



Water Protection Bureau
 P.O. Box 200901
 Helena, MT 59620-0901

PERMIT FACT SHEET

MONTANA GROUND WATER POLLUTION CONTROL SYSTEM

Permittee/Applicant:	Yellowstone Energy Limited Partnership
Permit Number:	MTX000061
Permit Type:	Industrial – Monitoring
Application Type:	Renewal
Facility Name:	Yellowstone Energy Limited Partnership Ash Monofill
Facility Location:	SE 1/4, Section 24, Township 08 South, Range 25 East NE 1/4, Section 25, Township 08 South, Range 25 East Carbon County Latitude: 45.12015°, Longitude: -108.60194°
Facility Contact:	Bruce Stevenson, Plant Engineer
Treatment Type:	None
Receiving Water:	Class I Ground Water
Number of Outfalls:	1
Outfall / Type:	001 / Ash Monofill
Effluent Type:	Industrial – Petroleum Coke Fly Ash
Mixing Zone:	None
Effluent Limits:	None
Fact Sheet Date:	June 10, 2019
Prepared By:	Chris Boe

1.0 PERMIT INFORMATION

DEQ authorizes placement of petroleum coke ash at an existing monofill located near Warren. This fact sheet provides the basis for DEQ's decision to continue monitoring and best management practice (BMPs) requirements at the Yellowstone Energy Limited Partnership (YELP) Ash Monofill. DEQ issues Montana Ground Water Pollution Control System (MGWPCS) permits for a period of five years.

The MGWPCS permit is for the ash monofill located near Warren. YELP also maintains the following permits and authorizations for their electricity generating facility in Billings that generates the petroleum coke ash byproduct:

- Montana Pollution Discharge Elimination System (MPDES) Individual Surface Water discharge permit, MT0030180;
- MPDES General Permit for Storm Water Discharges Associated with Industrial Activity, MTR000364; and,
- Montana Air Quality Permit (MAQP), 2650-08.

1.1 PERMIT HISTORY

On August 23, 1991, the State of Montana issued a new MGWPCS permit to Billings Generation, Inc. The permit established: ash monitoring, ground water monitoring, fugitive dust emission BMPs, rehabilitation procedures, and sedimentation and erosion control BMPs.

On October 17, 1996, DEQ reissued the permit and transferred ownership to YELP.

DEQ administratively continued the existing permit on March 25, 2003, and June 06, 2011.

On April 12, 2013, DEQ reissued the permit with a ground water monitoring emphasis on the shallow portion of the underlying water table.

1.3 APPLICATION

On December 22, 2017, DEQ received notice of the permittee's intent to renew their existing permit. DEQ determined that the respective application was complete, and administratively continued permit coverage on January 16, 2018.

1.4 CHANGES TO THIS PERMIT

DEQ received reports from the permittee in regards to dry well conditions at the existing MW-6 monitoring well, and an obstruction within the MW-7 monitoring well. After a reanalysis of current shallow ground water conditions, DEQ will require the replacement and deepening of these wells in order to best ensure long-term monitoring and data collection (**Section 6**).

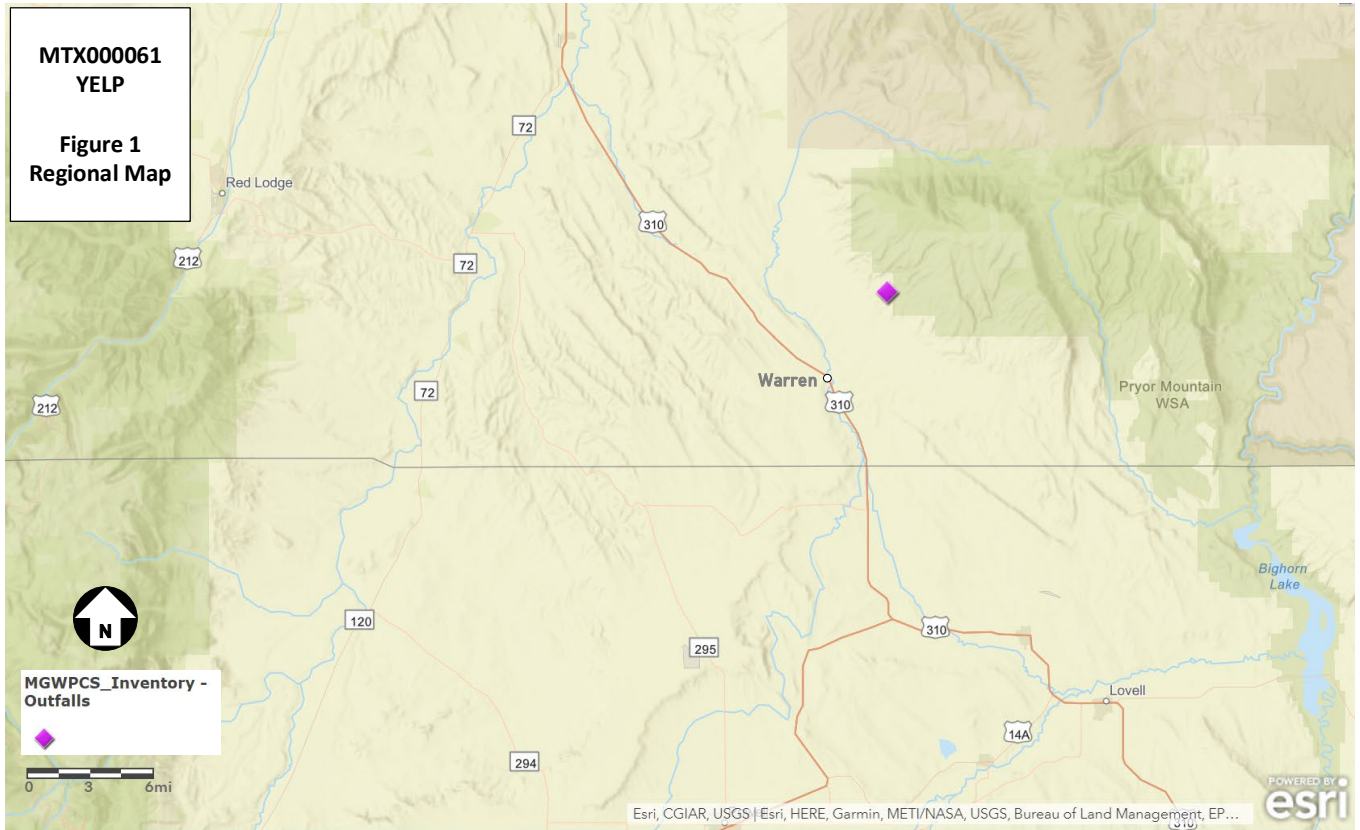
DEQ reanalyzed the Parameters of Interest (POIs) for this permit based on long-term ash and ground water monitoring results, research, and regulations (**Section 3**). This has resulted in a slight modification to the ash, underdrain, and ground water monitoring requirements (**Section 5**).

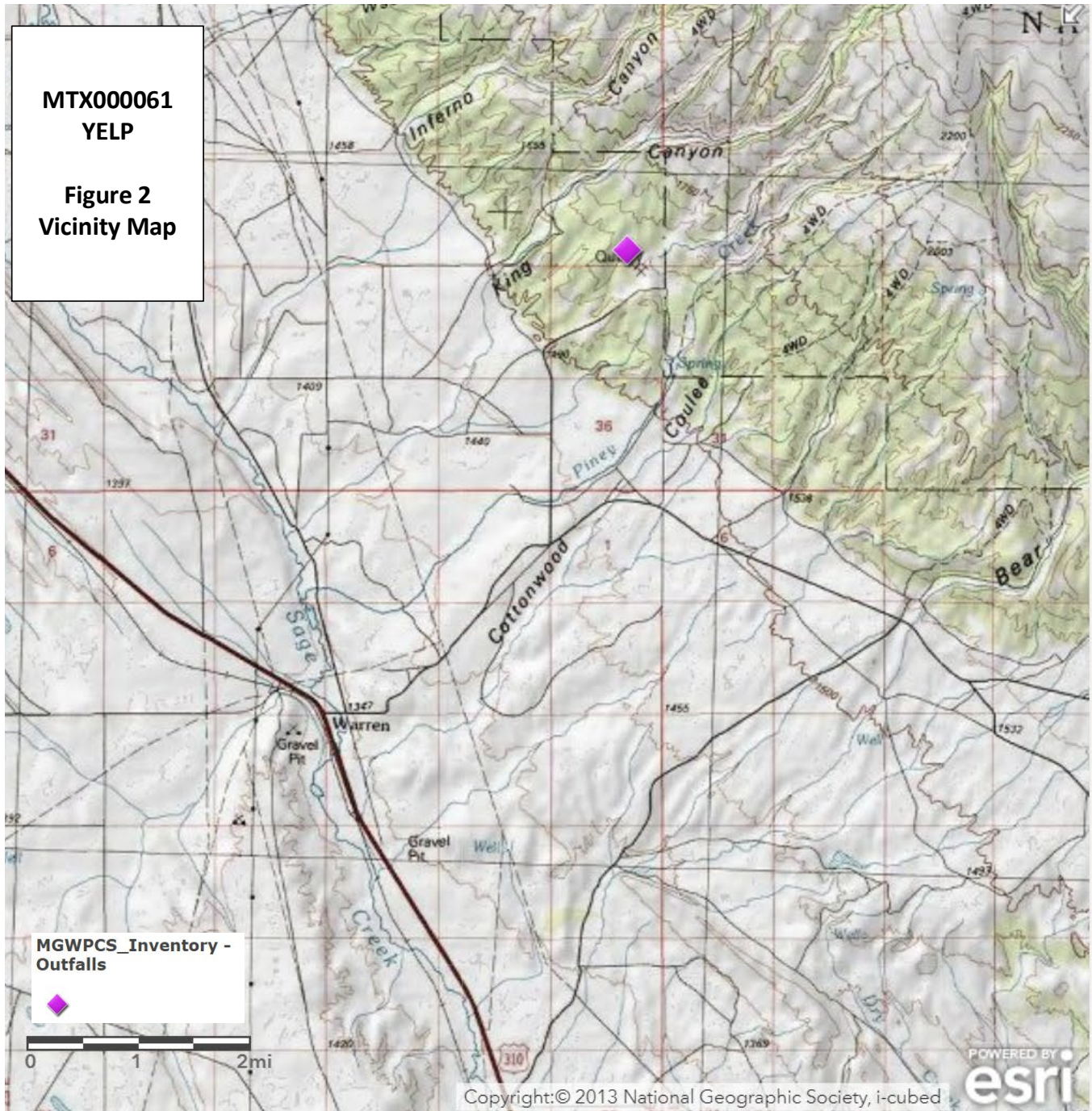
DEQ will require monitoring and reporting standard operating procedures (SOPs) to be created or updated for quality assurance purposes (**Section 6**). DEQ has updated the reporting requirements and methods to provide for data quality control (**Section 5**).

2.0 FACILITY INFORMATION

2.1 LOCATION

The existing monofill site is located in the southwest foothills of the Pryor Mountains, 4.5 miles northeast of Warren on Quarry Road (**Figure 1, Figure 2, Figure 3, Figure 4**).

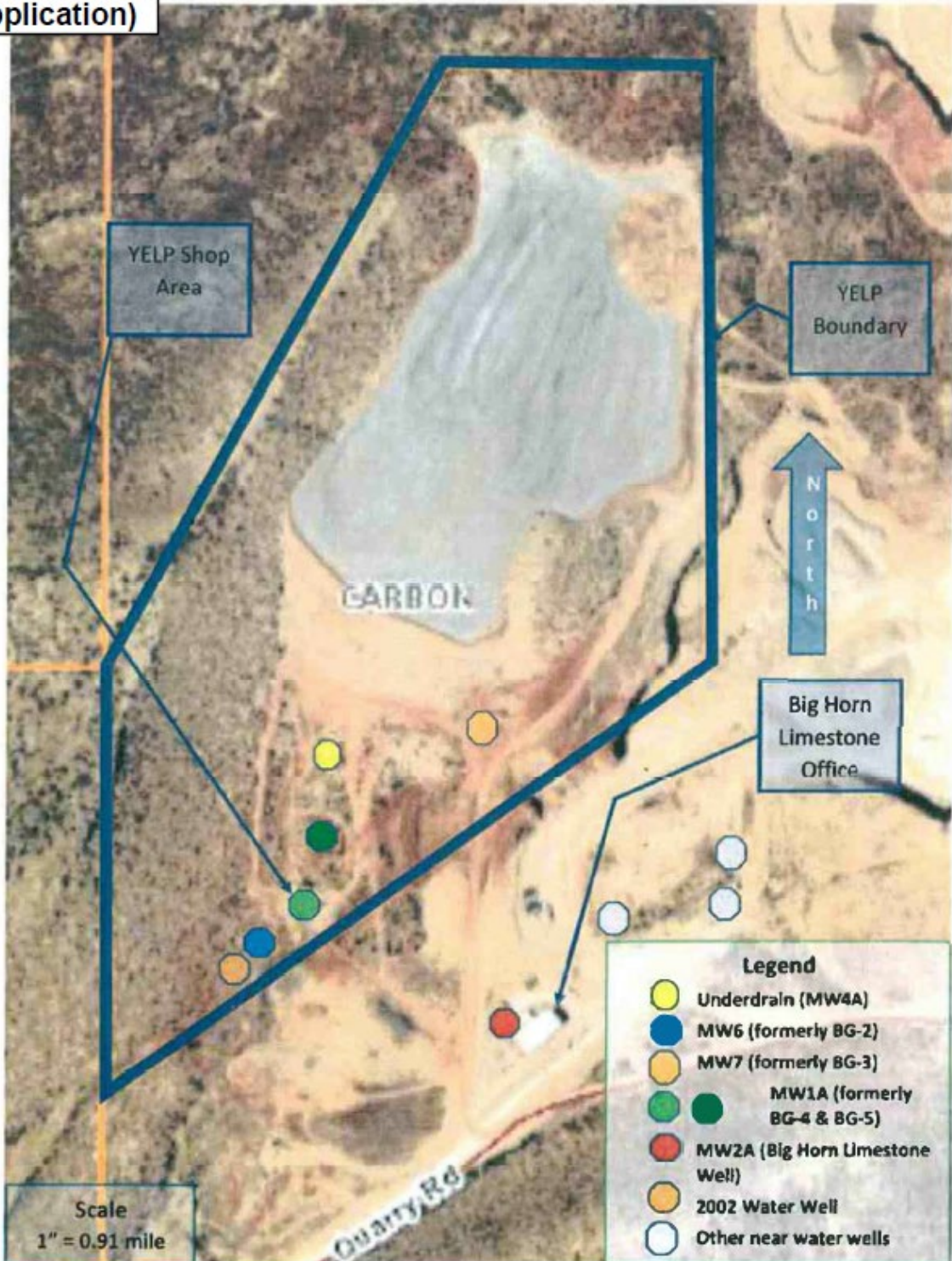




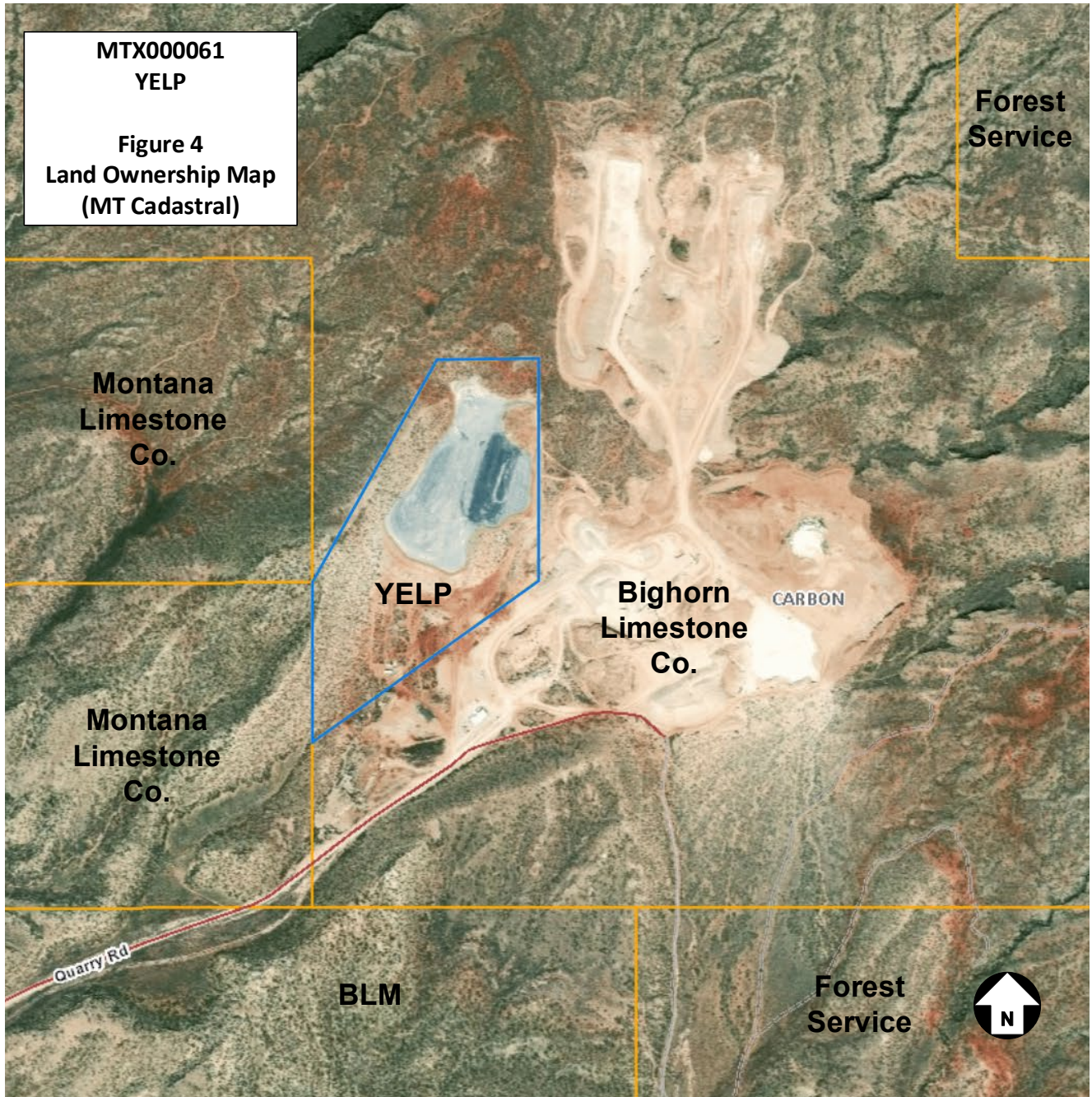
MTX000061
YELP

Figure 3
Facility Map
(2018 Application)

YELP Ash Landfill Site Plan



Base aerial photo from <http://svc.mt.gov/msl/mtcadastral/layout.aspx?8>



2.2 OPERATIONS

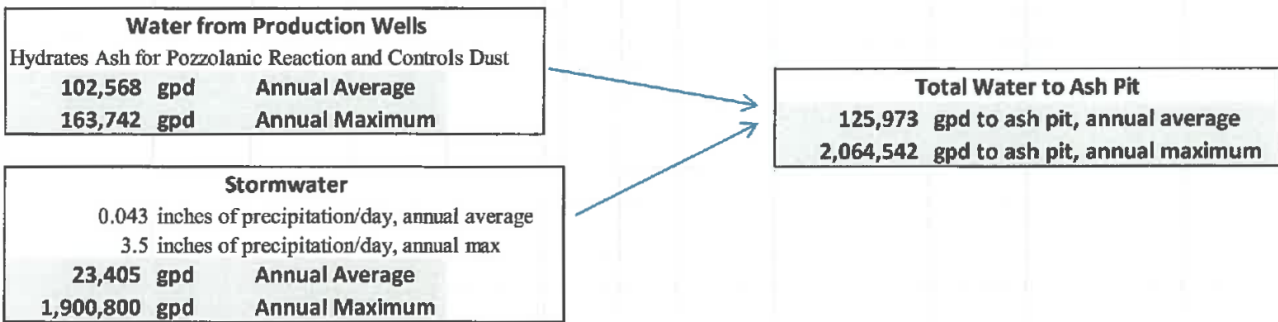
System operations are summarized in **Table 1**, and the water hydration line diagram is provided in **Figure 5**.

Table 1: Operations Summary
Collection
Contributing Sources of Wastewater: Industrial Standard Industrial Code(s) (SIC) of contributing sources: 2999-Petroleum Coke Fly Ash and Bottom Ash; generated from 4911-Electrical Services.
Treatment
None
Sampling/Monitoring
Ash: Combined fly ash and bottom ash samples are collected prior to hydration.
Disposal and Cementation Operation
Disposal Site: Outfall 001/Petroleum Coke Ash Monofill
Method of Disposal: Fly ash and bottom ash is a byproduct of the petroleum coke-fueled combustion process at the Yellowstone Energy Limited Partnership's electrical generating power plant in Billings. The ash is transported and deposited by truck on top of the existing monofill site that is located in the foothills of the Pryor Mountains, northeast of Warren. Each load of ash is hydrated with approximately 9,000 gallons of water by on-site water tender trucks. Hydration triggers the pozzolanic reaction of the ash's calcium hydroxide and siliceous/aluminous materials resulting in cementation.
Location: SE 1/4, Section 24, Township 08 South, Range 25 East NE 1/4, Section 25, Township 08 South, Range 25 East Carbon County Latitude: 45.12015°, Longitude: -108.60194°
Ash Disposal Rates: Design rate of 120,000 tons/year, with an average rate of 107,000 tons/year.

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Figure 5
Line Diagram
(2018 Application)

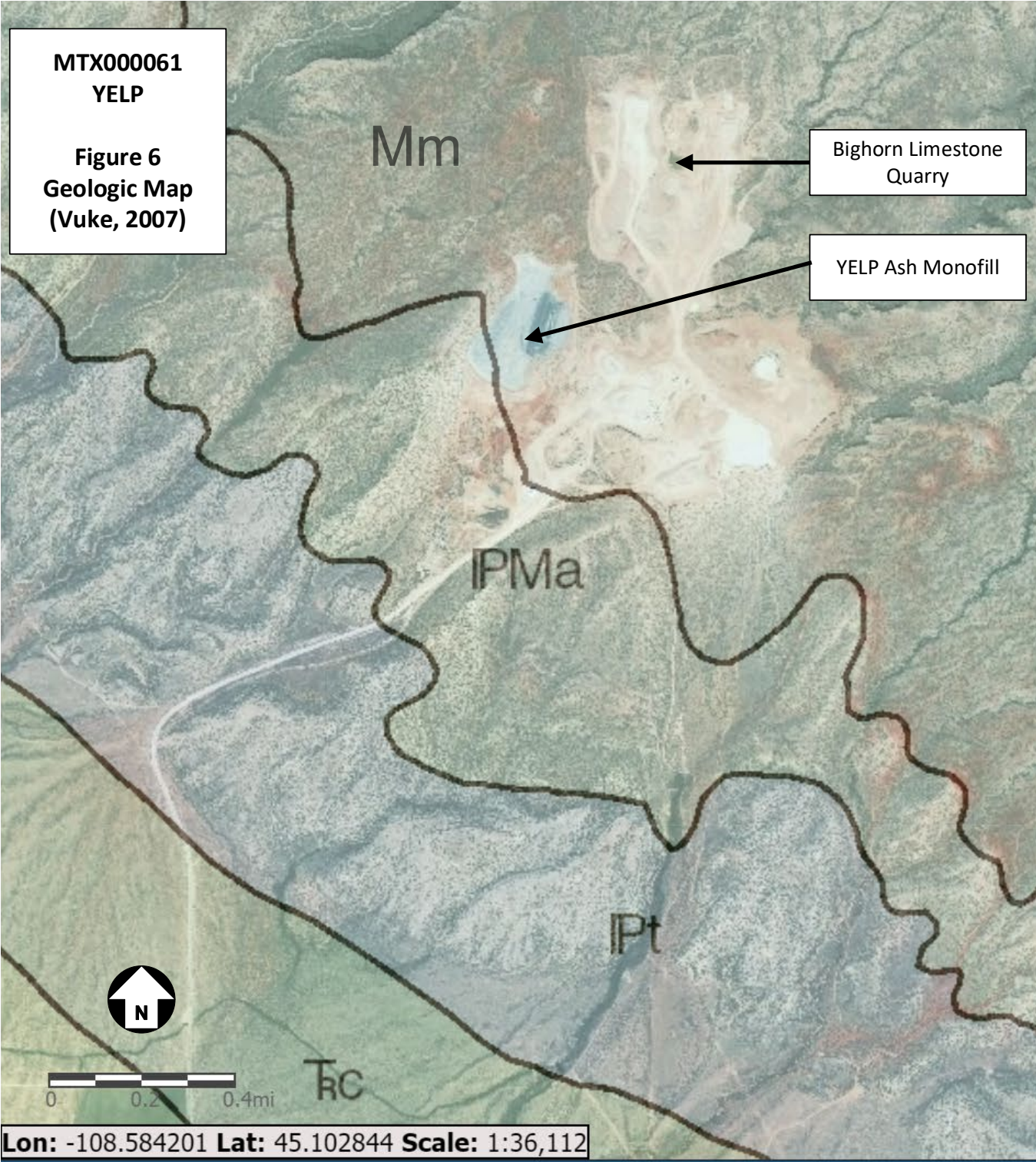
Line Drawing of Water Application at the YELP Ash Pit



2.3 GEOLOGY

The ash monofill is situated in the southwest foothills of the Pryor Mountains. The Pryor Mountains lie in the rain shadow cast by the Beartooth Mountains to the west. While topographically distinct from the Bighorn Mountains, the Pryor Mountains represent the northwest extension of the Bighorn structural uplift (Blackstone, 1975). The Pryor Mountains, formed by the erosion of uplifted limestone, began as large limestone blocks that were faulted and uplifted during the late Cretaceous period. Five tilted fault blocks compose the Pryor Mountains, with each block being uplifted highest at its northeast corner (Blackstone, 1975). Block boundaries include faults, and faulted or unfaulted folds (Van Gosen et al., 1996). The Pryor Mountains define a broad-topped uplift having steeply dipping or faulted flanks (Blackstone, 1940). The Tensleep Sandstone, Amsden Formation, and Madison Group are widely exposed on the crest of the uplift; steeply dipping Triassic and Jurassic rocks form the eastern flank (Mapel et al., 1975). The North Pryor (or Nye-Bowler lineament) fault abruptly terminates the uplift at its north end; the maximum displacement on this fault is 2,000 feet (Mapel et al., 1975). The surficial rocks on the southwest flanks of both the Big Pryor and East Pryor Mountain blocks dip gently to the southwest forming an incised dip slope. These slopes consist mainly of Madison Group and dip 5-8° southwesterly into the Bighorn basin (Van Gosen et al., 1996). The ash monofill site is located in this general area.

The ash monofill is in a small, steep (side slopes ranging from 10-70%) coulee incised into the Madison Formation (limestone and dolomitic limestone). The Amsden Formation (red shale and cherty to sandy limestone) starts near the base of the monofill trending to the southwest (down drainage) and overlying the Madison. The Madison Group in the vicinity of the ash monofill is 700 to 750 feet thick and forms cliffs and broad dip slopes on the flanks and crests of the Bighorn and Pryor Mountains (Mapel et al., 1975). The upper part of the Madison Group is the source of much of the high-purity limestone used in Montana (Chelini, 1965).



2.4 HYDROGEOLOGY

The Madison Group is the major water-bearing aquifer unit in the region (Keller, 2011). The ash monofill overlies the Madison aquifer on the southwest flank of the Pryor Mountains. The Madison aquifer is a heterogeneous and anisotropic fractured limestone aquifer deposited during the Mississippian subperiod of the Paleozoic era. Regional tectonics in the area has deformed the original depositional orientation of the strata in the area. The assumed recharge of Madison aquifer is from the area of the southwest Pryor Mountains (Envirocon, 1995).

Table 2: Hydrogeologic Site Information	
Mixing Zone	None. A discharge of pollutants to statewaters has not been authorized and is not expected.
Ground Water Flow Direction	Azimuth/bearing: S30°W Estimated using on-site well logs.
Geology	The Madison Formation (limestone and dolomitic limestone) underlies the region and serves as the basement for the ash monofill. The Amsden Formation (red shale and cherty to sandy limestone) starts near the base of the monofill trending to the southwest (down drainage) and overlying the Madison. Surficial alluvial and/or colluvial deposits cover most of the facility area.
Aquifer	The Madison Formation in and around the facility has a southwest strike and a 8° dip. This formation is the main source of groundwater in the region.
Water/Monitoring Well Construction	Ground water monitoring is representative of the shallow water bearing zone within the top portion of the Madison Formation. Facility production water wells are constructed deeper into the Madison Formation.
Thickness of Water Bearing Zones	The Madison Formation is estimated to generally be 700 to 750 feet thick. The Madison is overlain by the Amsden Formation immediately downgradient from the monofill. The Amsden is approximately 16 to 27 feet in and around the YELP field office.

2.5 HYDROLOGY

The only surface water in the area of the YELP ash monofill is Piney Creek located approximately one mile to the south-southeast (**Figure 2**). Piney Creek is fed from Piney Spring where ground water discharges at a rate of approximately 100-1,000 gallons per day (gpd); Piney Spring is the only significant aquifer discharge point on southwest flank of the Pryor Mountains (Envirocon, 1995).

2.6 GROUND WATER MONITORING WELLS AND UNDERDRAIN INFORMATION

There are two monitoring wells associated with this permit, MW-6 and MW-7. They are constructed to be representative of shallow ground water found in the top portion of the Madison Formation. There are also three production wells used for ash rehydration that are finished deeper into the Madison. A summary of these wells is provided in **Table 3**. The well locations are shown on **Figure 3**. Well construction diagrams and lithologic details are attached as **Appendix A**.

An underdrain was built into the incised coulee that serves as the basement of the monofill. The collection and monitoring point of the underdrain is located at the base of the lowest downgradient point of the monofill (**Figure 3**). The underdrain collection point serves as the convergence point for potential monofill permeate. A summary is provided in **Table 3**.

Maintenance requirements for these monitoring locations is discussed in **Section 6**.

Table 3: Underdrain and Ground Water Well Summary

Underdrain
Historic Permit Name: MW4A
Use: Monitoring
Permit Status: Active
Location: Located at the base of the ash monofill. Latitude: 45.11750 Longitude: -108.60432 Drain Elevation: 5,140 feet (ft)-Mean Sea Level (MSL)
Representation: Convergence point for potential monofill permeate. The monofill underdrain is actively monitored for signs of water.
Monitoring Well MW-6
Facility Name: BG-2
MBMG GWIC Id: Unassigned
Use: Monitoring of shallow ground water.
Permit Status: Active. Dry well conditions have been reported since 2016.
Location: Located in the ephemeral drainage, 635 ft downgradient and south of the monofill underdrain. Latitude: 45.11578 Longitude: -108.60477
Representation: The well as finished represents shallow ground water within the top reach of the Madison Formation. Unconfined conditions exist. Casing Measuring Point Elevation: 5,106.6 ft-MSL Height of Measuring Point: 2.5 ft above ground surface Static Water Level: Since 2016, dry conditions have been common with the water table lower than 117 ft-below ground surface (ft-bgs). Prior to this the water table was on average 104 ft-bgs (4,999 ft-MSL) with a high of 86 ft-bgs (5,017 ft-MSL). Total Depth Elevation: 117 ft-bgs (4,986 ft-MSL)
Monitoring Well: MW-7
Facility Name: BG-3
MBMG GWIC Id: Unassigned
Use: Monitoring of shallow ground water.
Permit Status: Active. An obstruction preventing access to the shallow water table was reported on September of 2018. From September of 2017 through 2018, only one sample has been collected.
Location: Located above the ephemeral drainage, 540 ft sidegradient and east of the monofill underdrain. Latitude: 45.11750 Longitude: -108.60222
Representation: The well as finished represents shallow ground water within the top portion of the Madison Formation. Unconfined conditions exist. Casing Measuring Point Elevation: 5,213.6 ft-MSL Height of Measuring Point: 3.3 ft above ground surface Static Water Level Elevation: A recent obstruction has prevented continual measurements. Earlier monitoring of the water table was on average 177 ft-bgs (5,033 ft-MSL) with a high of 160 ft-bgs (5,050 ft-MSL). Total Depth Elevation: 195 ft-bgs (5,015 ft-MSL)
Water Well: BG-4
Historic Permit Name: MW1A (manifolded with BG-5)
MBMG GWIC id: 149359
Use: On-site water production for ash rehydration. Permit sampling requirements were discontinued in 2013.
Facility Status: Active. Constructed on May 04, 1995
Location: Located next to the YELP field office, in the ephemeral drainage downgradient and approximately 490 ft south of the monofill underdrain. Latitude: 45.11618 Longitude: -108.60413
Representation: Confined. The well is finished 120 to 220 ft into the Madison Formation that underlies the Amsden Formation and surficial colluvial and alluvial deposits. Surface Elevation: 5,117 ft-MSL Static Water Level Elevation: 5,020 ft-MSL Completion/Perforation Elevation: 4,898-4,998 ft-MSL (TD: 220 ft-bgs)

Table 3: Underdrain and Ground Water Well Summary - Continued
Water Well: BG-5
Historic Permit Name: MW1A (manifolded with BG-4)
MBMG GWIC id: 158427
Use: On-site water production for ash rehydration. Permit monitoring requirements were discontinued in 2013.
Facility Status: Active. Constructed on June 28, 1996
Location: Located in-between the YELP field office and the underdrain, in the ephemeral drainage downgradient and approximately 280 ft south of the monofill underdrain. Latitude: 45.11672 Longitude: -108.60439
Representation: Confined. The well is finished 160 to 230 ft into the Madison Formation that underlies the Amsden Formation and shallow colluvial and alluvial deposits. Surface Elevation: 5,124 ft-MSL Static Water Level Elevation: 5,044 ft-MSL Completion/Perforation Elevation: 4,895-4,964 ft-MSL (TD: 230 ft-bgs)
Water Well: 2002 YELP Well
MBMG GWIC id: 195710
Use: On-site water production for ash rehydration. No permit monitoring requirements.
Facility Status: Active. Constructed on March 09, 2002.
Location: Located near MW-6, in the ephemeral drainage downgradient of the monofill, approximately 730 ft southwest of the underdrain. Latitude: 45.11547 Longitude: -108.60498
Representation: Confined. The well is finished 140 to 220 ft into the Madison Formation that underlies the Amsden Formation and shallow colluvial and alluvial deposits. Surface Elevation: 5,102 ft-MSL (TD: 220 ft-bgs) Static Water Level Elevation: 4,975 ft-MSL Completion/Perforation Elevation: 4,882-4,962 ft-MSL
Water Well: Big Horn Limestone Wells
MBMG Names and GWIC Ids: Big Horn Limestone Well (274484) Montana Limestone Co. Well (161427, 204598, 285956) Weaver Construction Well (105566, 8042)
Permit Use: None. The permit monitoring requirements for 274484 were discontinued in 2013.
Status: Well 285956 was installed in 2015 and is currently being used by the new quarry office building. Well 274484 was abandoned on June 14, 2013 to make way for the new building. Well 105566 and 8042 have incomplete records and may be the same well. Status of the other wells are unknown.
Location: The wells are located around the neighboring quarry building complex located approximately 1,000 ft southeast of the monofill underdrain.
Representation: The wells are finished in the Madison Formation.
Name: Piney Spring
Historic Permit Name: MW3A
MBMG GWIC id: 215249
Permit Use: Inactive
Status: Perennial flowing spring. Permit monitoring requirements were discontinued in 2013.
Location: Located in the piney creek drainage, 4,900 ft to the southeast of the monofill underdrain. Latitude: 45.10579 Longitude: -108.59487 Spring Elevation: 5,020 ft-MSL
Representation: Potential ground water drainage from the Madison Formation. A high volume spring flowing at approximately 100-1000 gpm.

2.7 MONITORING INFORMATION

The permittee monitored and reported the characteristics of ash, underdrain, and shallow ground water during the 2013 permit cycle. A summary of the monitoring efforts are provided in **Table 4**. Side-by-side sample results are provided in **Table 5**. Additional statistical information on ground water sampling results are also provided in **Appendix B**.

Table 4: Monitoring Information	
Monitor Source	Representation
Ash	Combined fly ash and bottom ash samples were collected prior to hydration. The results are provided in Table 5. The 2013 permit required annual ash spectrometry (EPA Method 6010C) and ash extraction sampling (ASTM D3987-06). The period of record is from September 2013 through December 2018. Two additional ash spectrometry samples (Method 6010B) were submitted with application materials.
Underdrain	The 2013 permit required quarterly monitoring of the underdrain located at the base of the ash monofill. The permittee reported no discharge for all monitoring events during the period of record from September 2013 through December 2018. DEQ will require individual observation records be maintained in the next permit cycle. An on-site visit by DEQ on 10/10/2017 documented no indications of water moving through or accumulating at or around the underdrain.
Ground Water MW-6	The permit requires quarterly downgradient monitoring of the shallow ground water table. Sample data is not available from January 2016 through December 2018 (except 2nd quarter of 2018). The permittee has indicated that these no sample events were a result of dry well conditions. The period of record is from September 2013 through December 2018. The permit requires the permittee to maintain viable monitoring wells for the purpose of collecting long-term ground water samples. Special conditions have been established to address the dry/obstructed well conditions (Section 6). Nondetect (ND) levels are displayed for the parameters with unknown laboratory reporting levels.
Ground Water MW-7	The permit requires quarterly downgradient monitoring of the shallow ground water table. Sample data is not available during: the first and fourth quarter of 2017; and the first, third, and fourth quarter of 2018. The permittee has indicated that these no sample events were a result of dry well conditions. On September 10, 2018, the permittee reported a failure with their pump equipment which may have resulted in an obstructed well. The period of record is from September 2013 through December 2018. The permit requires the permittee to maintain viable monitoring wells for the purpose of collecting representative ground water samples. Special conditions have been established to address the dry/obstructed well conditions (Section 6). Nondetect (ND) levels are displayed for the parameters with unknown laboratory reporting levels.

Table 5: Sample Results

Analyte/Measurement	units	Ash	Underdrain	Ground Water		Ground Water Human Health Standard
		ASTM D3987-06 EPA Method 6010B EPA Method 6010C EPA Method 6020		MW-6	MW-7	
		average		average	average	
Alkalinity, Total [as CaCO ₃]	mg/L	2354	dry	191	175	
Bicarbonate [as HCO ₃]	mg/L	ND	dry	233	212	
Carbonate [as CO ₃]	mg/L	83.4	dry	ND	ND	
Chloride [as Cl]	mg/L	411	dry	1	1	
Specific Conductivity @ 25°C	µS/cm	10940	dry	403	340	
Hardness, Total [as CaCO ₃]	mg/L	4408	dry	226	190	
Hydroxide [as OH]	mg/L	753	dry	ND	ND	
Nitrogen, Nitrite + Nitrate Total [as N]	mg/L		dry			
Nitrogen, Total [as N]	mg/L	ND		0.61	0.66	
Oil & Grease	mg/L					
pH	s.u.	12.3	dry	7.69	7.76	
Phosphorus [as P ₂ O ₅]	% by weight	0.017				
Solids, total dissolved [TDS]	mg/L			226	186	
Solids, total suspended	mg/L		dry			
Sulfate [as S]	mg/L	1925				
Sulfate, Total [as SO ₄]	mg/L		dry	25	7	
Sulfur, Total	% by weight	NR				
Sulfur [as SO ₃]	% by weight	11.8				
Sulfur [as SO ₄]	% by weight	NR				
Temperature	°C					
Well depth	ft-bmp					
Total production - mass	tons/year	107765				
Static Water Level (SWL)	ft-bmp					
Static Water Level (SWL)	ft-MSL			dry up to 5,017	5034	
Aluminum, Total [as Al]	mg/L					
Aluminum [as Al ₂ O ₃]	% by weight	0.52				
Arsenic, Total [as As]	mg/L	<0.0005	dry	ND	ND	0.010
Barium, Total [as Ba]	mg/L	29.5	dry	ND	0.1	1.0
Barium [as BaO]	% by weight	0.004				
Cadmium, Total [as Cd]	mg/L	ND	dry	ND	ND	
Calcium, Total [as Ca]	mg/L	1760	dry	57	50	
Calcium [as CaO]	% by weight	45.5				
Chromium, Total [as Cr]	mg/L					0.10
Copper, Total [as Cu]	mg/L					1.3
Iron, Total [as Fe]	mg/L					
Iron [as Fe ₂ O ₃]	% by weight	0.33				
Lead, Total [as Pb]	mg/L	ND	dry	ND	ND	
Magnesium, Total [as Mg]	mg/L	<0.005	dry	20	16	
Magnesium [as MgO]	% by weight	0.29				
Manganese, Total [as Mn]	mg/L					
Manganese [as MnO ₂]	% by weight	0.06				
Mercury, Total [as Hg]	mg/L	ND	dry	ND	ND	0.000005
Molybdenum, Total [as Mo]	mg/L	24	dry	ND	ND	
Nickle, Total	mg/L					
Potassium, Total [as K]	mg/L	ND				
Potassium [as K ₂ O]	% by weight	0.097				
Selenium, Total [as Se]	mg/L	0.02	dry	ND	ND	
Silicon [as SiO ₂]	% by weight	0.075				
Silver, Total [as Ag]	mg/L	ND				
Sodium, Total [as Na]	mg/L	6.9	dry	1	1	
Sodium [as Na ₂ O]	% by weight	0.043				
Strontium, Total [as Sr]	mg/L	119.5	dry	0.03	ND	4.0
Strontium [as SrO]	% by weight	0.011				
Titanium [as TiO ₂]	% by weight	0.0084				
Vanadium, Total [as V]	mg/L	988.5	dry	ND	ND	
Zinc, Total [as Zn]	mg/L	18.5	dry	ND	ND	2.0

Footnotes:

Supplemental sampling information provided in Appendix B.

ft-bmp: feet below measuring point

MSL: mean sea level

s.u.: standard units

2.8 FUGITIVE DUST CONTROL

The 1991 Permit and Environmental Assessment identified ash hauling and disposal as a potential impact on the physical environment. The DEQ precursor agency (Department of Health and Environmental Sciences) therefore required mitigation measures in the form of BMPs to control fugitive dust emissions. During a site visit in 2017, DEQ confirmed that the permittee is still actively using BMPs (DEQ, 2017). DEQ will continue to require dust control as a permit condition.

2.9 EROSION CONTROL

The 1991 Permit established permit requirements for the active control of on-site erosion and sedimentation. DEQ will continue these BMP requirements.

2.10 REHABILITATION

The 1991 Permit and Environmental Assessment identified the potential long term impacts of creating an ash monofill. The permittee must create and maintain plans for rehabilitation procedures prior to the creation of an additional monofill, or the major modification of the existing monofill. The design and implementation of rehabilitation procedures must include the placement of a surficial soil cap and the establishment of a native vegetation community. Post-rehabilitation requirements include: ground water and surface water monitoring, erosion control measures, and the successful establishment of a native vegetative cover. Post-rehabilitation monitoring shall be continued until approved and terminated by DEQ.

3.0 WATER QUALITY STANDARDS

The Montana Numeric Water Quality Standards Circular DEQ-7 document includes the Ground Water Human Health Standards associated with development of this permit. These standards are respectively listed in **Table 5** for each analyte as applicable. The standards along with long-term ash and ground water monitoring, research, and additional regulations (see **References**) were used by DEQ to reanalyze the POIs for this permit. The updated POIs are listed in **Table 6**. The POIs are used within the monitoring requirements of **Section 5**.

Table 6: Parameters of Interest
Analyte
Chloride [as Cl]
Specific Conductivity @ 25°C
Hydroxide [as OH]
pH
Solids, total dissolved [TDS]
Sulfate, Total [as SO ₄]
Sulfur, Total
Sulfur [as SO ₃]
Sulfur [as SO ₄]
Aluminum, Total [as Al]
Aluminum [as Al ₂ O ₃]
Arsenic, Total [as As]
Barium, Total [as Ba]
Barium [as BaO]
Chromium, Total [as Cr]
Copper, Total [as Cu]
Iron, Total [as Fe]
Iron [as Fe ₂ O ₃]
Manganese, Total [as Mn]
Manganese [as MnO ₂]
Mercury, Total [as Hg]
Molybdenum, Total [as Mo]
Strontium, Total [as Sr]
Strontium [as SrO]
Vanadium, Total [as V]
Zinc, Total [as Zn]

4.0 MIXING ZONE

A mixing zone has not been established as discharge of pollutants to state waters is not authorized under this permit.

5.0 MONITORING AND REPORTING REQUIREMENTS

In compliance with the Montana Water Quality Act, ash, underdrain, and ground water monitoring will be continued as a condition of this permit. A discharge of pollutants to state waters is not authorized. This is not a traditional facility with end-of-pipe discharge structures that direct wastewater into state waters, but rather an ash monofill (**Section 2**). Therefore, last-point of control wastewater limitations are not feasible for this facility. DEQ will continue the monitoring requirements first established in 1991 to characterize the ash, and to monitor for any potential leaching.

All monitoring and sampling required by this permit must be representative of the nature of the monitored media. The permit therefore identifies specific monitoring locations (**Table 3**), and requires monitoring SOPs that are based on BMPs (**Section 6**).

Reporting requirements have been adjusted to collect and analyze:

- Operational status information;
- Non-detect and low-detection sample results;
- Dry-well monitoring well conditions; and,
- Underdrain observations.

Monitoring and reporting requirements are provided in **Table 7, Table 8, Table 9, and Table 10**.

Table 7: Ash Sampling Requirements - Combined Coke Fly Ash and Bottom Ash

Sampling Location: Prior to Hydration and Disposal

Sampling Frequency: Annually

Required Laboratory Method: ASTM D3987-06 for all parameters except EPA Method 6010C for the % by weight measurements⁽¹⁾

Ash Reporting Requirements⁽²⁾

Cumulative Record of all Individual Sample Results through Term of the Current Permit Cycle

Statistical Summary Report of all Individual Results through Term of the Current Permit Cycle⁽³⁾

Report Action Date: To be Updated Annually on January 1st through the Term of the Permit Cycle.

Each Annual Report must be received by DEQ on or before January 28th.

Analyte/Measurement	Units	Individual Sample Record (Repeat as Necessary)							Permit Cycle Statistical Summary						
		Sample Collection Date	Operational during sampling period? (y/n)	Lab Result ⁽⁴⁾	Laboratory Reporting Level	Non-Detect? (y/n)	Laboratory Method	Laboratory Qualifier Code(s) ⁽⁵⁾	Count of Samples Collected	Lab Results				Count of Non-detects	Average Laboratory Reporting Level
										Minimum	Average	Median	Maximum		
Chloride [as Cl]	mg/L														
Specific Conductivity @ 25°C	µS/cm														
Hydroxide [as OH]	mg/L														
pH	s.u.														
Solids, total dissolved [TDS]	mg/L														
Sulfate, Total [as SO ₄]	mg/L														
Sulfur, Total	% by weight														
Sulfur [as SO ₃]	% by weight														
Sulfur [as SO ₄]	% by weight														
Total production - mass	tons/year														
Aluminum, Total [as Al]	mg/L														
Aluminum [as Al ₂ O ₃]	% by weight														
Arsenic, Total [as As]	mg/L														
Barium, Total [as Ba]	mg/L														
Barium [as BaO]	% by weight														
Chromium, Total [as Cr]	mg/L														
Copper, Total [as Cu]	mg/L														
Iron, Total [as Fe]	mg/L														
Iron [as Fe ₂ O ₃]	% by weight														
Manganese, Total [as Mn]	mg/L														
Manganese [as MnO ₂]	% by weight														
Mercury, Total [as Hg]	mg/L														
Molybdenum, Total [as Mo]	mg/L														
Strontium, Total [as Sr]	mg/L														
Strontium [as SrO]	% by weight														
Vanadium, Total [as V]	mg/L														
Zinc, Total [as Zn]	mg/L														

Footnotes:

s.u.: standard units

Submittal of reports will be required regardless of the operational status of the facility.

(1) The listed laboratory analytical methods must be used unless written approval by DEQ is received.

(2) The permittee may create their own report in a format that suits their operational and reporting needs. It must however contain all data inputs as shown above and in the respective permit condition.

All submitted data must be in a digital format and the report must be queryable (e.g. excel table). Report submittals directly to the MGWPCS Program Lead via email will be accepted.

(3) Each submitted report must cumulate all samples collected to date, starting with the permit effective date and continuing through the term of the permit.

(4) For nondetects, the laboratory reporting level must be entered in as the respective lab result.

(5) Laboratory qualifiers are not common, leave blank if none. Attach a description of all listed codes if any.

Table 8: Underdrain Monitoring Requirements

Sampling Frequency: Quarterly

Required Laboratory Method: 40 CFR 136⁽¹⁾

Underdrain Reporting Requirements⁽²⁾

Cumulative Record of all Individual Observation and Sampling Results through Term of the Current Permit Cycle

Statistical Summary Report of all Individual Results through Term of the Current Permit Cycle⁽³⁾

Report Action Date: To be Updated Annually on January 1st through the Term of the Permit Cycle.

Each Annual Report must be received by DEQ on or before January 28th.

Analyte/Measurement	Units	Individual Observation Record (Repeat as Necessary)			Individual Sample Record (Repeat as Necessary)						Permit Cycle Statistical Summary							
		Observation Date	Dry Underdrain Conditions? (y/n)	Monitoring Observation Notes ⁽⁴⁾⁽⁵⁾	Sample Collection Date	Lab Result ⁽⁶⁾	Laboratory Reporting Level	Non-Detect? (y/n)	Laboratory Method	Laboratory Qualifier Code(s) ⁽⁷⁾	Count of Samples Collected	Count of Dry Underdrain Occurrences	Lab Results				Count of Non-detects	Average Laboratory Reporting Level
													Minimum	Average	Median	Maximum		
Chloride [as Cl]	mg/L																	
Specific Conductivity @ 25°C	µS/cm																	
Hydroxide [as OH]	mg/L																	
pH	s.u.																	
Solids, total dissolved [TDS]	mg/L																	
Sulfate, Total [as SO ₄]	mg/L																	
Sulfur, Total	% by weight																	
Sulfur [as SO ₃]	% by weight																	
Sulfur [as SO ₄]	% by weight																	
Temperature	°C																	
Aluminum, Total [as Al]	mg/L																	
Aluminum [as Al ₂ O ₃]	% by weight																	
Arsenic, Total [as As]	mg/L																	
Barium, Total [as Ba]	mg/L																	
Barium [as BaO]	% by weight																	
Chromium, Total [as Cr]	mg/L																	
Copper, Total [as Cu]	mg/L																	
Iron, Total [as Fe]	mg/L																	
Iron [as Fe ₂ O ₃]	% by weight																	
Manganese, Total [as Mn]	mg/L																	
Manganese [as MnO ₂]	% by weight																	
Mercury, Total [as Hg]	mg/L																	
Molybdenum, Total [as Mo]	mg/L																	
Strontium, Total [as Sr]	mg/L																	
Strontium [as SrO]	% by weight																	
Vanadium, Total [as V]	mg/L																	
Zinc, Total [as Zn]	mg/L																	

Footnotes:

s.u.: standard units

Monitoring and Reporting will be required regardless of the operational status of the facility or of the condition of the underdrain. Footnote 5 further discusses sample requirements.

(1) The listed laboratory analytical method must be used unless written approval by DEQ is received.

(2) The permittee may create their own report in a format that suits their operational and reporting needs. It must however contain all data inputs as shown above and in the respective permit condition.

All submitted data must be in a digital format and the report must be queryable (e.g. excel table). Report submittals directly to the MGWPCS Program Lead via email will be accepted.

(3) Each submitted report must cumulate all observations and samples collected to date, starting with the permit effective date and continuing through the term of the permit.

(4) Provide a summary of field note observations for each individual monitoring event. The notes must provide site-specific reasoning as to how dry or wet underdrain conditions were determined.

(5) If wet underdrain conditions are observed, the permittee must determine and document whether this water originated from under the monofill or from another source. A sample is only required if the water originated from under the monofill.

(6) For nondetects, the laboratory reporting level must be entered in as the respective lab result.

(7) Laboratory qualifiers are not common, leave blank if none. Attach a description of all listed codes if any.

Table 9: Ground Water Monitoring Requirements for MW-6

Sampling Frequency: Quarterly

Required Laboratory Method: 40 CFR 136⁽¹⁾

Ground Water Reporting Requirements⁽²⁾

Cumulative Record of all Individual Monitoring and Sample Results through Term of the Current Permit Cycle

Statistical Summary Report of all Individual Results through Term of the Current Permit Cycle⁽³⁾

Report Action Date: To be Updated Annually on January 1st through the Term of the Permit Cycle.

Each Annual Report must be received by DEQ on or before January 28th.

Analyte/Measurement	Units	Individual Sample Record (Repeat as Necessary)							Permit Cycle Statistical Summary							
		Sample Collection Date	Dry-Well Conditions? (y/n)	Lab Result ⁽⁴⁾	Laboratory Reporting Level	Non-Detect? (y/n)	Laboratory Method	Laboratory Qualifier Code(s) ⁽⁵⁾	Count of Samples Collected	Count of Dry-Well Occurrences	Lab Results				Count of Non-detects	Average Laboratory Reporting Level
											Minimum	Average	Median	Maximum		
Chloride [as Cl]	mg/L															
Specific Conductivity @ 25°C	µS/cm															
Hydroxide [as OH]	mg/L															
pH	s.u.															
Solids, total dissolved [TDS]	mg/L															
Sulfate, Total [as SO ₄]	mg/L															
Sulfur, Total	% by weight															
Sulfur [as SO ₃]	% by weight															
Sulfur [as SO ₄]	% by weight															
Temperature	°C															
Well depth	ft-bmp															
Static Water Level (SWL)	ft-bmp															
Static Water Level (SWL)	ft-MSL															
Aluminum, Total [as Al]	mg/L															
Aluminum [as Al ₂ O ₃]	% by weight															
Arsenic, Total [as As]	mg/L															
Barium, Total [as Ba]	mg/L															
Barium [as BaO]	% by weight															
Chromium, Total [as Cr]	mg/L															
Copper, Total [as Cu]	mg/L															
Iron, Total [as Fe]	mg/L															
Iron [as Fe ₂ O ₃]	% by weight															
Manganese, Total [as Mn]	mg/L															
Manganese [as MnO ₂]	% by weight															
Mercury, Total [as Hg]	mg/L															
Molybdenum, Total [as Mo]	mg/L															
Strontium, Total [as Sr]	mg/L															
Strontium [as SrO]	% by weight															
Vanadium, Total [as V]	mg/L															
Zinc, Total [as Zn]	mg/L															

Footnotes:
ft-bmp: feet below measuring
ft-MSL: feet above mean sea
s.u.: standard units
Monitoring and Reporting will be required regardless of the operational status of the facility or of the condition of the monitoring well.
(1) The listed laboratory analytical method must be used unless written approval by DEQ is received.
(2) The permittee may create their own report in a format that suits their operational and reporting needs. It must however contain all data inputs as shown above and in the respective permit condition.
All submitted data must be in a digital format and the report must be queryable (e.g. excel table). Report submittals directly to the MGWPCS Program Lead via email will be accepted.
(3) Each submitted report must cumulate all monitoring events and samples collected to date, starting with the permit effective date and continuing through the term of the permit.
(4) For nondetects, the laboratory reporting level must be entered in as the respective lab result.
(5) Laboratory qualifiers are not common, leave blank if none. Attach a description of all listed codes if any.

Table 10: Ground Water Monitoring Requirements for MW-7

Sampling Frequency: Quarterly

Required Laboratory Method: 40 CFR 136⁽¹⁾

Ground Water Reporting Requirements⁽²⁾

Cumulative Record of all Individual Monitoring and Sample Results through Term of the Current Permit Cycle

Statistical Summary Report of all Individual Results through Term of the Current Permit Cycle⁽³⁾

Report Action Date: To be Updated Annually on January 1st through the Term of the Permit Cycle.

Each Annual Report must be received by DEQ on or before January 28th.

Analyte/Measurement	Units	Individual Sample Record (Repeat as Necessary)							Permit Cycle Statistical Summary							
		Sample Collection Date	Dry-Well Conditions? (y/n)	Lab Result ⁽⁴⁾	Laboratory Reporting Level	Non-Detect? (y/n)	Laboratory Method	Laboratory Qualifier Code(s) ⁽⁵⁾	Count of Samples Collected	Count of Dry-Well Occurrences	Lab Results				Count of Non-detects	Average Laboratory Reporting Level
											Minimum	Average	Median	Maximum		
Chloride [as Cl]	mg/L															
Specific Conductivity @ 25°C	µS/cm															
Hydroxide [as OH]	mg/L															
pH	s.u.															
Solids, total dissolved [TDS]	mg/L															
Sulfate, Total [as SO ₄]	mg/L															
Sulfur, Total	% by weight															
Sulfur [as SO ₃]	% by weight															
Sulfur [as SO ₄]	% by weight															
Temperature	°C															
Well depth	ft-bmp															
Static Water Level (SWL)	ft-bmp															
Static Water Level (SWL)	ft-MSL															
Aluminum, Total [as Al]	mg/L															
Aluminum [as Al ₂ O ₃]	% by weight															
Arsenic, Total [as As]	mg/L															
Barium, Total [as Ba]	mg/L															
Barium [as BaO]	% by weight															
Chromium, Total [as Cr]	mg/L															
Copper, Total [as Cu]	mg/L															
Iron, Total [as Fe]	mg/L															
Iron [as Fe ₂ O ₃]	% by weight															
Manganese, Total [as Mn]	mg/L															
Manganese [as MnO ₂]	% by weight															
Mercury, Total [as Hg]	mg/L															
Molybdenum, Total [as Mo]	mg/L															
Strontium, Total [as Sr]	mg/L															
Strontium [as SrO]	% by weight															
Vanadium, Total [as V]	mg/L															
Zinc, Total [as Zn]	mg/L															

Footnotes:

ft-bmp: feet below measuring

ft-MSL: feet above mean sea level

s.u.: standard units

Monitoring and reporting will be required regardless of the operational status of the facility or of the condition of the monitoring well.

(1) The listed laboratory analytical method must be used unless written approval by DEQ is received.

(2) The permittee may create their own report in a format that suits their operational and reporting needs. It must however contain all data inputs as shown above and in the respective permit condition.

All submitted data must be in a digital format and the report must be queryable (e.g. excel table). Report submittals directly to the MGWPCS Program Lead via email will be accepted.

(3) Each submitted report must cumulate all monitoring events and samples collected to date, starting with the permit effective date and continuing through the term of the permit.

(4) For nondetects, the laboratory reporting level must be entered in as the respective lab result.

(5) Laboratory qualifiers are not common, leave blank if none. Attach a description of all listed codes if any.

6.0 PERMIT CONDITIONS

6.1 LIMITATIONS

A discharge of pollutants to state waters is not authorized. Monitoring rationale is provided in **Section 5**.

6.2 SPECIAL CONDITIONS - GROUND WATER MONITORING, ANALYSIS, AND REPORTING PLAN

The permittee is required to use BMPs in developing SOPs for sampling, analyzing, and reporting of ground water. The plan needs to be site-specific and result in monitoring and reporting that is representative of the nature of shallow ground water. The plan will need to provide for consistent identification, development, monitoring, sampling, recording, calculating, and reporting of the monitoring wells. The plan will also need to provide for guidance on determining and documenting dry-well occurrences.

The completion and submittal dates for the plan are listed in **Table 11**. The permittee will need to maintain the plan, monitoring well development records, and dry well occurrence records on-site at all times (representative sample). Ground water monitoring requirements are further discussed in **Section 5**.

6.3 SPECIAL CONDITIONS - UNDERDRAIN MONITORING, ANALYSIS, AND REPORTING PLAN

The permittee is required to use BMPs in developing SOPs for monitoring, analyzing, and reporting of the underdrain. The plan needs to be site-specific and result in monitoring and reporting that is representative of the nature of the convergence point for potential monofill permeate. The plan will need to provide for consistent identification, monitoring, recording, and reporting of the underdrain.

The completion and submittal dates for the plan are listed in **Table 11**. The permittee will need to maintain the plan and underdrain monitoring records on-site at all times. Underdrain monitoring requirements are further discussed in **Section 5**.

6.4 SPECIAL CONDITIONS - MONITORING WELL INSTALLATION

DEQ received reports from the permittee in regards to dry well conditions at the existing MW-6 monitoring well, and an obstruction within the MW-7 monitoring well. After a reanalysis of current shallow ground water conditions, DEQ will require the replacement and deepening of these wells in order to best ensure long-term monitoring and data collection.

The permittee is required to submit a report documenting their proposed monitoring well installation and construction plans. The report must be received and approved by DEQ prior to construction. Unless otherwise approved by DEQ, the wells shall be constructed as follows:

- The MW-6 replacement well must be located in the immediate vicinity of the existing 1993 well and be constructed to represent shallow ground water from 90 to 160 feet below ground surface (ft-bgs). Perforated inner casing must be installed from total depth to approximately 95 ft-bgs and be supported with centralizers. An accompanying sand filter pack must be installed from total depth to approximately 90 ft-bgs. A bentonite seal must be placed from the top of the sand pack to ground surface. The inner casing shall be protected with a lockable riser casing. Well identification markings shall be kept on the underside of the riser casing cap.

- The MW-7 replacement well shall be located in the immediate vicinity of the existing 1993 well and be constructed to represent shallow ground water from 160 to 220 ft-bgs. Perforated inner casing must be installed from total depth to approximately 165 ft-bgs and be supported with centralizers. An accompanying sand filter pack must be installed from total depth to approximately 160 ft-bgs. A bentonite seal must be placed from the top of the sand pack to ground surface. The inner casing shall be protected with a lockable riser casing. Well identification markings shall be kept on the underside of the riser casing cap.

The permittee is required to submit a final written report documenting the installation of the MW-6 and MW-7 replacement monitoring wells. The report must include: drilling methods used; detailed lithologic description of borehole cuttings; the saturation level of the cuttings; well construction details and diagrams; water level measuring point details; surveyed ground surface locations; surveyed water level measuring point elevation; depth to the top contact of the first saturated ground water bearing zone; well development records; and depth to static water levels (post development). This information must be included for each respective monitoring well. The detail of the lithology description must be similar to the 1993 well logs created by Envirocon (**Appendix A**).

Upon approval by DEQ, the permittee shall commence monitoring of the MW-6 and MW-7 replacement wells and discontinue monitoring of the 1993 wells.

The planning, installation, reporting, and commencement due dates are listed in **Table 11**.

6.5 SPECIAL CONDITIONS – SAMPLING LOCATION MAINTENANCE

The permittee is required to maintain and, if necessary, rehabilitate the underdrain (MW4A) for the purposes of collecting samples representative of any potential monofill permeate.

The permittee is required to monitor and collect representative ground water samples from the shallow aquifer located in the upper portion of the Madison Formation. If any of the monitoring wells are abandoned, destroyed, decommissioned, or non-viable; or are no longer able to be sampled due to obstructions or fluctuations in the ground water table; the permittee shall install (or rehab) a new well to replace the abandoned, destroyed, decommissioned, or non-viable well(s).

COMPLIANCE SCHEDULE

The actions listed in **Table 11** must be completed on or before the respective scheduled completion date. A report documenting each respective action must be received by DEQ on or before the scheduled reporting date. Unless otherwise states, completion of all actions or deliverables must be reported to DEQ in accordance with Part II.D and Part IV.G of the permit.

Table 11: Compliance Schedule			
Action	Freq.	Scheduled Completion Date of Action⁽¹⁾	Scheduled Report Due Date.⁽²⁾
Develop and implement a site-specific Ground Water Monitoring, Analysis, and Reporting Plan. ⁽³⁾	Single event	<i>Within 180 days of the effective date of the permit.</i>	<i>Due on or before the 28th day of the month following the completion date.</i>
Develop and implement a site-specific Underdrain Monitoring, Analysis, and Reporting Plan. ⁽³⁾	Single event	<i>Within 180 days of the effective date of the permit.</i>	<i>Due on or before the 28th day of the month following the completion date.</i>
Continue monitoring of the 1993 MW-6 and MW-7 monitoring wells. ⁽⁴⁾	-	<i>Upon the effective date of the permit.</i>	
Complete a Monitoring Well Installation Plan for the replacement of the MW-6 and MW-7 wells. ⁽³⁾	Single event	<i>Within 90 days of the effective date of the permit.</i>	<i>Due on or before the 28th day of the month following the completion date.</i>
Complete the installation of the replacement MW-6 and MW-7 monitoring wells.	Single event	<i>Within one (1) year of the effective date of the permit.</i>	<i>Due on or before the 28th day of the month following the completion date.</i>
Submit Monitoring Well Installation Report for the MW-6 and MW-7 replacement monitoring wells. ⁽³⁾	Single event	<i>Within 13 months of the effective date of the permit.</i>	<i>Due on or before the 28th day of the month following the completion date.</i>
Commence monitoring and reporting of the newly installed MW-6 and MW-7 monitoring wells.	Single event	<i>Within 13 months of the effective date of the permit.</i>	<i>Due on or before the 28th day of the month following the completion date.</i>
Submit Annual Ground Water Monitoring Reports. ⁽⁵⁾	Annually	<i>At the end of each calendar year through term of permit.</i>	<i>Annually on January 28th.</i>
Submit Annual Underdrain Monitoring Reports. ⁽⁵⁾	Annually	<i>At the end of each calendar year through term of permit.</i>	<i>Annually on January 28th.</i>
Submit Annual Ash Sampling Reports. ⁽⁵⁾	Annually	<i>At the end of each calendar year through term of permit.</i>	<i>Annually on January 28th.</i>
Footnotes:			
(1) The actions must be completed on or before the scheduled completion dates.			
(2) Reports must be received by DEQ on or before the scheduled report due dates. The reports must include all information as required for each applicable action permit condition.			
(3) The completed plan (action), in place of a written report, must be received by DEQ on or before the scheduled report due date.			
(4) Monitoring of the existing monitoring wells shall continue until DEQ confirms the successful replacement of the wells.			
(5) Sampling and reporting requirements are listed in Section 5.			

PUBLIC NOTICE

Legal notice information for water quality discharge permits are listed at the following website: <http://deq.mt.gov/Public/notices/wqnotices>. Public comments on this proposal are invited any time prior to close of business on August 14, 2019. Comments may be directed to:

DEQWPBPublicComments@mt.gov

or to:

Montana Department of Environmental Quality
Water Protection Bureau
PO Box 200901
Helena, MT 59620

All comments received or postmarked prior to the close of the public comment period will be considered in the formulation of the final permit. DEQ will respond to all substantive comments pertinent to this permitting action and may issue a final decision within thirty days of the close of the public comment period.

All persons, including the applicant, who believe any condition of the draft permit is inappropriate, or that DEQ's tentative decision to deny an application, terminate a permit, or prepare a draft permit is inappropriate, shall raise all reasonably ascertainable issues and submit all reasonably available arguments supporting their position by the close of the public comment period (including any public hearing). All public comments received for this draft permit will be included in the administrative record and will be available for public viewing during normal business hours.

Copies of the public notice are mailed to the applicant, state and federal agencies, and interested persons who have expressed interest in being notified of permit actions. A copy of the distribution list is available in the administrative record for this draft permit. Electronic copies of the public notice, draft permit, fact sheet, and draft environmental assessment are available at the following website: <http://deq.mt.gov/Public/notices/wqnotices>.

Any person interested in being placed on the mailing list for information regarding this permit may contact the DEQ Water Protection Bureau at (406) 444-5546 or email DEQWPBPublicComments@mt.gov. All inquiries will need to reference the permit number (MTX000061), and include the following information: name, address, and phone number.

During the public comment period provided by the notice, DEQ will accept requests for a public hearing. A request for a public hearing must be in writing and must state the nature of the issue proposed to be raised in the hearing.

References

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- Subchapter 2 - Water Quality Permit Fees.
- Subchapter 5 – Mixing Zones in Surface and Ground Water.
- Subchapter 7 – Nondegradation of Water Quality.
- Subchapter 10 – Montana Ground Water Pollution Control System.
- Subchapter 13 – Montana Pollutant Discharge Elimination System.

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- Circular DEQ-2 – Design Standards for Wastewater Facilities.
- Circular DEQ-4 – Montana Standards for On-Site Subsurface Sewage Treatment Systems.
- Circular DEQ-7 – Montana Numeric Water Quality Standards, Required Reporting Values, and Trigger Values.

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APPENDIX A – WELL CONSTRUCTION DIAGRAMS

BG-2
MW-6

ENVIROCON WELL LOG

Page 1 of 2

Well: BG-2

Project: BGI

Location: WARREN, MT

Date Drilled: 11/9/93

Surface Elev: ~5100'

Screen Dia: 2"

Casing Dia: 2"

Drilling Co: ADT

Driller: ROSS LEHNER
WAYNE JEWETT

Owner: BGI

Project No: 1107

Total Depth: 117' BGL

Elevation TOC: ~5102'

Length: 20'

Length: 100'

Drilling Method: AIR ROTARY

Logged By: JM MICHALETZ

Diameter:

Initial WL: 75.5' (78.0' T/PVC)

Slot Size: .020"

Type: SCH. 40 PVC

DEPTH (ft)	WELL CONST.	SPT (blows/ft)	PID READING	SAMPLE NUMBER	GRAPHIC LOG	DESCRIPTION/SOIL CLASSIFICATION (Color, Texture, Structures)
5						Lt. brown/red sandy, clayey SILT. NOTE: lmst. begins at 6' BGL
10	6" Steel Case					lt. grey, fractured, continue same to 12.5'.
15						Change to white/lt. grey fine-grd. SS, calcareous at 14.5', friable.
20						At 17.5' change to very dark red sandy, clayey SILTSTONE, soft. NOTE: minor white, sand, silty clay pods at 20'.
25						Continue white/lt. grey fngrd. SS, V. friable, but becoming hard & well-indurated by 21'. Minor red silt zones. Back to lt. grey HARD, fractured LMST. at 25.5'-27'. Fractures discontinuous at 27'.
30	Sch. 40 2" PVC			27'-31' Karst fracture zone filled w/sand & silt of IPa		Into Mm? At 27.5', hard, lt. grey zone of CHERTY, V. fngrd. ss.
35				Begin 5' sampling		NOTE: more fractures, now into mixed zone of hard, fngrd. SS. and sandy SILTSTONE, LT. GREY TO DARK RED, w/lmst. Alternating soft to hard, moderate voids (i.e. vugs or fractures).
40	#6 Granular Bentonite					
45				Cuttings damp		At 44', softer, limy silt layers (interbedded?) filling lmst. voids. NOTE: cuttings are MOIST. Slightly fractured.
						At 47', no moisture, continue hard lmst. Back to silty lmst. at 48.5'-50', soft, slightly damp

ENVIROCON WELL LOG

Well: BG-2

DEPTH (ft)	WELL CONST.	SPT (blows/ft)	PID READING	SAMPLE NUMBER	GRAPHIC LOG	DESCRIPTION/SOIL CLASSIFICATION (Color, Texture, Structures)
50						Continue soft, silty, LMST., slightly moist. lt. grey, earthy feel & odor. Silt-filled karst? Slightly fractured, fine, alternating hard/soft beds. Slight color change to beige or buff-grey.
55	Centralizer					
60						Continue soft-medium hard, buff, silty LMST. (or calcareous, soft siltstone?) Becoming more uniform in color, texture, hardness. V. slightly fractured. less damp. Cuttings powdery.
65						PINK color at 65'. Lmst. becoming harder, no fractures. MED-GRAINED w/visible CALCITE CLEAVAGE. Red silt zone splotchy IRON OXIDE STAINING. (maybe MnO2 stains). Dry.
70						
75	Enviroplug Med. Bentonite					Alternate pink-buff-grey, med. to frngd. LMST. Slight, even fractures. BRACHIOPOD FOSSILS. Harder & frngd. at 76'-80'. Continue uniform, hard, MICRITIC lmst.
80						
85						Continue hard, dense, uniform, very slightly fractured pink, med.-grd. & buff-grey frngd. lmst. NOTE: thin but abrupt fracture zone (1"-2") at 86', 88', & 92'. Same as above, w/minor BROWN CHERT chips.
90	1/2" Bentonite Pellets					~2"-4" water in hole (overnight seepage)
95						
100						
105	.020" Screen					Continue hard, grey, frngd. lmst. slightly damp zones at 101' & 104'. Continued slightly fractured (?) Soft zone beginning at 106', driller notes moderate fractures. WATER AT 107.5'. (EST. 10 GPM) Lmst. harder again at 109'. NOTE: chert chips, and a few carmel-brown CALCITE XTALS. Soft, red-brown SILTSTONE. 113'-114'. Fractures filled w/ Pa.
110	Centralizer			▽		
115						Total Depth 117' 11/10/93 @ 0930

Silt may be falling into annulus from above

**BG-3
MW-7**

ENVIROCON WELL LC

Page 1 of 4

Well: BG-3

Project: BGI

Location: WARREN, MT

Date Drilled: 11/11/93

Surface Elev: ~5250'

Screen Dia: 2"

Casing Dia: 2"

Drilling Co: ADT

Driller: RUSS LEHNER
WAYNE JEWETT

Owner: BGI

Project No: 1107

Total Depth: 200' BGL

Elevation TOC: ~5253'

Length: 30'

Length: 170'

Drilling Method: AIR ROTARY

Logged By: JM MICHALETZ

Diameter:

Initial WL: 159.2' (162.5' T/PVC)

Slot Size: .020"

Type: SCH. 40 PVC

DEPTH (ft)	WELL CONST.	SPT (blows/ft)	PID READING	SAMPLE NUMBER	GRAPHIC LOG	DESCRIPTION/SOIL CLASSIFICATION (Color, Texture, Structures)
5	6" Steel Casing					Surface soil to 5': dark red silty, sandy, CLAY of Pa formation. Soft to med. stiff, plastic, damp. More moist at 7.5', then dry at 8'.
10						Continue dry, red, SILTY CLAY.
15						Same as above, slightly more silt. Powdery and harder.
20						
25						Dark red, dry, clayey SILT/SILTSTONE, w/ minor sand. Also note minor dark-red-grey CHERT chips.
30						Change to white, medium-dense, fine-med-grey SANDSTONE at 22'. Friable, w/calcite cement matrix. Drive casing w/shoe to 23.5'. Continue white to pinkish ss, moderately well sorted, subangular to subrounded.
35						Back to red silt at 31', then light grey Limestone, hard, V. fractured at 33'.
40						Continued fngrd, buff-lt. grey limst. Minor color alterations to lt. yellow-brown, and med.-grd. limst.
45						At 40' pink, coarse-grd. limst. w/distinct calcite SCALENAHEDRON XTALS, indicating fracture/vug fill. Also some brown chert.

ENVIROCON WELL LOG

Page 2 of 4

Well: BG-3

DEPTH (ft)	WELL CONST.	SPT (blows/ft)	PID READING	SAMPLE NUMBER	GRAPHIC LOG	DESCRIPTION/SOIL CLASSIFICATION (Color, Texture, Structures)
50						Continue buff-lt. grey fossiliferous lmst., hard, well-fractured.
55						Note 2"-4" tan. CHERT LAYER at 52'. Same lmst. at 55', but at 55.5' change to med-brown, hard, very fine-grd. lmst. Unfractured.
60						Continuing v. hard, mottled yellow-tan to pink, v. fngrd. Soft, grey at 57.5'. Minor red silt in fracture zone at 59'. BRACH FOSSILS.
65						Abrupt fracture zone at 65', cuttings of lmst. stuck together w/grey-brown and red silty CLAY. Continue fractured, soft lmst. w/clay fill.
70						Becoming less fractured & less brown/red clay fill matl. Continue soft, med.-grd. FOSSILIFEROUS lmst.
75						Lmst. hard, grey, less fractured at 76'-78', but then softer, fractured again at 79' with yellow-brown to red clay fill matl.
80						
85						Continue hard, moderately-fractured, fine-to med.-grd., buff to grey, fossiliferous lmst., minor silty clay fill. CHERT LAYER 86'. alternating hard/soft layers. Moderate fractures throughout, FOSSILIFEROUS, minor silty clays.
90						
95						
100						Continued light grey, moderately hard, moderately fractured lmst. Less clay matl. but still very uniform. EXTREMELY FRACTURED zone, soft from 100'-107', continue buff-grey lmst. but containing ABUNDENT BROWN SILTY CLAY MATL.
105						Minor chert. Harder formation again at 109', then softer, less clay fill, less fractured. Slight color change to tan.
110						
115						

#6 Granular Bentonite

Centralizer

ENVIROCON WELL LOG

Page 3 of 4

Well: BG-3

DEPTH (ft)	WELL CONST.	SPT (blows/ft)	PID READING	SAMPLE NUMBER	GRAPHIC LOG	DESCRIPTION/SOIL CLASSIFICATION (Color, Texture, Structures)
120						Slightly harder at 116', less fractured w/less silty clay fill. Continue fine-to med.-grd., buff grey to tan, fossiliferous lmst.
125						Continuing HARD, minor fractures, med.-grd., minor-silt, foss., plus MINOR SPARRY CALCITE. Also note mottled pink-brown-grey color of lmst.
130	Centralizer					
135						Fractured zone at 131' w/clay & chert, back to hard, dense, less fractured lmst. at 133.5'. Less dense fracture zone again at 137.5', change to slightly finer-grd. buff-tan lmst. w/silty clay fill matl. VERY FRACTURED AT 134' continued to 144' Abundant Brach. fossils & brown clay fill.
140	Enviroplug Med. Bentonite					
145						
150						Back to hard, dense, frgrd. lmst. at 146', MULTI-COLORED (grey, tan, to dark red-brown). No fractures or clay.
155	1/2" Bentonite Pellets					
160						Very fractured again at 151' Abundant tan-brown silty clay fill. Change from pink to grey color.
165	#10-20 Silica Sand					Less fractured at 157.5' w/ less clay. Pink hue to lmst. again. Mottled colors & varying fine-med-grd. Color changes to lt.-grey, then yellow-beige at very fractured zone 162.5'. Sparry calcite-filled veins.
170	.020" Screen					Moist, soft, mustard-YELLOW SILTY CLAY 167'-168'. Soft, fractured, pale-yellow lmst. 170'.
175						171'-178' DRILLING THROUGH CLAY ZONE No cuttings returned.
180	Centralizer					178'-180' v. fractured, mottled white-yellow-grey lmst. w/abundant red silt & clay, siltstone, sparry calcite, & chert, minor fine sands (fines washed from sample). MAJOR FRACTURE FILL ZONE.

Water slowly rising in borehole

ENVIROCON WELL LC

Well: BG-3

DEPTH (ft)	WELL CONST.	SPT (blows/ft)	PID READING	SAMPLE NUMBER	GRAPHIC LOG	DESCRIPTION/SOIL CLASSIFICATION (Color, Texture, Structures)
185	[Diagram: Well casing with horizontal lines]				[Diagram: Fractured limestone with asterisks]	Continue light-grey, frngd. lmst. w/pale-yellow, med-grd. lmst. very fractured, w/pink-red silt & tan clay, chert, & frngd red ss fill material, & sparry calcite from vugs/fracture voids. Lots of red silt & tan clay fines in water, washed from sample.
190	[Diagram: Well casing with horizontal lines]				[Diagram: Fractured limestone with asterisks]	
195	[Diagram: Well casing with horizontal lines]				[Diagram: Fractured limestone with asterisks]	Fracture-fill matl. continues to 200', w/noted 3"-6" voids water is very clayey/silty, light pink/beige color, flow est. 1 GPM. Total Depth 200' 11/13/93 @ 1530
200	[Diagram: Well casing with horizontal lines]				[Diagram: Fractured limestone with asterisks]	
		<i>Natural Collapse</i>				

APPENDIX B – INDIVIDUAL GROUND WATER MONITORING RESULTS

Ground Water Monitoring Results, MW-6							
Monitor Source	Parameter	Units	Reported Minimum Value	Reported Average Value	Reported Maximum⁽¹⁾ Value	# of Samples	Source of Data
MW-6	Alkalinity, total [as CaCO ₃]	mg/L	183	191	197	10	DMR
	Arsenic, total [as As]	mg/L	ND	ND	ND	10	DMR
	Barium, total [as Ba]	mg/L	ND	ND	0.09	10	DMR
	Bicarbonate ion- [as HCO ₃]	mg/L	223	233	240	10	DMR
	Cadmium, total [as Cd]	mg/L	ND	ND	0.0001	10	DMR
	Calcium, total [as Ca]	mg/L	51	57	64	10	DMR
	Carbonate ion- [as CO ₃]	mg/L	ND	ND	ND	10	DMR
	Chloride [as Cl]	mg/L	ND	1	2	10	DMR
	Conductivity	uS/cm	373	403	439	10	DMR
	Hardness, total [as CaCO ₃]	mg/L	199	226	253	10	DMR
	Hydroxide	mg/L	ND	ND	ND	10	DMR
	Lead, total [as Pb]	mg/L	ND	ND	ND	10	DMR
	Magnesium, total [as Mg]	mg/L	17	20	23	10	DMR
	Mercury, total [as Hg]	mg/L	ND	ND	ND	10	DMR
	Molybdenum, total [as Mo]	mg/L	ND	ND	0.002	10	DMR
	Nitrogen, total [as N]	mg/L	ND	0.61	0.80	10	DMR
	pH	SU	7.02	7.69	7.95	10	DMR
	Selenium, total [as Se]	mg/L	ND	ND	ND	10	DMR
	Sodium, total [as Na]	mg/L	1	1	2	10	DMR
	Solids, total dissolved [TDS]	mg/L	194	226	255	10	DMR
	Strontium, total [as Sr]	mg/L	ND	0.03	0.10	10	DMR
	Sulfate [as S]	mg/L	14	25	45	10	DMR
	Vanadium, total [as V]	mg/L	ND	ND	ND	10	DMR
Static water level	ft-MSL	4934.2	4998.8	5017.0	10	DMR	
Zinc, total [as Zn]	mg/L	ND	ND	ND	10	DMR	

Footnotes:
Supplemental sampling information provided in Appendix B.
ft-bmp: feet below measuring point
MSL: mean sea level
s.u.: standard units
(1) Maximum value of all quarterly reported values.

Ground Water Monitoring Results, MW-7							
Monitor Source	Parameter	Units	Reported Minimum Value	Reported Average Value	Reported Maximum Value⁽¹⁾	# of Samples	Source of Data
MW-7	Alkalinity, total [as CaCO ₃]	mg/L	151	175	200	16	DMR
	Arsenic, total [as As]	mg/L	ND	ND	ND	16	DMR
	Barium, total [as Ba]	mg/L	ND	0.13	0.20	16	DMR
	Bicarbonate ion- [as HCO ₃]	mg/L	174	212	244	16	DMR
	Cadmium, total [as Cd]	mg/L	ND	ND	ND	16	DMR
	Calcium, total [as Ca]	mg/L	37	50	58	16	DMR
	Carbonate ion- [as CO ₃]	mg/L	ND	ND	5	16	DMR
	Chloride [as Cl]	mg/L	ND	1	3	16	DMR
	Conductivity	uS/cm	296	340	370	16	DMR
	Hardness, total [as CaCO ₃]	mg/L	160	190	218	16	DMR
	Hydroxide	mg/L	ND	ND	ND	16	DMR
	Lead, total [as Pb]	mg/L	ND	ND	ND	16	DMR
	Magnesium, total [as Mg]	mg/L	14	16	18	16	DMR
	Mercury, total [as Hg]	mg/L	ND	ND	ND	16	DMR
	Molybdenum, total [as Mo]	mg/L	ND	ND	ND	16	DMR
	Nitrogen, total [as N]	mg/L	0.16	0.66	0.80	16	DMR
	pH	SU	6.86	7.76	7.99	16	DMR
	Selenium, total [as Se]	mg/L	ND	ND	ND	16	DMR
	Sodium, total [as Na]	mg/L	ND	1	1	16	DMR
	Solids, total dissolved [TDS]	mg/L	166	186	199	16	DMR
Strontium, total [as Sr]	mg/L	ND	ND	0.08	16	DMR	
Sulfate [as S]	mg/L	6	7	10	16	DMR	
Vanadium, total [as V]	mg/L	ND	ND	ND	16	DMR	
Static water level	ft-MSL	5022.7	5033.7	5050.9	16	DMR	
Zinc, total [as Zn]	mg/L	ND	ND	0.02	16	DMR	

Footnotes:
Supplemental sampling information provided in Appendix B.
ft-bmp: feet below measuring point
MSL: mean sea level
s.u.: standard units
(1) Maximum value of all quarterly reported values.