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NEVADA NATIONAL SECURITY SITE

2018 DATA REPORT: GROUNDWATER MONITORING PROGRAM AREA 5 RADIOACTIVE WASTE MANAGEMENT SITE

March 2019

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
Ca	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
Se	selenium
SiO_2	silicate
SO_4	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 is a compilation of the groundwater and waste cell leachate sampling results from the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada National Security Site, Nye County, Nevada. Groundwater samples from the aquifer immediately below the Area 5 RWMS have been collected and analyzed and static water levels have been measured in this aquifer since 1993. These groundwater data are evaluated for evidence of effects on the aquifer related to the Area 5 RWMS. Leachate from one lined mixed waste cell at the Area 5 RWMS (Cell 18) has been sampled since the cell opened in 2011. These leachate data are analyzed for hazardous contaminants to determine appropriate leachate handling and disposal. A second lined mixed waste cell at the Area 5 RWMS (Cell 25) began receiving waste in August 2018, but no leachate samples were collected or analyzed during 2018. This report includes data from 2014 through 2018 but focuses on the 2018 data.

During 2018, groundwater samples were collected and static water levels were measured at three wells surrounding the Area 5 RWMS. Groundwater samples were collected at wells UE5PW-1, UE5PW-2, and UE5PW-3 on March 6 and August 14, 2018. Static water levels were measured at each of these wells on March 5, June 4, August 13, and October 25, 2018. 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, beginning in 2017, toxicity characteristic metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). General water chemistry parameters (calcium, iron, magnesium, manganese, potassium, sodium, sulfate, chloride, fluoride, bicarbonate, and silicate) were also measured. Results from samples collected in 2018 are 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 lined mixed waste Cell 18 drains into a sump and is pumped into an aboveground tank. Samples are collected from the tank when the leachate volume approaches the 3,000-gallon tank capacity. During 2018, leachate samples were collected on March 1, 2018 and August 1, 2018. All leachate analysis 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 analysis results, RCRA Permit NEV HW0101 allowed all leachate collected from Cell 18 to be pumped from the collection tank and used for dust control at Cell 18.

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1.0 INTRODUCTION

This data report compiles groundwater and waste cell leachate monitoring results from the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada National Security Site (NNSS) located in Nye County, Nevada. The monitoring data include new results collected during calendar year 2018 and previous results from calendar years 2014 through 2017.

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 (pH, specific conductance [SC], total organic carbon [TOC], total organic halides [TOX], and tritium), general water chemistry parameters (calcium [Ca], iron [Fe], magnesium [Mg], manganese [Mn], potassium [K], sodium [Na], sulfate [SO_4], chloride [Cl], fluoride [F], bicarbonate [HCO_3], and silicate [SiO_2]), and toxicity characteristic metals (arsenic [As], barium [Ba], cadmium [Cd], chromium [Cr], lead [Pb], mercury [Hg], selenium [Se], and silver [Ag]) 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 (Cells 18 and 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 mixed waste disposal unit 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 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 2018 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 2014 through 2018 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.

1.2 SITE CHARACTERISTICS

The Area 5 RWMS is located in Frenchman Flat on 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 (800 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]).

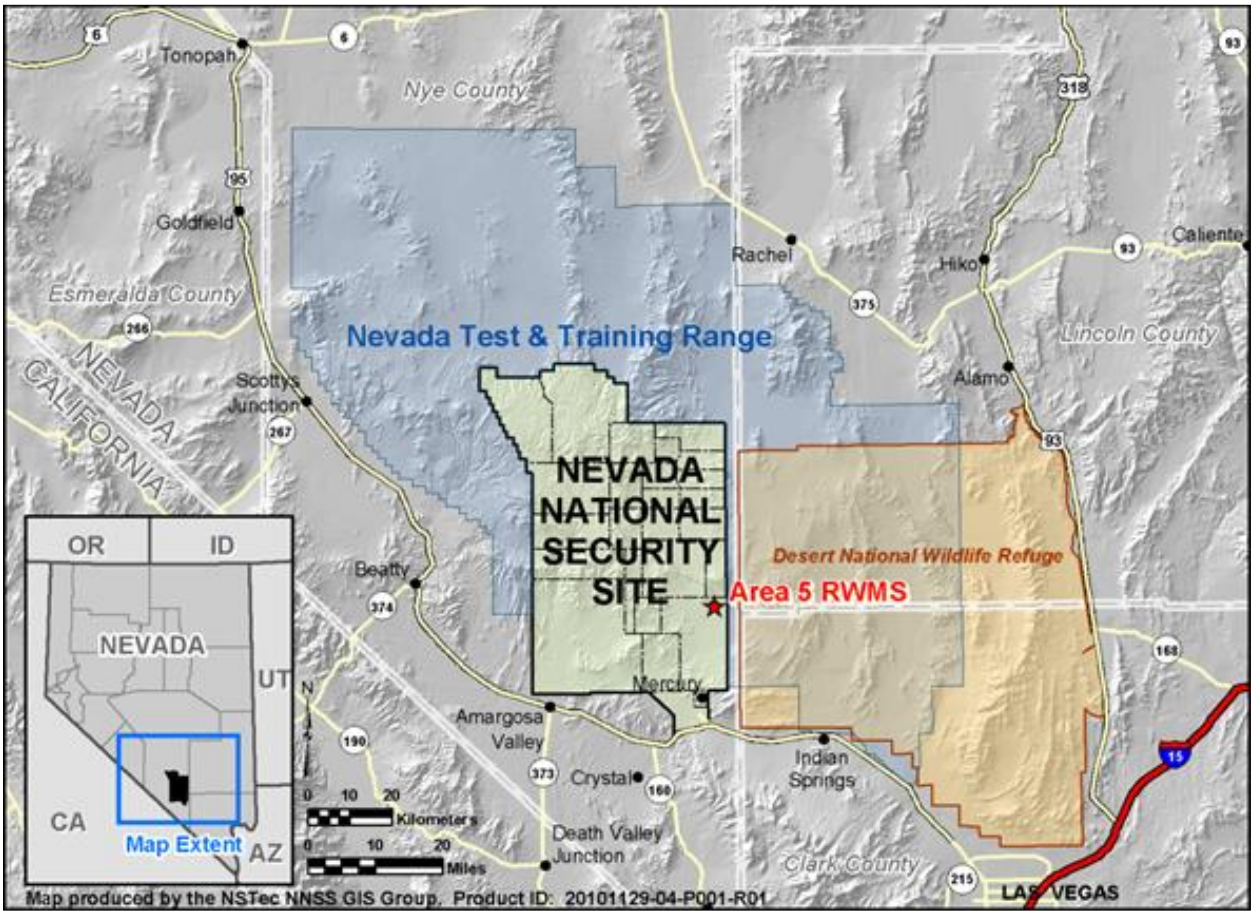


Figure 1-1 Location of the Area 5 RWMS and the Nevada National Security Site

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 m (6.6 ft) in a vegetated lysimeter. Water potential measurements indicate that vadose zone moisture flows upwards in the upper 35 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

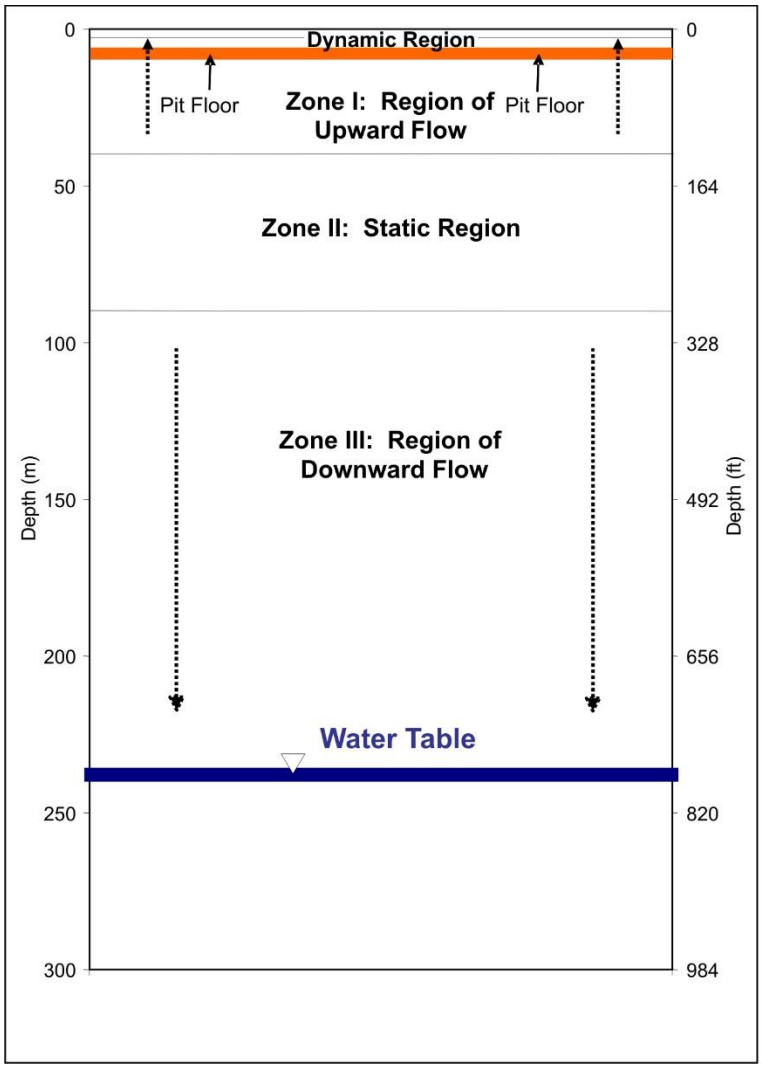
The water table in the uppermost aquifer is nearly flat with very little flow. At three monitoring wells surrounding the Area 5 RWMS, the aquifer elevation varied between 733.35 m (2,406.00 ft) and 733.75 m (2,407.30 ft) above mean sea level (AMSL) during the time interval of 2014 through 2018. During this period, the average hydraulic gradient was 0.000094 m/m to the south-southeast, and the average calculated flow velocity was 8.7 cm (3.4 in.) per year. Also, the Underground Test Area (UGTA) program conceptualized a slow (less than 1 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 the alluvium. 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 131 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 (131 and 295 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 indicate that soil-water contents at depths of 1 to 2 m (3 to 7 ft) are slowly increasing. 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 is composed 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 Groundwater 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 (e.g., SC, TOC, and TOX) 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 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], 2018).

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 designates UE5PW-1 as the Point of Compliance (POC) for the Area 5 RWMS, and UE5PW-2 and UE5PW-3 are designated as background wells. The POC is defined as a vertical surface located at the downgradient 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.

These 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 (618 ft), welded tuff to 280 m (918 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-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 Descriptions

	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]	3,178.39	968.77	3,246.11	989.41	3,295.63	1004.51
Measuring Point Elevation[6]	3,180.37	969.38	3,248.34	990.09	3,298.20	1005.29
Borehole Depth (bgs)[7]	839	255.73	920	280.42	955	291.08
Well Depth (bgs)[7]	822	250.55	890	271.27	938	285.90
Deviation at Water Table[7]	0.27	0.08	0.68	0.21	0.06	0.02
Water Table Depth (bgs)[8]	772.02	235.31	839.32	255.83	888.54	270.83
Water Level Elevation[8]	2,406.37	733.46	2,406.79	733.59	2,407.09	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 2014 through 2018

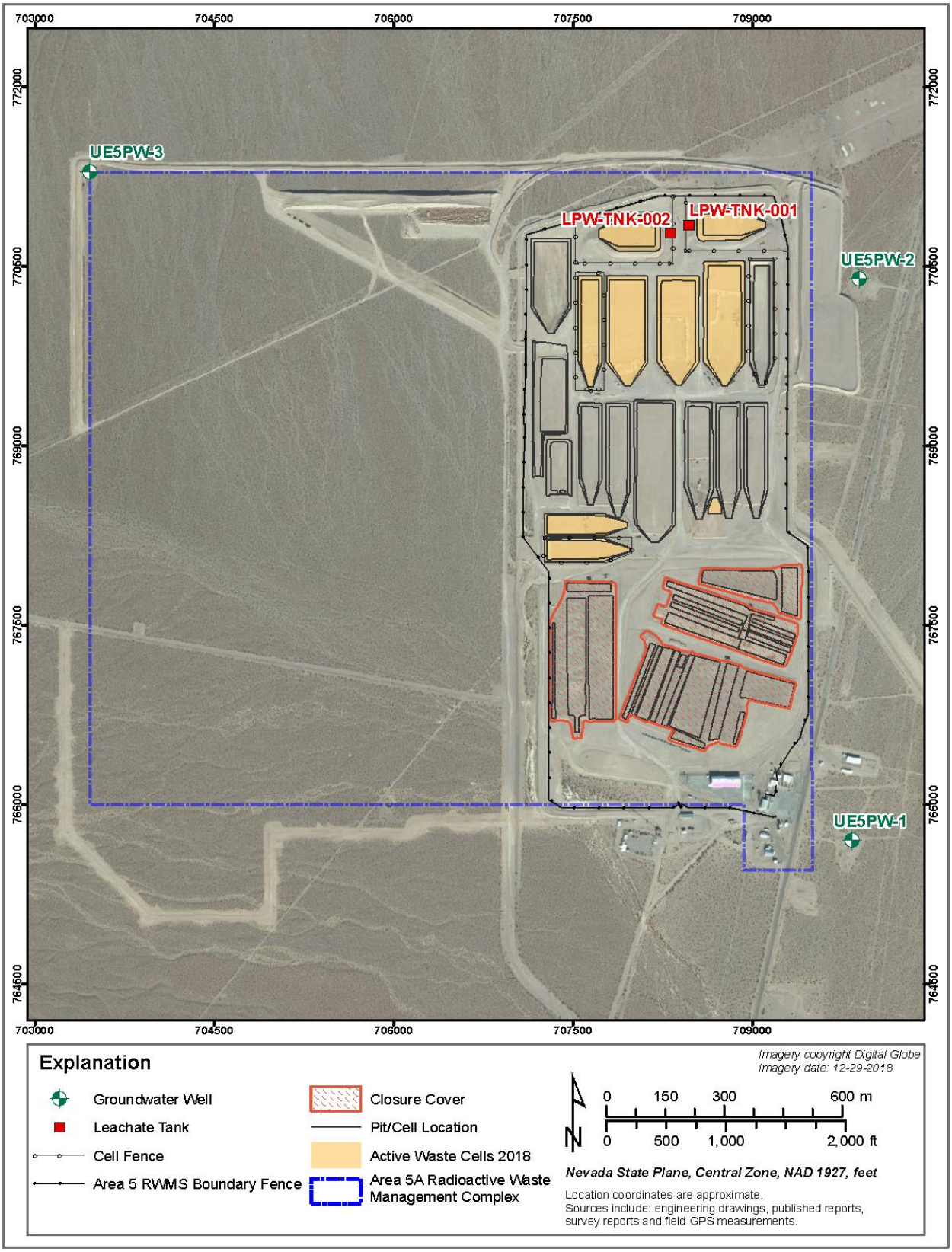


Figure 2-1 Locations of Pilot Wells and Leachate Collection Tanks

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
- TOC
- TOX
- tritium

Toxicity characteristic metals:

- As
- Ba
- Cd
- Cr
- Pb
- Hg
- Se
- Ag

General water chemistry parameters:

- Ca
- Fe
- Mg
- Mn
- K
- Na
- SO_4
- Cl
- F
- HCO_3
- SiO_2

Investigation levels (ILs) for indicator parameters with quantifiable results (i.e., pH, SC) are based on historical measurements. Because this is a detection monitoring plan, 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 approach using ILs for control limits is used to evaluate the groundwater data to determine if the facility has a significant effect on groundwater quality. If groundwater results are less than ILs, the groundwater is assumed to be unaffected by the facility.

Table 2-2 Investigation Levels for Pilot Wells

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

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

General water chemistry parameters provide an indication of major components in the groundwater and are evaluated for gross changes in groundwater chemistry. Water levels are measured and used with aquifer characteristics to calculate groundwater flux 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), 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 0.3 cm (0.1 in.). Each depth measurement is corrected for borehole deviation by subtracting the well deviation log measurement at the measured depth (Table 2-1) from the measured depth.

2.3.2 Groundwater Sample Collection

Upon completion of water level measurements, a pneumatic sample pump is lowered into each well to approximately 1.5 m (5 ft) below the water level, and the well bore is purged. At least three well volumes are purged from each well prior to sampling. The calculated value for 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 just prior to sampling. Groundwater samples are collected from the pump outflow in new, certified clean sample bottles appropriate for the required analyses. A unique number is assigned and affixed to each sample bottle. Sufficient sample is collected to fill all sample containers. 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 at the well 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 and 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.

The *Sampling and Analysis Plan, Nevada National Security Site, Area 5 Groundwater Monitoring* (NSTec, 2016a) and the *Sampling and/or Analysis Plan-Data Quality Objectives, Area 5 RWMS Groundwater Monitoring* (MSTS, 2018) 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 2018 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.

During 2018, water level depths were measured on March 5, June 4, August 13, and October 25, and groundwater samples were collected on March 6 and August 14. 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 field measurements and samples collected at UE5PW-1, UE5PW-2, and UE5PW-3 during 2018.

Table 2-3 Groundwater Samples and Bottles

Analysis	Sample Bottle	Preservative	03/06/2018			08/14/2018		
			Grab	FD	FB	Grab	FD	FB
pH, SC	Field Measurement[1]		3	-	-	3	-	-
Water Level[2]	Field Measurement[1]		6	-	-	6	-	-
Tritium	250-ml HDPE[3]	< 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[4]	500-ml Amber Glass	pH < 2 (H_2SO_4) < 6° C	3	6	3	3	6	3
As, Ba, Cd, Cr, Pb, Hg, Se, Ag	500-ml HDPE	pH < 2 (HNO_3) < 6° C	3	1	-	3	1	-
Ca, Fe, Mg, Mn, K, Na, SiO_2	500-ml HDPE	pH < 2 (HNO_3) < 6° C	3	1	-	3	1	-
SO_4, Cl, F, Alkalinity, pH, SC	500-ml HDPE	< 6° C	3	1	-	3	1	-

[1] No samples are collected for field measurements.
[2] Water level measurements were collected on March 5, June 4, August 13, and October 25, 2018.
[3] HDPE = high-density polyethylene
[4] No headspace in TOX sample bottles

2.4 GROUNDWATER RESULTS

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

Table 2-4 Analysis Methods for Groundwater

Analysis	Laboratory	Method	Method Description
Water Level	Field	SOP-2151.104	Electronic Tape
pH	Field	SOP-2151.104	Potentiometric
SC	Field	SOP-2151.104	Conductivity Bridge
pH	GEL	SM 4500	Potentiometric
SC	GEL	SW 9050	Conductivity Bridge
TOC	GEL	SM 5310	Oxidation to CO_2
TOX	GEL	SW 9020	Carbon Adsorption
Tritium	GEL	EPA 906.0	Liquid Scintillation
As, Ba, Cd, Cr, Pb, Se, Ag	GEL	SW 6010	Inductively Coupled Plasma Atomic Emission
Hg	GEL	SW 7470	Manual Cold-Vapor Technique
Ca, Fe, Mg, Mn, K, Na, SiO_2	GEL	SW 6010	Inductively Coupled Plasma Atomic Emission
SO_4, Cl, F,	GEL	EPA 300.0	Ion Chromatography
Alkalinity	GEL	SM 2320	Titration

No groundwater results exceeded ILs in 2018. 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

Groundwater depths were measured on March 5, June 4, August 13, and October 25, 2018. Measured depths were corrected for borehole deviation, and static water level elevations were calculated by subtracting the depth for the well reference point elevation (Table 2-1). The 2018 average groundwater elevations AMSL were 733.40 m (2,406.17 ft) at UE5PW-1, 733.54 m (2,406.64 ft) at UE5PW-2, and 733.64 m (2,406.94) at UE5PW-3. The corresponding 2018 average depths bgs were 235.37 m (772.23 ft) at UE5PW-1, 255.87 m (839.47 ft) at UE5PW-2, and 270.87 m (888.69 ft) at UE5PW-3. Average annual groundwater elevations AMSL from 2014 through 2018 are provided in Table 2-5. All measured groundwater depths bgs and groundwater elevations AMSL are provided in Table 2-6, and all groundwater elevations are provided in Figure 2-2.

Table 2-5 Average Annual Groundwater Elevations

Year	UE5PW-1 Average Groundwater Elevation AMSL (m [ft])	UE5PW-2 Average Groundwater Elevation AMSL (m [ft])	UE5PW-3 Average Groundwater Elevation AMSL (m [ft])
2014	733.50 (2,406.49)	733.61 (2,406.85)	733.70 (2,407.16)
2015	733.49 (2,406.46)	733.61 (2,406.87)	733.70 (2,407.15)
2016	733.48 (2,406.44)	733.62 (2,406.88)	733.70 (2,407.16)
2017	733.42 (2,406.24)	733.55 (2,406.66)	733.65 (2,406.98)
2018	733.40 (2,406.17)	733.54 (2,406.64)	733.64 (2,406.94)
Average	733.46 (2,406.36)	733.59 (2,406.78)	733.68 (2,407.08)

Table 2-6 Groundwater Depths and Elevations

Date	UE5PW-1		UE5PW-2		UE5PW-3	
	Groundwater Depth bgs (m[ft])[1]	Groundwater Elevation AMSL (m[ft])[2]	Groundwater Depth bgs (m[ft])[1]	Groundwater Elevation AMSL (m[ft])[2]	Groundwater Depth bgs (m[ft])[1]	Groundwater Elevation AMSL (m[ft])[2]
03/10/2014	235.23 (771.74)	733.55 (2,406.65)	255.79 (839.22)	733.62 (2,406.89)	270.76 (888.33)	733.75 (2,407.30)
06/02/2014	235.27 (771.87)	733.51 (2,406.52)	255.77 (839.15)	733.64 (2,406.96)	270.78 (888.37)	733.73 (2,407.26)
08/11/2014	235.29 (771.94)	733.49 (2,406.45)	255.81 (839.26)	733.61 (2,406.85)	270.80 (888.46)	733.71 (2,407.17)
10/14/2014	235.24 (771.78)	733.53 (2,406.61)	255.80 (839.24)	733.61 (2,406.87)	270.79 (888.42)	733.72 (2,407.21)
03/16/2015	235.24 (771.80)	733.53 (2,406.59)	255.80 (839.25)	733.61 (2,406.86)	270.79 (888.41)	733.72 (2,407.22)
06/08/2015	235.33 (772.08)	733.44 (2,406.31)	255.85 (839.41)	733.56 (2,406.70)	270.83 (888.56)	733.67 (2,407.07)
08/10/2015	235.29 (771.95)	733.48 (2,406.44)	255.78 (839.16)	733.64 (2,406.95)	270.81 (888.49)	733.70 (2,407.14)
10/20/2015	235.28 (771.91)	733.50 (2,406.48)	255.78 (839.16)	733.64 (2,406.95)	270.80 (888.45)	733.71 (2,407.18)
03/07/2016	235.24 (771.79)	733.53 (2,406.60)	255.70 (838.92)	733.71 (2,407.19)	270.77 (888.35)	733.74 (2,407.28)
06/06/2016	235.27 (771.88)	733.50 (2,406.51)	255.79 (839.20)	733.63 (2,406.91)	270.79 (888.42)	733.72 (2,407.21)
08/15/2016	235.31 (772.01)	733.46 (2,406.38)	255.83 (839.34)	733.58 (2,406.77)	270.81 (888.48)	733.70 (2,407.15)
10/24/2016	235.34 (772.12)	733.43 (2,406.27)	255.87 (839.48)	733.54 (2,406.63)	270.86 (888.65)	733.65 (2,406.98)
03/06/2017	235.37 (772.22)	733.40 (2,406.17)	255.87 (839.48)	733.54 (2,406.63)	270.86 (888.66)	733.64 (2,406.97)
06/05/2017	235.33 (772.09)	733.44 (2,406.30)	255.84 (839.38)	733.57 (2,406.73)	270.84 (888.59)	733.67 (2,407.04)
08/14/2017	235.28 (771.92)	733.49 (2,406.47)	255.79 (839.20)	733.63 (2,406.91)	270.82 (888.52)	733.69 (2,407.11)
10/23/2017	235.42 (772.39)	733.35 (2,406.00)	255.96 (839.75)	733.46 (2,406.36)	270.92 (888.83)	733.59 (2,406.80)
03/05/2018	235.42 (772.39)	733.35 (2,406.00)	255.90 (839.58)	733.51 (2,406.53)	270.91 (888.81)	733.60 (2,406.82)
06/04/2018	235.36 (772.17)	733.42 (2,406.22)	255.87 (839.47)	733.54 (2,406.64)	270.83 (888.55)	733.68 (2,407.08)

Date	UE5PW-1		UE5PW-2		UE5PW-3	
	Groundwater Depth bgs (m[ft])[1]	Groundwater Elevation AMSL (m[ft])[2]	Groundwater Depth bgs (m[ft])[1]	Groundwater Elevation AMSL (m[ft])[2]	Groundwater Depth bgs (m[ft])[1]	Groundwater Elevation AMSL (m[ft])[2]
08/13/2018	235.36 (772.18)	733.41 (2,406.21)	255.84 (839.38)	733.57 (2,406.73)	270.86 (888.66)	733.64 (2,406.97)
10/25/2018	235.35 (772.16)	733.42 (2,406.23)	255.87 (839.46)	733.55 (2,406.65)	270.89 (888.74)	733.62 (2,406.89)

[1] Groundwater depth bgs corrected for borehole deviation

[2] Elevation using 1929 National Geodetic Vertical Datum

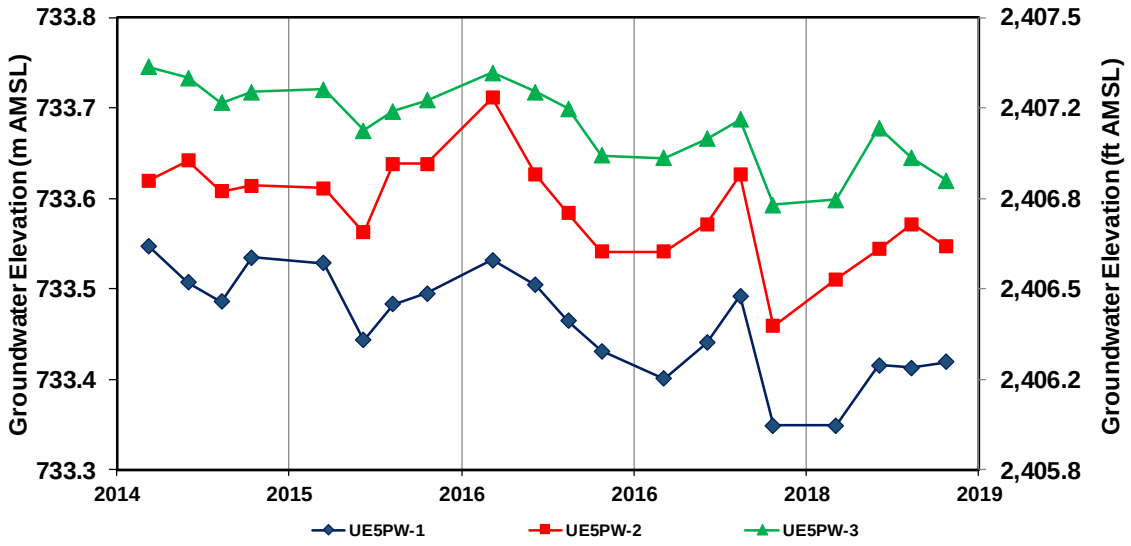


Figure 2-2 Groundwater Elevations

Well survey coordinates (Table 2-1) and measured water level elevations (Figure 2-2) are used to calculate the magnitude and direction of the aquifer hydraulic gradient using a simple plane approximation of the water table under the Area 5 RWMS. These three 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 were calculated for each set of elevation measurements in 2018 (Table 2-7). The average calculated groundwater flux in 2018 was 1.2E-09 m^3/m^2s, and the average velocity was 9.7 cm (3.8 in.) per year. The flow direction is south-southeast. Similar groundwater elevations, small aquifer gradients, and small groundwater flux show that the groundwater is essentially flat with negligible flow.

Table 2-7 Aquifer Flow Calculations

Date	Gradient Magnitude (m/m)	Gradient Direction (degrees)[1]	Groundwater Flux (m^3/m^2s)[2]	Groundwater Velocity (m/yr)[3]
03/05/2018	1.16E-04	165	1.30E-09	0.108
06/04/2018	1.04E-04	145	1.16E-09	0.096
08/13/2018	1.07E-04	169	1.20E-09	0.100
10/25/2018	0.89E-04	161	1.00E-09	0.083

[1] Degrees east of north

[2] Hydraulic conductivity = 1.12E-03 cm/s (3.67E-05 ft/s) (REECo, 1994)

[3] Effective porosity = 0.38 (REECo, 1994)

2.4.2 Groundwater pH

The measured pH at each well remained within the IL bounds of 7.6 and 9.2 in 2018. Prior to 2017, field measurements of pH were collected using a calibrated handheld meter just prior to sampling. These values are listed in Table 2-8. Since 2017, laboratory measurements of pH are reported. The 2018 measured pH values ranged from 8.34 to 8.41, and the 2018 average measured pH values were 8.38 at UE5PW-1, 8.36 at UE5PW-2, and 8.35 at UE5PW-3 (Table 2-8). Measured pH has remained relatively stable and within the IL bounds of 7.6 and 9.2 during the last five years (Table 2-8 and Figure 2-3).

No groundwater contamination is indicated by the pH monitoring results.

Table 2-8 Groundwater pH

Date	pH IL 7.6 < pH < 9.2		
	UE5PW-1	UE5PW-2	UE5PW-3
03/11/2014	8.36	8.35	8.22
08/12/2014	8.27	8.32	8.30
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	8.28[1]	8.29[1]	8.28[1]
08/15/2017	8.48[1]	8.33[1]	8.35[1]
03/06/2018	8.34[1]	8.36[1]	8.30[1]
08/14/2018	8.41[1]	8.36[1]	8.39[1]

[1] Laboratory measurement

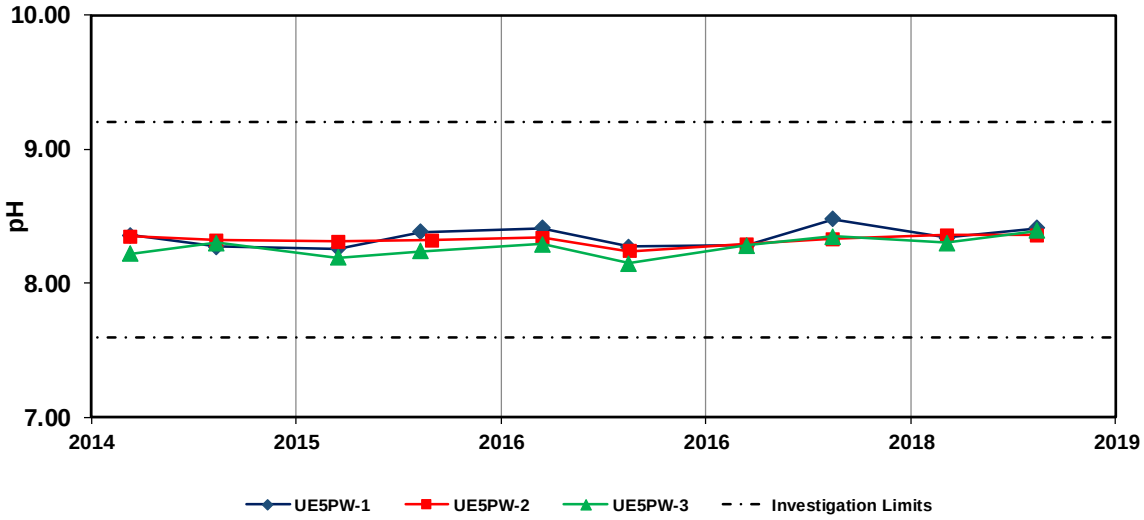


Figure 2-3 Groundwater pH

2.4.3 Groundwater Specific Conductance

The measured SC at each well remained below the IL of 0.440 mmho/cm in 2018. These field measurements are the stable SC measured at each well just prior to sampling. The 2018 measured SC values ranged from 0.355 to 0.384 mmho/cm. The 2018 average SC values were 0.380 mmho/cm at UE5PW-1, 0.360 mmho/cm at UE5PW-2, and 0.374 mmho/cm at UE5PW-3 (Table 2-9). SC values from each well have remained relatively stable and below the SC IL for the last five years (Figure 2-4).

No groundwater contamination is indicated by the SC monitoring results.

Table 2-9 Groundwater Specific Conductance

Date	Specific Conductance (mmho/cm) IL = 0.440 mmho/cm		
	UE5PW-1	UE5PW-2	UE5PW-3
03/11/2014	0.381	0.366	0.374
08/12/2014	0.379	0.331	0.374
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	0.355	0.370
08/14/2018	0.384	0.364	0.377

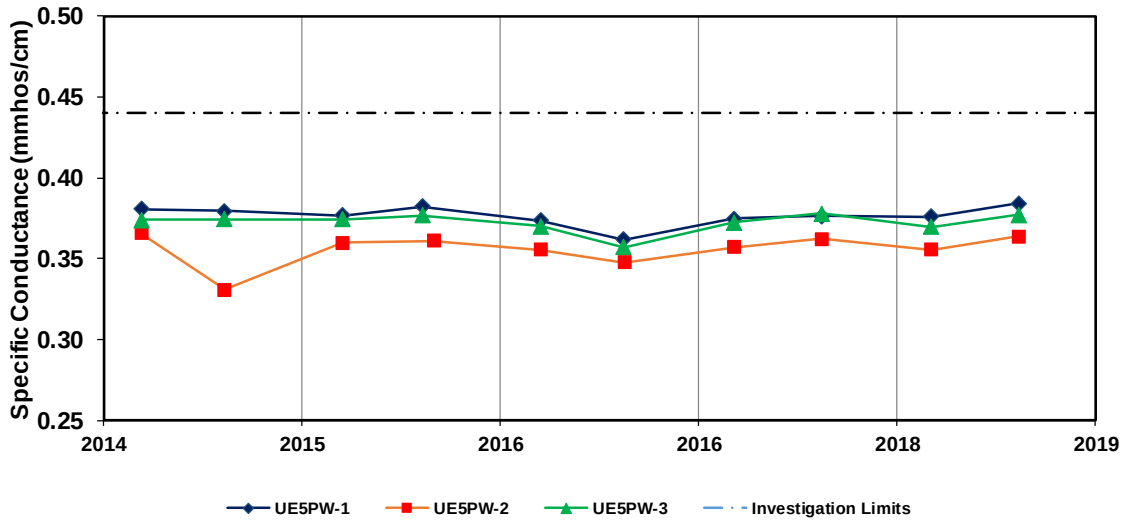


Figure 2-4 Groundwater Specific Conductance

2.4.4 Groundwater Tritium

Beginning in 2015, three replicate samples were collected consecutively at each well during each sampling event for tritium analysis. Because the tritium concentration is very low or not present, replicate samples provide useful additional data for evaluating possible false positive results when a single analysis may exceed the sample-specific MDL. Replicate samples also provide data for estimating the experimental error associated with these measurements.

All 2018 tritium results were below the IL of 2,000 pCi/l and below the tritium analysis RL of 300 pCi/l. No groundwater contamination is indicated by the tritium monitoring results. Every 2018 tritium result except for one grab sample from UE5PW-2 was also below the sample-specific MDL (Table 2-10). No tritium concentration greater than the 300 pCi/l analysis RL has been detected in any groundwater sample during the last five years (Table 2-10). Tritium results greater than the sample-specific MDL during the last five years are indicated in Table 2-10.

Table 2-10 Groundwater Tritium

	Tritium (pCi/l)[1] IL = 2,000 pCi/l								
	UE5PW-1			UE5PW-2			UE5PW-3		
Date	Grab	FD	FD	Grab	FD	FD	Grab	FD	FD
03/11/2014	<300	--	--	<300	--	--	<300	--	--
08/12/2014	<300	--	--	<300	--	--	<300[2]	--	--
03/17/2015	<300[2]	<300[2]	<300	<300[2]	<300	<300	<300	<300[2]	<300
08/11/2015	<300	<300	<300	--	--	--	<300	<300	<300
09/01/2015	--	--	--	<300[2]	<300	<300	--	--	--
03/15/2016	<300	<300	<300	<300	<300	<300[2]	<300	<300	<300
08/16/2016	<300	<300	<300	--	--	--	<300	<300[2]	<300
08/17/2016	--	--	--	<300[2]	<300[2]	<300[2]	--	--	--
03/07/2017	<300	<300	<300	--	--	--	--	--	--
03/08/2017	--	--	--	<300	<300	<300[2]	<300	<300	<300
08/15/2017	<300	<300	<300	<300	<300	<300	<300	<300	<300
03/06/2018	<300	<300	<300	<300	<300	<300	<300	<300	<300
08/14/2018	<300	<300	<300	<300[2]	<300	<300	<300	<300	<300

[1] Results < RL are reported as <300
[2] MDL < result < RL

2.4.5 Groundwater Total Organic Carbon and Total Organic Halides

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

All 2018 TOC results were below the IL of 2 mg/l, below the analysis RL of 1 mg/l, and below the analysis MDL of 0.33 mg/l. No TOC concentration greater than the 2 mg/l IL or greater than the 1.0 mg/l RL has been detected in any groundwater sample in the last five years (Table 2-11). Estimated TOC results greater than the 0.33 mg/l MDL during the last five years are indicated in Table 2-11.

All 2018 TOX results were below the IL of 0.1 mg/l and below the analysis RL of 0.01 mg/l. Four FD samples from 2018 at UE5PW-1 exceeded the TOX analysis MDL of 0.003 mg/l. During the last five years,

all TOX results were less than the 0.1 mg/l IL and less than the 0.01 mg/l RL (Table 2-12). TOX results greater than the 0.003 mg/l MDL are indicated in Table 2-12.

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

Table 2-11 Groundwater Total Organic Carbon

Date	Total Organic Carbon (mg/l)[1] IL = 2.0 mg/l								
	UE5PW-1			UE5PW-2			UE5PW-3		
	Grab	FD	FD	Grab	FD	FD	Grab	FD	FD
03/11/2014	<1	<1	<1	<1	<1	<1	<1[2]	<1	<1
08/12/2014	<1	<1	<1	<1	<1	<1	<1	<1	<1[2]
03/17/2015	<1[2]	<1[2]	<1[2]	<1[2]	<1[2]	<1[2]	<1[2]	<1[2]	<1[2]
08/11/2015	<1	<1	<1	--	--	--	<1	<1	<1
09/01/2015	--	--	--	<1	<1	<1	--	--	--
03/15/2016	<1	<1	<1	<1	<1	<1	<1	<1	<1
08/16/2016	<1	<1	<1	--	--	--	<1	<1	<1
08/17/2016	--	--	--	<1	<1	<1	--	--	--
03/07/2017	<1	<1	<1	--	--	--	--	--	--
03/08/2017	--	--	--	<1	<1	<1	<1	<1	<1
08/15/2017	<1	<1	<1	<1	<1	<1	<1	<1	<1
03/06/2018	<1	<1	<1	<1	<1	<1	<1	<1	<1
08/14/2018	<1	<1	<1	<1	<1	<1	<1	<1	<1

[1] Results < RL are reported as <1
[2] MDL < result < RL

Table 2-12 Groundwater Total Organic Halides

Date	Total Organic Halides (mg/l)[1] IL = 0.1 mg/l								
	UE5PW-1			UE5PW-2			UE5PW-3		
	Grab	FD	FD	Grab	FD	FD	Grab	FD	FD
03/11/2014	<0.01	<0.01	<0.01	<0.01[2]	<0.01	<0.01	<0.01[2]	<0.01	<0.01
08/12/2014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
03/17/2015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
08/11/2015	<0.01	<0.01	<0.01	--	--	--	<0.01	<0.01	<0.01
09/01/2015	--	--	--	<0.01	<0.01	<0.01	--	--	--
03/15/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
08/16/2016	<0.01	<0.01	<0.01	--	--	--	<0.01	<0.01	<0.01
08/17/2016	--	--	--	<0.01	<0.01	<0.01	--	--	--
03/07/2017	<0.01	<0.01	<0.01	--	--	--	--	--	--
03/08/2017	--	--	--	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
08/15/2017	<0.01	<0.01[2]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
03/06/2018	<0.01	<0.01	<0.01	<0.01	<0.01[2]	<0.01	<0.01	<0.01	<0.01[2]
08/14/2018	<0.01	<0.01[2]	<0.01	<0.01	<0.01[2]	<0.01	<0.01	<0.01	<0.01

[1] Results < RL are reported as <0.01
[2] MDL < result < RL

2.4.6 Groundwater Toxicity Characteristic Metals

The Area 5 RWMS groundwater monitoring plan (DOE, 2017) identifies toxicity characteristic metals as indicators of contamination for groundwater, so monitoring these parameters were incorporated into RCRA Permit HW0101, Revision 6, for the Area 5 RWMS. Routine measurements of toxicity characteristic metals began in 2017. The IL for each metal was set at the maximum concentration for groundwater protection listed in 40 CFR 264.94, Table 1 (see Table 2-2).

In March 2017, samples were prepared following waste liquid protocols, including sample dilution by a factor of 10 before analysis, but subsequent samples were not diluted before analysis. Consequently, the analysis MDL and RL are 10 times higher for the March 2017 samples. The March 2017 MDL for Se is greater than the IL, the March 2017 MDL for As and Ca are equal to the IL, the March 2017 IL for Pb is between the MDL and RL, and the March 2017 ILs for Cr and Ag are equal to the RL. The ILs for Ba and Hg are greater than the RL. After the March 2017 samples, the ILs for all toxicity characteristic metal contaminants are greater than the respective RLs.

All 2018 groundwater results for toxicity characteristic metals are below parameter ILs. Results greater than the RL are reported in Table 2-13, and results greater than the MDL but less than the RL are indicated in Table 2-13.

No groundwater contamination is indicated by the toxicity characteristic metals monitoring results.

Table 2-13 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[1]								
03/07/2017	<0.05[2]	<0.05[3]	<0.01[2]	<0.01[2]	<0.033[2]	<0.06[2,4]	<0.01[2]	<0.001[2]
08/15/2017	<0.03[3]	0.014	<0.005	<0.001[3]	<0.01	<0.006[2]	<0.005	<0.0002
08/15/2017 (FD)	<0.03[3]	0.014	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005	<0.0002
03/06/2018	<0.03[3]	0.014	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005	<0.0002
08/14/2018	<0.03[3]	0.014	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005	<0.0002
UE5PW-2[1]								
03/08/2017	<0.05[2]	<0.05	<0.01[2]	<0.01[2]	<0.033[2]	<0.06[2,4]	<0.01[2]	<0.001[2]
08/15/2017	<0.03[3]	<0.005[3]	<0.005	0.007	<0.01	<0.006[2]	<0.005	<0.0002
03/06/2018	<0.03[3]	0.005	<0.005	0.007	<0.01	<0.006[2]	<0.005	<0.0002
03/06/2018 (FD)	<0.03[3]	0.006	<0.005	0.008	<0.01	<0.006[2]	<0.005	<0.0002
08/14/2018	<0.03[3]	<0.005[3]	<0.005	0.006	<0.01	<0.006[2]	<0.005	<0.0002
UE5PW-3[1]								
03/08/2017[1]	<0.05[2]	<0.05[3]	<0.01[2]	<0.01[2]	<0.033[2]	<0.06[2,4]	<0.01[2]	<0.001[2]
08/15/2017[2]	<0.03[3]	0.010	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005	<0.0002
03/06/2018	<0.03[3]	0.010	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005	<0.0002
08/14/2018	<0.03[3]	0.010	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005	<0.0002
08/14/2018 (FD)	<0.03[3]	0.010	<0.005	<0.005[3]	<0.01	<0.006[2]	<0.005[3]	<0.0002

[1] Results < RL are reported as <RL

[2] Result < MDL is reported as <MDL

[3] MDL < result < RL is reported as <RL

[4] IL < MDL

2.4.7 Groundwater General Water Chemistry

General groundwater water chemistry analyses for cations (Ca, Fe, Mg, Mn, K, and Na), anions (SO_4, Cl, F, and HCO_3), and SiO_2 show similar groundwater in all three wells and stable groundwater chemistry since 2014. The groundwater type in all three wells is sodium bicarbonate (Table 2-14). A Piper diagram with a data point for each sampling event from 2014 through 2018 summarizes the groundwater chemistry monitoring 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 2-14 Groundwater General Water Chemistry

Date	Ca	Mg	K	Na	Mn[1]	Fe[1]	HCO_3	SO_4	Cl	F	SiO_2
UE5PW-1 (mg/l)											
03/11/2014	14.7	5.92	5.70	64.4	<0.002	0.12	120	34.2	9.9	1.2	64.5
08/12/2014	14.4	5.76	6.08	55.8	<0.002	<0.03	138	36.5	10.2	1.2	61.4
03/17/2015	14.4	6.96	6.31	49.4	<0.002	<0.03	154	34.2	9.7	1.1	61.9
08/11/2015	14.1	5.81	6.08	60.6	<0.002	<0.03	146	36.4	9.8	1.1	60.5
03/15/2016	14.1	5.61	6.35	55.6	<0.002	<0.03	154	35.0	9.8	1.1	59.3
08/16/2016	13.5	5.34	5.57	56.1	<0.002	<0.03	156	36.3	9.8	1.0	60.0
03/07/2017	13.1	5.16	5.71	57.9	<0.002	<0.03	160	35.2	9.7	1.1	57.1
08/15/2017	13.9	5.33	5.86	55.3	<0.002	<0.03	152	36.6	9.7	1.2	56.2
08/15/2017 (FD)	13.5	5.20	5.85	53.5	<0.002	<0.03	149	36.6	9.7	1.1	55.0
03/06/2018	13.0	4.98	5.73	55.4	<0.002	<0.03	110	35.0	10.0	1.3	57.5
08/14/2018	13.9	5.40	5.61	54.9	<0.002	<0.03	156	34.2	9.6	1.2	59.2
UE5PW-2 (mg/l)											
03/11/2014	16.4	7.44	4.89	55.7	<0.002	0.071[2]	150	28.7	8.2	1.0	62.9
08/12/2014	16.4	7.34	5.24	49.3	<0.002	<0.03	138	29.4	8.6	1.1	60.5
03/17/2015	16.4	5.68	5.40	57.4	<0.002	0.044[2]	157	27.7	8.0	1.0	60.3
09/01/2015	16.2	7.26	5.29	51.6	<0.002	<0.03	155	29.7	8.6	1.0	60.1
03/15/2016	15.4	6.70	5.20	46.2	<0.002	<0.03	159	28.1	8.0	0.9	56.3
08/17/2016	14.6	6.46	4.93	47.0	<0.002	<0.03	161	28.8	8.1	0.8	57.0
03/08/2017	15.1	6.18	4.71	48.5	<0.002	<0.03	163	28.2	8.0	0.9	55.3
08/15/2017	15.6	6.46	4.97	47.6	<0.002	<0.03	160	29.1	8.0	1.0	54.2
03/06/2018	15.3	6.60	5.00	49.0	<0.002	<0.03	160	29.0	8.2	1.1	57.2
03/06/2018 (FD)	15.4	6.67	5.19	50.8	<0.002	<0.03	161	29.2	8.2	1.1	58.2
08/14/2018	15.9	6.93	4.93	49.0	<0.002	<0.03	160	27.6	7.9	1.0	59.0
UE5PW-3 (mg/l)											
03/11/2014	16.5	6.38	3.89	60.9	<0.002	0.122	154	31.0	8.7	1.0	61.1
08/12/2014	15.9	6.22	4.12	52.0	<0.002	0.037[2]	139	32.3	9.2	1.0	57.7
03/17/2015	16.4	5.96	3.95	53.4	<0.002	<0.03	154	30.8	8.5	1.0	57.3
08/11/2015	16.3	6.31	4.21	59.1	<0.002	<0.03	151	32.2	8.7	1.0	58.2
03/15/2016	15.8	5.92	4.03	50.6	<0.002	<0.03	156	31.5	8.7	1.0	55.4
08/16/2016	15.2	5.78	3.84	52.6	<0.002	<0.03	160	32.4	8.6	0.9	56.3
03/08/2017	15.0	5.47	3.79	52.1	<0.002	<0.03	162	31.6	8.6	1.0	53.0
08/15/2017	15.9	5.74	4.03	52.7	<0.002	<0.03	161	32.2	8.5	1.0	53.7
03/06/2018	14.4	5.39	3.94	52.5	<0.002	<0.03	157	30.7	8.7	1.1	53.0
08/14/2018	14.9	5.75	3.86	51.3	<0.002	<0.03	155	30.0	8.4	1.1	54.8
08/14/2018 (FD)	14.9	5.87	3.81	51.1	<0.002	<0.03	156	30.8	8.4	1.0	54.1

[1] Results < MDL are reported as <MDL
[2] MDL < result < RL

UE5PW-1

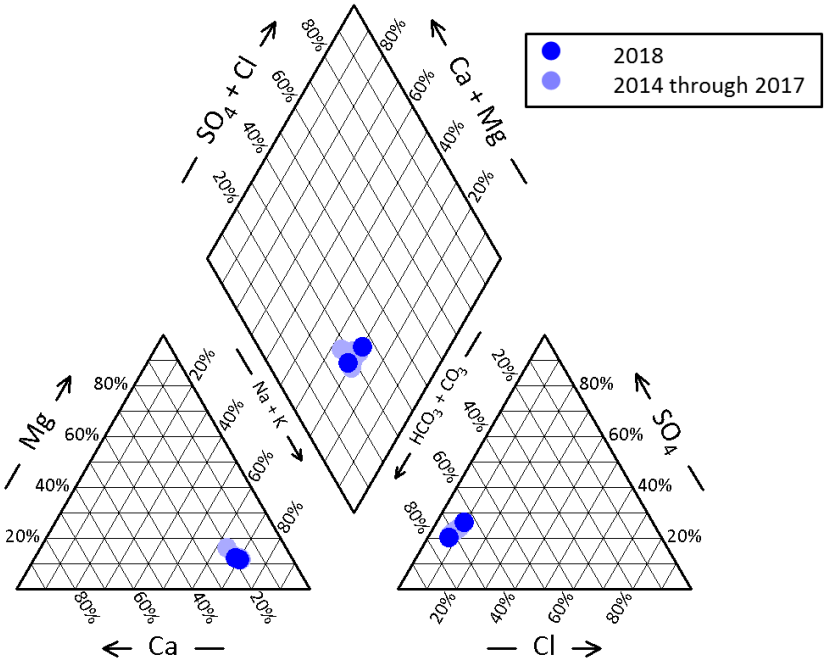


Figure 2-5 Piper Diagram for UE5PW-1

UE5PW-2

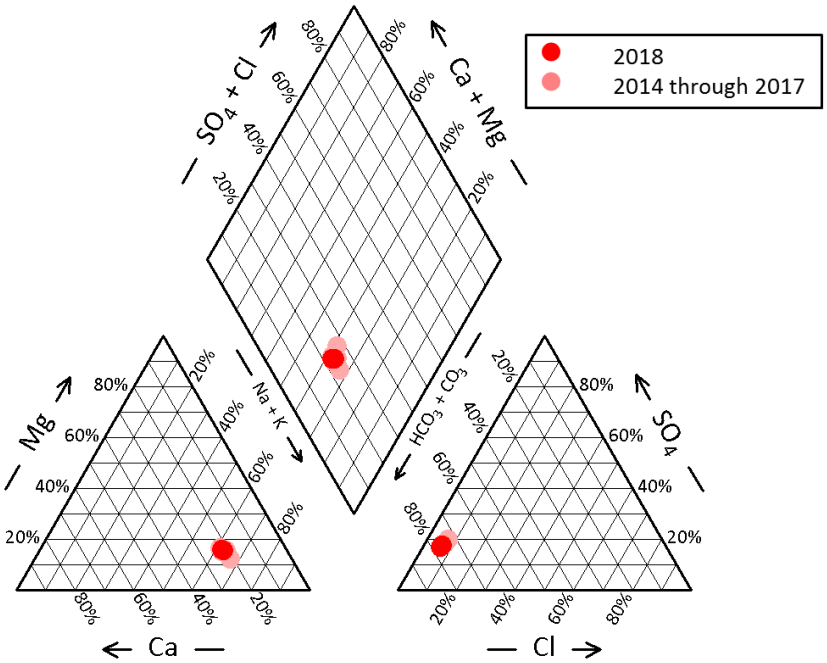


Figure 2-6 Piper Diagram for UE5PW-2

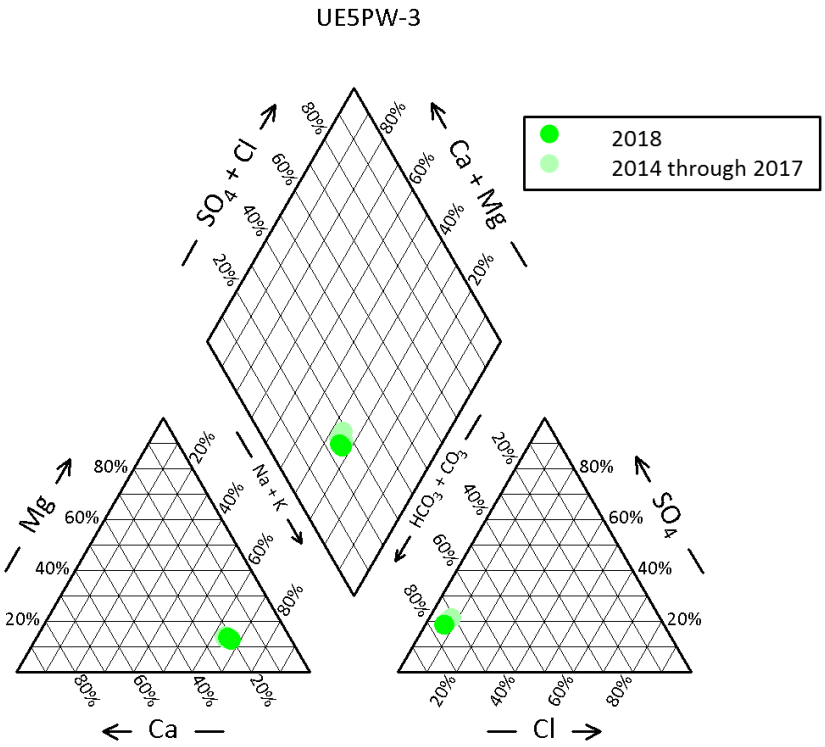


Figure 2-7 Piper Diagram for UE5PW-3

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3.0 LEACHATE MONITORING

Leachate monitoring data from the mixed waste disposal units 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 composition does not exceed any maximum regulatory levels for toxicity characteristic contaminants identified in 40 CFR 261.24, Table 1, and the tritium concentration does not exceed 1.33E06 pCi/l. If the leachate composition exceeds any of the maximum regulatory levels, 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 Sampling and Analysis Plan 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 regulatory and indicator parameters began when the first leachate was collected from Cell 18 in 2011 and continues to the present.

3.1 LEACHATE COLLECTION SYSTEM

Cell 18 and Cell 25 are lined, mixed waste disposal cells at the Area 5 RWMS that received mixed waste during 2018. Cell 18 is in the northeastern corner of the Area 5 RWMS. It was constructed in 2010 and began receiving waste in January 2011. Cell 25 is west of Cell 18 near the northern boundary of the Area 5 RWMS. It 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 placed over a geosynthetic clay liner. The double liner is covered by approximately 61 cm (24 in.) of compacted soil, and there is an additional 15 cm (6 in.) of aggregate material covering the compacted soil on the cell floor. The primary liner is 80-millimeter textured high-density polyethylene (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 covered by a liner 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 from the sump into to a double-walled leachate collection tank on the surface adjacent to the cell. Cell 18 has a 3,000-gallon storage tank (LPW-TNl-001), and Cell 25 has a 10,000-gallon storage tank (LPW-TNK-002) (Figure 2-1).

Leachate volume is monitored with a totalizing flow meter when the contents of a primary sump are pumped into a leachate collection tank, and pressure transducers monitor leachate levels in leachate collection tanks, primary sumps, and secondary sumps. Flow meter measurements are recorded at approximately one-week intervals, and pressure transducer measurements are recorded at the beginning of most workdays. Reported leachate volumes are calculated from the change in leachate tank level following pumping of leachate into the tank.

The cumulative volume pumped from the Cell 18 leachate tank from January 2011 through December 2018 was approximately 360,215 liters (95,159 gallons). From January 2011 through December 2018, precipitation was 88.03 cm (34.7 in.) at the Area 5 RWMS. The equivalent depth of the collected leachate distributed over the 1.35-hectare (3.33-acre) covered by the Cell 18 liner was 2.70 cm (1.1 in.). Neglecting additional water applied to Cell 18 for dust control, leachate was approximately 3.1 percent of precipitation. The total volume of leachate in 2018 was approximately 18,587 liters (4,910 gallons), and the equivalent depth of leachate was 0.14 cm (0.05 in.). The 2018 leachate was approximately 1.9 percent of the 7.45 cm (2.9 in.) of precipitation during 2018.

No leachate has been pumped from the Cell 25 sumps into the Cell 25 leachate tank.

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 in the tank 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 in the leachate 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 also 0.0005 mg/l (Table 3-2). 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 1,300,000 pCi/l would expose a worker to less than 10% 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	5.0	Pb	5.0
Ba	100	Se	1.0
Cd	1.0	Ag	5.0
Cr	5.0	Hg	0.2
SVOAs			
o-cresol	200	Hexachloroethane	3.0
m- and p-cresol	200	Nitrobenzene	2.0
1,4-dichlorobenzene	7.5	Pentachlorophenol	100
2,4-dinitrotoluene	0.13	Pyridine	5.0
Hexachlorobenzene	0.13	2,4,5-trichlorophenol	400
Hexachlorobutadiene	0.5	2,4,6-trichlorophenol	2.0
VOAs			
Benzene	0.5	1,1-Dichloroethylene	0.7
Carbon tetrachloride	0.5	Methyl ethyl ketone	200
Chlorobenzene	100	Tetrachloroethylene	0.7
Chloroform	6.0	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)	1.0
Lindane	0.4	2,4-D	10.0

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 Leachate System Management* (NSTec, 2017d), is followed for leachate sample collection. A liquid recirculation system in the leachate tank is run for at least 20 minutes before samples are collected 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 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 and shipment to Nevada-certified contract laboratories for analysis by the Radiological Control Department. Leachate samples from the Cell 18 leachate tank were collected on March 1 and August 1, 2018. A grab sample and a trip blank (TB) sample for VOA analysis were collected on each sample date.

Table 3-3 Leachate Samples and Bottles

Analysis	Sample Bottle	Preservative	03/01/2018		08/01/2018	
			Grab	TB	Grab	TB
pH	Field Measurement[1]		1	-	1	-
As, Ba, Cd, Cr, Pb, Se, Ag, Hg	500-ml Glass	< 6° C	1	-	1	-
SVOAs, Pesticides, Herbicides, PCBs	1-liter Amber Glass	< 6° C	3	-	3	-
VOAs	40-ml glass Teflon cap	pH < 2 (H_2SO_4) < 6° C	2	3	2	3
Tritium	125-ml HDPE	< 6° C	1	-	1	-
SC	125-ml HDPE	< 6° C	1	-	1	-

[1] No samples are collected for field measurements.

3.4 LEACHATE RESULTS

After the sample results were evaluated, the leachate tank was emptied and the leachate used for dust control at Cell 18 on March 22 and August 28, 2018. All laboratory analyses were done by ALS. 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). The *Sampling and/or Analysis Plan-Data Quality Objectives, MWDU Leachate* (NSTec, 2017b) provides the laboratory analysis procedures for these analyses summarized in Table 3-4.

Table 3-4 Analysis Methods for Leachate

Analysis	Laboratory	Procedure	Method Description
pH	Field	SOP-2151.104	Potentiometric
As, Ba, Cd, Cr, Pb, Se, Ag, Hg	ALS	SW 6010	Inductively Coupled Plasma Atomic Emission
Hg	ALS	SW 7470	Manual Cold-Vapor Technique
SVOAs	ALS	SW 8270	Gas Chromatography/Mass Spectrometry
VOAs	ALS	SW 8260	Gas Chromatography/Mass Spectrometry
Pesticides	ALS	SW 8081	Gas Chromatography
Herbicides	ALS	SW 8151	Gas Chromatography
PCBs	ALS	SW 8082	Gas Chromatography
Tritium	ALS	EPA 906.0	Liquid Scintillation
SC	ALS	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 2018 toxicity characteristic contaminant results were below these regulatory levels (Table 3-5, Table 3-6, Table 3-7, and Table 3-8). Results in these tables that are greater than the MDL and less than the RL are indicated.

Table 3-5 Leachate Toxicity Characteristic Metals

Date	As (mg/l)[2]	Ba (mg/l)[2]	Cd (mg/l)[2]	Cr (mg/l)[2]	Pb (mg/l)[2]	Se (mg/l)[2]	Ag (mg/l)[2]	Hg (mg/l)[2]
	Regulatory Level (mg/l)[1]							
	5.0	100	1.0	5.0	5.0	1.0	5.0	0.2
02/25/2014	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
03/05/2014	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
05/20/2014	<0.1	<1[3]	<0.05	<0.1[3]	<0.03	<0.05	<0.1	<0.002
08/12/2014	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
09/16/2014	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
11/04/2014	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05[3]	<0.1	<0.002
12/16/2014	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05[3]	<0.1	<0.002
01/28/2015	<0.1[3]	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
03/31/2015	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
06/09/2015	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.08	<0.1[3]	<0.002
10/28/2015	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
12/01/2015	<0.1	<1[3]	<0.05	<0.1	<0.03[3]	<0.05	<0.1	<0.002
01/13/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.08	<0.1	<0.002
02/09/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
03/09/2016	<0.1[3]	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
03/29/2016	<0.1[3]	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
04/18/2016	<0.1[3]	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
05/10/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
06/15/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
07/13/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05[3]	<0.1[3]	<0.002
08/04/2016	<0.1	<1[3]	<0.05[3]	<0.1	<0.03	<0.05	<0.1[3]	<0.002
09/14/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
11/08/2016	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
01/26/2017	<0.1[3]	<1[3]	<0.05	<0.1	<0.03[3]	<0.05	<0.1	<0.002
02/21/2017	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
03/28/2017	<0.1[3]	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
04/04/2017	<0.1	<1[3]	<0.05	<0.1	<0.03	<0.05	<0.1	<0.002
05/11/2017	<0.1	<1	<0.05	<0.1	<0.03	<0.05	<0.1	<0.0002
07/11/2017	<0.1	<1	<0.05	<0.1	<0.03[3]	<0.05	<0.1	<0.001
10/19/2017	<0.1	<1[3]	<0.05	<0.1	<0.04	<0.06	<0.1	<0.0002
03/01/2018	<0.1	<1[3]	<0.05	<0.1	<0.04	<0.06	<0.1	<0.002
08/01/2018	0.2	<1[3]	0.05[3]	<0.1	<0.04	<0.06	<0.1	<0.002

[1] Regulatory level from 40 CFR 261.24, Table 1

[2] Results < RL are reported as <RL

[3] MDL < result < RL

Table 3-6 Leachate SVOAs

Date	o-Cresol (mg/l)[2]	m- & p-Cresol (mg/l)[2]	1,4-Dichloro-benzene (mg/l)[2]	2,4-Dinitro-toluene (mg/l)[2])	Hexa-chloro-benzene (mg/l)[2]	Hexa-chloro-butadiene (mg/l)[2]	Hexa-chloro-ethane (mg/l)[2]	Nitro-benzene (mg/l)[2]	Penta-chloro-phenol (mg/l)[2]	Pyridine (mg/l)[2]	2,4,5-Tri-chloro-phenol (mg/l)[2]	2,4,6-Tri-chloro-phenol (mg/l)[2]
	Regulatory Level (mg/l)[1]											
	200	200	7.5	0.1	0.1	0.5	3.0	2.0	100	5.0	400	2.0
02/25/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
03/05/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
05/20/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
08/12/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
09/16/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
11/04/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
12/16/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
01/28/2015	<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

[1] Regulatory level from 40 CFR 261.24, Table 1
[2] Results < RL are reported as <RL

Table 3-7 Leachate VOAs

Date	Benzene (mg/l)[2]	Carbon tetra-chloride (mg/l)[2]	Chloro-benzene (mg/l)[2]	Chloroform (mg/l)[2]	1,2-Dichloro-ethane (mg/l)[2]	1,1-Dichloro-ethylene (mg/l)[2]	Methyl ethyl ketone (mg/l)[2]	Tetra-chloro-ethylene (mg/l)[2]	Trichloro-ethylene (mg/l)[2]	Vinyl chloride (mg/l)[2]
	Regulatory Level (mg/l)[1]									
	0.5	0.5	100	6.0	0.5	0.7	200	0.7	0.5	0.2
02/25/2014	<0.001	<0.001	<0.001	<0.001[3]	<0.001	<0.001	<0.01	<0.001[3]	0.0016	<0.001
03/05/2014	<0.001	<0.001	<0.001	<0.001[3]	<0.001	<0.001	<0.01	<0.001[3]	0.0014	<0.001
05/20/2014	<0.001	<0.001	<0.001	<0.001[3]	<0.001	<0.001	<0.01	<0.001	<0.001[3]	<0.001
08/12/2014	<0.001	<0.001	<0.001	<0.001[3]	<0.001	<0.001	<0.01	<0.001[3]	0.0013	<0.001
09/16/2014	<0.001	<0.001	<0.001	0.0014	<0.001	<0.001	<0.01	0.0012	0.0026	<0.001
11/04/2014	<0.001	<0.001	<0.001	<0.001[3]	<0.001	<0.001	<0.01	<0.001[3]	0.0013	<0.001
12/16/2014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.0011	0.0022	<0.001
01/28/2015	<0.001	<0.001	<0.001	0.001[3]	<0.001	<0.001	<0.01	0.0011	0.002	<0.001
03/31/2015	<0.001	<0.001	<0.001	0.001[3]	<0.001	<0.001	<0.01	0.0011	0.0016	<0.001
06/09/2015	<0.001	<0.001	<0.001	0.001[3]	<0.001	<0.001	<0.01	<0.001[3]	<0.001[3]	<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[3]	<0.01[3]	<0.01
01/13/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01[3]	<0.01[3]	<0.01
02/09/2016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01[3]	<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[3]	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
04/18/2016	<0.001	<0.001	<0.001	<0.001[3]	<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[3]	<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[3]	<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[3]	<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[3]	<0.001	<0.001	<0.01	0.001	<0.001[3]	<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[3]	<0.001	0.0015	<0.001	<0.001	<0.01	0.0018	0.0012	<0.001

[1] Regulatory level from 40 CFR 261.24, Table 1

[2] Results < RL are reported as <RL

[3] MDL < result < RL

Table 3-8 Leachate Pesticides

Date	Chlordane (mg/l)[2]	Endrin (mg/l)[2]	Heptachlor (mg/l)[2]	Lindane (mg/l)[2]	Meth-oxychlor (mg/l)[2]	Toxaphene (mg/l)[2]	2,4,5-TP (Silvex) (mg/l)[2]	2,4-D (mg/l)[2]
	Regulatory Level (mg/l)[1]							
	0.03	0.02	0.008	0.4	10.0	0.5	1.0	10.0
02/25/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
03/05/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
05/20/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
08/12/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
09/16/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
11/04/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
12/16/2014	<0.01	<0.0005	<0.0005	<0.0005	<0.0025	<0.025	<0.0005	<0.005
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

[1] Regulatory level from 40 CFR 261.24, Table 1
[2] Results < RL are reported as <RL

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 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 PCBs

The IL for leachate 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 leachate PCBs is 0.0005 mg/l. Table 3-9 provides leachate PCB results from 2014 through 2018. PCB results were below the RLs and below the MDLs. Although the results were all less than the MDLs, results are reported as less than the RLs. RLs provided in Table 3-9 range from <0.00047 mg/l to <0.00056 mg/l, but MDLs reported by the analysis laboratory range from <0.00014 mg/l to <0.00033 mg/l. There are no detectable PCBs in the leachate.

Table 3-9 Leachate PCBs

	Aroclor-1016 (mg/l)[2]	Aroclor-1221 (mg/l)[2]	Aroclor-1232 (mg/l)[2]	Aroclor-1242 (mg/l)[2]	Aroclor-1248 (mg/l)[2]	Aroclor-1254 (mg/l)[2]	Aroclor-1220 (mg/l)[2]
	Investigation Level (mg/l)[1]						
Date	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
02/25/2014	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
03/05/2014	<0.00053	<0.00053	<0.00053	<0.00053	<0.00053	<0.00053	<0.00053
05/20/2014	<0.00055	<0.00055	<0.00055	<0.00055	<0.00055	<0.00055	<0.00055
08/12/2014	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052	<0.00052
09/16/2014	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
11/04/2014	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
12/16/2014	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
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

[1] IL from 40 CFR 141.61

[2] Results < RL are reported as <RL

3.4.2.2 Leachate Tritium

All 2018 leachate tritium results were below the IL for leachate tritium of 400,000 pCi/l. Figure 3-1 and Table 3-10 provide leachate tritium results from 2014 through 2018.

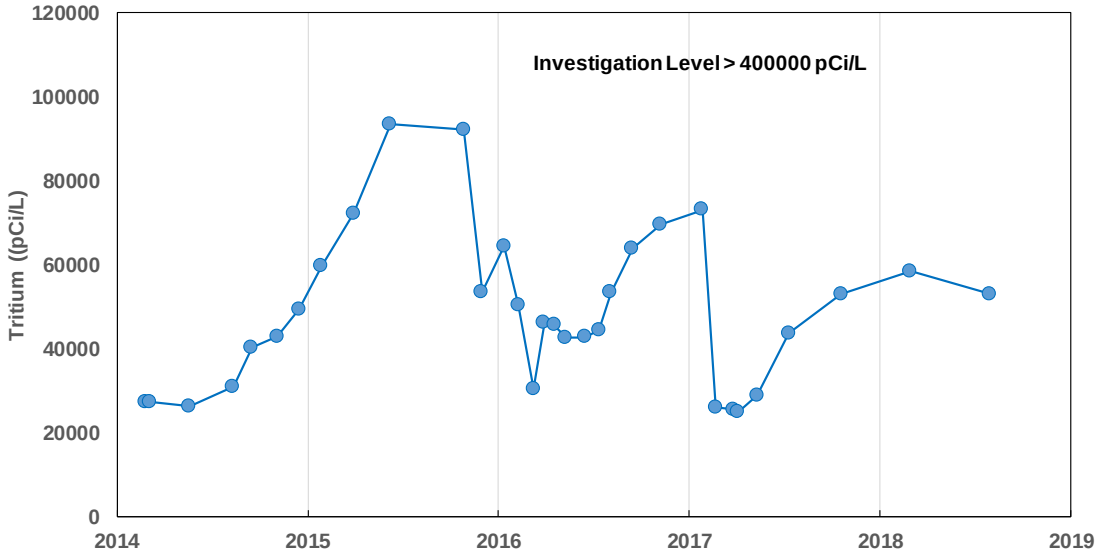

Figure 3-1 Leachate Tritium

3.4.2.3 Leachate SC

All 2018 leachate SC results were below the IL for leachate SC of 10.0 mmhos/cm. Figure 3-2 and Table 3-10 provide leachate SC results from 2014 through 2018.

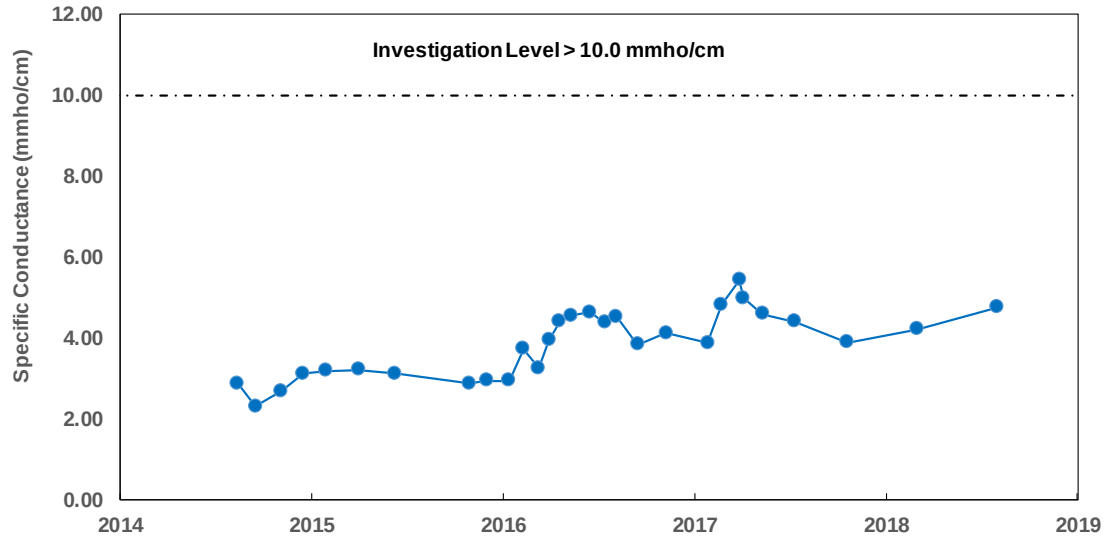

Figure 3-2 Leachate SC

3.4.2.4 Leachate pH

All 2018 leachate pH results were within the IL bounds for leachate pH of 6.0 and 9.0. Figure 3-3 and Table 3-10 provide leachate pH results from 2014 through 2018.

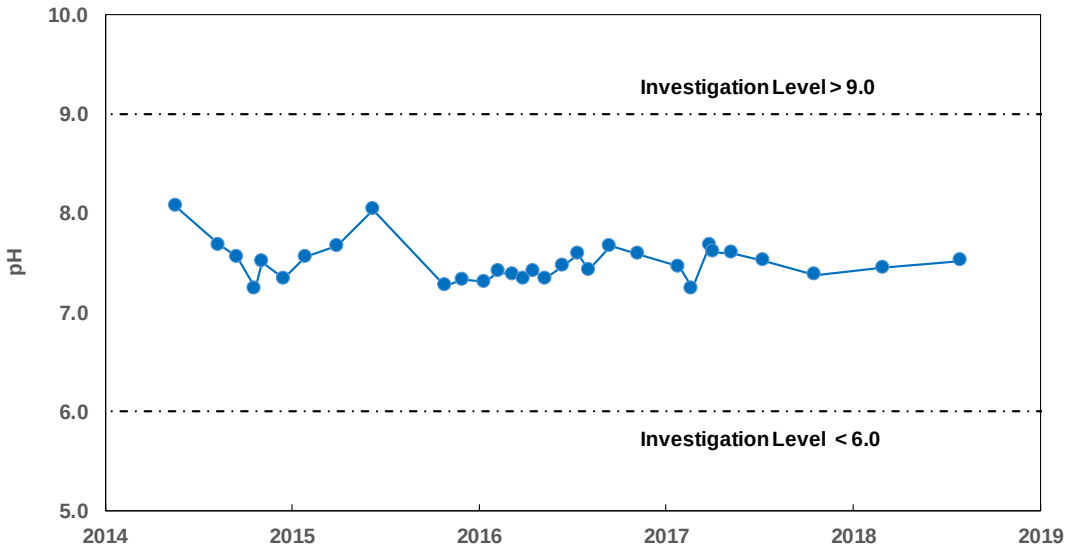

Figure 3-3 Leachate pH

Table 3-10 Leachate Tritium, SC, and pH

Date	Tritium (pCi/l)	SC (mmho/cm)	pH
	Investigation Level		
	400,000	10.0	6.0 < pH < 9.0
02/25/2014	27,300	2.97	7.43
03/05/2014	27,200	2.94	7.87
05/20/2014	26,200	3.07	8.07
08/12/2014	30,900	2.87	7.68
09/16/2014	40,200	2.31	7.56
11/04/2014	42,800	2.69	7.51
12/16/2014	49,300	3.12	7.34
01/28/2015	59,700	3.19	7.56
03/31/2015	72,200	3.21	7.67
06/09/2015	93,400	3.12	8.04
10/28/2015	92,100	2.88	7.27
12/01/2015	53,400	2.94	7.33
01/13/2016	64,400	2.95	7.31
02/09/2016	50,300	3.73	7.41
03/09/2016	30,400	3.25	7.38
03/29/2016	46,000	3.95	7.34
04/18/2016	45,600	4.41	7.41
05/10/2016	42,500	4.55	7.34
06/15/2016	42,700	4.64	7.47
07/13/2016	44,400	4.38	7.59
08/04/2016	53,300	4.53	7.43
09/14/2016	63,900	3.84	7.67
11/08/2016	69,600	4.12	7.59
01/26/2017	73,000	3.88	7.46

Date	Tritium (pCi/l)	SC (mmho/cm)	pH
	Investigation Level		
	400,000	10.0	6.0 < pH < 9.0
02/21/2017	25,900	4.82	7.24
03/28/2017	25,400	5.43	7.68
04/04/2017	24,800	4.98	7.61
05/11/2017	28,800	4.59	7.60
07/11/2017	43,600	4.40	7.52
10/19/2017	53,000	3.89	7.38
03/01/2018	58,400	4.21	7.45
08/01/2018	52,900	4.75	7.52

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 Sampling and Analysis Plan (SAP) establishes monitoring objectives, goals, requirements, methods, monitoring parameters, and criteria.
- Environmental sampling follows established procedures and site work controls, is done 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, 2018); *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, qualified, and have required skills for environmental sampling activities prior to collecting samples. In addition to procedure- and task-specific training, 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), is followed for groundwater sample collection, and SOP-2151.456, *Resource Conservation and Recovery Act (RCRA) Cell Leachate System Management* (NSTec, 2017d), is followed for sample collection from the 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 procedure OP-P420.118, *Sample Package Development* (NSTec, 2016c). Depending on the samples being 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 for each bottle; 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. Four chain of custody forms were generated for the samples collected in 2018 (Table 4-1). Copies of all chain of custody forms are included in Appendix A. The two well chain of custody forms (V4356 and V4391) each contain four extra 1-liter HDPE sample bottles, and the two leachate tank chain of custody forms (V4355 and V4390) each contain one extra 1-liter HDPE sample bottle. The analysis results for these bottles are not for this report.

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 on field documentation along with the instrument checks.

Table 4-1 Chain of Custody Forms

Sample	SDG #	Sample Date
Well Groundwater	V4356	03/06/2018
Well Groundwater	V4391	08/14/2018
Cell 18 Leachate	V4355	03/01/2018
Cell 18 Leachate	V4390	08/01/2018

4.3 LABORATORY ANALYSIS

All laboratory analysis 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. These areas are discussed in the following subsections.

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 made 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. Any 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 2018 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 2018.

Table 4-2 QC Analyses

Analyte	Grab	Laboratory QC				Field QC		
		MB	LCS	LR	MS	FD	FB	TB
pH	6	0	2	1	0	2	0	0
SC	8	0	2	2	0	2	0	0
TOC	6	2	2	2	2	12	6	0
TOX	6	5	5	4	4	12	6	0
Tritium	8	4	4	3	3	12	0	0
Chemistry[1]	66	20	20	20	20	22	0	0
Metals[2]	64	32	32	30	46	16	0	0
SVOAs[3]	24	24	48	0	24	0	0	0
VOAs[4]	24	24	48	0	0	0	0	24
Pesticides[5]	42	42	76	0	36	0	0	0
PCBs	14	14	6	0	0	0	0	0

[1] Water chemistry (Ca, Fe, Mg, Mn, K, Na, SO_4, Cl, F, HCO_3, SiO_2)
[2] Toxicity characteristic metals
[3] Toxicity characteristic SVOAs
[4] Toxicity characteristic VOAs
[5] Toxicity characteristic pesticides

4.4.2.1 Laboratory QC Samples

LCSs are prepared by spiking water with verified amounts of target analytes. LCSs are used to establish analytical precision and to identify measurement bias. LCS results are calculated as a percentage of true value, and acceptable results must fall within established control limits. LCS results outside control limits are biased, and the accuracy is insufficient.

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.

4.4.2.2 Field QC Samples

Field QC measurements include FD samples, FB samples, and TB samples. Equipment blank samples are only collected if there are indications that the sampling equipment is contaminated.

FD samples 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, transportation, and analysis. FDs provide a measure of the precision of analytical results including uncertainty associated with sample collection, transportation, and homogeneity of sampled medium. FD samples are collected at each well during each groundwater sample collection event. Typically, two FD samples are collected along with a grab sample and analyzed for tritium, TOC, and TOX. During each sample collection event, one FD sample from one groundwater well is analyzed for all other measured parameters.

FB samples are prepared at a sampling site during sample collection by filling a clean sample bottle with purified water without the target analytes and adding appropriate preservatives. FB samples are used to evaluate contamination during sampling and handling. One FB sample is collected at each groundwater well during each sample collection event with samples collected for TOC or TOX analysis.

TB samples are prepared in the laboratory prior to sampling by filling a clean sample bottle with purified water without the target analytes and adding appropriate preservatives. The sealed bottle is carried to the sampling sites and returned to the laboratory unopened. TB samples are used to evaluate contamination due to shipping and handling. One TB sample is prepared before each sample collection event with samples collected for VOA analysis.

4.5 ASSESSMENTS

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

5.0 SUMMARY AND CONCLUSIONS

RCRA Permit NEV HW0101, Revision 6, requires a groundwater detection monitoring program in compliance with 40 CFR 264.97 and 40 CFR 264.98 at the Area 5 RWMS. It also requires monitoring the 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, PCBs, SC, pH, and tritium. Groundwater monitoring is intended to identify impacts on the uppermost aquifer underlying the Area 5 RWMS from activity at 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 disposal unit of its origin in compliance with the requirements of RCRA Permit NEV HW0101, Revision 6. The permit identifies monitoring locations, monitoring parameters, and ILs or RLs for each parameter for both 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 during 2018 is provided along with previous data from 2014 through 2017.

5.1 GROUNDWATER MONITORING

Water levels were measured at the three wells on March 5, June 4, August 13, and October 25, 2018. Measured water table elevations ranged from 733.68 m (2,407.08 ft) to 733.35 m (2,406.00 ft) AMSL during 2018. The average calculated hydraulic gradient from these measurements was 1.0E-05 m/m to the south-southeast, and the groundwater flow velocity was approximately 0.095 m per year. Similar groundwater elevations, small aquifer gradient, and 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 6 and August 14, 2018, at UE5PW-1, UE5PW-2, and UE5PW-3. pH results ranged from 8.30 to 8.41, and all pH results were within the IL bounds of >7.8 and <9.2. SC results ranged from 0.355 to 0.384 mmho/cm, and 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 2018 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, Fe, Mg, Mn, K, Na, SO_4, Cl, F, HCO_3, and SiO_2 show similar groundwater In all three wells and stable groundwater chemistry since 2014. 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 this 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 from the lined mixed waste Cell 18 drains into a sump and is pumped into a tank at ground surface. Samples are collected from the tank when the leachate volume approaches the 3,000-gallon tank capacity. During 2018, leachate samples were collected on March 1 and August 1, 2018. Each leachate sample was analyzed for toxicity characteristic contaminants, PCBs, tritium, pH, and SC. All leachate analysis results are below the regulatory levels for toxicity characteristic contaminants (40 CFR 261.24) 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. Tritium levels ranged from 52,900 to 58,400 pCi/l, and SC values ranged from 4.21 to 4.76 mmho/cm.

Based on the leachate analysis results for the toxicity characteristic, RCRA Permit NEV HW0101, Revision 6, allowed all leachate collected from Cell 18 during 2018 to be pumped from the collection tank and used for dust control at Cell 18. The leachate tank was emptied on March 22 and August 28, 2018, and the leachate was sprayed on the Cell 18 surface for dust control.

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APPENDIX A

Chain of Custody Forms for 2018 Groundwater and Leachate Samples

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ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4356

Laboratory: GEL LABORATORIES, LLC

Work Order: 1803/WM/PILOT WELLS

Charge Number: 5CBS 7GSU

445463

Priority: 28 days

Purchase Order: 200091

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-1	WM32648	W	3/6/18 1000	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM32649	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	WM32650	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	WM32651	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: 1803/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			3/6/18 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	WM32652	W	3/6/18 1115	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM32653	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	WM32654	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	

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Work Order: 1803/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time		Line Item Code	Description	Comments
UE5PW-2	WM32655	W	3/6/18	1115	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	WM32656	W	3/6/18	1400	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
					NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM32657	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	WM32658	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	WM32659	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: 1803/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			3/6/18 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: 1803/WM/PILOT WELLS

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WM32648	WM32648-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32648	WM32648-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32649	WM32649-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32649	WM32649-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32649	WM32649-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32650	WM32650-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32650	WM32650-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32650	WM32650-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32651	WM32651-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32651	WM32651-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32651	WM32651-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32651	WM32651-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM32651	WM32651-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM32651	WM32651-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM32651	WM32651-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM32652	WM32652-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32652	WM32652-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32653	WM32653-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32653	WM32653-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32653	WM32653-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32654	WM32654-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32654	WM32654-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32654	WM32654-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32654	WM32654-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM32654	WM32654-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM32654	WM32654-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe

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Work Order: 1803/WM/PILOT WELLS

WM32654	WM32654-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM32655	WM32655-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32655	WM32655-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32655	WM32655-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32655	WM32655-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM32655	WM32655-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM32655	WM32655-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM32655	WM32655-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM32656	WM32656-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32656	WM32656-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32657	WM32657-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32657	WM32657-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32657	WM32657-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32658	WM32658-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32658	WM32658-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32658	WM32658-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32659	WM32659-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM32659	WM32659-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM32659	WM32659-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM32659	WM32659-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM32659	WM32659-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM32659	WM32659-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM32659	WM32659-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance

Number of Containers = 49

Work Order: 1803/WM/PILOT WELLS

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
[illegible]	CA Castaneda	3/6/18 @ 1600		
CA Castaneda	Fed Ex	3/7/18 @ 1300	FED EX	7717 4395 7339 7717 4395 7340
				7717 4395 7648 7717 4395 8287
				7717 4395 8405
	[illegible]	3/8/18 0850	FED EX	NST # 7717 4395 7339

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%
- 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.

X Applicable
___ Not Applicable

Signature: [illegible]

Date: 3-6-18

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ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4391

Work Order: 1808/WM/PILOT WELLS

Priority: 28 days

Laboratory: GEL LABORATORIES, LLC
Charge Number: 5CBS7GSU
Purchase Order: 207957

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
UE5PW-1	WM33708	W	8/14/18 0900	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-1	WM33709	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	WM33710	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	WM33711	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: 1808/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			8/14/18 0900	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	WM33712	W	8/14/18 1000	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-2	WM33713	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	WM33714	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	WM33715	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

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Work Order: 1808/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			8/14/18 1000	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
				NWCH-A-034	SPECIFIC CONDUCTANCE	
UE5PW-3	WM33716	W	8/14/18 1300	NWCH-A-032	ORGANIC CARBON, TOTAL (TOC)	
				NWCH-A-033	ORGANIC HALIDES, TOTAL (TOX)	
UE5PW-3	WM33717	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	WM33718	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	WM33719	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: 1808/WM/PILOT WELLS

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
			8/14/18 1300	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: 1808/WM/PILOT WELLS

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WM33708	WM33708-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33708	WM33708-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33709	WM33709-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33709	WM33709-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33709	WM33709-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33710	WM33710-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33710	WM33710-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33710	WM33710-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33711	WM33711-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33711	WM33711-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33711	WM33711-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33711	WM33711-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM33711	WM33711-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM33711	WM33711-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM33711	WM33711-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM33712	WM33712-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33712	WM33712-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33713	WM33713-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33713	WM33713-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33713	WM33713-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33714	WM33714-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33714	WM33714-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33714	WM33714-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33715	WM33715-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33715	WM33715-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33715	WM33715-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water

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Work Order: 1808/WM/PILOT WELLS

WM33715	WM33715-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM33715	WM33715-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM33715	WM33715-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM33715	WM33715-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM33716	WM33716-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33716	WM33716-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33717	WM33717-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33717	WM33717-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33717	WM33717-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33718	WM33718-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33718	WM33718-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33718	WM33718-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33718	WM33718-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L), water
WM33718	WM33718-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM33718	WM33718-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM33718	WM33718-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance
WM33719	WM33719-1	H2S04, PH<2, COOL, 6C	250ML AMBER GLASS	Organic Carbon, Total (TOC)
WM33719	WM33719-2	H2S04, NO HEADSPACE, COOL 6C	500ML AMBER GLASS	Organic Halides, Total (TOX)
WM33719	WM33719-3	COOL 6C	250ML HIGH DENSITY POLYETHYLENE	Tritium 300 pCi/L; Water
WM33719	WM33719-4	HN03, PH<2, COOL, 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2pCi/L) & Gross Beta (4pCi/L); water
WM33719	WM33719-5	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	RCRA 8 Metals
WM33719	WM33719-6	HN03, PH<2, COOL, 6C	500ML HIGH DENSITY POLYETHYLENE	Metals - Ca,Na,K,Si,Mg,Mn,Fe
WM33719	WM33719-7	COOL 6C	500ML HIGH DENSITY POLYETHYLENE	Cl, F, SO4, TDS, Alkalinity, pH, Specific Conductance

Number of Containers = 49

Work Order: 1808/WM/PILOT WELLS

Transfer Information:

C. D. Castaneda

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
~~C. Castaneda~~	~~8-14-18 @ 1535~~ CDC	8-14-18@1535		7729 8096 9361
C.D. Castaneda	Fed. Ex	8-15-18@1300	Fed Ex #	7729 8096 9810 7729 8096 9475 7729 8096 9660
	B. Luthman	8/16/18 0915		

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: Martin Coronado

Date: 8/14/18

1803072

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

Mission Support and Test Services

SDG #: V4355

Work Order: 1803/WC/A5 MWDU LEACHATE TANK

Priority: 7 days

Laboratory: ALS FORT COLLINS
Charge Number: 5CBS8GLT
Purchase Order: 199980

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
RWMC MWDU LEACHATE TANK	WC1832749	AL	3/1/18 9:04	NHER-A-003	HERBICIDES - TCLP	
			9:02	GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
			9:00	LSC-A-001	TRITIUM, 400 PCI/L; WATER, SOIL, WASTE	Distillation Required
			9:13	MET-A-031	METALS - TCLP	
			9:04	PEP-A-005	PESTICIDES - TCLP	
			9:04	PEP-A-006	PCB ONLY	
			9:04	SVO-A-013	SVOA - TCLP	
			9:10	VOA-A-016	VOA - TCLP	
			9:13	NWCH-A-034	SPECIFIC CONDUCTANCE	
BLDG 652 ROOM 10	WC1832750	W	3/1/18 6:25	NVOA-A-003	VOA - TOTAL, TCLP LIST	

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Work Order: 1803/WC/A5 MWDU LEACHATE TANK

1803 072

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WC1832749	WC1832749-1	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Tritium, 400 pCi/L; Water, Soil, Waste
WC1832749	WC1832749-2	COOL 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WC1832749	WC1832749-3	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1832749	WC1832749-4	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1832749	WC1832749-5	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1832749	WC1832749-6	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1832749	WC1832749-7	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1832749	WC1832749-8	COOL 6C	500ML CLEAR GLASS	Metals - TCLP
WC1832749	WC1832749-9	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Specific Conductance
WC1832750	WC1832750-1	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1832750	WC1832750-2	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1832750	WC1832750-3	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List

Number of Containers = 12

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Work Order: 1803/WC/A5 MWDU LEACHATE TANK

1803072

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
[illegible]	C D Castaneda	3/1/18@ 1329		
C D Castaneda	Fed Ex	3/05/18@ 1300	Fed Ex	7717 2059 0689
FED EX	C Trumbo	3-6-18@ 1020		

Comments:

Potential Contamination	Yes	No	Comments
Radiological	X		Tritium
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%
- X 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: [illegible]

Date: 3/1/18

ANALYSES REQUEST AND CHAIN OF CUSTODY RECORD

1808059

Mission Support and Test Services

SDG #: V4390

Work Order: 1808/WC/A5 MWDU LEACHATE TANK

Priority: 7 days

Laboratory: ALS FORT COLLINS

Charge Number: 5CBS8GLT

Purchase Order: 207250

Station	Sample ID	Sample Matrix	Collection Date Time	Line Item Code	Description	Comments
RWMC MWDU LEACHATE TANK	WC1833728	AL	8/1/18 0858	NHER-A-003	HERBICIDES - TCLP	
			0900	GPC-A-001	GROSS ALPHA (2 PCI/L) & GROSS BETA (4 PCI/L); WATER	
			0901	LSC-A-001	TRITIUM, 400 PCI/L; WATER, SOIL, WASTE	Distillation Required
			0901	MET-A-031	METALS - TCLP	
			0858	PEP-A-005	PESTICIDES - TCLP	
			0858	PEP-A-006	PCB ONLY	
			0858	SVO-A-013	SVOA - TCLP	
			0905	VOA-A-016	VOA - TCLP	
			0902	NWCH-A-034	SPECIFIC CONDUCTANCE	
BLDG 652 ROOM 10	WC1833729	W	8/1/18 0755	NVOA-A-003	VOA - TOTAL, TCLP LIST	

Revision 1

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Work Order: 1808/WC/A5 MWDU LEACHATE TANK

1808059

SAMPLE	CONTAINER_ID	PRESERVATIVE	CONTAINER TYPE	COMMENTS
WC1833728	WC1833728-1	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Tritium, 400 pCi/L; Water, Soil, Waste
WC1833728	WC1833728-2	COOL 6C	1L HIGH DENSITY POLYETHYLENE	Gross Alpha (2 pCi/L) & Gross Beta (4 pCi/L); Water
WC1833728	WC1833728-3	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1833728	WC1833728-4	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1833728	WC1833728-5	COOL 6C	1L AMBER GLASS	PCB, TCLP (SVOA, Pest, Herb)
WC1833728	WC1833728-6	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1833728	WC1833728-7	COOL 6C, ZERO HEADSPACE	40ML GLASS VOA CONTAINER	VOA - TCLP
WC1833728	WC1833728-8	COOL 6C	500ML CLEAR GLASS	Metals - TCLP
WC1833728	WC1833728-9	COOL 6C	125ML HIGH DENSITY POLYETHYLENE	Specific Conductance
WC1833729	WC1833729-1	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1833729	WC1833729-2	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List
WC1833729	WC1833729-3	H2S04, NO HEADSPACE, COOL 6C	40ML GLASS VOA CONTAINER	VOA - Total, TCLP List

Revision 1

Number of Containers = 12

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Work Order: 1808/WC/A5 MWDU LEACHATE TANK

Transfer Information:

Relinquished By	Received By	Transfer Date & Time	Shipper	Air Bill #
Matthew Weaver	Elizabeth Burns	8/01/18 16:15		
Elizabeth Burns	FED EX	8/2/18 1300	FED EX	7728 7977 7916
	CT Laboratory	8-3-18 9:30		

Comments:

Potential Contamination	Yes	No	Comments
Radiological	✓		Tritium ~ 58,000 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.

X Applicable
____ Not Applicable

Signature: Matthew Weaver

Date: 8/1/18

Revision 1

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APPENDIX B

Data Review Forms for 2017 Groundwater and Leachate Data

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4356

Summary

Environmental Monitoring (EMon) OP-P420.457, dated 1/23/17 "Radioanalytical Data Verification, Data Validation, and Data Review" and OP-P420.458, dated 1/12/17 "Organic Data Verification and Validation," and OP-P420.459, dated 1/12/17 "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.

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4356

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 Group V4356

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 limits.
- 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 and TOX were within the limits and performed on samples WM32648 (445463001), WM32656 (445463009); WM32648 (445463001) and WM32654 (445463007). See pages 321 and 322 in the TOC and TOX data package.

Metals
- The laboratory replicate for ICP Metals was within the limits and performed on sample WM32651 (445463004). 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 and Sulfate was within limits and was performed on sample WM32659 (445463012). See pages 322 and 323 in the laboratory General Chemistry data package.

Radiological
- The laboratory replicate for Gross Alpha/Beta and Tritium was within limits and was performed on sample WM32654 (445463007) and WM32649 (445463002), respectively. See pages 527 and 528 in the laboratory radiological data package.

Data Reviewed by: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2018.04.16 08:44:52 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2018.04.16 09:08:56 -07'00'

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16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4391

Summary

Environmental Monitoring (EMon) OP-P420.457, dated 1/23/17 "Radioanalytical Data Verification, Data Validation, and Data Review" and OP-P420.458, dated 1/12/17 "Organic Data Verification and Validation," and OP-P420.459, dated 1/12/17 "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.

16-SAP-002 Area 5 Groundwater Monitoring Data Review Report
Sample Delivery Group V4391

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 Group V4391

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.
- 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 TOX were within the limits and performed on samples WM33708 (457472001), WM33714 (457472007). See page 212 in the TOX 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 WM33711 (457472004). See page 38 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 WM33719 (457472012). See page 213 in the laboratory General Chemistry data package.
- The laboratory replicate for pH was within limits and was performed on sample WM33719 (457472012). See page 214 in the laboratory General Chemistry data package.
- The laboratory replicate for Specific Conductance was within limits and was performed on sample WM33711 (457472004). See page 215 in the laboratory General Chemistry data package.

Radiological
- The laboratory replicate for Gross Alpha/Beta was within limits and was performed on sample WM33719 (457472012). See page 384 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 Group V4391

Data Reviewed by: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2018.09.19 12:50:28 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2018.09.19 12:51:57 -07'00'

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11-SAP-001 MWDU Leachate Tank Data Review Report
Sample Delivery Group V4355

Summary

Environmental Monitoring (EMon) OP-420.458, Revision 2, dated 1/12/17 "Organic Data Verification and Validation," and OP-P420.459, Revision 2, dated 1/12/17 "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 March 06, 2018 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), 6010B (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, Revision 4, February 2007, 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 V4355

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.

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 V4355

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, all matrix spike recoveries were within acceptance criteria.
- For TCLP SVOCs, all blank spike recoveries were within acceptance criteria.
- For TCLP SVOCs, all matrix spike recoveries were within acceptance criteria.

PCB
- Matrix spike samples could not be performed because of insufficient sample. However, an LCS and LCSD were performed.
- 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.

TCLP Metals
- All 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 was within the limits and was performed on sample WC1832749 (1803072-3). See pages 18 and 57 in the laboratory metals data package.

Data Reviewer: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2018.03.21 14:12:42 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2018.03.21 14:16:28 -07'00'

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Sample Delivery Group V4390

Summary

Environmental Monitoring (EMon) OP-420.458, Revision 2, dated 1/12/17 "Organic Data Verification and Validation," and OP-P420.459, Revision 2, dated 1/12/17 "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 March 06, 2018 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), 6010B (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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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.

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.

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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, matrix spike recovery was not reported due to a crack in the glassware.
- For TCLP SVOCs, all blank spike recoveries were within acceptance criteria.
- For TCLP SVOCs, all matrix spike recoveries were within acceptance criteria.

PCB
- The matrix spike sample was performed on a non-SDG sample.
- 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.

TCLP Metals
- All 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 was within the limits and was performed on sample WC1833728 (1808059-3). See pages 18 and 43 in the laboratory metals data package.

Data Reviewer: Elizabeth Burns & Ted Redding

Reviewed by: Elizabeth Burns Digitally signed by Elizabeth Burns Date: 2018.08.22 09:34:09 -07'00'

Approved by: Theodore J. Redding Digitally signed by Theodore J. Redding Date: 2018.08.22 09:36:54 -07'00'

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