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:	Manley Meadows Homeowners Association
Permit Number:	MTX000153
Permit Type:	Domestic wastewater
Application Type:	Renewal
Facility Name:	Manley Meadows Subdivision
Facility Location:	Gallatin County Northeast ¼ of Section 25, Township 01 South, Range 05 East Latitude: 45.727365° Longitude: -111.045336°
Facility Address:	3209 McIlhattan Rd, Bozeman, MT, 59715
Facility Contact:	C. R. Roberts, Consultant RNR Engineering, LLC 299 Willow Boulevard Bozeman, MT 59718
Treatment Type:	Level II
Receiving Water:	Class I Ground Water
Number of Outfalls:	1
Outfall / Type:	001 / Elevated Sand Mound (ESM)
Effluent Type:	Domestic strength wastewater
Mixing Zone:	Standard
Compliance Limit Type:	Groundwater compliance limit
Groundwater Limits:	Nitrogen (Nitrate + Nitrite): 7.5 mg/L – MW-2, MW-2a, MW-3, MW-3a *Escherichia coli*: Equal to or greater than one organism per 100 ml – MW-1
Flow Rate:	Design maximum: 14,700 gpd
Mid-treatment sampling:	Samples must be collected from the dose tank prior to the ESM.
Ground water sampling:	MW-1, MW-2, MW-2a, MW-3, MW-3a, MW-4: quarterly
Fact Sheet Date:	September 2018
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 issued to Manley Meadows Homeowners Association (applicant) for the Manley Meadows Subdivision wastewater treatment system.

1.1 APPLICATION

DEQ received an application for renewal of the permit on October 29, 2015. Renewal fees accompanied the application. DEQ reviewed the submittal and issued a completeness letter on November 9, 2015.

1.2 PERMIT HISTORY

The original permit was first issued on March 1, 2005. A renewal permit became effective April 1, 2011. Effluent limits from previous permit were set at 474 lbs/ year for phosphorus. Groundwater compliance limitations were established with trigger values for nitrogen (nitrate + nitrite) at 7.5 mg/L and *Escherichia coli* (*E. coli*) bacteria at equal to or greater than one organism per 100 ml.

1.3 CHANGES TO THIS PERMIT

Groundwater compliance limitations will remain in effect at the same levels. However, the previous permit established effluent limits for nitrogen in the event that a change to the system allowed for effluent sampling. Effluent limits were also calculated in this permit using ambient groundwater data collected from monitoring wells on the property. Effluent limits are discussed in **Section 5**. Effluent limit calculations are provided in detail in **Appendix A**.

This system does not have an effluent sampling location. Samples at the dose tank prior to treatment in the ESM are mid-stream treatment samples. The term mid-stream treatment will be used to describe dose tank samples.

There is no longer a phosphorus limit in pounds per year as phosphorus breakthrough is considered nonsignificant (**Section 5.2**). Therefore, there is also a change in monitoring and reporting. Total phosphorus in pounds per day and pounds per year will not be required. Water quality monitoring is described in **Section 6** and in **Table 9**.

In terms of groundwater monitoring total phosphorus has been added as has ammonia and total Kjeldahl nitrogen. *E.* coli will no longer be a required sampling parameter for monitoring wells MW-2, MW-2a, MW-3 and MW-3a. MW-1 is the bacterial well and *E.* coli monitoring will remain in effect for this well. Groundwater monitoring is discussed in Section **6.2** and **Table 10**.

2.0 FACILITY INFORMATION

2.1 LOCATION

The Manley Meadows Subdivision wastewater treatment system is located about 2 miles north of Bozeman at the junction of McIlhattan Road and Quinn David Lane **(Figure 1)**. The subdivision encompasses 42 residential lots on about 160 acres. **(Figure 2).** 20 lots are currently developed with residential homes. The Manley Meadows wastewater system is located in the north-eastern portion of the property **(Figure 3).**

Figure 1. Location of MANLEY MEADOWS Subdivision

Figure 2. Manley Meadows Subdivision showing lot lines and wastewater system location.

Figure 3. MANLEY MEADOWS WASTEWATER SYSTEM

2.2 OPERATIONS

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

Table 1: Collection, Treatment, and Disposal System Summary
Inflows
Contributing Sources of Wastewater: Domestic In-Nature Standard Industrial Code(s) (SIC) of contributing sources: 4952 The number of connected residences: 20 single-family residences of 42 maximum. The number of connected business: 0
Influent Sampling Location: None
Influent Flow Monitoring Equipment: None
Treatment
Individual septic tanks for primary treatment (one 1500-gallon tank then one 1000-gallon tank per residence) followed by advanced treatment in an elevated sand mound (ESM).
Treatment Level: Level 2
Location: 45.727353° Latitude and -111.04532° Longitude
Disposal System
Disposal Structure: Pressure-dosed four-zoned elevated sand mound (Outfall 001)
Method of Disposal: Infiltration to ground water
Location: 45.727353° Latitude and -111.04532° Longitude
Daily Maximum Design Flow (gpd): 14,700
Mid-stream Treatment Sampling Location: MID-001: Water quality samples are taken from the dose tank (Outfall 001).
Flow Monitoring Equipment: 4 Flow meters FM-001, FM-002, FM-003, FM-004 (F in Figure 4) are located between the dose tank and drainfield. Flow meters are Sure Flow brand meters. Type: paddle wheel with indicator and totalizer.

The Manley Meadows Subdivision wastewater system consists of septic tanks for primary treatment followed by a dosed elevated sand mound for secondary treatment. Each home has a 1500-gallon septic tank with an effluent filter for removal of solids and primary treatment, followed by a 1000-gallon dosing tank. From the dosing tanks effluent is collected into a 7000-gallon dosing tank that discharges to four separate pressure-dosed distribution networks within the ESM. **Figure 4** is a line diagram of the system. Pressure dosing uniformly distributes the effluent over the surface of the sand mound through the laterals. The system transfers effluent several times per day. These periodic applications of effluent to the sand mound allow the mound to rest between applications of water. The mound can drain drawing air in, resulting in aerobic treatment of the wastewater. Treated wastewater flows through the sand allowing for filtration before it enters the groundwater.

There is not an effluent sampling location. Mid-stream treatment sampling is at the dose tank prior to the ESM (MID-001) (**Figure 4**). Monitoring well, MW-1, is located directly downgradient of the outfall. Samples from MW-1 are representative of water quality following the last point of treatment and initial mixing with the natural groundwater table. The original permit (2005) considered samples collected from MW-1 to be representative of effluent characteristics. The 2010 permit stated that these samples will no longer be representative of effluent discharged from the system because of the mixing that occurs immediately with the groundwater at MW-1.

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

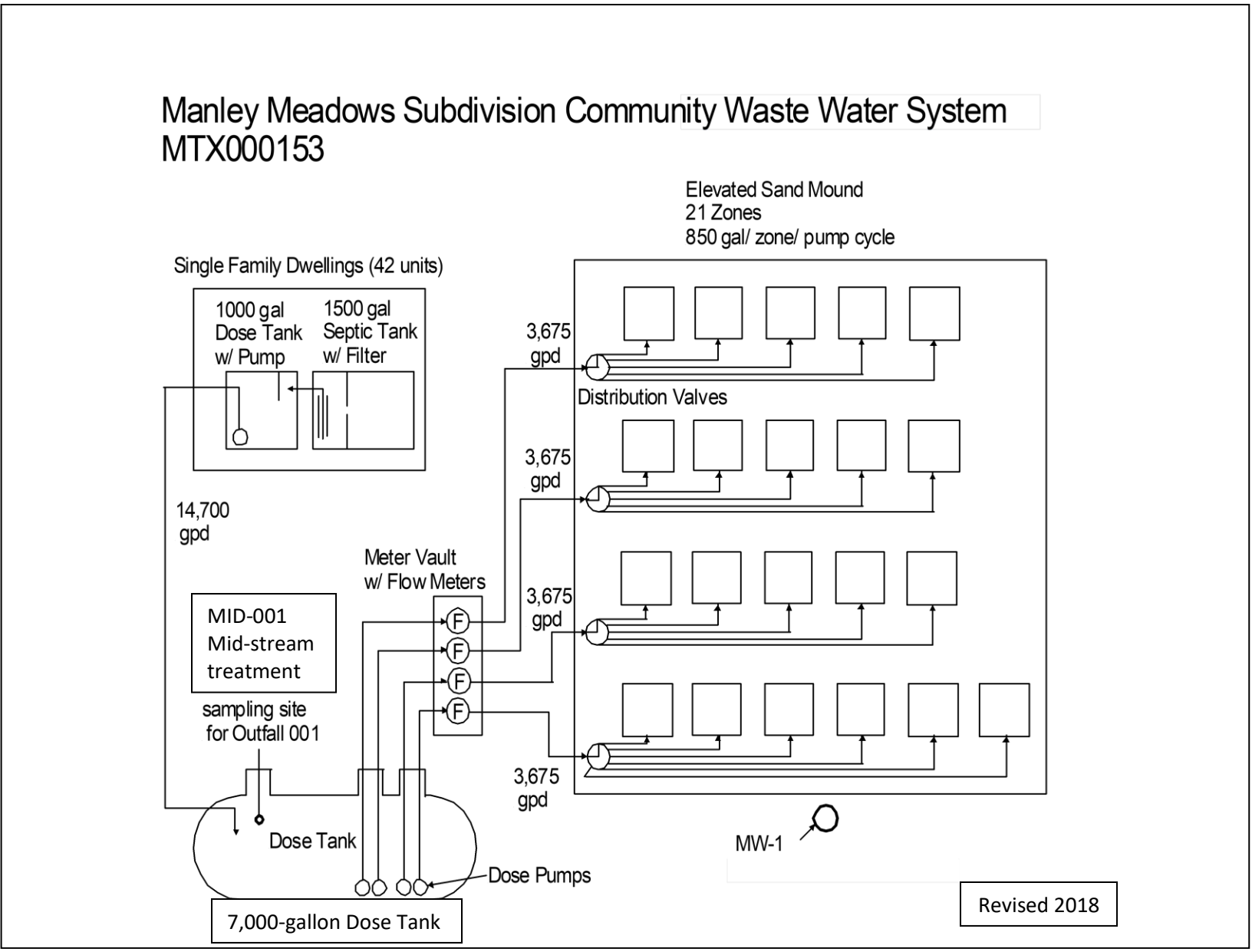


Figure 4. Wastewater Treatment System Line Diagram.

COMPLIANCE HISTORY

Review of monitoring information, identified the following findings:

- Groundwater compliance limits were set at 7.5 mg/L Nitrate + Nitrite (as N) for monitoring wells at the end of the mixing zone (MW-2, MW-2a, MW-3, MW-3a). There have been no exceedances for nitrogen in groundwater samples during the previous permit cycle.
- Groundwater compliance limits were set for *E. coli* at one or more organisms per 100 ml. Samples were above the limit for *E. coli* in all but one groundwater monitoring well during the 6/30/2017 sampling. High groundwater in the area is thought to be the cause.
- Monitoring well, MW-1, has not had a positive sample for *E. coli.*
- Effluent limits of 474 lbs/year phosphorus were set in previous permit. There have been no violations for phosphorus.

2.3 MID-STREAM WASTEWATER CHARACTERISTICS

DEQ requires a permit applicant to disclose the quality of the wastewater so that DEQ may evaluate the potential for pollution of state water. During the previous permit cycle, the facility sampled and reported wastewater quality criteria to DEQ in the form of discharge monitoring reports (DMRs). These data are summarized below 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: Wastewater Quality Data – Dose Tank – (MID-001) - Reported DMR values

Parameter[1]	Units	Reported Minimum Value	Reported Average Value	Reported Maximum[2] Value	# of Samples	2012 Permit Limit
Biochemical Oxygen Demand (BOD_5)	mg/L	46.00	106.57	190.00	28	
Chloride (as Cl)	mg/L	249.00	530.71	780.00	28	
Flow rate, Discharge	gpd	2248.00	5219.78	13,709.00	28	14,700
Nitrogen, Nitrate + Nitrite (as N)	mg/L	0.01	0.03	0.06	28	
Nitrogen, Total Ammonia (as N)	mg/L	22.00	51.04	60.00	28	
Nitrogen, Total Kjeldahl (as N)	mg/L	21.00	57.70	78.40	28	
Nitrogen, Total (as N)	mg/L	21.01	57.73	78.46	28	
	lbs/day	0.46	0.97	1.74	28	
Phosphorus, Total (as P)[3]	lbs/yr	26.50	40.83	51.00	6	474.0
	mg/L	3.90	6.67	7.91	28	
Total Suspended Solids (TSS)	mg/L	13.00	29.54	58.00	28	

Footnotes:

DMR = Self-Reported Discharge Monitoring Reports

Period of Record: June 2011 through June 2018.

Wastewater quality is measured prior to treatment in Elevated Sand Mound

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

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

(3) Phosphorus values (mg/L) calculated from past 16 monthly averages

2.4 GEOLOGY

The ESM is constructed on top of quaternary fluvial and quaternary / tertiary alluvial deposits. Based on soil test pits in the area of the proposed ESM the soils consist of silty/sandy clay loams, silty-clays and clay loams that overly coarser sands, loamy sands and gravelly loamy sands. The coarser materials occur in the soil profile at depths greater than 45 inches below ground surface. The Natural Resource Conservation Service mapping of soils in this area is consistent with the test pits in the area of the sand mound (DEQ, 2004).

2.5 HYDROGEOLOGY

Hydraulic conductivity (K) of the shallow ground water (281.8 feet/day) was estimated from the average values calculated from three wells located in the same area as the ESM. All three wells are constructed in the upper shallow aquifer (less than 40 feet) as discussed in the original statement of basis (DEQ, 2004). The hydraulic gradient (0.007 ft/ft) and ground water flow direction (N50°W) were estimated from ground water levels of four monitoring wells located in the vicinity of the ESM prior to construction of the facility (DEQ, 2004). Important hydrogeologic characteristics are summarized below in **Table 3**.

Table 3. Hydrogeologic Summary	
Average depth to ground water	6 feet (MW-4: 2011 – 2018, DMR)
General ground water flow direction	N50°W
Hydraulic conductivity	281.8 feet per day
Hydraulic gradient	0.007 feet/feet
Nearest downgradient surface water	Churn Creek (570 feet)

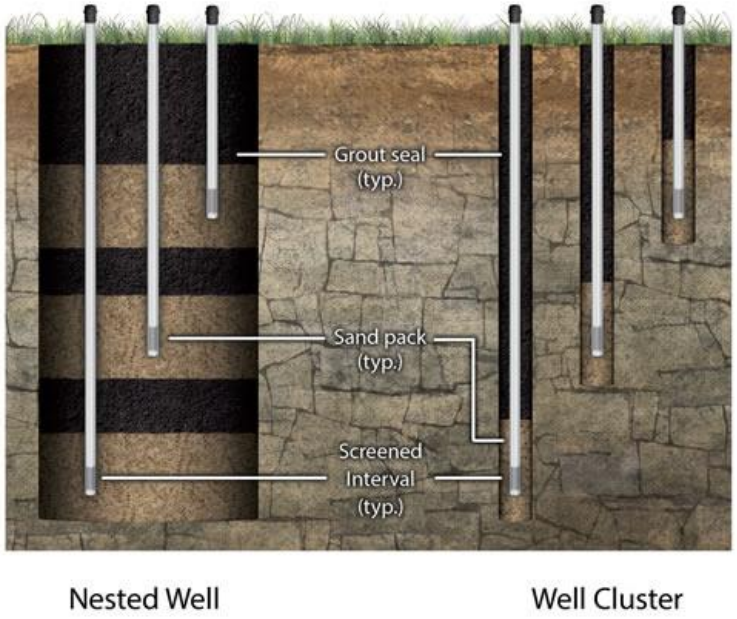
2.6 GROUND WATER MONITORING WELLS

There are 6 monitoring wells associated with this permit: MW-1, MW-2, MW-2a, MW-3, MW-3a and MW-4. These wells are plotted on **Figure 3**. Monitoring well construction details are provided below in **Table 4**. Each well was constructed to monitor groundwater quality in relation to the wastewater system. Rationale for each is discussed in **Table 4**. Driller's logs for each monitoring well are attached as **Appendix B**.

Table 4. Monitoring Well Summary
Monitoring Well: MW-1
MBMG GWIC #: 222726
Status: Constructed on November 29, 2005 Depth: 25 feet; Screen: 5-25 feet
Location: Latitude: 45.72781º North Longitude: - 111.04619º West
Representation: Immediately downgradient of Outfall 001 (ESM); groundwater quality in early mixing zone
Monitoring Well: MW-2
MBMG GWIC #: 222731
Status: Constructed on November 30, 2005 Depth: 25 feet; Screen: 5 - 25 feet
Location: Latitude: 45.72826º North Longitude: - 111.04759º West
Representation: Down gradient of Outfall 001 (500-feet); groundwater quality at end of mixing-zone
Monitoring Well: MW-2a
MBMG GWIC #: 222728
Status: Constructed on November 30, 2005 Depth: 47 feet; Screen: 24 - 44 feet
Location: Latitude: 45.72826º North Longitude: - 111.04759º West
Representation: Down gradient of Outfall 001 (500-feet); groundwater quality at end of mixing-zone
Monitoring Well: MW-3
MBMG GWIC #: 222735
Status: Constructed on December 1, 2005 Depth: 53 feet; Screen: 1.5 - 16 feet
Location: Latitude: 45.72888º North Longitude: - 111.04703º West
Representation: Downgradient of Outfall 001 (500-feet); groundwater quality at end of mixing-zone

Monitoring Well: MW-3a
MBMG GWIC #: 222735
Status: Constructed on December 1, 2005 Depth: 53 feet; Screen: 24 - 31 feet
Location: Latitude: 45.72888º North Longitude: - 111.04703º West
Representation: Downgradient of Outfall 001 (500-feet); groundwater quality at end of mixing-zone
Monitoring Well: MW-4
MBMG GWIC #: 253325
Status: Constructed on December 3, 2005 Depth: 26 feet; Screen: 5 - 25 feet
Location: Latitude: 45.72641º North Longitude: - 111.04565º West
Representation: Upgradient of Outfall 001; ambient groundwater quality

There is no sampling location that is representative of effluent quality following treatment from the ESM. Therefore, the four monitoring wells located at the end of the mixing zone are important in monitoring water quality as a result of the wastewater discharge of this system (MW-2, MW-2a, MW-3, MW-3a). The system has met water quality standards set for nitrogen and phosphorus the entire length of the permit cycle. One round of quarterly samples was positive for *E. coli* bacteria (6/30/2017).



MW-2 and MW-2a are clustered wells that are respectively perforated from 5 – 25 feet and 24 – 44 feet below ground surface (bgs). MW-3 and MW-3a are nested wells that are respectively perforated from 1.5 – 16 feet and 24 – 31 feet bgs. A graphic example of clustered and nested wells can be found in **Figure 5**.

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.

Figure 5. Examples of a Nested Well and a Well Cluster. (Johnson, 1983)

2.7 GROUND WATER QUALITY CHARACTERISTICS

Receiving water for outfall 001 is ground water. Information from multiple water quality samples collected from MW-4, which is representative of receiving water quality, is summarized in **Table 5**. The average specific conductance is 547.93 µS/cm which is characteristic of Class I ground water.

Groundwater monitoring results from all of the monitoring wells are summarized in **Table 5.**

Table 5. Ground Water Monitoring Results

Monitor Source	Representation	Parameter	Units	Reported Minimum Value	Reported Average Value	Reported Maximum Value	# of Samples	Source of Data (1) (2) (3)
MW4	Ambient Ground Water Quality Shallow ground water, 150 feet sidegradient from Outfall 001. Depth 26 feet. Screen 5-25 feet	Chloride (as Cl)	mg/L	7.00	12.25	21.00	28	DMR
		Escherichia coli Bacteria	CFU/100 ml	<1	<1	3.00	28	DMR
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	0.03	1.90	3.96	28	DMR
		Specific Conductivity (@ 25°C)	µS/cm	126.00	547.93	851.00	28	DMR
		Total Dissolved Solids	mg/L	293.00	308.00	329.00	3	APP
		pH	s.u.	7.40	7.60	7.89	3	APP
		Total Organic Carbon	mg/L	0.80	0.87	1.00	3	APP
		Static Water Level	ft-bgs	3.54	5.99	10.00	28	DMR
MW1	Shallow ground water, Immediately downgradient from ESM / Outfall 001. Depth 25 feet. Screen 5-25 feet	Chloride (as Cl)	mg/L	19.00	34.74	86.00	28	DMR
		Escherichia coli Bacteria	CFU/100 ml	< 1	< 1	< 1	28	DMR
		Nitrogen, total (as N)	mg/L	1.60	3.47	9.30	28	DMR
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	1.60	3.43	8.10	28	DMR
		Static Water Level	ft-bgs	4.33	6.36	9.00	28	DMR
MW2	Shallow ground water, 500 feet downgradient from Outfall 001. Depth 25 feet. Screen 5-25 feet	Chloride (as Cl)	mg/L	9.00	16.31	38.00	28	DMR
		Escherichia coli Bacteria	CFU/100 ml	< 1	< 1	3.00	28	DMR
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	0.84	2.21	4.02	28	DMR
		Specific Conductivity (@ 25°C)	µS/cm	122.00	573.86	675.00	28	DMR
		Static Water Level	ft-bgs	2.21	3.97	10.00	28	DMR
MW2a	Shallow ground water, 500 feet downgradient from Outfall 001. Depth 47 feet. Screen 24-44 feet	Chloride (as Cl)	mg/L	9.00	15.28	22.00	28	DMR
		Escherichia coli Bacteria	CFU/100 ml	< 1	< 1	18.00	28	DMR
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	0.15	2.15	3.70	28	DMR
		Specific Conductivity (@ 25°C)	µS/cm	124.00	576.14	777.00	28	DMR
		Static Water Level	ft-bgs	1.79	3.98	10.00	28	DMR
MW3	Shallow ground water, 500 feet downgradient from Outfall 001. Depth 53 feet. Screen 1.5-16 feet	Chloride (as Cl)	mg/L	13.00	23.62	47.00	28	DMR
		Escherichia coli Bacteria	CFU/100 ml	<1	<1	2.00	28	DMR
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	1.53	2.91	3.76	28	DMR
		Specific Conductivity (@ 25°C)	µS/cm	533.00	632.45	743.00	28	DMR
		Static Water Level	ft-bgs	1.00	2.76	12.00	28	DMR
MW3a	Shallow ground water, 500 feet downgradient from Outfall 001. Depth 53 feet. Screen 24-31 feet	Chloride (as Cl)	mg/L	12.00	25.64	43.00	28	DMR
		Escherichia coli Bacteria	CFU/100 ml	< 1	< 1	14.00	28	DMR
		Nitrogen, Nitrate + Nitrite (as N)	mg/L	0.14	3.06	5.45	28	DMR
		Specific Conductivity (@ 25°C)	µS/cm	541.00	650.85	897.00	28	DMR
		Static Water Level	ft-bgs	1.00	2.76	12.00	28	DMR

Footnotes:

Period of Record: 06/30/2011 through 06/30/2018.

(1) Self-reported DMR Reports. Ground water quality samples collected from MW-2, MW-2a, MW-3 and MW-3a, for location see Figure 3

(2) DMR = Self Reported Discharge Monitoring Reports

(3) APP = Application Form GW-2 and supplemental materials.

CFU = Colony Forming Units

ft-bgs = feet below ground surface

s.u. = standard units

ESM = Elevated Sand Mound

3.0 WATER QUALITY STANDARDS AND NONDEGRADATION

Ground water is a water of the state. The State of Montana uses several water quality measures to protect, sustain, and improve the quality of state waters. These water quality limitations provide the basis for effluent limits that DEQ applies to discharge permits (**Section 5**). 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 BENEFICIAL USES

With a specific conductivity of 547.93 µS/cm (**Table 5** above), 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

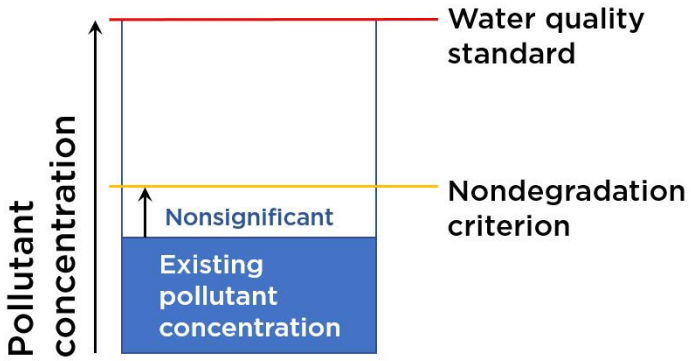
DEQ protects all the assigned beneficial uses by protecting the most sensitive. Drinking water is the most sensitive use of this receiving water.

3.2 WATER QUALITY STANDARDS

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 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 states that certain types of common activities cause nonsignificant changes in water quality, and provides criteria for determining whether changes in water quality are significant.



Nonsignificant changes do not require further nondegradation review. Therefore, DEQ must determine whether the proposed discharge will result in significant changes in water quality.

3.4 NONSIGNIFICANCE

When developing the initial permit (2005), DEQ determined that discharges in compliance with this permit result in nonsignificant changes in water quality. This discharge has not increased since this determination, and therefore DEQ did not perform a new significance determination for this permit renewal. DEQ determined that the discharge continues to meet ground water nonsignificance/nondegradation criteria (described below) at the end of the mixing zone (**Section 4**). DEQ used these criteria and updated ground water quality data to establish effluent limits (discussed below in **Section 5**).

For this discharge to ground water, the following nonsignificance criteria are relevant:

Nitrogen

Under Montana statute, ground water total nitrogen at or below 7.5 mg/L at the downgradient end of the mixing zone (see **Section 4**) is a nonsignificant change in water quality, so long as the discharge does not cause degradation of surface water. Using the nonsignificance criterion of 7.5 mg/L, DEQ established effluent limits that cause the discharge to comply with ground water nonsignificance/nondegradation criteria at the end of the mixing zone. This is discussed in detail in **Section 5.1**.

Phosphorus

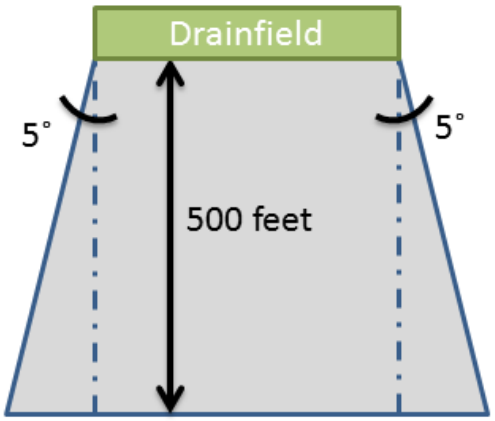
A total phosphorus surface water breakthrough time of greater than 50 years is a nonsignificant change in water quality. The phosphorus criterion requires an analysis to determine a breakthrough time. Breakthrough occurs when the subsurface soils lose their capability to adsorb any more phosphorus, and it reaches surface water.

A phosphorus breakthrough analysis conducted by DEQ in 2005 estimated the phosphorus breakthrough to occur in 50.6 (*i.e.* >50) years. Phosphorus breakthrough time of greater than 50 years is considered nonsignificant. The 2005 permit established an effluent limit to maintain the 50-year breakthrough.

4.0 MIXING ZONE

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. These values are drawn from the previous fact sheet.

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.

Table 6. Hydrogeologic and Mixing Zone Information - Outfall 001

Parameter	Units	Value
Mixing Zone Type	-	Standard
Authorized Parameters	-	Total Nitrogen
Length of Mixing Zone	feet	500
Thickness of Mixing Zone	feet	15
Outfall Width, Perpendicular to Ground Water Flow Direction	feet	321
Width of Mixing Zone at Down Gradient Boundary	feet	408.5
Cross Sectional Area of Mixing Zone (A)	ft^2	6127.5
Hydraulic Conductivity (K)	feet/day	282
Hydraulic Gradient (I)	ft/ft	0.0070
Volume of Ground Water Available for Mixing (Q_{gw})	ft^3/day	12,087

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 below 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 Criteria

Parameter [(1)]	Human Health Standard	Beneficial Use Support	Nondegradation Criteria
Nitrogen, Nitrate + Nitrite (as N)	10 mg/L	-	-
Total Nitrogen	-	10 mg/L	**7.5 mg/L**
Escherichia coli bacteria	**< 1 CFU/100mL**	-	-

Footnotes:

CFU = Colony Forming Unit

(1) The list includes indentified parameters of interest.

This discharge permit includes numeric WQBELs that restrict the strength and volume of the discharge. The ground water nonsignificance criteria (**Section 3.4**) 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.

Ground water compliance limits specific to monitoring wells for this system are found in Table 11 and Table 12.

5.1 TOTAL NITROGEN EFFLUENT LIMIT

Due to the design of the wastewater system, the establishment of an effluent sampling point that is representative of the last point of treatment for total nitrogen is not feasible. Therefore a total nitrogen effluent limit shall not be established within this permit. In place of a total nitrogen effluent limit, the Department will establish a ground water compliance limit as discussed below. The Department assumes all the nitrogen discharged to the ESM in the effluent is converted to nitrate (as N). The significance criteria at ARM 17.30.715(1)(d) states that nitrate concentrations in ground water at the end of the mixing zone may not exceed the numeric criterion of 7.5 mg/L, therefore the Department will establish this as a ground water compliance limit as displayed in Table 7 and Table 11. As previously discussed in Section 2.6, monitoring wells have been established along the down gradient boundary of the end of the mixing zone. The monitoring locations to

determine compliance with this limit are the monitoring wells MW-2, MW-2a, MW-3, and MW-3a (Figure 3). Ground water monitoring requirements are discussed in Section 6.2.

In the future it may be deemed necessary to make modifications to the system that would allow for effluent monitoring and reporting. In that event the effluent limit for nitrogen load has been calculated in Appendix A.

The nonsignificance criterion of 7.5 mg/L is the most restrictive of the water quality criteria applicable to this permit; therefore, it is the water quality target for this effluent limit. Groundwater compliance limit / trigger value of 7.5 mg/L nitrogen (nitrate + nitrite) is set for monitoring wells MW-2, MW-2a, MW-3 and MW-3a.

The previous permit established effluent limits for nitrogen in the event that a change to the system allowed for effluent sampling. Effluent limits were also calculated in this permit using ambient groundwater data collected from monitoring wells on the property. Effluent limit calculations are provided in detail in Appendix A.

5.2 TOTAL PHOSPHORUS EFFLUENT LIMIT

DEQ previously determined (2005) that phosphorous discharged to ground water would reach the surface water (Churn Creek) in 50.6 years. Phosphorus breakthrough time of greater than 50 years is considered nonsignificant. As this discharge of phosphorus is nonsignificant, this permit does not include a phosphorus limit.

6.0 MONITORING AND REPORTING REQUIREMENTS

DEQ requires system water quality and ground water monitoring to assure compliance with water quality standards and groundwater compliance limitations. Wastewater quality monitoring and ground water monitoring are 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. Monitoring requirements and rationale are summarized below.

6.1 WATER QUALITY MONITORING

This permit includes numeric water quality 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 to demonstrate compliance with these limitations.

Water quality samples and discharge flow measurements must be representative of the nature and volume of the wastewater. There is not an effluent sampling location for this system. Mid-stream treatment sampling occurs at the dose tank prior to treatment in the elevated sand mound (MID-001) (**Figure 4).** The permittee is required to maintain and report flow measurements using a flow-measuring device capable of measurements that are within 10 percent of the actual flow. There are 4 flow measuring devices (FM-001 – FM-004) that measure flow to each individual zone in the elevated sand mound. The flow meters are located between the dose tank and the elevated sand mound (**Figure 4**). The flow measuring devices must be in operating condition during discharge.

Water quality monitoring and reporting requirements are summarized in **Table 9** below. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

Table 9: Wastewater Quality Monitoring and Reporting Requirements – Dose Tank – MID-001

Parameter	Units	Sample Type (1)	Minimum Sample Frequency	Reporting Requirements (1)(2)(3)	Report Frequency	Rationale
Flow Rate, Effluent (4)	gpd	Continuous	Continuous	Daily Maximum Quarterly Average	Quarterly	Permit Compliance
Nitrogen, Nitrite + Nitrate (as N)	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly	Permit Compliance
Nitrogen, Total Ammonia (as N)	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly	Proper O&M
Nitrogen, Total Kjeldahl (TKN) (as N)	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly	Proper O&M
Nitrogen, Total (as N) (5)	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly	Permit Compliance
	lbs/day	Calculate	1/Quarter	Daily Maximum Quarterly Average	Quarterly	
Phosphorus, Total (as P)	mg/L	Grab	1/Quarter	Quarterly Average	Quarterly	Permit Compliance

Footnotes:

Samples collected from dose tank prior to release of wastewater into the elevated sand mound (ESM) MID-001.

FM-001 – FM-004: located between the dose tank and the elevated sand mound

If no discharge occurs during the reporting period, "no discharge" shall be recorded on the effluent Discharge Monitoring Report (DMR) report forms.

Grab sample will represent concentration for a 24-hour period.

Parameter analytical methods shall be in accordance with the Code of Federal Regulations, 40 CFR Part 136, unless specified above.

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

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

(3) Daily Minimum: Report lowest measured daily value for the reporting period on Discharge Monitoring Report (DMR).

(4) Requires recording device or totalizing meter, must be capable of recording daily effluent volume.

(5) Total Nitrogen is the sum of Nitrate + Nitrite and Total Kjeldahl Nitrogen

6.2 GROUND WATER MONITORING

A condition of this permit requires ground water monitoring to provide long term ambient and downgradient characterization of the aquifer. Ground water monitoring is required at monitoring wells MW-1, MW-2, MW-2a, MW-3, MW-3a, and MW-4. Data collected via ground water monitoring will be used for mixing zone evaluation, aquifer characterization in future permit renewals, and for compliance monitoring. Ground water monitoring and reporting requirements are summarized **Table 10**. Sampling and reporting requirements shall continue through the duration of the permit. Ground water monitoring was established in the previous permit (DEQ 2012).

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, units[1]	Location[2]	Minimum Sample Frequency	Reporting Frequency	Sample Type[3]	Reporting Requirements[6][7]
Static Water Level (SWL)[4], feet	MW-1, MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Instantaneous	Quarterly Average
Specific Conductivity, µS/cm @ 25°C	MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Grab	Quarterly Average
Nitrate + Nitrite (as N), mg/L	MW-1, MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Grab	Daily Maximum Quarterly Average
Total Kjeldahl Nitrogen (TKN), mg/L	MW-1, MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Grab	Daily Maximum Quarterly Average
Chloride, mg/L	MW-1, MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Grab	Quarterly Average
Escherichia Coli, <1 CFU[5]/100mL	MW-1	Quarterly	Quarterly	Grab	Daily Maximum Quarterly Avg.
Total Phosphorus, mg/L	MW-1, MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Grab	Quarterly Average
Ammonia, mg/L	MW-2, MW-2a, MW-3, MW-3a, MW-4	Quarterly	Quarterly	Grab	Quarterly Average

Footnotes:

1. Each monitor well to be individually sampled and analyzed for each respective parameter listed
2. Refer to Figure 3 and Table 4 of the Fact Sheet for the existing location of the monitoring wells
3. See definitions provided in the permit
4. Measuring point (point of reference) for SWL measurements shall be from top of casing within 1/100th foot.
5. Colony forming units
6. Daily Maximum: Report highest measured daily value for the reporting period on Discharge Monitoring Report
7. The geometric mean must be reported if more than one sample is taken during a reporting period.

SPECIFIC GROUND WATER COMPLIANCE LIMITS

Effective immediately and lasting through the term of the permit, the ground water shall not exceed the water quality compliance limits at monitoring wells MW-1, MW-2, MW-2a, MW-3, MW-3a as shown in Table 11 and 12. If limits are exceeded, requirements as outlined the Special Conditions section of the permit shall be followed. Special Conditions are located in **Section 7.0** of this Fact Sheet.

Table 11: Ground Water Compliance Limits (Trigger Values) - MW-2, MW-2a, MW-3 and MW-3a.

Parameter	Trigger Value
Nitrate + Nitrite (as N), mg/L	7.5

Table 12: Ground Water Compliance Limits (Trigger Values) – MW-1.

Parameter	Trigger Value
Escherichia Coliform, organisms/100 ml	Equal to or greater than 1

7.0 SPECIAL CONDITIONS

The following special conditions will be included in the permit. The previous permit set forth groundwater monitoring as a special condition. This monitoring will remain a condition of the current permit. Groundwater monitoring requirements are discussed in detail in **Section 6.2** and **Table 10**.

SPECIAL CONDITIONS – GROUND WATER CONTINGENCY MEASURES

The permittee must perform contingency measures when a ground water analytical sample result from any monitoring well exceeds the respective limitation defined in **Table 11** or **Table 12** for any listed parameter.

1. The contingency measures performed must at minimum include the following:
   a. Notify DEQ WPB, of ground water exceedance within 72 hours of the reporting date of the laboratory analysis report;
   b. Re-sample the monitoring well(s) in which the exceedance(s) occurred (**Table 10**) within 72 hours of the reporting date of the laboratory analysis report; and,
   c. Submit all respective laboratory analytical reports to DEQ WPB, within 60 calendar days from the laboratory report date of the original laboratory analysis report. Include a report summarizing the exceedance(s), all laboratory analysis reporting dates, DEQ notification dates, re-sampling procedures, and water quality.

2. Following submittal of the resample results, DEQ may also require the permittee to perform the following measures:
   a. In coordination with DEQ, review water quality trends, discharge data, and other site activities to identify the probable cause and extent of the water quality changes;
   b. Increase sampling (frequency and/or constituents);
   c. Installation of additional ground water monitoring wells;
   d. Installation of additional treatment or the installation of treatment system components that are capable of collecting post treatment wastewater samples;
   e. Supply drinking water to residences, business and irrigation districts located downgradient of the wastewater system;
   f. Invoke the reopener provisions of the permit.

8.0 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 **12/06/2018.** 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 (MTX000153), 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.

9.0 REFERENCES

Administrative Rules of Montana, March 2006 Title 17, Chapter 30, Sub-chapter 5 – *Mixing Zones in Surface and Ground Water*.

Administrative Rules of Montana, March 2000, Title 17, Chapter 30, Sub-chapter 7 – *Nondegradation of Water Quality*.

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Department of Environmental Quality, Montana Numeric Water Quality Standards (DEQ-7), August 2010.

Department of Environmental Quality, List of Subsurface Wastewater Treatment Systems that are Approved as a Nitrogen-Reducing System, 2004 (updated June 16, 2008).

Department of Environmental Quality, E. Regensburger, How to Perform a Nondegradation Analysis for Subsurface Wastewater Treatment Systems, Revised February 2009.

Department of Environmental Quality, Final MGWPCS Permit MTX000153 for Discharge of Domestic Wastewater from the Manley Meadows Subdivision. 2005.

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Ground-Water Information Center, Montana Bureau of Mines and Geology, Retrieved July 22, 2009 from the GWIC database, http://mbmggwic.mtech.edu

Johnson, T.L. 1983. "A comparison of well nests vs. single-well completions." Ground Water Monitoring Review 3 (1):76-78. doi=10.1111/j.1745-6592.1983.tb00864.x.

Kendy, Eloise; Tresch, R. E., (August 1996), Geographic, Geologic, and Hydrologic Summaries of Intermontane Basins of the Northern Rocky Mountain, Montana, August 1996, Water Resources Investigation Report 96-4025, pages 225-245.

Montana Code Annotated, Title 75, Chapter 5, *Montana Water Quality Act*, 2009.

Natural Resources Conservation Service, National Cooperative Soil Survey. Retrieved July 23, 2009 from the Web Soil Survey 2.1, http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

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

U.S. Environmental Protection Agency, NPDES Permit Writers Manual, December 1996.

Woessner, W., et al., Virus Transport in the Capture Zone of a Well Penetrating a High Hydraulic Conductivity Aquifer Containing a Preferential Flow Zone: Challenges to Natural Disinfection, University of Montana, Missoula, Montana, April 1998.

APPENDIX A – EFFLUENT LIMIT CALCULATIONS

Due to the design of the wastewater system, the establishment of an effluent sampling point that is representative of the last point of treatment for total nitrogen is not feasible. Therefore a total nitrogen effluent limit shall not be established within this permit. In place of a total nitrogen effluent limit, the Department will establish a ground water compliance limit as discussed below. The Department assumes all the nitrogen discharged to the ESM in the effluent is converted to nitrate (as N). The significance criteria at ARM 17.30.715(1)(d) states that nitrate concentrations in ground water at the end of the mixing zone may not exceed the numeric criterion of 7.5 mg/L, therefore the Department will establish this as a ground water compliance limit as displayed in Table 7 and Table 11.

As previously discussed in Section 2.6, monitoring wells have been established along the down gradient boundary of the end of the mixing zone. The monitoring locations to determine compliance with this limit are the monitoring wells MW-2, MW-2a, MW-3, and MW-3a (Figure 3). Ground water monitoring requirements are discussed in Section 6.2.

In the future it may be deemed necessary to make modifications to the system that would allow for effluent monitoring and reporting. In that event the effluent limit for nitrogen load has been calculated in this section (Appendix A).

Water Quality Based Effluent Limitations – Nitrogen

The system consists of an Elevated Sand Mound (ESD) system (Class 2 method for nitrogen treatment).

To protect beneficial uses there shall be no increase of a parameter to a level that renders the waters harmful, detrimental, or injurious to the beneficial uses. Therefore, no wastes may be discharged such that the waste either alone or in combination with other wastes will violate or can reasonably be expected to violate any standard. DEQ will establish the effluent limitations for nitrogen based on the projection that the entire nitrogen load in the wastewater stream may ultimately be converted to nitrate (USEPA, 2002a).

The allowable discharge concentrations are derived from a mass-balance equation which is a simple steady-state model, used to determine concentration after accounting for other sources of pollution in the receiving water and any dilution as provided by a mixing zone. The mass-balance equation (Equation 1) derived for ground water is as follows:

Equation 1:

$$Q_{gw}C_{gw} + Q_{eff}C_{eff} = Q_{comb}C_{proj}$$

Where:

Q_{gw}	=	ground water available for mixing
C_{gw}	=	ambient receiving ground water concentration
Q_{eff}	=	maximum design capacity of wastewater system
C_{eff}	=	effluent pollutant concentration
Q_{comb}	=	combined ground water and effluent ($Q_{comb} = Q_{gw} + Q_{eff}$)
C_{proj}	=	projected pollutant concentration (after available mixing)

The mass-balance equation has been arranged to calculate effluent so that the discharge does not cause or contribute to an exceedance of the most restrictive water quality standard. This equation can be applied to any effluent and receiving water where the applicable dilution ratio is known. This equation will only be used for nitrogen which has been authorized mixing (Section III).

Equation 2:

$$C_{lmt} = C_{std} + D(C_{std} - C_{gw})$$

Where:
C_{lmt} = effluent concentration
C_{std} = water quality standard concentration = 7.5 mg/L
C_{gw} = ambient receiving ground water concentration = 1.90 mg/L
D = dilution ratio (Q_{gw} / Q_{eff}) = 12,087 / 1965.10

$$C_{lmt} = 7.5 + (12{,}087 / 1965.10)(7.5 - 1.90) = \mathbf{41.95\ mg/L}$$

A mass-balance approach is used to calculate the effluent quality of the discharge that meets the most restrictive water quality standard at the end of the mixing zone. Based on the proposed design capacity, the respective load is:

5.14 lb/day
[$(8.34*10^{-6})$* 41.94 mg/L*14,700 gpd]
as based on the following equation:

Equation 3:

$$L_{lmt} = CON * C_{eff} * DC_{eff}$$

Where:
L_{lmt} = effluent load
C_{eff} = allowable effluent concentration
DC_{eff} = design capacity of wastewater treatment system (gpd)
CON = conversion factor [$8.34*10^{-6}$]

APPENDIX B – MONITORING WELL SUMMARY

MW-1

MONTANA WELL LOG REPORT

Other Options

Plot this site on a topographic map

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 complied 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.

Site Name: MANLEY MEADOWS HOME OWNERS ASSOCIATION, .
GWIC Id: 222726

Section 1: Well Owner

Owner Name
MANLEY MEADOWS HOME OWNERS ASSOCIATION

Mailing Address
P.O. BOX 11353

City	State	Zip Code
BOZEMAN	MT	59719

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	25	NW¼ NE¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.7265	111.0479	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
MANLEY MEADOWS		

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY

Section 5: Well Completion Date
Date well completed: Tuesday, November 29, 2005

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	25	6

Section 7: Well Test Data

Total Depth: 25
Static Water Level: 6
Water Temperature:

** 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
MONITORING WELL #1 - EAST WELL - 05143

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	8	TOPSOIL
8	25	GRAVEL 15 GPM

MW-1

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	3	6	0.250		WELDED	A53B STEEL
-2	5	2			FLUSH THREAD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
5	25	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	1	CONCRETE	
0	5	BENTONITE	
5	25	10-20 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 DRILL
License No: MWC-94
Date Completed: 11/29/2005

MW-2a

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 complied 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

Plot this site on a topographic map

Site Name: MANLEY MEADOWS HOME OWNERS ASSOCIATION, .
GWIC Id: 222728

Section 1: Well Owner

Owner Name
MANLEY MEADOWS HOME OWNERS ASSOCIATION

Mailing Address
P.O. BOX 11353

City	State	Zip Code
BOZEMAN	MT	59719

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	25	NW¼ NE¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.7265	111.0479	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
MANLEY MEADOWS		

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY

Section 5: Well Completion Date
Date well completed: Wednesday, November 30, 2005

Section 6: Well Construction Details
Borehole dimensions

From	To	Diameter
0	47	6

Section 7: Well Test Data

Total Depth: 47
Static Water Level: 3
Water Temperature:

** 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
MONITORING WELL #2 - SOUTHWEST WELL - 05144

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	5	TOPSOIL
5	38	GRAVEL 30 GPM
38	43	CLAYBOUND GRAVEL
43	44	GRAVEL 20 GPM
44	47	CLAYBOUND GRAVEL

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	3	6	0.250		WELDED	A53B STEEL
-2	24	2			FLUSH THREAD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
24	44	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	1	CONCRETE	
0	23	BENTONITE	
23	47	10-20 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 DRILL
License No: MWC-94
Date Completed: 11/30/2005

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 complied 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

Plot this site on a topographic map

Site Name: MANLEY MEADOWS HOME OWNERS ASSOCIATION, .
GWIC Id: 222731

Section 1: Well Owner

Owner Name
MANLEY MEADOWS HOME OWNERS ASSOCIATION,

Mailing Address
P.O. BOX 11353

City	State	Zip Code
BOZEMAN	MT	59719

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	25	NW¼ NE¼

County
GALLATIN

Geocode

Latitude	Longitude	Geomethod	Datum
45.7265	111.0479	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
MANLEY MEADOWS		

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY

Section 5: Well Completion Date
Date well completed: Wednesday, November 30, 2005

Section 6: Well Construction Details
Borehole dimensions

From	To	Diameter
0	25	6

Section 7: Well Test Data

Total Depth: 25
Static Water Level: 3
Water Temperature:

** 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
MONITORING WELL #3 - SOUTHWEST - 05145

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	5	TOPSOIL
5	25	GRAVEL

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	3	6	0.250		WELDED	A53B STEEL
-2	5	2			FLUSH THREAD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
5	25	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	1	CONCRETE	
0	4	BENTONITE	
4	25	10-20 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 DRILL
License No: MWC-94
Date Completed: 11/30/2005

MW-3 & MW- 3a

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 complied 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

Plot this site on a topographic map

Site Name: MANLEY MEADOWS HOME OWNERS ASSOCIATION, .
GWIC Id: 222735

Section 1: Well Owner

Owner Name
MANLEY MEADOWS HOME OWNERS ASSOCIATION

Mailing Address
P.O. BOX 11353

City	State	Zip Code
BOZEMAN	MT	59719

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	25	NW¼ NE¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.7265	111.0479	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
MANLEY MEADOWS		

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: ROTARY

Section 5: Well Completion Date
Date well completed: Thursday, December 01, 2005

Section 6: Well Construction Details
Borehole dimensions

From	To	Diameter
0	53	6

Section 7: Well Test Data

Total Depth: 53
Static Water Level: 1.5
Water Temperature:

** 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
MONITORING #4 & #5 - NORTHWEST - BY POND - 05146 NESTED 2 - 2" PEZOMETERS IN 1 - 6" HOLE

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	4	TOPSOIL
4	31	GRAVEL
31	53	DRY CLAY/GRAVEL

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	1.5	2			FLUSH THREAD	PVC-SCHED 40
-2	3	6	0.250		WELDED	A53B STEEL
-2	24	2			FLUSH THREAD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
1.5	16	2		.020	SCREEN-CONTINUOUS-PVC
24	31	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	1	CONCRETE	
0	1.5	BENTONITE	
1.5	18	10-20 SAND	
18	23	BENTONITE	
23	32	10-20 SAND	
32	53	BENTONITE	

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 DRILL

License No: MWC-94

Date Completed: 12/1/2005

MW-4

Site Name: MANLEY MEADOWS HOA
GWIC Id: 253325

Section 1: Well Owner(s)
1) MANLEY MEADOWS HOA (MAIL)
P.O. BOX 11353
BOZEMAN MT 59719 [12/03/2009]

Section 2: Location

Township	Range	Section	Quarter Sections
01S	05E	25	SW¼ SW¼ NE¼ NE¼

County	Geocode
GALLATIN	

Latitude	Longitude	Geomethod	Datum
45.72602	111.044419	TRS-SEC	NAD83

Ground Surface Altitude	Method	Datum	Date

Addition	Block	Lot
MANELY MEADOWS		

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: Thursday, December 03, 2009

Section 6: Well Construction Details
Borehole dimensions

From	To	Diameter
0	26	6

Casing

From	To	Diameter	Wall Thickness		
Rating	Joint	Pressure	Type		
-2	3	6	0.25		A53B STEEL
-2	5	2		FLUSH THREAD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
5	25	2		.020	FACTORY SLOTTED

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	26	SAND	Y
0	1	CONCRETE	
1	3	BENTONITE	Y

Section 7: Well Test Data

Total Depth: 26
Static Water Level: 5
Water Temperature:

Air Test *

_ 20 _ gpm with drill stem set at _ 20 _ feet for _ 1 _ hours.
Time of recovery _ 1 _ hours.
Recovery water level _ 5 _ 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	7	TOPSOIL
7	26	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: KEVIN HAGGERTY
Company: KEVIN HAGGERTY DRILLING INC.
License No: MWC-94
Date Completed: 12/3/2009