Montana Department of Environmental Quality

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

PERMIT FACT SHEET

MONTANA GROUND WATER POLLUTION CONTROL SYSTEM (MGWPCS)

Permittee:	Valley Grove County Sewer District
Permit Number:	MTX000112
Permit Type:	Domestic wastewater
Application Type:	Renewal
Facility Name:	Valley Grove Subdivision
Facility Location:	Southwest ¼ of Section 20, Township 1 South, Range 5 East, Gallatin County Latitude: 45.73571° Longitude: -111.13923°
Facility Address:	500 Drifter Drive
Facility Contacts:	Craig Gagne, President, HOA; Terry Hooge, Operator
Treatment Type:	Level 2, (4 Sequencing Batch Reactors -SBR)
Receiving Water:	Class I Ground Water
Number of Outfalls:	1
Outfall / Type:	001 / multi-zone pressure-dosed drainfield
Effluent Type:	Domestic strength wastewater
Mixing Zone:	Standard
Effluent Limit Type:	WQBEL
Effluent Limits:	Total nitrogen: 12.4 lbs./day
Flow Rate:	Design maximum: 43,000 gpd Design average: 23,000 gpd
Effluent sampling:	Drainfield dose tank (EFF-001), quarterly
Ground water sampling:	MW-1, quarterly
Fact Sheet Date:	July 2020
Prepared By:	Darryl Barton

1.0 PERMIT INFORMATION

DEQ issues MGWPCS permits for a period of five years. The permit may be reissued at the end of the period, subject to reevaluation of the receiving water quality and permit limitations. This fact sheet provides the basis for DEQ's decision to renew a MGWPCS wastewater discharge permit Valley Grove County Sewer District (applicant) for the Valley Grove Subdivision wastewater treatment system.

1.1 APPLICATION

DEQ received an application for renewal of the permit on December 10, 2018. Renewal fees accompanied the application. DEQ reviewed the submittal and issued a completeness letter on January 4, 2019.

1.2 PERMIT HISTORY

The first permit for this facility was issued May 21, 2001. The permit has been renewed twice: May 1, 2008 and June 1, 2014. All permits have contained effluent and monitoring and reporting requirements. The effluent limit in the initial permit was 30 mg/L total inorganic nitrogen. The first renewal had a concentration limit in the effluent of 30 mg/L total nitrogen and a phosphorus limit of 4.74 lbs/day based on the average load in 90 days. The next renewal, which is also the prior permit, changed the nitrogen limit to a load based limit of 7.2 lbs/day total nitrogen and established a phosphorus limit of 1,727 lbs/year.

1.3 CHANGES TO THIS PERMIT

Phosphorus limit has been removed. Rationale is discussed in Section 5.2. The effluent limit for nitrogen is recalculated based on updated ambient groundwater nitrogen sampling results. Nitrogen effluent limit is discussed in Section 5.1.

2.0 FACILITY INFORMATION

2.1 LOCATION

Valley Grove (VG) is a 123 lot subdivision (122 homes built) about 3.5 miles northwest of Bozeman at the intersection of East Valley Center Road and Love Lane (**Figure 1 and 2**). The wastewater system in located in the northern portion of the subdivision (**Figure 3**).

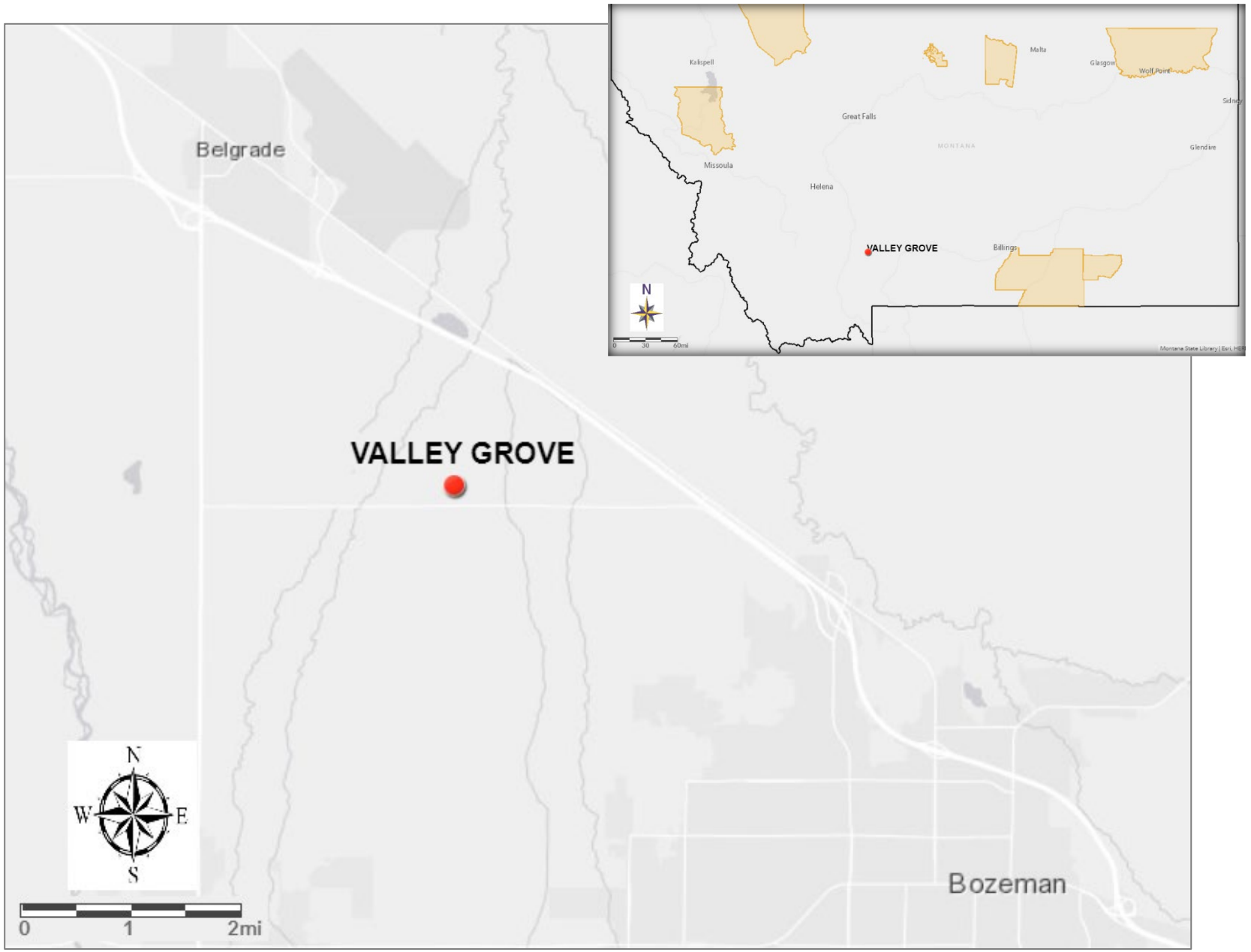


Figure 1. Location of VALLEY GROVE

Figure 2. VALLEY GROVE Subdivision

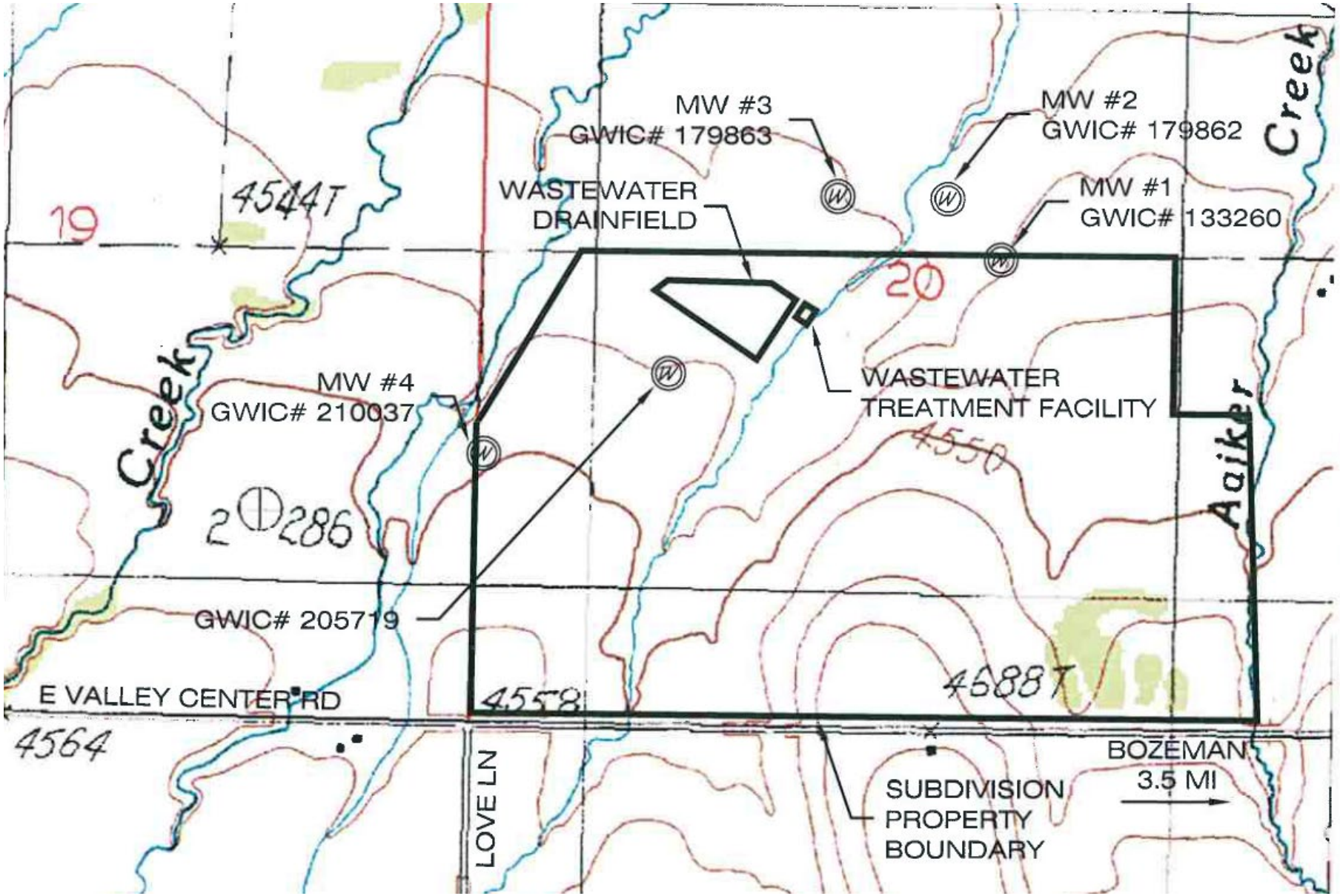


Figure 3. VALLEY GROVE Wastewater System

2.2 OPERATIONS

System operations are summarized in **Table 1**.

Table 1. Collection, Treatment, and Disposal Summary

Collection	
Contributing sources:	122 residences
Standard industrial code(s) of sources:	237210 -Subdivision; 4952-Sewerage System
Collection method:	Gravity-driven sewer lines
Flow Meter:	FM-001 - Seametrics IP81 paddlewheel
Flow volume:	Average daily design flow: 23,000 gallons per day Maximum daily design flow: 43,000 gallons per day
Treatment	
Treatment level:	Level 2
Treatment technology:	Sequencing Batch Reactor (SBR)
Treatment location:	Latitude: 45.73571°, Longitude: -111.13747°
Disposal	
Method of disposal:	Infiltration to ground water
Disposal structure:	Four zone pressure-dosed subsurface drainfield (Outfall 001)
Outfall location:	Latitude: 45.73578°, Longitude: -111.13937°

The wastewater treatment system (WWTS) is a sequencing batch reactor (SBR) system and consists of a lift station, bar screen, grit chamber, 6,000-gallon distribution tank, four SBR units, six sludge tanks, UV disinfection, dose tank, and a four zone drainfield. Wastewater from each home flows through an 8-inch main to the lift station. The lift station pumps into a 6,000-gallon distribution tank that supplies effluent to four sequencing batch reactors (SBR). Each SBR consists of two hydraulically connected tanks. The second tank is divided by a baffle wall creating a mixing area which consists of 1/3 of the tank volume and the second area, a clarifier, which is 2/3 the tank volume. The mixing area allows for aerobic biological treatment. Within the clarifier area, aeration stops, allowing the solids to settle. The clear decant separates from the settling solids and is pumped from the SBR into a feed tank that discharges to a multi zone pressure-dosed drainfield. The sludge is pumped, placed in one of the six sludge holding tanks, and disposed of by a licensed hauler. **Figure 4** is a line drawing of the collection, treatment, and disposal process.

Effluent sampling and monitoring occur at the drainfield dose tank (EFF-001). The dose tank pumps are shut off for a period of up to six hours before sample collection. Flow is measured with a Seametrics IP81 paddlewheel flow meter (FM-001) after the dose tank prior to discharge in the drainfield (**Figure 4**).

Monitoring and sampling requirements are further discussed in **Section 6**.

The WWTS provides Level 2 treatment which is considered a higher level of treatment than conventional systems.

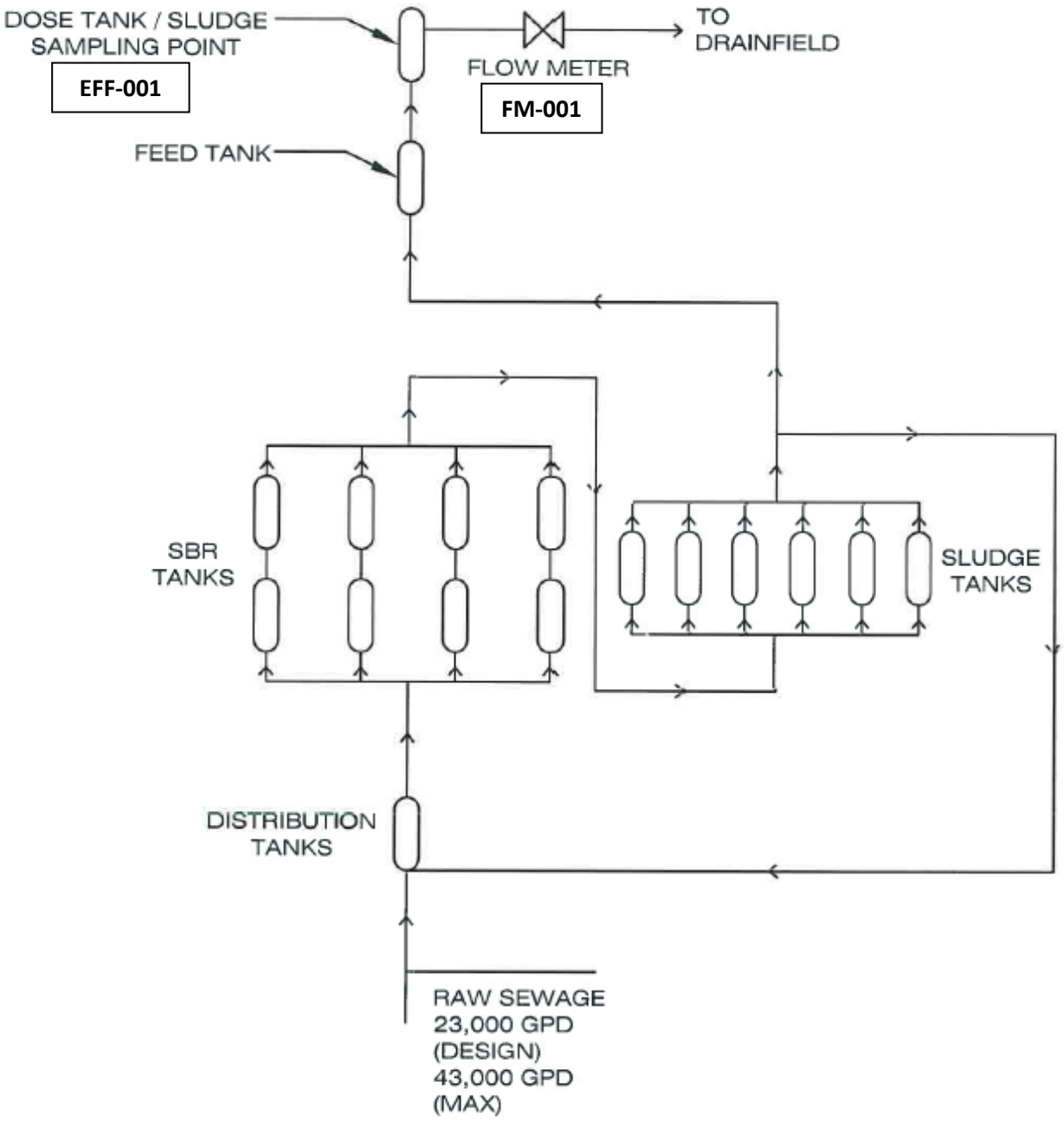


Figure 4. Wastewater Treatment System Line Diagram.

2.3 EFFLUENT CHARACTERISTICS

DEQ requires a permit applicant to disclose the quality of the effluent so that DEQ may evaluate the potential for pollution of state water. During the previous permit cycle, the facility sampled and reported effluent quality criteria to DEQ in the form of discharge monitoring reports (DMRs). These data are summarized in **Table 2**. The majority of the concentrations are reported in units of milligrams per liter (mg/L), which is equivalent to one part per million.

Table 2: Effluent Quality – Outfall 001. DMR Results

Parameter[1]	Location	Units	Reported Minimum Value	Reported Average Value	Reported Maximum[2] Value	# of Samples
Biochemical Oxygen Demand (BOD_5)	EFF-001	mg/L	5.00	15.35	40.0	20
Flow rate, Discharge	FM-001	gpd	13,897	16,229	41,237	20
Nitrogen, Nitrate + Nitrite (as N)	EFF-001	mg/L	2.54	8.84	17.90	20
Nitrogen, Ammonia	EFF-001	mg/L	0.10	0.49	1.50	20
Nitrogen, Total Kjeldahl (as N)	EFF-001	mg/L	0.80	2.57	5.00	20
Nitrogen, Total (as N)	EFF-001	mg/L	4.15	11.29	20.76	20
		lbs/day	1.16	2.38	4.71	20
Phosphorus, Total (as P)	EFF-001	mg/L	0.23	1.31	2.93	20
Total Suspended Solids (TSS)	EFF-001	mg/L	1.00	6.38	14.0	20

Footnotes:

DMR = Self-Reported Discharge Monitoring Reports

EFF-001: Effluent sample site located at dose tank.

FM-001: Effluent flow meter located at dose tank.

Period of Record: 03/2015 through 03/2020.

(1) Conventional and nonconventional pollutants only, table does not include all possible toxics.

(2) Maximum value recorded of all quarterly reported Daily Maximum Values.

2.4 GEOLOGY

Soils in the vicinity of the wastewater treatment system drainfield are Hyalite- Beaverton complex. These are loamy soils with clay and silt concentrations increasing with depth. At 17 inches sand and cobbles increase. A cobbly, loamy coarse sand is found from 25 to 60 inches. The area is fairly level with slopes from 0 to 4%. Soil information is found in **Appendix B**.

Other predominant soil types in the subdivision include Amsterdam silt loam, and Beaverton cobbly clay loam.

The drainfield is constructed in alluvial-fan deposits. The Bozeman-Belgrade alluvium primarily consists of cobbles and course to fine gravel with a few minor interbeds of sand.

2.5 HYDROGEOLOGY

Ground water fluctuates seasonally and is highest during the spring and midsummer. During June the depth to ground water is approximately 7 feet below ground surface. Although much ground water is available in the Gallatin Valley, this resource is largely undeveloped. The principal aquifer is the alluvium beneath the valley floor. This aquifer is characterized by generally high coefficients of transmissibility 100,000 to 300,000 gpd (gallons per day) per foot and in many places would yield ample water for irrigation. The adjacent alluvial fans generally yield sufficient water for only stock and domestic use, but the more extensive fans probably would yield supplies sufficient for some irrigation. Low to moderate coefficients of transmissibility (7,000 to 65,000 gpd per foot)

characterize the alluvial fans. The Tertiary strata have relatively low coefficients of transmissibility (generally less than 6,000 gpd per foot) and yield sufficient water for only stock and domestic use. The ground water reservoir is recharged principally by infiltrating irrigation water. Influent seepage from streams, particularly during the period of high runoff in the spring, is another important means of recharge. Ground water is discharged by seepage to the streams at the lower end of the valley and by evapotranspiration. The discharge of ground water as surface flow from the valley is estimated to be about 240,000 acre-feet per year. Recharge to the ground water reservoir exceeds this amount by the unknown volume of ground water consumed through evapotranspiration

The nearest down gradient surface water is McDonald Creek at about 900 feet. In previous permitting actions, DEQ evaluated the potential for surface water degradation against McDonald Creek, and determined that discharges in compliance with the terms of the permit would be nonsignificant. However, ground water elevation information demonstrates that McDonald Creek is losing water to ground water all year long. Therefore, although it is the nearest surface water in a downgradient direction, McDonald Creek is not influenced by this discharge. Hydrogeological conditions pertinent to the site include an estimate hydraulic gradient (I) of 0.00536 ft/ft with ground water moving N28°E and an estimated hydraulic conductivity (K) of 199.3 ft/day.

Important hydrogeologic characteristics are summarized in **Table 3**.

Table 3. Hydrogeologic Summary

Average depth to ground water	16 feet
General ground water flow direction	N28°E
Hydraulic conductivity	199 feet per day
Hydraulic gradient	0.005 feet/feet
Nearest downgradient surface water	McDonald Creek (900 feet)

2.6 GROUND WATER MONITORING WELLS

There is one up gradient monitoring well associated with this permit: MW-4 and three potential down gradient monitoring wells MW-1, MW-2 and MW-3. These wells are plotted on **Figure 3**. Monitoring well construction details are provided in **Table 4**. Well logs for each monitoring well are attached as **Appendix A**.

Table 4. Monitoring Well Summary

Monitoring Well MW-4	
MBMG GWIC ID:	210037
Location- latitude/longitude:	Latitude: 45.73334° Longitude: -111.14456°
Location- narrative:	Southwest of drainfield, refer to Figure 3 for specific location
Rationale:	Ambient up gradient receiving water quality
Depth; screened interval:	Total depth of 60 feet, screened from 45-60 feet. Static water level of 15 feet
Notes:	
Monitoring Well MW-1	
MBMG GWIC ID:	133260
Location- latitude/longitude:	Latitude: 45.73650° Longitude: -111.13326° (from Montana GWIC)
Location- narrative:	Northeast of drainfield, refer to Figure 3 for specific location
Rationale:	Down gradient water quality

Depth; screened interval:	Total depth of 65 feet, open bottom. Static water level of 22 feet
Notes:	Not used in previous renewal cycle.
Monitoring Well MW-2	
MBMG GWIC ID:	179862
Location- latitude/longitude:	Latitude: 45.73743° Longitude: -111.13447° (from Montana GWIC}
Location- narrative:	Northeast of drainfield, refer to Figure 3 for specific location
Rationale:	Down gradient water quality
Depth; screened interval:	Total depth of 26 feet, screened from 10-25 feet. Static water level of 12 feet
Notes:	Not used in previous renewal cycle.
Monitoring Well MW-3	
MBMG GWIC ID:	179863
Location- latitude/longitude:	Latitude: 45.73743° Longitude: -111.13689° (from Montana GWIC)
Location- narrative:	Northeast of drainfield, refer to Figure 3 for specific location
Rationale:	Down gradient water quality
Depth; screened interval:	Total depth of 24 feet, screened from 9-24 feet. Static water level of 13 feet
Notes:	Not used in this previous cycle.

If a DEQ-approved monitoring well is abandoned, destroyed or decommissioned, or is no longer able to be sampled due to fluctuations in the ground water table, the permittee must install or designate a new well to replace the abandoned, destroyed, decommissioned, or non-viable well.

2.7 GROUND WATER QUALITY CHARACTERISTICS

Water sampling results from MW-4 are provided in **Table 5**. Based on the 424 microsiemens per centimeter (µS/cm) specific conductance, the receiving water is Class I ground water.

Table 5: Ground Water Monitoring Results (1)

Monitor Source (2)	Representation	Parameter	Units	Reported Average Value
MW4	Ambient Ground Water Quality Shallow ground water, 1200 feet upgradient from Outfall 001	Chloride (as Cl)	mg/L	8.44
		Escherichia coli Bacteria	CFU/100 ml	<1, ND
		Nitrogen, Ammonia (as N)	mg/L	ND
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	0.44
		Nitrogen, Total Kjeldahl (as N)	mg/L	0.52
		Organic Carbon, Total	mg/L	2.6
		pH	s.u.	7.6
		Specific Conductivity (@ 25°C)	µS/cm	424
		Static Water Level (SWL)	ft-bgs	15.9
		Total Dissolved Solids (TDS)	mg/L	316

Footnotes:
(1) Source of Data = Application and supplemental materials (sampling reports).
(2) Refer to Figure 3 of the Fact Sheet for the existing location of the monitoring well.
CFU = Colony Forming Units
ND = Not Detected
s.u. = standard units
bgs = below ground surface

Total nitrogen was not reported; however, it may be calculated as the sum of nitrate + nitrite and total Kjeldahl nitrogen. The calculated total nitrogen concentration in the receiving water is 0.96 mg/L.

3.0 WATER QUALITY STANDARDS AND NONDEGRADATION

Part of DEQ's mission is to protect, sustain, and improve the quality of state waters. Water quality standards provide the basis for effluent limits that DEQ applies to discharge permits (**Section 5**). These standards include three components: designated uses, water quality criteria, and nondegradation policy. DEQ protects all designated uses of state water by basing effluent limits on the most restrictive water quality limitations, intended to protect the most sensitive uses.

3.1 DESIGNATED USES

With a specific conductivity of 424 µS/cm, the receiving water is Class I ground water and therefore a high-quality water of the State. Class I ground waters must be maintained suitable for the following uses with little or no treatment:

- Public and private drinking water supplies
- Culinary and food processing purposes
- Irrigation
- Drinking water for livestock and wildlife
- Commercial and industrial purposes

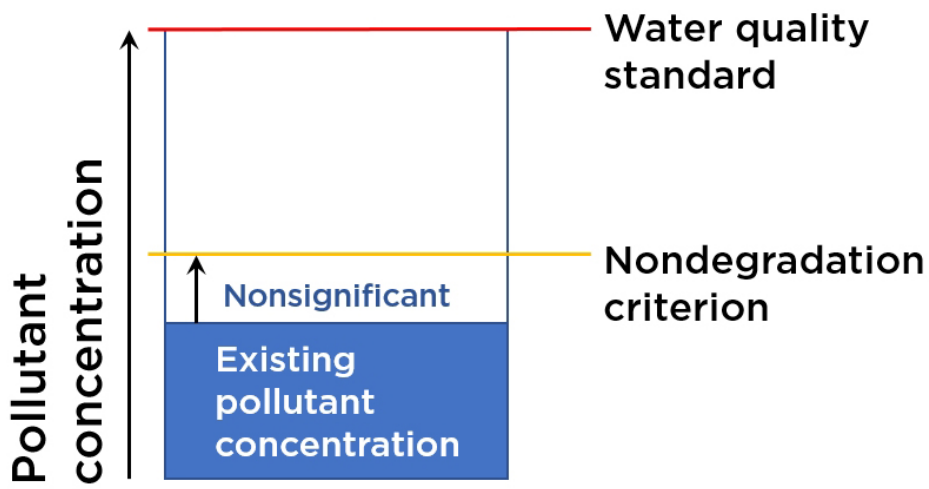
DEQ protects all the assigned beneficial uses by protecting the most sensitive. Drinking water is the most sensitive use of this receiving water.

3.2 WATER QUALITY CRITERIA

Montana has water quality standards for both surface water and ground water. The numeric criteria for each are different because they must support different uses. DEQ writes permits to protect the most sensitive, thereby protecting all uses. DEQ's ground water standard for nitrate is 10.0 mg/L, as is the standard for nitrate + nitrite (as nitrogen). Class I ground water must be maintained suitable for use as a drinking water supply with little or no treatment, and therefore must meet the corresponding human health standard of 10.0 mg/L total nitrogen. These water quality standards may not be exceeded outside a designated mixing zone (**Section 4**).

3.3 NONDEGRADATION

Montana's nondegradation policy is intended to preserve the existing condition of high-quality state waters. Any water whose existing condition is better than the water quality standards must be maintained in that high quality. Nondegradation policy allows discharges to cause only nonsignificant changes in water quality. Changes in water quality that are deemed significant require an authorization to degrade. An authorization to degrade is not an authorization to pollute; the water quality standard must not be exceeded.



DEQ must determine whether the proposed discharge will result in significant changes in water quality.

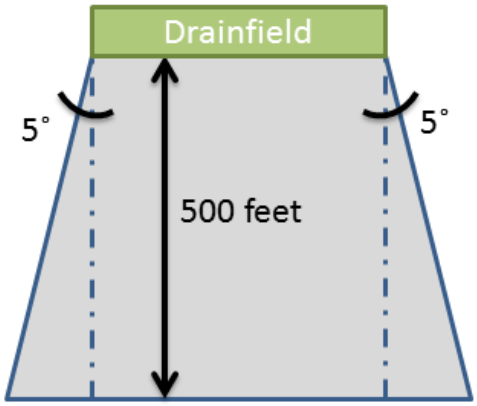
3.4 NONSIGNIFICANCE

DEQ has determined that the activity is not considered to be a new or increased source resulting in a change of existing water quality occurring on or after April 29, 1993. The nature of the discharge has not changed since that determination. DEQ is therefore not required to perform a significance determination with this permit renewal . The applicable water quality standards for Class I ground water are summarized in **Table 3**. This permit includes monitoring, reporting, and corrective action requirements to establish, confirm, and maintain compliance with permit limitations.

4.0 MIXING ZONE

DEQ authorizes a standard mixing zone for total nitrogen discharged from Outfall 001. A mixing zone is a specifically defined area of the receiving water where water quality standards may be exceeded. DEQ evaluates the suitability according to criteria established in the Administrative Rules of Montana. The mixing zone is then defined in the permit. The applicant requested a standard mixing zone for this discharge, consistent with previous permit cycles.

A standard mixing zone extends 500 feet downgradient from the source. The upgradient boundary is equal to the width of the source (measured perpendicular to the of ground water flow direction). The mixing zone widens in the downgradient direction by 5° on either side. The width of the downgradient boundary is calculated by adding the increased width for each side (the tangent of 5° (0.0875) times the mixing zone length) to the width of the upgradient boundary. Standard mixing zones extend 15 feet below the ground water table.



The volume of ground water (Q_{GW}) available to mix with the effluent is calculated using Darcy's Equation: $Q_{GW} = KIA$

Where:
Q_{GW} = ground water flow volume (feet^3/day)
K = hydraulic conductivity (feet/day)
I = hydraulic gradient (feet/feet)
A = cross-sectional area (feet^2) at the downgradient boundary of the mixing zone.

Table 6 summarizes the variables used in Darcy's equation and the resulting volume of ground water available to mix at Outfall 001.

Table 6: Hydrogeologic and Mixing Zone Information - Outfall 001

Parameter	Units	Value
Mixing Zone Type	-	Standard
Authorized Parameters	-	Nitrogen
Ambient Ground Water Concentrations, Nitrate + Nitrite	mg/L	0.44
Ground Water Flow Direction	azimuth/bearing	N28°E
Length of Mixing Zone	feet	500
Thickness of Mixing Zone	feet	15
Outfall Width, Perpendicular to Ground Water Flow Direction	feet	1400
Width of Mixing Zone at Down Gradient Boundary	feet	1487.5
Cross Sectional Area of Mixing Zone (A)	ft^2	22312.5
Hydraulic Conductivity (K)	feet/day	199
Hydraulic Gradient (I)	ft/ft	0.005
Volume of Ground Water Available for Mixing (Q_{gw})	ft^3/day	23,799

In order to determine whether a mixing zone is allowable, DEQ calculates a predicted concentration at the downgradient end of the mixing zone. This mixing calculation follows the following procedure:

- Volume of ground water times the concentration of the parameter = existing load;
- Volume of discharge times the concentration of the parameter = waste load; and
- (Existing load + waste load) / total volume = predicted concentration.

Because the predicted concentration must satisfy the most stringent nonsignificance criterion (**Section 3**), DEQ can calculate water quality based effluent limits (WQBELs) by rearranging the equation and solving for the effluent concentration (**Section 5**).

5.0 PERMIT CONDITIONS

Discharge permits include conditions that ensure compliance with the Montana Water Quality Act and the regulations used to implement it. These conditions include effluent limits as well as any special conditions that DEQ deems necessary to protect the quality of the receiving water.

Montana's numeric water quality standards are published in Circular DEQ-7. Water quality criteria applicable to this permit are summarized in **Table 7**. The permit establishes effluent limits that will meet water quality standards and nondegradation criteria, thereby protecting beneficial uses and existing high quality waters. The most restrictive criteria in **Table 7** provide the basis for the effluent limits.

Table 7: Applicable Ground Water Quality Standards

Parameter(1)	Human Health Standard(2)	Nondegradation Significance Criteria(3) (4)
Total Nitrogen	10.0 mg/L	7.5 mg/L
Phosphorus, Total Inorganic	-	Surface water breakthrough time greater than 50 years

Footnotes:
(1) Includes parameters of concern only.
(2) Circular DEQ-7 (2019)
(3) Changes in water quality that do not comply with the listed criteria are significant degradation.
(4) Changes in receiving ground water quality are not significant if water quality protection practices approved by DEQ have been fully implemented and if the listed significance criteria are met (ARM 17.30.715).

This discharge permit includes numeric WQBELs that restrict the strength and volume of the discharge. The ground water nonsignificance criteria provide the basis for the limits. DEQ calculates WQBELs by rearranging the mixing zone equation (**Section 4**) and solving for the effluent concentration that satisfies the water quality criteria. DEQ evaluates and recalculates the limits using updated water quality data as part of every permit renewal cycle. In this way, DEQ protects the receiving water quality by continually assessing cumulative impacts to the receiving water.

DEQ calculated the effluent limits using the same method as for the previous permit. DEQ uses updated ambient ground water quality data to re-evaluate the receiving water quality and the assimilative capacity for dilution.

5.1 TOTAL NITROGEN EFFLUENT LIMIT

The nondegradation significance criterion of 7.5 mg/L for total nitrogen is the most restrictive of the water quality criteria applicable to this permit; therefore, it is the water quality target for this effluent limit. DEQ established the final WQBEL for this discharge by back-calculating the effluent concentration that results in mg/L at the end of the mixing zone, given the available dilution. Available dilution is determined by recent ground water quality sampling of the receiving water. Ambient total nitrogen averaged 0.44 mg/L. DEQ calculates an effluent limit that protects receiving water quality and beneficial uses according to the following equation:

$$L_{EFF} = [C_{STD}(Q_{GW} + Q_{EFF})]X - C_{AMB}Q_{GW}X$$

Where:

L_{EFF} = daily maximum load (lbs/day)
C_{STD} = most stringent applicable ground water quality standard (mg/L)
C_{AMB} = ambient ground water concentration (mg/L) of total nitrogen (as N)
Q_{GW} = ground water volume (gpd) available for mixing at the end of the mixing zone
Q_{EFF} = volume of effluent (gpd)
X = $8.34x10^{-6}$, the conversion factor that converts concentration (mg/L) and flow (gpd) into load (lbs/day)

L_{EFF} = [7.5 mg/L(178,020 gpd + 43,000 gpd)]$8.34x10^{-6}$ – (0.96 mg/L)(178,020 gpd)($8.34x10^{-6}$)

L_{EFF} = **12.4 lbs/day**

Thus, the WQBEL for Outfall 001 is **12.4 lbs/day** total nitrogen.

5.2 TOTAL PHOSPHORUS EFFLUENT LIMIT

DEQ determined in previous permitting that phosphorous discharged to ground water would reach McDonald Creek in **91.8** years. A phosphorous breakthrough time of greater than 50 years is considered insignificant. There will be no proposed effluent limit for phosphorus.

Based on the information and analyses presented above, DEQ proposes the following numerical effluent limitations in **Table 8**.

Table 8: Final Effluent Limits – Outfall 001

Parameter	Units	Daily Maximum(1)
Total Nitrogen (as N)	lbs/day	12.4

Footnotes:
(1) See definition in Part V of permit.

6.0 MONITORING AND REPORTING REQUIREMENTS

DEQ requires effluent monitoring to assure compliance with the effluent limitations and therefore water quality standards. Effluent monitoring is required as a condition of this permit. All monitoring and sampling required by this permit must be representative; therefore, the permit identifies specific monitoring locations.

6.1 EFFLUENT MONITORING

This permit includes numeric effluent limitations with specific magnitudes and durations to ensure the discharge will not cause or contribute to an exceedance of an applicable water quality standard (see **Section 3**). Accordingly, the permittee is required to monitor and report at a specified frequency in order to demonstrate compliance with these limitations.

Effluent samples and discharge flow measurements must be representative of the nature and volume of the effluent. The effluent sample location (EFF-001) is located at the drainfield dose tank as shown in **Figure 4**. The permittee is required to install, maintain and report flow measurements using a flow-measuring device capable of measurements that are within 10 percent of the actual flow. The flow measuring device (FM-001) is located prior to discharge in the drainfield (**Figure 4**). The flow measuring device must be in operating condition prior to discharge. Effluent monitoring and reporting requirements are summarized in **Table 9**. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

Table 9: Effluent Monitoring and Reporting Requirements

Parameter	Monitoring Location	Units	Sample Type(1)(2)	Minimum Sampling Frequency	Reporting Requirements(1)(3)	Report Frequency	Rationale
Flow Rate(4)(5)	Flow Meter	gpd	Continuous	Continuous	Daily Max and Quarterly Average	Quarterly	Permit Compliance/ Effluent Characterization
Biochemical Oxygen Demand (BOD_5)	Dose Tank	mg/L	Grab	1/Quarter	Quarterly Average	Quarterly	Proper O&M/ Effluent Characterization
Total Suspended Solids (TSS)	Dose Tank	mg/L	Grab	1/Quarter	Quarterly Average	Quarterly	Proper O&M/ Effluent Characterization
Nitrate + Nitrite (as N)	Dose Tank	mg/L	Grab	1/Quarter	Daily Max and Quarterly Average	Quarterly	Permit Compliance/ Proper O&M
Total Ammonia (as N)	Dose Tank	mg/L	Grab	1/Quarter	Daily Max and Quarterly Average	Quarterly	Proper O&M
Total Kjeldahl Nitrogen (as N)	Dose Tank	mg/L	Grab	1/Quarter	Daily Max and Quarterly Average	Quarterly	Permit Compliance
Total Nitrogen (as N)(5)(6)	Dose Tank	mg/L lbs/day(8)	Calculate	1/Quarter	Daily Max and Quarterly Average	Quarterly	Permit Compliance
Total Phosphorus (as P)(5)(7)	Dose Tank	mg/L	Grab	1/Quarter	Daily Max and Quarterly Average	Quarterly	Permit Compliance

Footnotes:
NA = Not Applicable
(1) See definitions in Part IV of the permit.
(2) Grab sample will represent concentration for a 24 hour period.
(3) Daily Maximum: Report highest measured daily value for the reporting period on Discharge Monitoring Report (DMR) form.
(4) If no discharge occurs during the reporting period, "No Discharge" shall be recorded on the DMR report form.
(5) Requires recording device or totalizing meter, must record daily effluent volume.
(6) Total Nitrogen is the sum of the Nitrate + Nitrite and Total Kjeldahl Nitrogen parameters.
(7) Annual maximum load shall be reported on an annual basis on a DMR (due on January 28 of each year of the permit cycle).
(8) Quarterly Average Load calculation: lbs/day = the average of all calculated individual daily average loads (lbs/day) recorded during the reporting period.
(9) Annual Load calculation: lbs/year = the total average of all calculated individual daily average loads (lbs/day) recorded during the calendar year, multiplied by 365 (days/year).

6.2 GROUND WATER MONITORING

As a special condition, this permit requires ground water monitoring to provide long term ambient and downgradient characterization of the aquifer. The 2008 permit for Valley Grove included ground water monitoring as a condition of the permit. The current permit renewal also includes ground water monitoring to better ensure water quality. Valley Grove may use the previous well for ground water monitoring, which was designated MW-4 or any of the wells identified in the permit renewal application: MW-1, MW-2 or MW3 (**Figure 3**). Data collected via ground water monitoring will be used for mixing zone evaluation, aquifer characterization in

future permit renewals, and compliance monitoring . Sampling and reporting requirements shall commence upon the effective date of the permit. The groundwater monitoring well will be identified in this permit as MW-1.

Ground water monitoring and reporting requirements are summarized in **Table 10**. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

Table 10: Ground Water Monitoring and Reporting Requirements

Parameter[1]	Monitoring Locations	Units	Sample Type[2]	Minimum Sampling Frequency	Reporting[2][3][4] Requirements	Reporting Frequency
Chloride (as Cl)	MW-1	mg/L	Grab	Quarterly	Quarterly Average	Quarterly
Nitrate + Nitrite (as N)	MW-1	mg/L	Grab	Quarterly	Daily Maximum & Quarterly Average	Quarterly
Nitrogen (as N), Total Kjeldahl Nitrogen	MW-1	mg/L	Grab	Quarterly	Daily Maximum & Quarterly Average	Quarterly
Static Water Level (SWL)[5]	MW-1	ft-bmp	Instantaneous	Quarterly	Quarterly Average	Quarterly
Specific Conductivity @ 25°C	MW-1	µS/cm	Instantaneous	Quarterly	Quarterly Average	Quarterly

Footnotes:

CFU = Colony Forming Units

ft-bmp = feet below measuring point

At no time shall the permittee mark or state “no discharge” on any monitoring well DMR form.

(1) Parameter analytical methods shall be in accordance with the Code of Federal Regulations, 40 CFR Part 136

(2) See definitions in Part V of the permit.

(3) Daily Maximum: Report highest measured daily value for the reporting period on Discharge Monitoring Report (DMR) form.

(4) The geometric mean must be reported if multiple samples are taken during a reporting period.

(5) Measuring point for SWL measurements shall be from top of casing and measured to within 1/100th of one foot.

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 **October 8, 2020**. 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 (MTX000112), 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.

APPENDIX A – MONITORING WELL LOGS

Upgradient Monitoring Well – MW-4

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps

Site Name: VALLEY GROVE, SUBDIVISION
GWIC Id: 210037

Section 1: Well Owner(s)
1) VALLEY GROVE SUBDIVISION (MAIL)
2066 STADIUM DR, UNIT 202C
BOZEMAN MT 59715 [04/21/2004]

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	20	SW¼ SW¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.730941	-111.140526	TRS-SEC	NAD83

Ground Surface Altitude	Ground Surface Method	Datum Date

Addition	Block	Lot
LEWIS & CLARK ST		

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: Wednesday, April 21, 2004

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	60	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	60	6	0.250		WELDED	A53B STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
45	60	6	3 PER FOOT	1/4" WIDE X 4" LONG	TORCH OR PLASMA CUTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	20	BENTONITE	Y

Section 7: Well Test Data

Total Depth: 60
Static Water Level: 15
Water Temperature:

Air Test *

15 gpm with drill stem set at 55 feet for 1 hours.
Time of recovery 1 hours.
Recovery water level 15 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	2	TOPSOIL
2	60	GRAVEL & SAND

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: KEVIN HAGGERTY DRILLING INC
License No: MWC-94
Date Completed: 4/21/2004

Downgradient Monitoring Well – MW-3

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (1/18/2007 6:49:23 PM)

Site Name: CARTER FAMILY FARMS * #2
GWIC Id: 179863

Section 1: Well Owner(s)
1) CARTER FAMILY FARMS #2 (MAIL)
2320 E CAMERON BRIDGE RD
BOZEMAN MT 59718 [12/15/1999]

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	20	SW¼ SE¼ NW¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.73743305865	-111.1368965135	TRS-SEC	NAD83

Ground Surface Altitude	Ground Surface Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: Wednesday, December 15, 1999

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	27	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1	24	2			THREADED	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
-9	24	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	7	ENVIRO PLUG & BENTON	
7	27	10/20 SILICA	

Section 7: Well Test Data

Total Depth: 24
Static Water Level: 13.25
Water Temperature:

Air Test *

12 gpm with drill stem set at 23 feet for 0.5 hours.
Time of recovery 0 hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	1	TOPSOIL
1	27	SAND AND GRAVELS

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: RED TIGER DRILLING
License No: WWC-365
Date Completed: 12/15/1999

Downgradient Monitoring Well – MW-1

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (1/18/2007 6:47:58 PM)

Site Name: GIARD EARL
GWIC Id: 133260

Section 1: Well Owner(s)
1) GIARD, EARL (MAIL)
HARPER PUCKET RD
BOZEMAN MT 59715 [09/15/1992]

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	20	

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.736506	-111.133267	TRS-SEC	NAD83

Ground Surface Altitude	Ground Surface Method	Datum Date

Addition	Block	Lot

Section 3: Proposed Use of Water
DOMESTIC (1)

Section 4: Type of Work
Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: Tuesday, September 15, 1992

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	65	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.5	58.5	6	.250		WELDED	STEEL
55	65	4.5		160.00	WELDED	PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
65	65	4.5			OPEN BOTTOM *

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	20	BENTONITE	

Section 7: Well Test Data

Total Depth: 65
Static Water Level: 22
Water Temperature:

Air Test *

50 gpm with drill stem set at 57 feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 57 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	3	TOPSOIL
3	65	SAND & GRAVEL

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: VAN DYKEN DRILLING INC
License No: WWC-380
Date Completed: 9/15/1992

Downgradient Monitoring Well – MW-2

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (1/18/2007 6:49:32 PM)

Site Name: CARTER FAMILY FARMS * #1
GWIC Id: 179862

Section 1: Well Owner(s)
1) CARTER FAMILY FARMS #1 (MAIL)
2320 E CAMERON BRIDGE RD
BOZEMAN MT 59718 [12/15/1999]

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	20	SE¼ NW¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.73743305865	-111.1344768885	TRS-SEC	NAD83

Ground Surface Altitude	Ground Surface Method	Datum Date

Addition	Block	Lot

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: Wednesday, December 15, 1999

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	26	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	4	6	.250		WELDED	STEEL
-1	25	2			THREADED	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
-10	25	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	7	ENVIRO PLUG/BENT	
7	26	10/20 SILICA	

Section 7: Well Test Data

Total Depth: 25
Static Water Level: 11.75
Water Temperature:

Air Test *

3 gpm with drill stem set at 23 feet for 0.5 hours.
Time of recovery 0 hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	1	TOPSOIL
1	26	SAND GRAVEL

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: RED TIGER DRILLING
License No: WWC-365
Date Completed: 12/15/1999

APPENDIX B – SOILS INFORMATION

Valley Grove Soils Map

Gallatin County Area, Montana (MT622)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
53B	Amsterdam silt loam, 0 to 4 percent slopes	108.8	27.4%
53C	Amsterdam silt loam, 4 to 8 percent slopes	61.8	15.6%
57B	Turner loam, 0 to 4 percent slopes	26.5	6.7%
249A	Beaverton cobbly clay loam, 0 to 2 percent slopes	67.2	16.9%
307A	Sudworth silty clay loam, 0 to 2 percent slopes	12.8	3.2%
448A	Hyalite-Beaverton complex, moderately wet, 0 to 2 percent slopes	47.3	11.9%
453B	Amsterdam-Quagle silt loams, 0 to 4 percent slopes	0.7	0.2%
453C	Amsterdam-Quagle silt loams, 4 to 8 percent slopes	4.6	1.2%
457A	Turner loam, moderately wet, 0 to 2 percent slopes	14.7	3.7%
509B	Enbar loam, 0 to 4 percent slopes	12.0	3.0%
748A	Hyalite-Beaverton complex, 0 to 4 percent slopes	40.1	10.1%
Totals for Area of Interest		**396.4**	**100.0%**

Gallatin County Area, Montana

748A—Hyalite-Beaverton complex, 0 to 4 percent slopes

Map Unit Setting

- *National map unit symbol:* 570v
- *Elevation:* 4,350 to 6,150 feet
- *Mean annual precipitation:* 15 to 19 inches
- *Mean annual air temperature:* 39 to 45 degrees F
- *Frost-free period:* 90 to 110 days
- *Farmland classification:* Farmland of local importance

Map Unit Composition

- *Hyalite and similar soils:* 70 percent
- *Beaverton and similar soils:* 20 percent
- *Minor components:* 10 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Hyalite

Setting

- *Landform:* Alluvial fans, stream terraces
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Loamy alluvium

Typical profile

- *A - 0 to 5 inches:* loam
- *Bt1 - 5 to 9 inches:* clay loam
- *Bt2 - 9 to 17 inches:* silty clay loam
- *2Bt3 - 17 to 26 inches:* very cobbly sandy clay loam
- *3C - 26 to 60 inches:* very cobbly loamy sand

Properties and qualities

- *Slope:* 0 to 4 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 5 percent
- *Available water storage in profile:* Low (about 4.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* 3e
- *Land capability classification (nonirrigated):* 4e
- *Hydrologic Soil Group:* C
- *Ecological site:* Upland Grassland (R043BP818MT)
- *Hydric soil rating:* No

Description of Beaverton

Setting

- *Landform:* Alluvial fans, stream terraces
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear

- *Parent material:* Alluvium

Typical profile

- *A - 0 to 5 inches:* cobbly loam
- *Bt - 5 to 21 inches:* very gravelly clay loam
- *Bk - 21 to 25 inches:* very cobbly coarse sandy loam
- *2Bk - 25 to 60 inches:* extremely cobbly loamy coarse sand

Properties and qualities

- *Slope:* 0 to 4 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 15 percent
- *Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
- *Available water storage in profile:* Low (about 3.7 inches)

Interpretive groups

- *Land capability classification (irrigated):* 4s
- *Land capability classification (nonirrigated):* 6s
- *Hydrologic Soil Group:* B
- *Ecological site:* Upland Grassland (R043BP818MT)
- *Hydric soil rating:* No

Minor Components

Hyalite

- *Percent of map unit:* 5 percent
- *Landform:* Alluvial fans, stream terraces
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Ecological site:* Shallow to Gravel (SwGr) 15-19" p.z. (R044XS354MT)
- *Hydric soil rating:* No

Turner

- *Percent of map unit:* 5 percent
- *Landform:* Stream terraces
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Ecological site:* Silty (Si) 15-19" p.z. (R044XS355MT)
- *Hydric soil rating:* No

APPENDIX C – REFERENCES

40 CFR § 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants. 2017.

Administrative Rules of Montana, Title 17, Chapter 30, Water Quality:
- Subchapter 2 – Water Quality Permit Fees.
- Subchapter 5 – Mixing Zones in Surface and Ground Water.
- Subchapter 6 – Surface Water Quality Standards and Procedures.
- Subchapter 7 – Nondegradation of Water Quality.
- Subchapter 10 – Montana Ground Water Pollution Control System.
- Subchapter 13 – Montana Pollutant Discharge Elimination System.

Brady, N.C. and Weil, R. R. 2004. Elements of the Nature and Properties of Soils 2nd Edition. Prentice Hall. Upper Saddle River, NJ.

Cherry, J.A. and Freeze, R. A. 1979. Groundwater, Prentice-Hall Inc., Englewood Cliffs, J.J.

Department of Environmental Quality. 2001. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Valley Grove MTX000112.

Department of Environmental Quality. 2008. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Valley Grove MTX000112.

Department of Environmental Quality. 2014. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Valley Grove MTX000112.

Department of Environmental Quality. 2019. Administrative Record of Montana Ground Water Pollution Control System (MGWPCS) permit application and supplemental materials, Valley Grove MTX000112.

Department of Environmental Quality, Water Quality Circulars:
- 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.

Driscoll, F.G. 1986. Groundwater and Wells 2nd Edition. Johnson Division. St. Paul, Minnesota.

Fetter, C.W. 2001. Applied Hydrogeology 4th Edition. Prentice Hall. Upper Saddle River, NJ.

Ground-Water Information Center (GWIC), Montana Bureau of Mines and Geology. Retrieved 2020 from GWIC database, http://mbmggwic.mtech.edu.

Hackett, O. M., F. N. Visher, R. G. McMurtrey and W. L. Steinhilber. 1960. Geology and Groundwater Resources of the Gallatin Valley, Gallatin County, Montana. United States Government Printing Office. Washington D. C.

Montana Code Annotated (MCA), Title 75, Chapter 5, Montana Water Quality Act. 2017.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2020. National Cooperative Soil Survey. Retrieved from http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

U.S. Environmental Protection Agency, Effluent Limitation Guidelines, http://water.epa.gov/scitech/wastetech/guide/, 2019.

U.S. Environmental Protection Agency. 2002. Office of Water and Office of Research and Development. Onsite Wastewater Treatment Systems Manual. 625-R-00-008.

U.S. Environmental Protection Agency. 2010. Office of Wastewater Management. NPDES Permit Writers Manual. 833-K-10-001.

U.S. Geological Survey, Basic Ground Water Hydrology, http://pubs.usgs.gov/wsp/2220/report.pdf, 2010.

U.S. Geological Survey, Groundwater Resources, http://water.usgs.gov/ogw/basics.html, 2020.

Weight, W. D. and J. L. Sonderegger. 2001. Manual of Applied Field Hydrogeology. McGraw-Hill. New York.