1	U	U	U	<0.05	<0.1	U
08/04/2016	U	<1	<0.05	U	U	U	<0.1	U
09/14/2016	U	<1	U	U	U	U	U	U
11/08/2016	U	<1	U	U	U	U	U	U
01/26/2017	<0.1	<1	U	U	U	U	U	U
02/21/2017	U	<1	U	U	U	U	U	U
03/28/2017	<0.1	<1	U	U	U	U	U	U
04/04/2017	U	<1	U	U	U	U	U	U
05/11/2017	U	U	U	U	U	U	U	U
07/11/2017	U	U	U	U	<0.03	U	U	U
10/19/2017	U	<1	U	U	U	U	U	U
03/01/2018	<0.1	<1	U	U	U	U	U	U
08/01/2018	0.20	<1	<0.05	U	U	U	U	U
03/14/2019	<0.1	<1	U	U	<0.04	<0.06	U	U
05/29/2019	U	U	U	U	U	U	U	U
12/11/2019	<0.1	<1	U	U	<0.04	U	U	U
	Cell 25 Leachate Tank							
08/01/2019	U	0.0838	U	U	<0.2	<0.3	U	U

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

Table 3-6. Leachate Toxicity Characteristic Semivolatile Organic Analytes

	o-Cresol	m- & p-Cresol	1,4-Dichloro benzene	2,4-Dinitro toluene	Hexa chloro benzene	Hexa chloro butadiene	Hexa chloro ethane	Nitro benzene	Penta chloro phenol	Pyridine	2,4,5-Trichloro phenol	2,4,6-Trichloro phenol
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
	Regulatory Level (mg/l)											
	200	200	7.5	0.1	0.1	0.5	3.0	2.0	100	5.0	400	2.0
	Maximum and Minimum Method Detection Limit (mg/L)											
	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.12	0.043	0.03	0.03
	0.015	0.019	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Date	Cell 18 Leachate Tank											
01/28/2015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/31/2015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
06/09/2015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
10/28/2015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
12/01/2015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
01/13/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
02/09/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/09/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/29/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
04/18/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
05/10/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
06/15/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
07/13/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
08/04/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
09/14/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
11/08/2016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
01/26/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
02/21/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/28/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
04/04/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
05/11/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
07/11/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
10/19/2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/01/2018	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
08/01/2018	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/14/2019	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
05/29/2019	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
12/11/2019	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
	Cell 25 Leachate Tank											
08/01/2019	U	U	U	U	U	U	U	U	U	U	U	U

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

Table 3-7. Leachate Toxicity Characteristic Volatile Organic Analytes

	Benzene	Carbon tetra chloride	Chloro benzene	Chloroform	1,2-Dichloro ethane	1,1-Dichloro ethylene	Methyl ethyl ketone	Tetra chloro ethylene	Trichloro ethylene	Vinyl chloride
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
	Regulatory Level (mg/l)									
	0.5	0.5	100.0	6.0	0.5	0.7	200.0	0.7	0.5	0.2
	Maximum and Minimum Method Detection Limit (mg/l)									
	0.0032	0.0032	0.003	0.003	0.003	0.003	0.03	0.003	0.005	0.0031
	0.0003	0.0002	0.0003	0.0003	0.0002	0.0003	0.003	0.0002	0.0003	0.0002
Date	Cell 18 Leachate Tank									
01/28/2015	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.0011	0.002	<0.001
03/31/2015	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.0011	0.0016	<0.001
06/09/2015	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
10/28/2015	<0.001	<0.001	<0.001	0.0014	<0.001	<0.001	<0.01	0.0025	0.0023	<0.001
12/01/2015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
01/13/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
02/09/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
03/09/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
03/29/2016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
04/18/2016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
05/10/2016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
06/15/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
07/13/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
08/04/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
09/14/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
11/08/2016	<0.001	<0.001	<0.001	0.0011	<0.001	<0.001	<0.01	0.0019	0.0016	<0.001
01/26/2017	<0.001	<0.001	<0.001	0.0019	<0.001	<0.001	<0.01	0.0023	0.0021	<0.001
02/21/2017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
03/28/2017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
04/04/2017	<0.001	<0.001	<0.001	0.0017	<0.001	<0.001	<0.01	0.0022	0.0013	<0.001
05/11/2017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
07/11/2017	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
10/19/2017	<0.001	<0.001	<0.001	0.0011	<0.001	<0.001	<0.01	0.0019	0.0013	<0.001
03/01/2018	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
08/01/2018	<0.001	<0.001	<0.001	0.0015	<0.001	<0.001	<0.01	0.0018	0.0012	<0.001
03/14/2019	<0.001	0.0028	<0.001	0.0037	<0.001	<0.001	<0.01	0.0022	0.0026	<0.001
05/29/2019	<0.001	0.0037	<0.001	0.0038	<0.001	<0.001	<0.01	0.0017	0.0029	<0.001
12/11/2019	<0.001	0.0045	<0.001	0.0062	<0.001	<0.001	<0.01	0.0026	0.0041	<0.001
	Cell 25 Leachate Tank									
08/01/2019	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

Table 3-8. Leachate Toxicity Characteristic Pesticides

	Chlordane	Endrin	Heptachlor	Lindane	Meth oxychlor	Toxaphene	2,4,5-TP (Silvex)	2,4-D
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
	Regulatory Level (mg/l)							
	0.03	0.02	0.008	0.4	10.0	0.5	1.0	10.0
	Minimum and Maximum Method Detection Limit (mg/l)							
	0.003	0.00043	0.0003	0.0003	0.0012	0.0075	0.0167	0.0167
	0.000765	0.0001	0.0000665	0.0000665	0.0003	0.0015	0.0002	0.0026
Date	Cell 18 Leachate Tank							
01/28/2015	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/31/2015	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
06/09/2015	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
10/28/2015	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
12/01/2015	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
01/13/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
02/09/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/09/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/29/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
04/18/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
05/10/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
06/15/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
07/13/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
08/04/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
09/14/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
11/08/2016	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
01/26/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
02/21/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/28/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
04/04/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
05/11/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
07/11/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
10/19/2017	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/01/2018	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
08/01/2018	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/14/2019	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
05/29/2019	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
12/11/2019	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
	Cell 25 Leachate Tank							
08/01/2019	U	U	U	U	U	U	U	U

Result<MDL reported as "U"
MDL<Result<RL reported as <RL value

3.4.2 Leachate Indicator Parameters

Leachate indicator parameters include PCBs, pH, SC, and tritium. Indicator parameters do not have defined regulatory levels, but have ILs set by RCRA Permit NEV HW0101, Revision 6. The premise for ILs is that when a result is outside the bounds of an IL, this is an indication that something in the waste disposal system has changed, and the consequences of this change require investigation to determine what, if any, remedial actions are required.

3.4.2.1 Leachate Polychlorinated Biphenyls

The IL for PCBs is set at the EPA MCL in public drinking water systems as defined in the National Primary Drinking Water Regulations (40 CFR 141.61). The IL for PCBs is 0.0005 mg/l. Table 3-9 provides leachate sample PCB results. PCB results ranged from <0.00047 mg/l to <0.00056 mg/l, but MDLs reported by the analysis laboratory ranged from <0.00014 mg/l to <0.00033 mg/l. There were no detectable PCBs in the collected leachate.

Table 3-9. Leachate Polychlorinated Biphenyls

	Aroclor 1016	Aroclor 1221	Aroclor 1222	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1220
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
	Regulatory Level (mg/l)						
	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
	Maximum and Minimum Method Detection Limit (mg/l)						
	0.00033	0.00033	0.00033	0.00033	0.00033	0.00033	0.00033
	0.000034	0.000034	0.000034	0.000034	0.000034	0.000034	0.000034
Date	Cell 18 Leachate Tank						
01/28/2015	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047
03/31/2015	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049
06/09/2015	<0.00056	<0.00056	<0.00056	<0.00056	<0.00056	<0.00056	<0.00056
10/28/2015	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052
12/01/2015	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
01/13/2016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
02/09/2016	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049
03/09/2016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
03/29/2016	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052
04/18/2016	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049
05/10/2016	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
06/15/2016	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049	<0.00049
07/13/2016	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
08/04/2016	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
09/14/2016	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
11/08/2016	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052
01/26/2017	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
02/21/2017	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
03/28/2017	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
04/04/2017	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
05/11/2017	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
07/11/2017	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
10/19/2017	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052
03/01/2018	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047
08/01/2018	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047
03/14/2019	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047
05/29/2019	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048	<0.00048
12/11/2019	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047	<0.00047
	Cell 25 Leachate Tank						
08/01/2019	U	U	U	U	U	U	U

Result<MDL reported as "U"

MDL<Result<RL reported as <RL value

3.4.2.2 Leachate Tritium

All 2019 leachate tritium results from Cell 18 and Cell 25 were below the IL of 400,000 pCi/l. The single tritium result from Cell 25 was less than the MDL. Figure 3-1 and Table 3-10 provide leachate tritium results from 2015 through 2019.

All 2019 leachate tritium results were below the regulatory level of 1,330,000 pCi/l identified in RCRA Permit NEV HW0101, Revision 6. Exceeding this limit would prohibit use of collected leachate for dust suppression within the cell of origin.

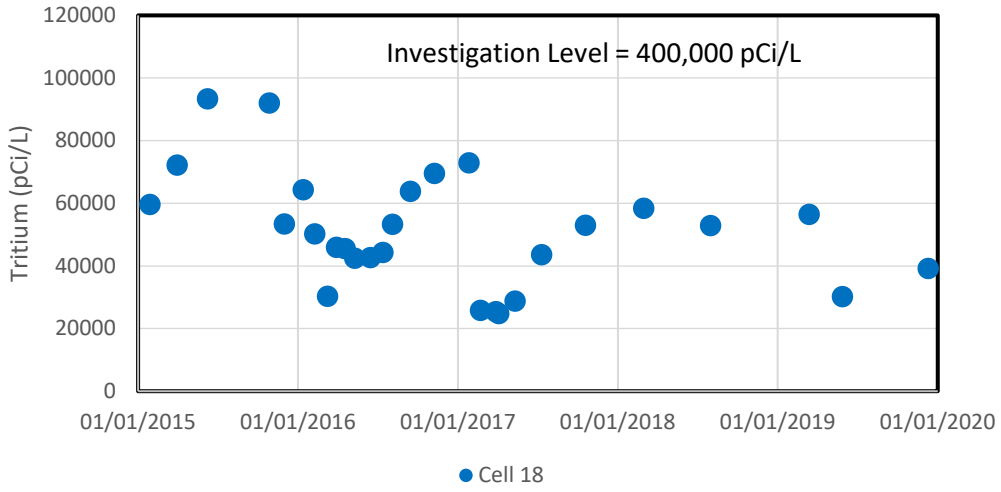

Figure 3-1. Leachate Tritium

3.4.2.3 Leachate Specific Conductance

All 2019 leachate SC results from Cell 18 and Cell 25 were below the IL of 10.0 mmhos/cm. Measurements were collected in the field with a handheld meter, and samples were sent to a laboratory for analysis. Figure 3-2 and Table 3-10 provide leachate SC results from 2015 through 2019.

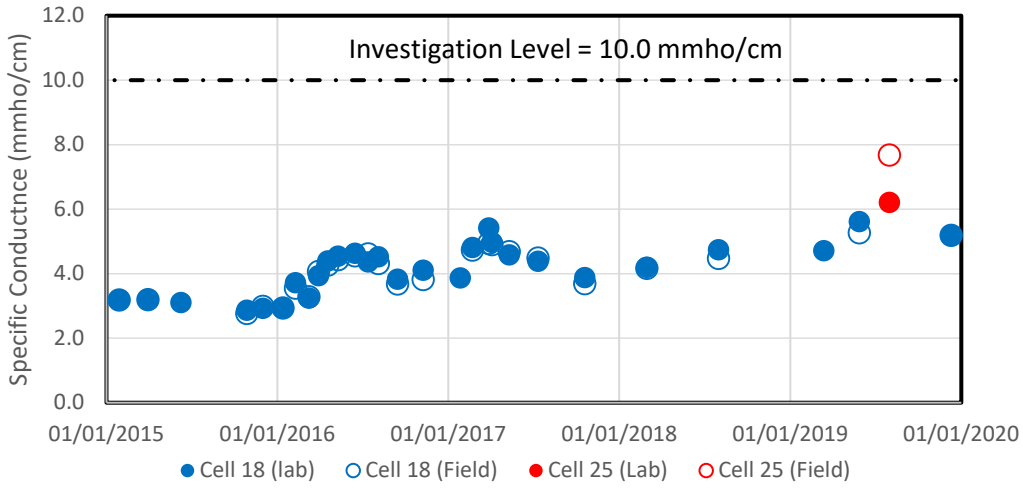

Figure 3-2. Leachate Specific Conductance

3.4.2.4 Leachate pH

All 2019 leachate pH results from Cell 18 and Cell 25 were within the IL bounds of 6.0 and 9.0. Figure 3-3 and Table 3-10 provide leachate pH results from 2015 through 2019.

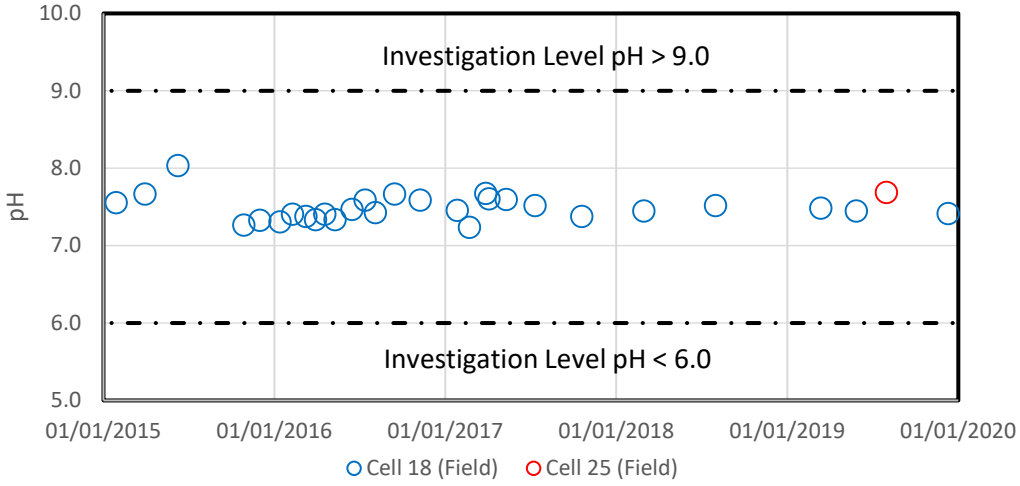

Figure 3-3. Leachate pH

Table 3-10. Leachate Tritium, Specific Conductance, and pH

Date	Tritium (pCi/l)	Specific Conductance (Lab) (mmho/cm)	Specific Conductance (Field) (mmho/cm)	pH (Field)
	Investigation Level			
	400,000	10.0	10.0	6.0 < pH < 9.0
	Cell 18 Leachate Tank			
01/28/2015	59,700	3.19	3.20	7.56
03/31/2015	72,200	3.21	3.21	7.67
06/09/2015	93,400	3.12	—	8.04
10/28/2015	92,100	2.88	2.77	7.27
12/01/2015	53,400	2.94	3.00	7.33
01/13/2016	64,400	2.95	2.95	7.31
02/09/2016	50,300	3.73	3.56	7.41
03/09/2016	30,400	3.25	3.29	7.38
03/29/2016	46,000	3.95	4.08	7.34
04/18/2016	45,600	4.41	4.27	7.41
05/10/2016	42,500	4.55	4.45	7.34
06/15/2016	42,700	4.64	4.56	7.47
07/13/2016	44,400	4.38	4.62	7.59
08/04/2016	53,300	4.53	4.33	7.43
09/14/2016	63,900	3.84	3.69	7.67
11/08/2016	69,600	4.12	3.83	7.59
01/26/2017	73,000	3.88	—	7.46
02/21/2017	25,900	4.82	4.74	7.24
03/28/2017	25,400	5.43	4.95	7.68
04/04/2017	24,800	4.98	4.91	7.61
05/11/2017	28,800	4.59	4.69	7.60
07/11/2017	43,600	4.40	4.50	7.52
10/19/2017	53,000	3.89	3.70	7.38
03/01/2018	58,400	4.21	4.17	7.45
08/01/2018	52,900	4.75	4.48	7.52
03/14/2019	56,500	4.72	—	7.49
05/29/2019	30,300	5.63	5.28	7.45
12/11/2019	39,200	5.20	5.20	7.42
	Cell 25 Leachate Tank			
08/01/2019	U	6.22	6.51	7.69

Result<MDL reported as "U"

4.0 QUALITY ASSURANCE

Environmental monitoring conducted for the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office is performed according to the Quality Assurance Program (QAP) established by the Management and Operations (M&O) contractor. The QAP describes the methods used to ensure that quality is integrated into monitoring work and complies with 10 CFR 830, Subpart A, *Quality Assurance Requirements*, and DOE Order DOE O 414.1D, *Quality Assurance*.

The Data Quality Objective (DQO) process developed by the EPA is used to provide the quality assurance (QA) structure for designing, implementing, and improving environmental monitoring efforts when environmental sampling and analysis are involved. This process helps ensure the collected environmental monitoring data are useful and defensible; the results meet identified metrics for precision, accuracy, representativeness, and comparability; and workers and the environment are protected.

The key elements of the environmental monitoring process are listed below. Each element is designed to ensure that applicable QA requirements are implemented.

- A SAP establishes monitoring objectives, goals, requirements, methods, monitoring parameters, and criteria.
- Environmental sampling follows established procedures and site work controls, is performed by qualified personnel, and is documented.
- Laboratory analyses meet DOE, M&O contractor, and RCRA requirements.
- Data review verifies and validates that DQOs and data are suitable for their intended purpose.
- Assessments verify procedures are followed and data quality requirements are met to identify nonconforming items and their cause, implement corrective actions, and evaluate corrective action effectiveness.

4.1 SAMPLING AND ANALYSIS PLAN

The SAP for groundwater and leachate monitoring at the Area 5 RWMS is found in the RCRA Part B Permit Application for the mixed waste disposal unit (DOE 2017). The environmental monitoring SAP identifies the following:

- Monitoring requirements, objectives, and regulations
- Monitoring wells and leachate sampling locations
- Parameters and ILs or regulatory levels for these parameters
- Sampling methods, procedures, and frequencies
- Analysis methods and requirements
- Quality metrics (precision, accuracy, representativeness, and comparability)
- Reporting requirements

The SAP summarizes, combines, and expands the information from *Sampling and Analysis Plan, Nevada National Security Site, Area 5 Groundwater Monitoring* (NSTec 2016a); *Sampling and/or Analysis Plan-Data Quality Objectives, Area 5 RWMS Groundwater Monitoring* (MSTS 2018a); *Sampling and Analysis Plan, Nevada National Security Site, Mixed Waste Disposal Unit Leachate* (NSTec 2017a); and *Sampling and/or Analysis Plan-Data Quality Objectives, MWDU Leachate* (NSTec 2017b).

4.2 ENVIRONMENTAL SAMPLING

The key components supporting the quality and defensibility of the sampling process and products include personnel training and qualification, following established procedures and methods, documentation of field activities, and sample inspection and acceptance testing.

4.2.1 Training and Qualification

Sampling personnel are trained and qualified and have the required skills for environmental sampling activities prior to collecting samples. In addition to procedure- and task-specific training, the environmental, safety, and health aspects of sampling are addressed with training. Records of personnel training, qualifications, and skills are maintained by the M&O contractor.

4.2.2 Procedures and Methods

The standard operating procedure SOP-2151.104, *Instructions for Area 5 RWMS Groundwater Well Preparation and Groundwater Sampling* (NSTec 2016b and MSTS 2019a), was followed for groundwater sample collection. SOP-2151.456, *Resource Conservation and Recovery Act (RCRA) Cell 18 Leachate System Management* (NSTec 2017d), and SOP-2151.456, *Resource Conservation and Recovery Act (RCRA) Cell 18 Leachate System Management* (MSTS 2019b), were followed for sample collection from the Cell 18 leachate tank. SOP-2151.459, *Resource Conservation and Recovery Act (RCRA) Cell 25 Leachate System Management* (MSTS 2018b), was followed for sample collection from the Cell 25 leachate tank.

4.2.3 Field Documentation

A sample package is used for field documentation of sample collection activities. A unique sample package is prepared for each sampling event using the operating procedure OP-0732.118, *Sample Package Development* (MSTS 2018c). Depending on the samples collected, a sample package may include a statement of work; work control documents; work authorization; equipment and vehicle checklists; a field log; calibration check sheets; data sheets; lists of samples, sample bottles, and preservation methods; printed sample bottle labels; chain of custody documentation; sampling procedures; equipment manuals; safety information and procedures; and maps.

A sample collector uses chain of custody forms to document the custody of samples from the time of collection through shipment to the laboratory. These forms are included in sample packages. The forms include the sampling location, method of shipment and destination, collection date and time, sample identification numbers, analysis methods, and sample preservation methods. When samples are transferred from one custodian to another (e.g., from sampler to shipper or shipper to analytical laboratory), the receiving custodian inspects the form and samples and notes any deficiencies. Each transfer of custody is documented by the printed names and signatures of the custodian relinquishing the samples and the custodian receiving the samples with the time and date of transfer. Seven chain of custody forms were generated for the samples collected in 2019 (Table 4-1). Each sample delivery group (SDG) sent to a laboratory for analysis has a unique Identifier. Copies of all chain of custody forms are included in Appendix A.

Equipment used for field measurements of pH and SC are checked using standard solutions prior to use and after sampling is complete. Each instrument is assigned a unique number that is associated with each measurement and tracked in field documentation along with instrument checks.

Table 4-1. Chain of Custody Forms

Sample Delivery Group	Sample Location	Sample Type	Sample Date
V4460	UE5PW-1 UE5PW-3	Groundwater	03/05/2019
V4462	UE5PW-2	Groundwater	03/12/2019
V4504	Pilot Wells	Groundwater	08/06/2019
V4461	Cell 18	Leachate	03/14/2019
V4480	Cell 18	Leachate	05/29/2019
V4542	Cell 18	Leachate	12/11/2019
V4494	Cell 25	Leachate	08/01/2019

4.3 LABORATORY ANALYSIS

All laboratory data are generated by qualified laboratories whose services were obtained through subcontracts. Ensuring the quality of procured laboratory services is accomplished through procurement, initial and continuing assessment, and data evaluation.

4.3.1 Procurement

The analytical services technical basis is codified in the DOE Quality Systems for Analytical Services (QSAS). The QSAS is based on the National Environmental Laboratory Accreditation Conference, Chapter 5, *Quality Systems*, based on International Organization for Standardization Standard ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

The subcontract places numerous requirements on the laboratory, including the following:

- Maintaining the following documents:
  - A QAP and/or manual describing the laboratory's policies and approach to the implementation of QA requirements
  - An environment, safety, and health plan
  - A waste management plan
  - Procedures pertinent to subcontract scope
- The ability to generate data deliverables, both hard copy reports and electronic files
- Responding to all data quality questions in a timely manner
- Mandatory participation in proficiency testing programs
- Maintaining specific licenses, accreditations, and certifications
- Conducting internal audits of laboratory operations as well as audits of vendors
- Allowing external audits

4.3.2 Initial and Continuing Assessment

An initial assessment is performed during the proposal process, including a pre-award audit. Continuing assessment consists of the ongoing monitoring of a laboratory's performance against contract terms and conditions, of which the technical specifications are a part.

4.3.3 Data Evaluation

Data products are evaluated for compliance with contract terms and specifications. This primarily involves review of the data against the specified analytical method to determine the laboratory's ability to adhere to the QA and quality control (QC) requirements, as well as an evaluation of the data against the DQOs. Discrepancies are documented and resolved with the laboratory, and continuous assessment tracks the recurrence and efficacy of corrective actions.

4.4 DATA REVIEW

A systematic approach to evaluate data is essential for understanding and sustaining data quality. This determines whether the DQOs established in the planning phase were achieved. An electronic data management system achieves standardization and integrity in managing environmental data. The primary objective is to store and manage unclassified environmental data in an easily and efficiently retrievable form. Forms documenting the data review process for 2019 are provided in Appendix B.

4.4.1 Data Verification and Validation

Data verification ensures all laboratory data and sample documentation are present and complete. Sampling and analysis process information are reviewed, including but not limited to, sample preservation and temperature, chain of custody documentation and integrity, and analytical hold-time compliance. Data verification also ensures that electronic data correctly represent the sampling and analyses performed and includes evaluation of laboratory QC sample results.

Data validation supplements verification and is a more thorough review to better determine if the data meet the analytical and project requirements. Data validation ensures that the reported results correctly represent the sampling and analyses performed, determines the validity of the reported results, and assigns data qualifiers to flag questionable, uncertain, inaccurate, or estimated data.

4.4.2 Data Quality Assessment

Data quality assessment is a scientific and statistical review to determine whether data are the right type, quality, and quantity for the intended use and includes reviewing data for accuracy, representativeness, and fit with historical measurements. Laboratory QC measurements include laboratory control samples (LCSs), method blanks (MBs), laboratory replicates (LRs), and matrix spike (MS) samples. Field QC measurements include FDs, FBs, and TBs. The numbers of analyses done for laboratory QC and the number of analyses using field QC samples are provided in Table 4-2 for each type of analysis during 2019.

Table 4-2. Number of Quality Control Samples

Analysis	Grab	Laboratory QC				Field QC		
		MB	LCS	LR	MS	FD	FB	TB
pH	6	0	3	2	0	2	0	0
SC	10	0	4	3	0	2	0	0
TOC	6	4	4	1	1	12	6	0
TOX	6	4	4	4	4	12	6	0
Tritium	10	7	7	5	6	12	0	0
General water chemistry[1]	66	33	33	29	27	22	0	0
Toxicity characteristic metals	80	64	59	29	45	16	0	0
Toxicity characteristic SVOAs	48	72	84	0	0	0	0	0
Toxicity characteristic VOAs	47	47	94	0	0	0	0	47
Toxicity characteristic pesticides	72	83	121	0	36	0	0	0
PCBs	28	28	14	0	0	0	0	0

[1] Ca^{+2}, Fe, Mg^{+2}, Mn, K^{+}, Na^{+}, SO_4^{-2}, Cl^{-}, F^{-}, HCO_3^{-}, SiO_4^{-4})

4.4.2.2 Laboratory Quality Control Samples

LCSs are prepared by spiking water with verified amounts of target analytes. LCSs establish analytical precision and to identify measurement bias. LCS results are a percentage of true value, and acceptable results must fall within established control limits.

MB samples are prepared using water without target analytes. MB samples are processed simultaneously with and under the same conditions as a batch of samples through all steps of the analytical procedure. Detection of target analytes in MB samples indicates sample contamination.

LR analyses are replicate measurements from a separate aliquot of the same sample. LR samples are processed simultaneously with and under the same conditions as the original aliquot through all steps of the analytical procedure. LR results are evaluated as a relative percent difference (RPD), and acceptable results must fall within established control limits. RPD is calculated by dividing the absolute value of the difference between the sample and the LR result by the average of the sample and the LR result. RPDs outside control limits indicate that measurement precision is insufficient.

MS samples are spiked with known amounts of target analytes and subject to the same sample preparation and analysis as the original sample. MS samples are evaluated as the percent recovery of the MS. The MS is used to indicate if the matrix interferes with the analytical results.

4.4.2.3 Field Quality Control Samples

Field QC measurements include FDs, FBs, and TBs. Equipment blank samples are collected if there are indications that the sampling equipment is contaminated.

FDs are collected at the same location and time as the initial grab sample. Grab and FD samples are handled simultaneously through all steps of sample collection, transport, and analysis. FDs provide a measure of the precision of analytical results, including uncertainty associated with sample collection, transport, and homogeneity of sampled medium. Two FDs are typically collected with each grab sample and analyzed for tritium, TOC, and TOX. During each sample collection event, one FD from one well is also analyzed for all other measured parameters.

FBs are prepared during sample collection by filling a clean sample bottle with purified water and adding appropriate preservatives. FBs are used to evaluate contamination during sampling and handling. One FB is collected at each well during each sample event for TOC or TOX analysis.

TBs are prepared before a sampling event by filling a clean sample bottle with purified water and adding appropriate preservatives. The sealed bottle is carried to the sampling site and returned to the laboratory unopened. TBs are used to evaluate contamination due to shipping and handling. One TB is prepared before each sampling event for VOA analysis.

4.5 ASSESSMENTS

Assessments include evaluations of work planning, execution, and performance by personnel independent of the work activity to evaluate compliance with established requirements and identify deficiencies. Corrective actions are developed and implemented for identified deficiencies.

The most recent management assessment review was performed in 2017 (NSTec 2017e). The purpose of this assessment was to determine whether groundwater monitoring is conducted in compliance with the worker safety and health program. Work control documents and procedures were reviewed, work activities were observed, and personnel were interviewed. An issue with the sampling procedure and an issue with the documentation of the skill of the workers were identified, and both were corrected.

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5.0 SUMMARY AND CONCLUSIONS

RCRA Permit NEV HW0101, Revision 6, requires a groundwater detection monitoring program at the Area 5 RWMS in compliance with 40 CFR 264.97 and 40 CFR 264.98. It also requires monitoring of leachate from the mixed waste disposal unit at the Area 5 RWMS for the toxicity characteristic contaminants identified in 40 CFR 261.24, Table 1, and for PCBs, SC, pH, and tritium. Groundwater monitoring is intended to identify impacts on the uppermost aquifer underlying the Area 5 RWMS. Leachate monitoring is intended to determine if leachate can be safely and appropriately used for dust control on the mixed waste cell of its origin in compliance with RCRA Permit NEV HW0101, Revision 6. The permit identifies monitoring locations, parameters, and ILs or regulatory levels for each parameter for groundwater and leachate monitoring. This report satisfies the data reporting requirements of RCRA Permit NEV HW0101, Revision 6, for groundwater and leachate monitoring at the Area 5 RWMS. Groundwater data collected in 2019 are provided along with previous data from 2015 through 2018.

5.1 GROUNDWATER MONITORING

Static water levels were measured at UE5PW-1 and UE5PW-3 on March 4, June 10, August 5, and October 7, 2019, and at UE5PW-2 on March 6, June 10, August 5, and October 7, 2019. Measured water table elevations in 2019 ranged from 733.70 m (2,407.2 ft) AMSL to 733.36 m (2,406.0 ft) AMSL. The average water table depths in 2019 were 235.37 m (772.20 ft) bgs at UE5PW-1, 255.88 m (839.49 ft) bgs at UE5PW-2, and 270.85 m (888.60 ft) bgs at UE5PW-3. The average calculated hydraulic gradient from these measurements was 1.1E-05 m/m to the south-southeast, and the average calculated groundwater flow velocity was approximately 0.104 m per year. Similar groundwater elevations, a small aquifer gradient, and a small groundwater velocity show that the groundwater below the Area 5 RWMS is essentially flat with negligible flow. The expected travel time for any contaminant from the Area 5 RWMS through the vadose zone to the groundwater is greater than 50,000 years (Shott et al. 1998), and advective flow of any contaminant reaching the groundwater would be negligible.

Groundwater samples were collected on March 5 and August 6, 2019, at UE5PW-1 and UE5PW-3 and on March 12 and August 6, 2019, at UE5PW-2. Field measurement pH results ranged from 8.08 to 8.25, and laboratory analysis pH results ranged from 8.31 to 8.47. All pH results were within the IL bounds of 7.8 and 9.2. Field measurement SC results ranged from 0.357 to 0.381 mmho/cm, and laboratory analysis SC results ranged from 0.359 to 0.383 mmho/cm. All SC results were less than the IL of 0.44 mmho/cm. All tritium results were less than the IL of 2,000 pCi/l and less than the laboratory RL of 300 pCi/l. All TOC results were less than the IL of 2.0 mg/l and less than the laboratory RL 1.0 mg/l. All TOX results were less than the IL of 0.1 mg/l and less than the RL of 0.01 mg/l. The IL for each of the toxicity characteristic metals (As, Ba, Cd, Cr, Pb, Hg, Se, and Ag) was set at its maximum concentration for groundwater protection listed in 40 CFR 264.94, Table 1. All 2019 toxicity characteristic metal results were less than the corresponding ILs. Ba results were slightly above the laboratory RL, but all other toxicity characteristic metal results were less than the corresponding laboratory RL. General groundwater water chemistry results for Ca^{+2}, Fe, Mg^{+2}, Mn, K^{+}, Na^{+}, SO_4^{-2}, Cl^{-}, F^{-}, HCO_3^{-}, and SiO_4^{-4} show similar groundwater in all three wells and stable groundwater chemistry since 2015. The groundwater type in all three wells is sodium bicarbonate.

The hydrologic conditions in the uppermost aquifer beneath the Area 5 RWMS remain stable and are not affected by the Area 5 RWMS. Groundwater flow in the uppermost aquifer is negligible. No significant changes were detected in the water chemistry, and all indicator parameters remain within the established ILs. There is no measurable impact to the uppermost aquifer from the Area 5 RWMS.

5.2 LEACHATE MONITORING

Leachate was sampled from the leachate collection tanks at both Area 5 RWMS lined mixed waste cells in 2019. The 3,000-gallon leachate tank at Cell 18 was sampled on March 14, May 29, and December 11, 2019, when the leachate volume approached the tank capacity. The 10,000-gallon leachate tank at Cell 25 was sampled on August 1, 2019, to meet the annual sampling requirement of RCRA Permit NEV HW0101, Revision 6. The Cell 25 leachate tank was at about 60 percent capacity.

Each leachate sample was analyzed for toxicity characteristic contaminants, PCBs, tritium, pH, and SC. All leachate analytical results were below the regulatory levels for toxicity characteristic contaminants and below the ILs for PCBs, tritium, pH, and SC specified in RCRA Permit NEV HW0101, Revision 6. No quantifiable PCB levels were detected in any leachate sample. At Cell 18, tritium levels ranged from 30,300 to 56,500 pCi/l, SC values ranged from 4.72 to 5.63 mmho/cm, and pH ranged from 7.42 to 7.49. At Cell 25, tritium was below the detection limit, the laboratory SC value was 6.22 mmho/cm, the field measurement SC value was 6.51 mmho/cm, and the pH was 7.69.

Based on leachate analytical results for the toxicity characteristic contaminants being below the regulatory maximum concentration for each contaminant listed in 40 CFR 261.24, Table 1, and tritium results being less than 1,330,000 pCi/l, all leachate was pumped from the tanks and used for dust control at the cell of origin. The Cell 18 leachate collection tank was emptied on April 11, 2019, July 11, 2019, and January 16, 2020, and the leachate was sprayed on the Cell 18 surface for dust control. The Cell 25 tank was emptied on August 15, 2019, and the leachate was sprayed on the Cell 25 surface for dust control.

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APPENDIX A
2019 CHAIN OF CUSTODY FORMS FOR GROUNDWATER AND LEACHATE SAMPLES

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A.1 SDG V4460 – UE5PW-1 AND UE5PW-3 (MARCH 2019)

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services SDG #: V4460

Laboratory: GEL LABORATORIES, LLC
Charge Number: 5RWPGWMR
Purchase Order: 218659 472943

Work Order: 1903/WM/PILOT WELLS
Priority: 28 days

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-1	WM35908	W	3-5-19 0910	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM35909	W		NLS-A-005	TRITIUM: 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM35910	W		GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	
				WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	

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Page 5 of 783 SDG: V4460

Work Order: 1903/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			3-5-19 0910	NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
UE5PW-1	WM35911	W		GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	
				WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
UE5PW-3	WM35916	W	3-5-19 1020	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM35917	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM35918	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	

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Work Order: 1903/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-3	WM35919	W	3-5-19 1020	GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM: 300 PCI/L: WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY. BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	
				WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	

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Work Order: 1903/WM/PILOT WELLS

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WM35908	WM35908-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35908	WM35908-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35909	WM35909-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35909	WM35909-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35909	WM35909-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35910	WM35910-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35910	WM35910-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35910	WM35910-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35910	WM35910-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross ALpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM35910	WM35910-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM35910	WM35910-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM35910	WM35910-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM35911	WM35911-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35911	WM35911-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35911	WM35911-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L, Water
WM35911	WM35911-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross ALpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM35911	WM35911-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM35911	WM35911-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM35911	WM35911-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM35916	WM35916-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35916	WM35916-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35917	WM35917-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35917	WM35917-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)

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Work Order: 1903/WM/PILOT WELLS

WM35917	WM35917-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35918	WM35918-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35918	WM35918-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35918	WM35918-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35919	WM35919-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35919	WM35919-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35919	WM35919-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35919	WM35919-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross ALpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM35919	WM35919-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM35919	WM35919-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM35919	WM35919-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance

Number of Containers = 34

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Work Order: 1903/WM/PILOT WELLS

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
E. CAVANAUGH	Elliott Bunn	3/5/19 14:15		7746 3547 3936
C.D. Cattaneda for EB	FED EX	3/6/19 @ 1300	FED EX*	7746 3547 4612
FedEX	L. Matthews	3-7-19 850		7746 3547 4748

Comments:

Potential Contamination	Yes	No	Comments
Radiological		✓	
Chemical		✓	

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply):

- ____ Hydrochloric acid (HCl) at 0.04%
- ____ Mercury chloride (HgCl2) at 0.004%
- _X_ Nitric acid (HNO3) at 0.15%
- _X_ Sulfuric acid (H2SO4) at 0.35%
- ____ Sodium Hydroxide (NaOH) at 0.080%, or
- ____ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

_✓_ Applicable
____ Not Applicable

Signature: Martin Cavanaugh

Date: 3/5/19

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A.2 SDG V4462 – UE5PW-2 (MARCH 2019)

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ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4462

Work Order: 1903/WM/PILOT WELLS

Priority: 28 days

Laboratory: GEL LABORATORIES, LLC

Charge Number: 5RWP GWMR

Purchase Order: 219044

473436

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-2	WM35912	W	3-12-19 0935	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM35913	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM35914	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM35915	W		GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	

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Work Order: 1903/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			3-12-19 0935	WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
			↓	WCH-A-036	SULFATE AS SO4	Method 300.0
			↓	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
			↓	NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
			↓	NWCH-A-034	SPECIFIC CONDUCTANCE	

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Work Order: 1903/WM/PILOT WELLS

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WM35912	WM35912-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35912	WM35912-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35913	WM35913-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35913	WM35913-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35913	WM35913-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35914	WM35914-1	H2S04, PH<2, COOL 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35914	WM35914-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35914	WM35914-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35915	WM35915-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM35915	WM35915-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM35915	WM35915-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM35915	WM35915-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM35915	WM35915-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM35915	WM35915-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM35915	WM35915-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance

Number of Containers = 15

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Work Order: 1903/WM/PILOT WELLS

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
Dave Blank	CD Castaneda	3/12/19 @ 1102		
C.D. Castaneda	Fed Ex	3/12/19 @1300	Fed Ex	774683355443
	L. Matthews	3/13/19 @ 900		

Comments:

Potential Contamination	Yes	No	Comments
Radiological		✓	
Chemical		✓	

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply);

- ___ Hydrochloric acid (HCl) at 0.04%
- ___ Mercury chloride (HgCl2) at 0.004%
- ✓ Nitric acid (HNO3) at 0.15%
- ✓ Sulfuric acid (H2SO4) at 0.35%
- ___ Sodium Hydroxide (NaOH) at 0.080%, or
- ___ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

✓ Applicable
___ Not Applicable

Signature: Dave Blank

Date: 3-12-19

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A.3 SDG V4504 – PILOT WELLS (AUGUST 2019)

Page 5 of 930 SDG: V4504

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4504

Work Order: 1908/WM/PILOT WELLS

Priority: 28 days

Laboratory: GEL LABORATORIES, LLC

Charge Number: 5RWPGWMR

Purchase Order: 228538

486982

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-1	WM36770	W	8-6-19 1000	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM36771	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM36772	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM36773	W		GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	

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Work Order: 1908/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			8-6-19 1000	WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
UE5PW-2	WM36774	W	8-6-19 1100	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM36775	W		NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM36776	W		GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	
				WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	

Work Order: 1908/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-2	WM36777	W	8-6-19 1100	GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	
				NLS-A-005	TRITIUM: 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	
				WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
UE5PW-3	WM36778	W	8-6-19 1400	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM36779	W		NLS-A-005	TRITIUM: 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM36780	W		NLS-A-005	TRITIUM: 300 PCI/L; WATER	
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM36781	W		GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				MET-A-029	RCRA 8 METALS	

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Work Order: 1908/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			8-6-19 1400	NLS-A-005	TRITIUM; 300 PCI/L; WATER	
				NMET-A-005	METALS - RWMS	Ca,Na,K,Si,Mg,Mn,Fe - Method 6010
				NWCH-A-015	HYDROGEN ION (PH)	
				WCH-A-003	ALKALINITY, BICARBONATE (AS CACO3)	
				WCH-A-004	ALKALINITY, CARBONATE (AS CACO3)	
				WCH-A-011	CHLORIDE	
				WCH-A-018	FLUORIDE	
				WCH-A-033	TOTAL DISSOLVED SOLIDS (TDS)	
				WCH-A-036	SULFATE AS SO4	Method 300.0
				NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	

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Work Order: 1908/WM/PILOT WELLS

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WM36770	WM36770-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36770	WM36770-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36771	WM36771-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36771	WM36771-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36771	WM36771-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36772	WM36772-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36772	WM36772-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36772	WM36772-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36773	WM36773-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36773	WM36773-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36773	WM36773-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36773	WM36773-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM36773	WM36773-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM36773	WM36773-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM36773	WM36773-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM36774	WM36774-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36774	WM36774-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36775	WM36775-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36775	WM36775-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36775	WM36775-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36776	WM36776-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36776	WM36776-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36776	WM36776-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36776	WM36776-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water

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Page 10 of 930 SDG: V4504

Work Order: 1908/WM/PILOT WELLS

WM36776	WM36776-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM36776	WM36776-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM36776	WM36776-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM36777	WM36777-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36777	WM36777-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36777	WM36777-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36777	WM36777-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM36777	WM36777-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM36777	WM36777-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM36777	WM36777-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM36778	WM36778-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36778	WM36778-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36779	WM36779-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36779	WM36779-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36779	WM36779-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36780	WM36780-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36780	WM36780-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36780	WM36780-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36781	WM36781-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM36781	WM36781-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM36781	WM36781-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM36781	WM36781-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WM36781	WM36781-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM36781	WM36781-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM36781	WM36781-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance

Number of Containers = 49

Work Order: 1908/WM/PILOT WELLS

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
David Black	C.D. Castaneda	8/6/19 @ 1546		
C.D. Castaneda	Fed. Ex.	8/7/19 @ 1300	FED EX*	7759 2856 1504 7759 2856 1560 7759 2856 1927
FED EX	[illegible signature]	8/8/19 @ 9:00		

Comments:

Potential Contamination	Yes	No	Comments
Radiological		X	
Chemical		X	

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply):

- ___ Hydrochloric acid (HCl) at 0.04%
- ___ Mercury chloride (HgCl2) at 0.004%
- ✓ Nitric acid (HNO3) at 0.15%
- ✓ Sulfuric acid (H2SO4) at 0.35%
- ___ Sodium Hydroxide (NaOH) at 0.080%, or
- ___ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

✓ Applicable
___ Not Applicable

Signature: [signature]

Date: 8-6-19

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A.4 SDG V4461 – CELL 18 LEACHATE TANK (MARCH 2019)

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services SDG # V4461

1903292

Work Order: 1903/WC/A5 MWDU LEACHATE TANK

Priority: 7 days

Laboratory: ALS FORT COLLINS

Charge Number: 5RWPLECH

Purchase Order: 219046

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
(1) RWMC MWDU LEACHATE TANK	WC1935928	AL	3/14/19 0912	NHER-A-003	HERBICIDES - TCLP	
			0912	GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
			0912	LSC-A-001	TRITIUM, 400 PCI/L; WATER, SOIL, WASTE	Distillation Required
			0912	MET-A-031	METALS - TCLP (3)	
			0912	PEP-A-005	PESTICIDES - TCLP	
			0912	PEP-A-006	PCB ONLY	
			0912	SVO-A-013	SVOA - TCLP	
			0912	VOA-A-016	VOA - TCLP	
			0912	NWCH-A-034	SPECIFIC CONDUCTANCE	
(2) BLDG 652 ROOM 10	WC1935929	W	0700	NVOA-A-003	VOA - TOTAL, TCLP LIST	

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Work Order: 1903/WC/A5 MWDU LEACHATE TANK

1903292

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WC1935928	WC1935928-1	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Tritium, 400 pCi/L; Water, Soil, Waste
WC1935928	WC1935928-2	COOL 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WC1935928	WC1935928-3	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1935928	WC1935928-4	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1935928	WC1935928-5	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1935928	WC1935928-6	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1935928	WC1935928-7	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1935928	WC1935928-8	COOL 6C	500ML CLEAR GLASS	Metals - TCLP
WC1935928	WC1935928-9	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Specific Conductance
WC1935929	WC1935929-1	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1935929	WC1935929-2	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1935929	WC1935929-3	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List

Number of Containers = 12

Work Order: 1903/WC/A5 MWDU LEACHATE TANK

1903292

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
~~C. Castaneda~~	Elizabeth Jurns	3/14/19 13:52		
C.D. Castaneda for EB	Fed Ex	3/18/19 @ 1300	Fed Ex #	774727613409
FEDEX	Keli-Jean Smith	3-19-19 0930		

Comments:

Potential Contamination	Yes	No	Comments
Radiological	✓		Tritium ~ 53,000 pCi/L
Chemical		✓	

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply);

- ___ Hydrochloric acid (HCl) at 0.04%
- ___ Mercury chloride (HgCl2) at 0.004%
- ___ Nitric acid (HNO3) at 0.15%
- ✓ Sulfuric acid (H2SO4) at 0.35%
- ___ Sodium Hydroxide (NaOH) at 0.080%, or
- ___ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

___✓ Applicable
_____ Not Applicable

Signature: Carlos Castaneda

Date: 3/14/19

A.5 SDG V4480 – CELL 18 LEACHATE TANK (MAY 2019)

1905035

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4480

Work Order: 1905/WC/A5 MWDU LEACHATE TANK

Priority: 7 days

Laboratory: ALS FORT COLLINS

Charge Number: 5RWP LECH

Purchase Order: 223925

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
(1) RWMC MWDU LEACHATE TANK	WC1938390	AL	5/29/19 0900	NHER-A-003	HERBICIDES - TCLP	
				GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				LSC-A-001	TRITIUM. 400 PCI/L; WATER, SOIL, WASTE	Distillation Required
				MET-A-031	METALS - TCLP	
				PEP-A-005	PESTICIDES - TCLP	
				PEP-A-006	PCB ONLY	
				SVO-A-013	SVOA - TCLP	
				VOA-A-016	VOA - TCLP (3)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
(2) BLDG 652 ROOM 10	WC1938391	W		NVOA-A-003	VOA - TOTAL, TCLP LIST	

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1905635

Work Order: 1905/WC/A5 MWDU LEACHATE TANK

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WC1936390	WC1936390-1	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Tritium, 400 pCi/L; Water, Soil, Waste
WC1936390	WC1936390-2	COOL 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WC1936390	WC1936390-3	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1936390	WC1936390-4	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1936390	WC1936390-5	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1936390	WC1936390-6	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1936390	WC1936390-7	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1936390	WC1936390-8	COOL 6C	500ML CLEAR GLASS	Metals - TCLP
WC1936390	WC1936390-9	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Specific Conductance
WC1936391	WC1936391-1	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1936391	WC1936391-2	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1936391	WC1936391-3	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List

Number of Containers = 12

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Work Order: 1905/WC/A5 MWDU LEACHATE TANK

1905U35

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
M. CAVANAUGH	C.D. Cantwell	5/29/19 @ 1250		
C.D. Cantwell	Fed Ex	5/30/19 @ 1300	Fed Ex	7753 4711 4610
[redacted]	KELLI-JEAN SMITH	5/31/19 @ 1015		

Comments:

Potential Contamination	Yes	No	Comments
Radiological	✓		Tritium ~57,000 pCi/L
Chemical		✓	

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply):

- ___ Hydrochloric acid (HCl) at 0.04%
- ___ Mercury chloride (HgCl2) at 0.004%
- ___ Nitric acid (HNO3) at 0.15%
- ✓ Sulfuric acid (H2SO4) at 0.35%
- ___ Sodium Hydroxide (NaOH) at 0.080%, or
- ___ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

X Applicable
___ Not Applicable

Signature: Martin Cavanaugh

Date: 5/29/19

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ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4542

Work Order: 1912/WC/A5 MWDU LEACHATE TANK

Priority: 7 days

Laboratory: ALS FORT COLLINS

Charge Number: 5RWPLECH

Purchase Order: 234805 1912276

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
RWMC MWDU LEACHATE TANK (1)	WC1938852	AL	12/11/19 0900	NHER-A-003	HERBICIDES - TCLP	(3)
				GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
				LSC-A-001	TRITIUM, 400 PCI/L; WATER, SOIL, WASTE	Distillation Required
				MET-A-031	METALS - TCLP	
				PEP-A-005	PESTICIDES - TCLP	
				PEP-A-006	PCB ONLY	
				SVO-A-013	SVOA - TCLP	
				VOA-A-016	VOA - TCLP (3)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
BLDG 652 ROOM 10 (2)	WC1938853	W	0700	NVOA-A-003	VOA - TOTAL, TCLP LIST	

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Work Order: 1912/WC/A5 MWDU LEACHATE TANK

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WC1938852	WC1938852-1	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Tritium, 400 pCi/L; Water, Soil, Waste
WC1938852	WC1938852-2	COOL 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WC1938852	WC1938852-3	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1938852	WC1938852-4	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1938852	WC1938852-5	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1938852	WC1938852-6	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1938852	WC1938852-7	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1938852	WC1938852-8	COOL 6C	500ML CLEAR GLASS	Metals - TCLP
WC1938852	WC1938852-9	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Specific Conductance
WC1938853	WC1938853-1	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1938853	WC1938853-2	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1938853	WC1938853-3	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List

Number of Containers = 12

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Work Order: 1912/WC/A5 MWDU LEACHATE TANK

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
RCSAWAUGH	C.D. Castaneda	12/12/19@ 0730		
C.D. Castaneda	Fed Ex	12/12/19@ 1300	Fed Ex #	7772 2876 6619
FEDEX	Emily Lyons	12-13-19 1025		

Comments:

Potential Contamination	Yes	No	Comments
Radiological	✓		Tritium ~ 31,000 pCi/L
Chemical		✓	

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply);

- ___ Hydrochloric acid (HCl) at 0.04%
- ___ Mercury chloride (HgCl2) at 0.004%
- ___ Nitric acid (HNO3) at 0.15%
- X Sulfuric acid (H2SO4) at 0.35%
- ___ Sodium Hydroxide (NaOH) at 0.080%, or
- ___ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

✓ Applicable
___ Not Applicable

Signature: Martin Cranaugh

Date: 12/11/19

A.7 SDG V4494 – CELL 25 LEACHATE TANK (AUGUST 2019)

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4494

Laboratory: ALS FORT COLLINS

Charge Number: 5RWPLECH

Purchase Order: 227084

1908080

Work Order: 1908/WC/A5 CELL 25 LEACHATE TANK

Priority: 7 days

	Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
1	RWMC CELL 25 LEACHATE TANK	WC1936730	AL	8/1/19 1020	VOA-A-016	VOA - TCLP	
2	BLDG 652 ROOM 10	WC1936731	W	↓ 0645	NVOA-A-003	VOA - TOTAL, TCLP LIST	

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Work Order: 1908/WC/A5 CELL 25 LEACHATE TANK

1908080

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WC1936730	WC1936730-6	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1936730	WC1936730-7	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1936731	WC1936731-1	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1936731	WC1936731-2	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1936731	WC1936731-3	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List

Number of Containers = 5

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Work Order: 1908/WC/A5 CELL 25 LEACHATE TANK

1908080

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
[illegible]	C.D. Contarnida	8/1/19 @ 1245		
C.D. Contarnida	FED EX	8/1/19 @ 1500	FED EX #	775898293435
[illegible]	Emily Lyons	08.02.19 0900		

Comments:

Potential Contamination	Yes	No	Comments
Radiological	X		POTENTIAL TRITIUM CONTAMINATION
Chemical			

I certify that the preservative concentrations (weight/weight) in the water samples submitted are within the following thresholds (check those that apply);

- ___ Hydrochloric acid (HCl) at 0.04%
- ___ Mercury chloride (HgCl2) at 0.004%
- ___ Nitric acid (HNO3) at 0.15%
- X Sulfuric acid (H2SO4) at 0.35%
- ___ Sodium Hydroxide (NaOH) at 0.080%, or
- ___ Phosphoric acid (H3PO4) yielding pH between 2 and 4.

___ Applicable
___ Not Applicable

Signature: Martin Coronado

Date: 8/1/19

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APPENDIX B
2019 DATA REVIEW FORMS FOR GROUNDWATER AND LEACHATE DATA

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B.1 SDG V4460 AND V4462 - PILOT WELLS (MARCH 2019)

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Groups V4460 & V4462

Summary

Environmental Monitoring (EMon) OP-0732.457, dated 10/11/18 "Radioanalytical Data Verification, Data Validation, and Data Review" and OP-0732.458, dated 10/11/18 "Organic Data Verification and Validation," and OP-0732.459, dated 10/11/18 "Inorganic Data Verification and Validation" were used to satisfy the validation requirements. Data qualifiers, if used, are consistent with these guidelines.

The Sampling and Analysis Plan Data Quality Objectives document, Title: Area 5 RWMS Groundwater Monitoring dated February15, 2018 was used as a basis for this review.

Chains of Custody

- Chain of Custody is complete and custody transfers are documented.

Method/Analysis

The laboratory processed 9 liquid samples and 3 Field Blanks for;
- Total Organic Carbon (TOC) by SM5310B
- Total Organic Halogen (TOX) by SW-846 Method 9020B

The laboratory processed 4 liquid samples for;
- Metals by SW-846 Methods 3005A (preparation), 7470A (preparation) and 6010C (analysis), 7470A (analysis)
- Chloride, Fluoride, Sulfate by EPA300.0
- Total Dissolved Solids by SM2540C
- Alkalinity (Bicarbonate and Carbonate) by SM2320B
- pH by SM4500-H+ B
- Specific Conductance by SW9050A
- Gross Alpha/Beta by EPA 900.0 / SW-846 Method 9310

The laboratory processed 9 liquid samples for;
- Tritium by EPA 906.0

Holding Times

TOC and TOX
- Samples were prepared and analyzed within required holding time.

Metals
- Samples were prepared and analyzed within required holding time

General Chemistry
- Samples were prepared and analyzed within required holding time with the exception of pH which was received at the lab outside the hold time.

Page 1 of 4

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Groups V4460 & V4462

Radiological
- Samples were prepared and analyzed within required holding time.

Calibrations

TOC and TOX
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Metals
- Calibrations, Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within control limits.

General Chemistry
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Radiological
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Method Blank

TOC and TOX
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The method blank was within acceptance criteria.

Metals
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The preparation/method blank was within method criteria.

General Chemistry
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The method blank was within method criteria.

Radiological
- The method blank was below the reporting limits for all target compounds.

Spike Recoveries

TOC and TOX
- All matrix spike recoveries were within acceptance criteria.
- All blank spike recoveries were within acceptance criteria.

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Groups V4460 & V4462

Metals
- All matrix spike recoveries were within acceptance criteria on the ICP. A non-SDG sample was used as a matrix spike sample for CVAA.
- All blank spike recoveries were within acceptance criteria.

General Chemistry
- All matrix spike recoveries were within acceptance criteria with the exception of Chloride which was outside the upper control limit for both SDGs.
- All blank spike recoveries were within acceptance criteria.

Radiological
- All matrix spike recoveries were within acceptance criteria for Gross Alpha/Beta. A non-SDG sample was used as a matrix spike sample for tritium.
- All blank spike recoveries were within acceptance criteria.

Laboratory Replicates SDG V4460

TOC and TOX
- The laboratory replicate for TOX was within the limits and performed on sample WM35908 (472943001). See page 299 in the laboratory General Chemistry data package. The laboratory replicate for TOC was performed on a non-SDG sample.

Metals
- The laboratory replicate for ICP Metals was within the limits and performed on sample WM35910 (472943003). See page 37 in the Metals data package. The laboratory replicate for CVAA was performed on a non-SDG sample.

General Chemistry
- The laboratory replicate for Chloride, Fluoride and Sulfate was within limits and was performed on sample WM35919 (472943008). See pages 299 and 300 in the laboratory General Chemistry data package.
- The laboratory replicate for pH was within limits and was performed on sample WM35910 (472943003). See page 301 in the laboratory General Chemistry data package.
- The laboratory replicate for Specific Conductance and Total Dissolved Solids were performed on a non-SDG sample.
- The laboratory replicate for Alkalinity was within limits and was performed on sample WM35910 (472943003). See page 301 in the laboratory General Chemistry data package.

Radiological
- The laboratory replicate for Gross Alpha/Beta was within limits and was performed on sample WM35919 (472943008). See page 437 in the laboratory radiological data package. The laboratory replicate for tritium was performed on a non-SDG sample.

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Groups V4460 & V4462

Laboratory Replicates SDG V4462

TOC and TOX

- The laboratory replicate for TOX were within the limits and performed on samples WM3512 (473436001). See page 174 in the laboratory General Chemistry data package. The laboratory replicate for TOC was performed on a non-SDG sample.

Metals

- The laboratory replicate for ICP Metals was within the limits and performed on sample WM35915 (473436004). See page 30 in the Metals data package. The laboratory replicate for CVAA was performed on a non-SDG sample.

General Chemistry

- The laboratory replicate for Chloride, Fluoride and Sulfate was within limits and was performed on sample WM35915 (473436004). See pages 174 and 175 in the laboratory General Chemistry data package.
- The laboratory replicate for Specific Conductance was within limits and was performed on sample WM35915 (473436004). See page 176 in the laboratory General Chemistry data package.
- The laboratory replicate for Total Dissolved Solids, Alkalinity and pH were performed on a non-SDG sample.

Radiological

- The laboratory replicate for Gross Alpha/Beta was within limits and was performed on sample WM35915 (473436004). See page 296 in the laboratory radiological data package. The laboratory replicate for tritium was performed on a non-SDG sample.

Data Reviewed by: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2019.04.11 10:04:07 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2019.04.11 10:06:39 -07'00'

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B.2 SDG V4504 – PILOT WELLS (AUGUST 2019)

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4504

Summary

Environmental Monitoring (EMon) OP-0732.457, dated 10/11/18 "Radioanalytical Data Verification, Data Validation, and Data Review" and OP-0732.458, dated 10/11/18 "Organic Data Verification and Validation," and OP-0732.459, dated 10/11/18 "Inorganic Data Verification and Validation" were used to satisfy the validation requirements. Data qualifiers, if used, are consistent with these guidelines.

The Sampling and Analysis Plan Data Quality Objectives document, Title: Area 5 RWMS Groundwater Monitoring dated February15, 2018 was used as a basis for this review.

Chains of Custody

- Chain of Custody is complete and custody transfers are documented.

Method/Analysis

The laboratory processed 9 liquid samples and 3 Field Blanks for;
- Total Organic Carbon (TOC) by SM5310B
- Total Organic Halogen (TOX) by SW-846 Method 9020B

The laboratory processed 4 liquid samples for;
- Metals by SW-846 Methods 3005A (preparation), 7470A (preparation) and 6010C (analysis), 7470A (analysis)
- Chloride, Fluoride, Sulfate by EPA300.0
- Total Dissolved Solids by SM2540C
- Alkalinity (Bicarbonate and Carbonate) by SM2320B
- pH by SM4500-H+ B
- Specific Conductance by SW9050A
- Gross Alpha/Beta by EPA 900.0 / SW-846 Method 9310

The laboratory processed 9 liquid samples for;
- Tritium by EPA 906.0

Holding Times

TOC and TOX
- Samples were prepared and analyzed within required holding time.

Metals
- Samples were prepared and analyzed within required holding time

General Chemistry
- Samples were prepared and analyzed within required holding time with the exception of pH which was received at the lab outside the hold time.

Page 1 of 4

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4504

Radiological
- Samples were prepared and analyzed within required holding time.

Calibrations

TOC and TOX
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Metals
- Calibrations, Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within control limits.

General Chemistry
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Radiological
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Method Blank

TOC and TOX
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The method blank was within acceptance criteria.

Metals
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The preparation/method blank was within method criteria.

General Chemistry
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The method blank was within method criteria.

Radiological
- The method blank was below the reporting limits for all target compounds.

Spike Recoveries

TOC and TOX
- All matrix spike recoveries were within acceptance criteria with the exception of TOX for sample WM36776 which was outside the lower control limit at 60.5%.
- All blank spike recoveries were within acceptance criteria.

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16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4504

Metals
- All matrix spike recoveries were within acceptance criteria on the ICP. A non SDG sample was used as a matrix spike sample for CVAA.
- All blank spike recoveries were within acceptance criteria.

General Chemistry
- The matrix spike was performed on a non SDG sample.
- All blank spike recoveries were within acceptance criteria.

Radiological
- All matrix spike recoveries were within acceptance criteria.
- All blank spike recoveries were within acceptance criteria.

Laboratory Replicates

TOC and TOX
- The laboratory replicate for TOC was within the limits and performed on sample WM36776 (4869822007). The laboratory replicate for TOX was within the limits and performed on samples WM36770 (486982001) and WM36776 (486982007). See pages 221 and 222 in the General Chemistry data package.

Metals
- The laboratory replicate for ICP Metals was within the limits and performed on sample WM36773 (486982004). See page 39 in the Metals data package. The laboratory replicate for CVAA was performed on a non SDG sample.

General Chemistry
- The laboratory replicate for Chloride, Fluoride, Sulfate, Total Dissolved Solids and Specific Conductivity was performed on a non SDG sample.
- The laboratory replicate for Alkalinity, pH was performed on sampled WM36773 (486982004). See pages 224 and 225 in the General Chemistry data package.

Radiological
- The laboratory replicate for Gross Alpha/Beta and Tritium was within limits and was performed on sample WM36773 (486982004) and WM36771 (486982002), respectively. See page 442 in the radiological data package.

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16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4504

Data Reviewed by: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2019.09.11 11:01:43 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2019.09.11 15:08:03 -07'00'

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B.3 SDG V4461 – CELL 18 LEACHATE TANK (MARCH 2019)

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4461

Summary

Environmental Monitoring (EMon) OP-0732.458, dated 10/11/18 "Organic Data Verification and Validation," and OP-0732.459, dated 10/11/18 "Inorganic Data Verification and Validation" were used to satisfy the validation requirements. Data qualifiers, if used, are consistent with these guidelines.

The Sampling and Analysis Plan Data Quality Objectives document, Title: MWDU Leachate dated January 09, 2019 was used as a basis for this review.

Method/Analysis

The laboratory processed 1 liquid sample and 1 Trip Blank for;
- Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOCs) by SW-846 Methods 1311 (extraction), 5030C (preparation) and 8260 (analysis)

The laboratory processed 1 liquid sample for;
- TCLP Semi-volatile Organic Compounds (SVOCs) by SW-846 Methods 1311 (extraction), 3520C (preparation) and 8270D (analysis)
- TCLP Herbicides by SW-846 Methods 1311 (extraction), 8151A (analysis)
- Polychlorinated Biphenyls (PCB) by SW-846 Methods 3665A (clean up), 3520C (preparation), 8082 (analysis)
- TCLP Pesticides by SW-846 Methods 1311 (extraction), 3520C (preparation), 8081B (analysis)
- TCLP Metals by SW-846 Methods 1311 (extraction), 3010A (preparation), 7470A Mercury (preparation), 6010D (analysis) and 7470A Mercury (analysis)
- Specific Conductance by 120.1 (analysis)

Holding Times

TCLP VOC
- Samples were extracted and analyzed within required holding time.

TCLP SVOC / Herbicides
- Sample was extracted and analyzed within required holding time.

PCB
- According to SW-846 Chapter 4, there are no holding times for PCB.

TCLP Pesticides
- Sample was extracted and analyzed within required holding time.

TCLP Metals
- Sample was extracted and analyzed within required holding time.

Specific Conductance
- Sample was prepared and analyzed within required holding time.

Page 1 of 4

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4461

Calibrations

TCLP VOC
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.
- For TCLP SVOC, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

PCB
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria with the exception of the 1660 CCV (data file 26393) for decachlorobiphenyl which was out low on column 2.

TCLP Pesticides
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP Metals
- Calibrations, Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within control limits.

Specific Conductance
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Method Blank

TCLP VOC
- The method blank was below the reporting limits for all target compounds.

TCLP SVOC / Herbicides
- The method blanks were below the reporting limits for all target compounds.

PCB
- The method blank was below the reporting limits for all target compounds.

TCLP Pesticides
- The method blank was below the reporting limits for all target compounds.

TCLP Metals
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The preparation/method blank was within method criteria.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4461

Surrogate Recoveries

TCLP VOC
- All surrogate recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all surrogate recoveries were within acceptance criteria.
- For TCLP SVOC, all surrogate recoveries were within acceptance criteria.

PCB
- All surrogate recoveries were within acceptance criteria.

TCLP Pesticides
- All surrogate recoveries were within acceptance criteria.

Spike Recoveries

TCLP VOC
- The matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- All blank spike recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all blank spike recoveries were within acceptance criteria.
- For TCLP Herbicides, all matrix spike recoveries were within acceptance criteria.
- For TCLP SVOCs, all blank spike recoveries were within acceptance criteria.
- For TCLP SVOCs, the matrix spike sample was performed on a non-SDG sample.

PCB
- The matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- All blank spike recoveries were within acceptance criteria.

TCLP Pesticides
- All matrix spike recoveries were within acceptance criteria.
- All blank spike recoveries were within acceptance criteria with the exception of Endrin and Endosulfan sulfate which were outside the lower control limit.

TCLP Metals
- For ICP metals, the matrix spike sample was performed on a non-SDG sample. For Mercury, the matrix spike recoveries were within acceptance criteria.
- All blank spike recoveries were within acceptance criteria.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4461

Laboratory Replicates

TCLP Metals

- The laboratory replicate for ICP metals was performed on a non-SDG sample. The laboratory replicate for Mercury was within the limits and was performed on sample WC1935928 (1903292-3). See page 38 in the laboratory metals data package.

Data Reviewer: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2019.04.04 06:26:12 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2019.04.04 08:51:07 -07'00'

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B.4 SDG V4480 – CELL 18 LEACHATE TANK (MAY 2019)

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4480

Summary

Environmental Monitoring (EMon) OP-0732.458, dated 10/11/18 "Organic Data Verification and Validation," and OP-0732.459, dated 10/11/18 "Inorganic Data Verification and Validation" were used to satisfy the validation requirements. Data qualifiers, if used, are consistent with these guidelines.

The Sampling and Analysis Plan Data Quality Objectives document, Title: MWDU Leachate dated January 09, 2019 was used as a basis for this review.

Method/Analysis

The laboratory processed 1 liquid sample and 1 Trip Blank for;
- Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOCs) by SW-846 Methods 1311 (extraction), 5030C (preparation) and 8260 (analysis)

The laboratory processed 1 liquid sample for;
- TCLP Semi-volatile Organic Compounds (SVOCs) by SW-846 Methods 1311 (extraction), 3520C (preparation) and 8270D (analysis)
- TCLP Herbicides by SW-846 Methods 1311 (extraction), 8151A (analysis)
- Polychlorinated Biphenyls (PCB) by SW-846 Methods 3665A (clean up), 3520C (preparation), 8082 (analysis)
- TCLP Pesticides by SW-846 Methods 1311 (extraction), 3520C (preparation), 8081B (analysis)
- TCLP Metals by SW-846 Methods 1311 (extraction), 3010A (preparation), 7470A Mercury (preparation), 6010D (analysis) and 7470A Mercury (analysis)
- Specific Conductance by 120.1 (analysis)

Holding Times

TCLP VOC
- Samples were extracted and analyzed within required holding time.

TCLP SVOC / Herbicides
- Sample was extracted and analyzed within required holding time.

PCB
- According to SW-846 Chapter 4, there are no holding times for PCB.

TCLP Pesticides
- Sample was extracted and analyzed within required holding time.

TCLP Metals
- Sample was extracted and analyzed within required holding time.

Specific Conductance
- Sample was prepared and analyzed within required holding time.

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11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4480

Calibrations

TCLP VOC
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.
- For TCLP SVOC, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

PCB
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria with the exception of the CCV (data file 26839) for TCMX, aroclor 1016 and aroclor 1260; CCV (data file 26840) for TCMX and aroclor 1254; CCV (data file 26852) for TCMX, DCB, aroclor 1016 and aroclor 1260; and CCV (data file 26853) for TCMX and aroclor 1254 which were out high on column 2. The analyte results were reported from the column that passed initial and continuing calibration criteria.

TCLP Pesticides
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria with the exception of the CCV for 4,4'-DDT which was out high on column 2.

TCLP Metals
- Calibrations, Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within control limits.

Specific Conductance
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Method Blank

TCLP VOC
- The method blank was below the reporting limits for all target compounds.

TCLP SVOC / Herbicides
- The method blanks were below the reporting limits for all target compounds.

PCB
- The method blank was below the reporting limits for all target compounds.

TCLP Pesticides
- The method blank was below the reporting limits for all target compounds.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4480

TCLP Metals
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The preparation/method blank was within method criteria.

Surrogate Recoveries

TCLP VOC
- All surrogate recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all surrogate recoveries were within acceptance criteria.
- For TCLP SVOC, all surrogate recoveries were within acceptance criteria.

PCB
- All surrogate recoveries were within acceptance criteria.

TCLP Pesticides
- All surrogate recoveries were within acceptance criteria.

Spike Recoveries

TCLP VOC
- The matrix spike sample was performed on a non-SDG sample.
- All blank spike recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all blank spike recoveries were within acceptance criteria.
- For TCLP Herbicides, the matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- For TCLP SVOCs, all blank spike recoveries were within acceptance criteria.
- For TCLP SVOCs, the matrix spike sample was performed on a non-SDG sample.

PCB
- The matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- All blank spike recoveries were within acceptance criteria.

TCLP Pesticides
- The matrix spike samples were not performed due to insufficient sample. However, an LCS and LCD were performed instead.
- All blank spike recoveries were within acceptance criteria.

TCLP Metals
- For ICP metals, the matrix spike recoveries were within acceptance criteria. For Mercury, the matrix spike sample was performed on a non-SDG sample.
- All blank spike recoveries were within acceptance criteria.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4480

Laboratory Replicates

TCLP Metals
- The laboratory replicate for ICP metals was performed on a non-SDG sample.

Data Reviewer: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2019.07.08 10:49:53 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2019.07.08 10:50:47 -07'00'

Page 4 of 4

B.5 SDG V4542 – CELL 18 LEACHATE TANK (DECEMBER 2019)

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4542

Summary

Environmental Monitoring (EMon) OP-0732.458, dated 10/11/18 "Organic Data Verification and Validation," and OP-0732.459, dated 10/11/18 "Inorganic Data Verification and Validation" were used to satisfy the validation requirements. Data qualifiers, if used, are consistent with these guidelines.

The Sampling and Analysis Plan Data Quality Objectives document, Title: MWDU Leachate dated January 09, 2019 was used as a basis for this review.

Method/Analysis

The laboratory processed 1 liquid sample and 1 Trip Blank for;
- Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOCs) by SW-846 Methods 1311 (extraction), 5030C (preparation) and 8260 (analysis)

The laboratory processed 1 liquid sample for;
- TCLP Semi-volatile Organic Compounds (SVOCs) by SW-846 Methods 1311 (extraction), 3520C (preparation) and 8270D (analysis)
- TCLP Herbicides by SW-846 Methods 1311 (extraction), 8151A (analysis)
- Polychlorinated Biphenyls (PCB) by SW-846 Methods 3665A (clean up), 3520C (preparation), 8082 (analysis)
- TCLP Pesticides by SW-846 Methods 1311 (extraction), 3520C (preparation), 8081B (analysis)
- TCLP Metals by SW-846 Methods 1311 (extraction), 3010A (preparation), 7470A Mercury (preparation), 6010D (analysis) and 7470A Mercury (analysis)
- Specific Conductance by 120.1 (analysis)

Holding Times

TCLP VOC
- Samples were extracted and analyzed within required holding time.

TCLP SVOC / Herbicides
- Sample was extracted and analyzed within required holding time.

PCB
- According to SW-846 Chapter 4, there are no holding times for PCB.

TCLP Pesticides
- Sample was extracted and analyzed within required holding time.

TCLP Metals
- Sample was extracted and analyzed within required holding time.

Specific Conductance
- Sample was prepared and analyzed within required holding time.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4542

Calibrations

TCLP VOC
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria with the following exceptions – CCV (data file 15478) for dalapon was out high on column 2; CCV (data file 15487) for dalapon was out high on both columns. The analyte results were reported from the column that passed initial and continuing calibration criteria.
- For TCLP SVOC, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

PCB
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP Pesticides
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP Metals
- Calibrations, Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within control limits.

Specific Conductance
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Method Blank

TCLP VOC
- The method blank was below the reporting limits for all target compounds.

TCLP SVOC / Herbicides
- The method blanks were below the reporting limits for all target compounds.

PCB
- The method blank was below the reporting limits for all target compounds.

TCLP Pesticides
- The method blank was below the reporting limits for all target compounds.

TCLP Metals
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4542

- The preparation/method blank was within method criteria.

Surrogate Recoveries

TCLP VOC
- All surrogate recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all surrogate recoveries were within acceptance criteria.
- For TCLP SVOC, all surrogate recoveries were within acceptance criteria.

PCB
- All surrogate recoveries were within acceptance criteria.

TCLP Pesticides
- All surrogate recoveries were within acceptance criteria.

Spike Recoveries

TCLP VOC
- The matrix spike samples were not performed due to insufficient sample.
- All blank spike recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all blank spike recoveries were within acceptance criteria.
- For TCLP Herbicides, the matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- For TCLP SVOCs, all blank spike recoveries were within acceptance criteria.
- For TCLP SVOCs, the matrix spike sample was performed on a non-SDG sample.

PCB
- The matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- All blank spike recoveries were within acceptance criteria.

TCLP Pesticides
- All matrix spike sample recoveries were within acceptance criteria.
- All blank spike recoveries were within acceptance criteria.

TCLP Metals
- The matrix spike sample was performed on a non-SDG sample.
- All blank spike recoveries were within acceptance criteria.

11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4542

Laboratory Replicates

TCLP Metals
- No laboratory replicate was performed.

Data Reviewer: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2020.01.08 16:38:28 -08'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2020.01.08 16:46:47 -08'00'

Page 4 of 4

B.6 SDG V4494 – CELL 25 LEACHATE TANK (AUGUST 2019)

11-SAP-001 RWMC CELL 25 Leachate Tank Data Review Report
Sample Delivery Group V4494

Summary

Environmental Monitoring (EMon) OP-0732.458, dated 10/11/18 "Organic Data Verification and Validation," and OP-0732.459, dated 10/11/18 "Inorganic Data Verification and Validation" were used to satisfy the validation requirements. Data qualifiers, if used, are consistent with these guidelines.

The Sampling and Analysis Plan Data Quality Objectives document, Title: MWDU Leachate dated January 09, 2019 was used as a basis for this review.

Method/Analysis

The laboratory processed 1 liquid sample and 1 Trip Blank for;
- Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOCs) by SW-846 Methods 1311 (extraction), 5030C (preparation) and 8260 (analysis)

The laboratory processed 1 liquid sample for;
- TCLP Semi-volatile Organic Compounds (SVOCs) by SW-846 Methods 1311 (extraction), 3510C (preparation) and 8270D (analysis)
- TCLP Herbicides by SW-846 Methods 1311 (extraction), 8151A (analysis)
- Polychlorinated Biphenyls (PCB) by SW-846 Methods 3665A (clean up), 3535A (preparation), 8082 (analysis)
- TCLP Pesticides by SW-846 Methods 1311 (extraction), 3535A (preparation), 8081B (analysis)
- TCLP Metals by SW-846 Methods 1311 (extraction), 3010A (preparation), 7470A Mercury (preparation), 6010C (analysis) and 7470A Mercury (analysis)
- Specific Conductance by 9050A (analysis)

Holding Times

TCLP VOC
- Samples were extracted and analyzed within required holding time.

TCLP SVOC / Herbicides
- Sample was extracted and analyzed within required holding time.

PCB
- According to SW-846 Chapter 4, there are no holding times for PCB.

TCLP Pesticides
- Sample was extracted and analyzed within required holding time.

TCLP Metals
- Sample was extracted and analyzed within required holding time.

Specific Conductance
- Sample was prepared and analyzed within required holding time.

Page 1 of 4

11-SAP-001 RWMC CELL 25 Leachate Tank Data Review Report
Sample Delivery Group V4494

Calibrations

TCLP VOC
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.
- For TCLP SVOC, Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

PCB
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance.

TCLP Pesticides
- Calibrations, Initial Calibration Verifications (ICV), and the Continuing Calibration Verifications (CCV) were within acceptance.

TCLP Metals
- Calibrations, Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within control limits.

Specific Conductance
- Initial Calibration Verifications (ICV) and the Continuing Calibration Verifications (CCV) were within acceptance criteria.

Method Blank

TCLP VOC
- The method blank was below the reporting limits for all target compounds.

TCLP SVOC / Herbicides
- The method blanks were below the reporting limits for all target compounds.

PCB
- The method blank was below the reporting limits for all target compounds.

TCLP Pesticides
- The method blank was below the reporting limits for all target compounds.

TCLP Metals
- All Initial and Continuing Calibration Blanks (ICB/CCB) were within method criteria.
- The preparation/method blank was within method criteria.

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Surrogate Recoveries

TCLP VOC
- All surrogate recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all surrogate recoveries were within acceptance criteria.
- For TCLP SVOC, all surrogate recoveries were within acceptance criteria.

PCB
- All surrogate recoveries were within acceptance criteria.

TCLP Pesticides
- All surrogate recoveries were within acceptance criteria.

Spike Recoveries

TCLP VOC
- The matrix spike samples were not performed due to insufficient sample. However, an LCS and LCSD were performed instead.
- All blank spike recoveries were within acceptance criteria.

TCLP SVOC / Herbicides
- For TCLP Herbicides, all blank spike recoveries were within acceptance criteria.
- For TCLP Herbicides, the matrix spike samples were performed on a non-SDG sample.
- For TCLP SVOCs, all blank spike recoveries were within acceptance criteria with the exception of Hexachlorobutadiene and Hexachloroethane which were outside the lower control limit.
- For TCLP SVOCs, the matrix spike sample was performed on a non-SDG sample.

PCB
- The matrix spike samples were performed on a non-SDG sample.
- All blank spike recoveries were within acceptance criteria.

TCLP Pesticides
- The matrix spike samples were performed on a non-SDG sample.
- All blank spike recoveries were within acceptance criteria.

TCLP Metals
- For ICP metals and Mercury the matrix spike recoveries were within acceptance criteria.
- All blank spike recoveries were within acceptance criteria.

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Laboratory Replicates

TCLP Metals

- The laboratory replicate for ICP metals and Mercury was within the limits and was performed on sample WC1936730 (1204348978). See pages 568 and 569 in the metals data package

Data Reviewer: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2019.08.13 09:09:17 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2019.08.13 09:12:52 -07'00'

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