Technical Memorandum

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Subject: Assessment of Septic System Options – Montanore Mine Project, Montana

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INTRODUCTION

This Memorandum presents results of an assessment of water quality conditions for septic system options for the Montanore Mine Project. A mixing analysis is performed to evaluate resultant quality of groundwater or surface water that may occur for each of the septic system options. The following four septic system options are included in this assessment:

1. Level 2 domestic septic system, with septic tank and drainfield near Plant site.
2. Level 2 domestic septic system, with septic tank and drainfield farther from Plant site and Libby Creek.
3. Septic tank with disinfectant, followed by discharge to tailings storage facility (TSF).
4. Lagoon system, with septic tank and disinfectant, followed by discharge to TSF.

For the two Level 2 treatment options, water from the drainfield would infiltrate down to the groundwater table. For the first option, the drainfield would be located within ¼-mile of Libby Creek; whereas, for the second option, the drainfield would be located farther from the creek so that there would be no potential connection between groundwater and surface water.

This assessment includes the following tasks:

1. Describe how each system would be constructed and operated;
2. Assess water quality conditions at the end of treatment steps, including nitrate and phosphorus;
3. Evaluate water quality standards, including the BHES Order;
4. Address nondegradation requirements; and
5. Consider transmission of diseases (requires disinfection of microorganisms).

WATER QUALITY

In order to assess water quality conditions relative to septic systems, several assumptions about quality of water sources are made. The various water sources include groundwater, surface water (Libby Creek), tailings impoundment water, raw sewage, primary treated sewage, secondary treated sewage, and lagoon treated sewage. **Table 1** summarizes the water quality assumptions used in this assessment:

TABLE 1
Water Quality Characteristics of Sewage and Receiving Water

Water Source	Nitrate + Nitrite (mg/L)	Ammonia (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Phosphorus (mg/L)	Biochemical Oxygen Demand (mg/L)	Total Suspended Solids (mg/L)
Receiving Water						
Groundwater [1]	0.07	0.12	----	<0.005	----	----
Libby Creek [1]	0.04	<0.05	----	<0.005	----	<1
Tailings Pond [1]	16.1	7.3	----	----	----	----
Sewage						
Raw Sewage	<1.0 [2]	4 – 13 [2] 31 – 160 [3]	70 [4]	8 – 12 [2]	155 – 290 [2]	155 – 330 [2]
Primary Treated Sewage (septic tank effluent)	<1.0 [2]	31 – 160 [3]	39 – 82 [2] 44 [2]	11 – 22 [2] 8.6 [2]	118 – 189 [2] 94 [2]	35 – 85 [2]
Secondary Treated Sewage (drainfield or Level 2 system)	24 – 50 [5] 13 – 22 [2]	<2.0 [2]	0.3 – 2.1 [2]	0.2 – 1.8 [2] 10.6 [5]	5 – 40 [4]	<1 [2] 5 – 20 [4]
Lagoon Treated Sewage	24 [5] (assumed)	<2.0 [2] (assumed)	0.3 – 2.1 [2] (assumed)	4 – 10 [2]	<30 [6]	5 – 100 [2]

[1] Draft EIS for Montanore Project, February 2009.
[2] U.S. EPA 2002. Onsite Wastewater Treatment Systems Manual; EPA/625/R-00/008; February 2002.
[3] Harman et al. 1996. Impacts on Sand Aquifer from an Old Septic System: Nitrate and Phosphate. Ground Water, Vol. 34, No. 6. November-December 1996.
[4] AdvanTex® Treatment Systems, 2001. Operation & Maintenance Manual.
[5] Montana DEQ Trigger Value Calculation for Adjacent to Surface Water Dilution Analysis Guideline.
[6] Montana DEQ, 1999. General Discharge Permit for Domestic Sewage Treatment Lagoons.

Note: mg/L = milligrams per liter.

WATER QUANTITY

The amount of water used for the chemical mixing analysis completed for the septic systems is summarized in **Table 2**. Assumptions for water quantity are made for the same water sources described above for water quality characterization. For water usage that would go to the septic system, the following values are assumed: toilet flushing = 2 gal/flush x 3 flushes per person per shift (6 gal/person/shift); faucet water use = 1.4 gal/use x 4 uses (5.6 gal/person/shift); and shower = 2.5 gal/min x 5 minutes (12.5 gal/person/shift) (EPA 2002). Therefore, total water use expected for each miner or

mill worker would be approximately 25 gal/person/shift. Office workers would not shower, so their water usage would be about 12 gal/person/shift.

Maximum number of workers expected at the Montanore Mine would be comprised of two shifts: (1) Shift A = 100 miners, 15 mill workers, and 30 office staff; (2) Shift B = 100 miners, 15 mill workers, and no office staff. Therefore, there would be a daily total of 200 miners, 30 mill workers, and 30 office staff. For water usage that would go to the septic system, this equates to 5,750 gal/day for miners/mill workers, and 360 gal/day for office workers (total = 6,110 gal/day). To be conservative, a total maximum of 7,000 gal/day (5 gal/min) water to the Montanore septic system is used in this analysis.

TABLE 2
Water Quantity Characteristics of Sewage and Receiving Water

Water Source	Water Quantity (gal/min)	Water Quantity (ft^3/sec)
Groundwater Flux [1]	35	0.08
Libby Creek [2]	996 (LB-300) 1,346 (LB-500)	2.22 (LB-300) 3.0 (LB-500)
Tailings Pond [3]	2,000	4.45
Raw Sewage [4]	5	0.01
Primary Treated Sewage [4]	5	0.01
Secondary Treated Sewage [4]	5	0.01
Lagoon Treated Sewage [4]	5	0.01
Tailings Impoundment Seepage [5]	25 / 17 / 5	0.06 / 0.04 / 0.01

[1] Groundwater flux in area of tailings storage facility.
[2] 7Q10 low flow at Libby Creek at LB-300 (below Libby Adit) and LB-500 (near Libby Plant site).
[3] Approximate tailings impoundment inflow from water balance.
[4] Assume maximum 30 office workers (12 gal/day) and 230 miners/mill workers (25 gal/day) = 6,110 gal/day, rounded to 7,000 gal/day or 5 gal/min or 936 ft^3/day.
[5] Tailings impoundment seepage rate (declining over time).

Note: gal/min = gallons per minute; ft^3/sec = cubic feet per second.

LEVEL 2 DOMESTIC SEPTIC SYSTEM NEAR PLANT SITE

This septic system would consist of a Level 2 treatment system and conventional septic tank and drainfield located near the Libby Plant site. The on-site sewage treatment and disposal system selected for the Construction phase of the project at the Libby Adit site is a pressure dosed trench system preceded by an AdvanTex® AX20 treatment unit. This system was selected in order to meet nondegradation requirements for treatment of waste prior to discharge to the subsurface, and to meet residential waste standards for the effluent waste. The system consists of the following components: (1) four 1000 gallon septic tanks; (2) a two-pod AdvanTex® AX20 treatment unit and combination recirculation tank/drainfield dosing tank; (3) effluent distribution system; and (4) infiltrator trenches. For

the initial Construction phase of extending the Libby Adit, this system was designed for a total of 30 industrial employees (5 office workers and 21 miners), totaling 585 gallons per day (gal/day) or 78 cubic feet per day (ft^3/day). Due to the use of the AdvanTex® AX20 treatment unit, the calculated drainfield size of 1,180 ft^2 was reduced to 600 ft^2.

Using Montana DEQ guidelines for performing a nitrate sensitivity analysis for the septic system described above, the resultant nitrate concentration calculated at the end of the groundwater mixing zone is 0.75 milligrams per liter (mg/L). Montana DEQ guidelines were also used for assessing compliance with nondegradation using a surface water dilution analysis (trigger value calculation) for nitrate and phosphorus. Results of this analysis using the AdvanTex® AX20 system show that the calculated increase in concentrations for nitrate (0.0099 mg/L) and phosphorus (0.0007 mg/L) do not exceed the trigger values of 0.01 mg/L for nitrate and 0.001 mg/L for phosphorus. Calculation sheets for the nitrate sensitivity analysis and surface water dilution analysis are included in **Attachments A** and **B**, respectively.

If a similar system was constructed at the Libby Plant site for the same Construction workforce, the resultant nitrate concentration calculated at the end of the groundwater mixing zone is 0.99 mg/L. This change in location has a resultant change in subsurface hydraulic conductivity (10 ft/day at Libby Plant site versus 70.5 ft/day at Libby Adit site), hydraulic gradient (0.1 at Libby Plant site versus 0.05 at Libby Adit site), and background nitrate concentration in groundwater (0.1 mg/L at Libby Plant site versus 0.49 mg/L at Libby Adit site). Results of the surface water dilution analysis using the AdvanTex® AX20 system show that the calculated increase in concentrations for nitrate (0.0072 mg/L) and phosphorus (0.0005 mg/L) do not exceed the trigger value of 0.01 mg/L for nitrate and 0.001 mg/L for phosphorus. See **Attachments A** and **B** for calculation sheets.

If a similar system was constructed at the Libby Plant site for 260 industrial employees (30 office workers and 230 mine/mill workers) during the Operational phase, the resultant nitrate concentration calculated at the end of the groundwater mixing zone is 1.38 mg/L. Results of the surface water dilution analysis using the AdvanTex® AX20 system show that the calculated increase in concentration for nitrate (0.086 mg/L) does exceed the trigger value of 0.01 mg/L for nitrate. Also, the calculated increase in concentration for phosphorus (0.0065 mg/L) exceeds the associated trigger value of 0.001 mg/L. See **Attachments A** and **B** for calculation sheets.

The nitrate standard in groundwater under the Montanore BHES Order and Circular DEQ-7 is 10 mg/L. The surface water standard for nitrate in the BHES Order is 1.0 mg/L total inorganic nitrogen, and is 10 mg/L in Circular DEQ-7 for human health (there is no aquatic life standard for nitrate). There is no water quality standard for phosphorus. Under the existing MPDES Permit (MT-0030279) for the Montanore Libby Adit, the effluent limit for total inorganic nitrogen is 2.2 and 2.5 mg/L. The following is the nondegradation criterion for nitrate in groundwater (ARM 17.30.715(1)):

> *Changes in the concentration of nitrate in groundwater which will not cause degradation of surface water if the sum of the predicted concentrations of nitrate at the boundary of any applicable mixing zone will not exceed the following values:*
>
> - *7.5 mg/L for nitrate sources other than domestic sewage;*
> - *5.0 mg/L for domestic sewage effluent discharged from a conventional septic system;*
> - *7.5 mg/L for domestic sewage effluent discharged from a septic system using level two treatment; and*
> - *7.5 mg/L for domestic sewage effluent discharged from a conventional septic system in areas where the groundwater nitrate level exceeds 5.0 mg/L primarily from sources other than human waste.*

In addition to nitrate and phosphorus, other constituents of concern that would be reduced during the treatment process include ammonia, biochemical oxygen demand (BOD), and total suspended solids (TSS). Estimated concentrations of these constituents are included in **Table 1**.

LEVEL 2 DOMESTIC SEPTIC SYSTEM FARTHER FROM PLANT SITE

This septic system would consist of the same conventional design described above using the AdvanTex® AX20 system; however, the drainfield would be located farther from the Plant site and Libby Creek. The purpose for moving the system is to have the drainfield located far enough from surface water (i.e. Libby Creek and Ramsey Creek) such that a groundwater connection to surface water would not be considered.

For the Operational phase (260 industrial employees), the resultant nitrate concentration calculated at the end of the groundwater mixing zone is 1.38 mg/L (same as calculation above; see **Attachment A** for calculation sheet). Since connection with surface water is assumed to not be present, completing a surface water dilution analysis using trigger values is not necessary. However, it may be difficult to find a site near the Libby Plant area where there would be no possible connection to surface water.

PRIMARY TREATMENT WITH DISINFECTANT AND DISCHARGE TO TSF

This septic system would consist of septic tanks for primary treatment, followed by discharge to the TSF impoundment for final disposal. Disinfection of effluent from the septic tanks would occur prior to pumping to the TSF, and would be accomplished by chlorination, ozonation, or ultraviolet light. This step would disinfect the effluent in order to reduce the number of microorganisms and eliminate potential hazards due to human exposure of the water in the TSF. Disinfection would be conducted as the effluent water is pumped from the septic tanks to the TSF.

Sewage water subject to primary treatment from the septic tanks that goes into the TSF impoundment would have the following estimated concentrations of constituents (**Table 1**): nitrate = <1 mg/L; phosphorus = 8.6 mg/L; and ammonia = 30 to 160 mg/L. In the TSF impoundment, ammonia would be subject to nitrification where ammonia is oxidized to nitrate. Therefore, ammonia concentrations would decrease, and nitrate concentrations would increase in the impoundment. These constituents would mix with the TSF impoundment water which would have the following estimated concentrations before mixing (**Table 1**): nitrate = 16 mg/L and ammonia = 7 mg/L. Assuming the tailings water inflow rate is about 2,000 gal/min and the effluent flow rate from the lagoon is about 5 gal/min (**Table 2**), then the combined nitrate concentration after mixing would be just slightly higher than the TSF impoundment water of 16 mg/L prior to mixing.

Assuming that the TSF impoundment water then infiltrates at a rate of 25 gal/min to groundwater, which is flowing beneath the impoundment at a flux of about 35 gal/min (**Table 2**), the resultant nitrate concentration in groundwater after mixing would be 6.7 mg/L. Using the Montana DEQ nitrate sensitivity analysis method, the resultant nitrate concentration in groundwater after mixing would be 2.1 mg/L (see calculation sheet in **Attachment A**). The use of pump-back wells located downgradient of the TSF would intercept any of the seepage water (mixed with groundwater) so that none of this water would flow to and mix with Libby Creek. Any water from the TSF that would go to the water treatment plant for subsequent discharge to a permitted outfall would require nitrogen treatment.

LAGOON SYSTEM WITH DISINFECTANT AND DISCHARGE TO TSF

A lagoon system would initially consist of septic tanks for primary treatment, followed by discharge to a lagoon for secondary treatment. After sufficient treatment, water from the lagoon would be pumped for final disposal in the TSF impoundment. Disinfection of the lagoon water, however, would occur prior to pumping to the TSF. The lagoon consists of a lined pond where effluent from the septic tanks is discharged and aerobic bacteria are allowed to further degrade the sewage water. When wastes are broken down, some of the material is given off as gases in the air, and small amounts of solids settle to the bottom of the lagoon.

Either an aerated lagoon or facultative lagoon can be constructed at the Montanore site. Aerated lagoons use mechanical equipment to enhance and intensify the biodegradation rate, and they do not produce a high algal load. Facultative lagoons do not require any mechanical equipment, but do require relative large areas of land to construct. The layer of water near the surface contains dissolved oxygen due to natural atmospheric aeration and algal respiration. The bottom layer of the lagoon includes sludge deposits and supports anaerobic organisms.

Disinfection of the lagoon water would be accomplished by chlorination, ozonation, or ultraviolet light. This step would disinfect the effluent in order to reduce the number of microorganisms and eliminate potential hazards due to human exposure of the water in the TSF. Disinfection would be conducted as the effluent water is pumped from the lagoon to the TSF.

Treated sewage water from the lagoon that goes into the TSF impoundment would have the following estimated concentrations of constituents (**Table 1**): TSS = <100 mg/L; BOD = <30 mg/L; nitrate = ≤24 mg/L; phosphorus = ≤5 mg/L; and ammonia = <2 mg/L. These constituents would mix with the TSF impoundment water which would have the following estimated concentrations before mixing (**Table 1**): nitrate = 16 mg/L and ammonia = 7 mg/L. Assuming the tailings water inflow rate is about 2,000 gal/min and the effluent flow rate from the lagoon is about 5 gal/min (**Table 2**), then the combined nitrate concentration after mixing would be just slightly higher than the TSF impoundment water of 16 mg/L prior to mixing.

Assuming that the TSF impoundment water then infiltrates at a rate of 25 gal/min to groundwater, which is flowing beneath the impoundment at a flux of about 35 gal/min (**Table 2**), the resultant nitrate concentration in groundwater after mixing would be 6.7 mg/L. Using the Montana DEQ nitrate sensitivity analysis method, the resultant nitrate concentration in groundwater after mixing would be 2.1 mg/L (see calculation sheet in **Attachment A**). Similar to the analysis above for TSF seepage effects on Libby Creek, the use of pump-back wells downgradient of the TSF would prevent any seepage from entering Libby Creek. Any water from the TSF that would go to the water treatment plant for subsequent discharge to a permitted outfall would require nitrogen treatment.

The Montana DEQ currently has a "Domestic Sewage Treatment Lagoons" General Permit under its Montana Pollutant Discharge Elimination System (MPDES) permitting program. Under this permit, the following effluent limits are established: BOD = 30 mg/L (30-day average) and 45 mg/L (7-day average); TSS = 100 mg/L (30-day average) and 135 mg/L (7-day average); pH shall remain between 6.0 and 9.0; and oil & grease = 15 mg/L. Effluent monitoring shall include the following constituents: flow rate, pH, BOD, TSS, fecal coliform bacteria, total phosphorus, ammonia, nitrate+nitrite, total kjeldahl nitrogen, and total nitrogen.

CONCLUSIONS

Results of the septic system assessment presented in this Memo show that concentrations of nitrate in groundwater that would result for all septic options would be less than 7.5 mg/L, which is the nondegradation standard for Level 2 septic systems. Operation of a septic system near the Libby Plant site would result in exceedences of nondegradation trigger values for nitrate and phosphorus with respect to groundwater connection to surface water (i.e. Libby Creek) assuming a total of 260 mine employees per day. If the septic system is moved farther from surface water where the groundwater to

surface water connection is not expected, then the nondegradation trigger values for surface water would not apply. However, it may be difficult to find such a site near the Libby Plant area. For the options where sewage effluent is pumped to the TSF, either directly from the septic tanks or after treatment in a lagoon, disinfection would occur prior to the water going into the TSF impoundment. The additional chemical load to the TSF pond water would be insignificant, including seepage from the TSF to groundwater which would be intercepted by pump-back wells to prevent this water from reaching and entering Libby Creek. Any water from the TSF that would go to the water treatment plant for subsequent discharge to a permitted outfall would require nitrogen treatment.

REFERENCES

Advantex® Treatment Systems, 2001. Operation & Maintenance Manual. Orenco Systems Incorporated. www.orenco.com.

Harman J., Robertson, W.D., Cherry, J.A., and Zanini, L., 1996. Impacts on Sand Aquifer from an Old Septic System: Nitrate and Phosphate. Ground Water, Vol. 34, No. 6. November-December 1996.

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U.S. Forest Service and Montana Department of Environmental Quality (USFS/MDEQ), 2009. Draft Environmental Impact Statement for the Montanore Project. February 2009.

U.S. Environmental Protection Agency (USEPA), 2002. Onsite Wastewater Treatment Systems Manual; EPA/625/R-00/008; February 2002.

ATTACHMENTS

ATTACHMENT A – NITRATE SENSTIVITY ANALYSIS CALCULATIONS

ATTACHMENT B – SURFACE WATER DILUTION ANALYSIS CALCULATIONS USING TRIGGER VALUES

ATTACHMENT A

NITRATE SENSITIVITY ANALYSIS CALCULATIONS

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

NITRATE SENSITIVITY ANALYSIS

SITE NAME: Libby Adit Site Septic System - Montanore Mine Project
COUNTY: Lincoln County
LOT #:
NOTES: Advantex AX20 System - Initial Construction Period

VARIABLES	DESCRIPTION	VALUE	UNITS
K	Hydraulic Conductivity	70.50	ft/day
I	Hydraulic Gradient	0.0500	ft/ft
D	Mixing Zone Thickness (usually constant)	15.0	ft
L	Mixing Zone Length (see ARM 17.30.517(1)(d)(viii)	200	ft
Y	Width of Drainfield Perpendicular to Ground Water Flow	100	ft
Ng	Background Nitrate (as Nitrogen) Concentration	0.49	mg/L
Nr	Nitrate (as Nitrogen) Concentration in Precipitation (usually constant)	1.0	mg/L
Ne	Nitrate (as Nitrogen) Concentration in Effluent	24.00	mg/L
#l	Number of Single Family Homes on the Drainfield	1.0	
Ql	Quantity of Effluent per Single Family Home	78.00	ft3/day
P	Precipitation	36.0	in/year
V	Percent of Precipitation Recharging Ground Water (usually constant)	0.20	
EQUATIONS			
W	Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L)+(Y)	135.00	ft
Am	Cross Sectional Area of Aquifer Mixing Zone = (D)(W)	2025.00	ft2
As	Surface Area of Mixing Zone = (L)(W)	27000.00	ft2
Qg	Ground Water Flow Rate = (K)(I)(Am)	7138.13	ft3/day
Qr	Recharge Flow Rate = (As)(P/12/365)(V)	44.38	ft3/day
Qe	Effluent Flow Rate = (#l)(Ql)	78.00	ft3/day
SOLUTION			
Nt	**Nitrate (as Nitrogen) Concentration at End of Mixing Zone =((Ng)(Qg)+(Nr)(Qr)+(Ne)(Qe)) / ((Qg)+(Qr)+(Qe))**	**0.75**	**mg/L**

BY: D. Rogness
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MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

NITRATE SENSITIVITY ANALYSIS

SITE NAME: Libby Plant Site Septic System - Montanore Mine Project
COUNTY: Lincoln County
LOT #:
NOTES: Advantex AX20 System - Initial Construction Period

VARIABLES	DESCRIPTION	VALUE	UNITS
K	Hydraulic Conductivity	10.00	ft/day
I	Hydraulic Gradient	0.1000	ft/ft
D	Mixing Zone Thickness (usually constant)	15.0	ft
L	Mixing Zone Length (see ARM 17.30.517(1)(d)(viii)	200	ft
Y	Width of Drainfield Perpendicular to Ground Water Flow	100	ft
Ng	Background Nitrate (as Nitrogen) Concentration	0.10	mg/L
Nr	Nitrate (as Nitrogen) Concentration in Precipitation (usually constant)	1.0	mg/L
Ne	Nitrate (as Nitrogen) Concentration in Effluent	24.00	mg/L
#l	Number of Single Family Homes on the Drainfield	1.0	
Ql	Quantity of Effluent per Single Family Home	78.00	ft3/day
P	Precipitation	36.0	in/year
V	Percent of Precipitation Recharging Ground Water (usually constant)	0.20	
EQUATIONS			
W	Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L)+(Y)	135.00	ft
Am	Cross Sectional Area of Aquifer Mixing Zone = (D)(W)	2025.00	ft2
As	Surface Area of Mixing Zone = (L)(W)	27000.00	ft2
Qg	Ground Water Flow Rate = (K)(I)(Am)	2025.00	ft3/day
Qr	Recharge Flow Rate = (As)(P/12/365)(V)	44.38	ft3/day
Qe	Effluent Flow Rate = (#l)(Ql)	78.00	ft3/day
SOLUTION			
Nt	**Nitrate (as Nitrogen) Concentration at End of Mixing Zone =((Ng)(Qg)+(Nr)(Qr)+(Ne)(Qe)) / ((Qg)+(Qr)+(Qe))**	**0.99**	**mg/L**

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MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

NITRATE SENSITIVITY ANALYSIS

SITE NAME: Libby Plant Site Septic System - Montanore Mine Project
COUNTY: Lincoln County
LOT #:
NOTES: Advantex AX20 System - Operational Period

VARIABLES	DESCRIPTION	VALUE	UNITS
K	Hydraulic Conductivity	10.00	ft/day
I	Hydraulic Gradient	0.1000	ft/ft
D	Mixing Zone Thickness (usually constant)	15.0	ft
L	Mixing Zone Length (see ARM 17.30.517(1)(d)(viii)	500	ft
Y	Width of Drainfield Perpendicular to Ground Water Flow	1000	ft
Ng	Background Nitrate (as Nitrogen) Concentration	0.10	mg/L
Nr	Nitrate (as Nitrogen) Concentration in Precipitation (usually constant)	1.0	mg/L
Ne	Nitrate (as Nitrogen) Concentration in Effluent	24.00	mg/L
#l	Number of Single Family Homes on the Drainfield	12.0	
Ql	Quantity of Effluent per Single Family Home	78.00	ft3/day
P	Precipitation	36.0	in/year
V	Percent of Precipitation Recharging Ground Water (usually constant)	0.20	
EQUATIONS			
W	Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L)+(Y)	1087.50	ft
Am	Cross Sectional Area of Aquifer Mixing Zone = (D)(W)	16312.50	ft2
As	Surface Area of Mixing Zone = (L)(W)	543750.00	ft2
Qg	Ground Water Flow Rate = (K)(I)(Am)	16312.50	ft3/day
Qr	Recharge Flow Rate = (As)(P/12/365)(V)	893.84	ft3/day
Qe	Effluent Flow Rate = (#l)(Ql)	936.00	ft3/day
SOLUTION			
Nt	**Nitrate (as Nitrogen) Concentration at End of Mixing Zone =((Ng)(Qg)+(Nr)(Qr)+(Ne)(Qe)) / ((Qg)+(Qr)+(Qe))**	**1.38**	**mg/L**

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MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

NITRATE SENSITIVITY ANALYSIS

SITE NAME: TSF Seepage to Groundwater - Montanore Mine Project
COUNTY: Lincoln County
LOT #:
NOTES: TSF Seepage = 25 gpm; GW Flux = 35 gpm

VARIABLES	DESCRIPTION	VALUE	UNITS
K	Hydraulic Conductivity	10.00	ft/day
I	Hydraulic Gradient	0.1000	ft/ft
D	Mixing Zone Thickness (usually constant)	15.0	ft
L	Mixing Zone Length (see ARM 17.30.517(1)(d)(viii)	500	ft
Y	Width of Drainfield Perpendicular to Ground Water Flow	2000	ft
Ng	Background Nitrate (as Nitrogen) Concentration	0.07	mg/L
Nr	Nitrate (as Nitrogen) Concentration in Precipitation (usually constant)	1.0	mg/L
Ne	Nitrate (as Nitrogen) Concentration in Effluent	16.00	mg/L
#l	Number of Single Family Homes on the Drainfield	1.0	
Ql	Quantity of Effluent per Single Family Home	4800.00	ft3/day
P	Precipitation	36.0	in/year
V	Percent of Precipitation Recharging Ground Water (usually constant)	0.20	
EQUATIONS			
W	Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L)+(Y)	2087.50	ft
Am	Cross Sectional Area of Aquifer Mixing Zone = (D)(W)	31312.50	ft2
As	Surface Area of Mixing Zone = (L)(W)	1043750.00	ft2
Qg	Ground Water Flow Rate = (K)(I)(Am)	31312.50	ft3/day
Qr	Recharge Flow Rate = (As)(P/12/365)(V)	1715.75	ft3/day
Qe	Effluent Flow Rate = (#l)(Ql)	4800.00	ft3/day
SOLUTION			
Nt	**Nitrate (as Nitrogen) Concentration at End of Mixing Zone =((Ng)(Qg)+(Nr)(Qr)+(Ne)(Qe)) / ((Qg)+(Qr)+(Qe))**	**2.13**	**mg/L**

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ATTACHMENT B

SURFACE WATER DILUTION ANALYSIS CALCULATIONS USING TRIGGER VALUES

TRIGGER VALUE CALCULATION FOR ADJACENT TO SURFACE WATER DILUTION ANALYSIS
STANDARD LEVEL 2 ADVANTEX SEPTIC SYSTEM - LIBBY ADIT - CONSTRUCTION
MONTANORE MINE PROJECT
29-Nov-10

"An analysis of the effect of the proposed drainfield system on the quality of any adjacent surface water is required by ARM 17.36.312 and 17.30.715(1c). The increase in the nutrient concentration in surface water cannot exceed the trigger value (T.V. of 0.01 mg/L nitrate and 0.001 mg/L phosphorus as set forth in Circular DEQ-7"

DILUTION EQUATION:

$$\frac{(QD)(CD) + (QL)(CL)}{QD + QL} < T.V. = \text{nonsignificant}$$

Note: Effluent flow rate (QD) must be multiplied by the number of drainfields in the subdivision.

NITRATE CALCULATION:

	Input	Unit		
	1			Number of drainfields in subdivision
QD =	78	ft3/day		Effluent flow rate from drainfield in ft3/day (commonly 200 gpd or 26.7 ft3/day for 2-5 bedroom home)
CD =	24	mg/L		Nitrate concentration mg/L in effluent (50 mg/L for standard drainfield; 24 mg/L for Level 2 treatment system)
QL =	2.22	ft3/sec	LB-300	Flow rate in ft3/sec into or out of surface water determined by stream gage (usually 7Q10 low flow)
CL =	0	mg/L		Nitrate concentration in mg/L in surface water; can typically assume zero since increase is important
Result:	**0.00976**	**mg/L**		Final result must be <0.01 mg/L to be considered nonsignificant nitrate increase

PHOSPHORUS CALCULATION:

	Input	Unit		
	1			Number of drainfields in subdivision
QD =	78	ft3/day		Effluent flow rate from drainfield in ft3/day (commonly 200 gpd or 26.7 ft3/day for 2-5 bedroom home)
CD =	1.8	mg/L		Phosphorus concentration mg/L in effluent (commonly 10.6 mg/L)
QL =	2.22	ft3/sec	LB-300	Flow rate in ft3/sec into or out of surface water determined by stream gage (usually 7Q10 low flow)
CL =	0	mg/L		Phosphorus concentration in mg/L in surface water; can typically assume zero since increase is important
Result:	**0.00073**	**mg/L**		Final result must be <0.001 mg/L to be considered nonsignificant phosphorus increase
				Note: effluent phosphorus value of 1.8 mg/L is from EPA (2002) report (Table 3-18).

TRIGGER VALUE CALCULATION FOR ADJACENT TO SURFACE WATER DILUTION ANALYSIS
STANDARD LEVEL 2 ADVANTEX SEPTIC SYSTEM - LIBBY PLANT - CONSTRUCTION
MONTANORE MINE PROJECT
29-Nov-10

"An analysis of the effect of the proposed drainfield system on the quality of any adjacent surface water is required by ARM 17.36.312 and 17.30.715(1c). The increase in the nutrient concentration in surface water cannot exceed the trigger value (T.V. of 0.01 mg/L nitrate and 0.001 mg/L phosphorus as set forth in Circular DEQ-7"

DILUTION EQUATION:

$$\frac{(QD)(CD) + (QL)(CL)}{QD + QL} < T.V. = \text{nonsignificant}$$

Note: Effluent flow rate (QD) must be multiplied by the number of drainfields in the subdivision.

NITRATE CALCULATION:

	Input	Unit		
	1			Number of drainfields in subdivision
QD =	78	ft3/day		Effluent flow rate from drainfield in ft3/day (commonly 200 gpd or 26.7 ft3/day for 2-5 bedroom home)
CD =	24	mg/L		Nitrate concentration mg/L in effluent (50 mg/L for standard drainfield; 24 mg/L for Level 2 treatment system)
QL =	3	ft3/sec	LB-500	Flow rate in ft3/sec into or out of surface water determined by stream gage (usually 7Q10 low flow)
CL =	0	mg/L		Nitrate concentration in mg/L in surface water; can typically assume zero since increase is important
Result:	**0.00722**	**mg/L**		Final result must be <0.01 mg/L to be considered nonsignificant nitrate increase

PHOSPHORUS CALCULATION:

	Input	Unit		
	1			Number of drainfields in subdivision
QD =	78	ft3/day		Effluent flow rate from drainfield in ft3/day (commonly 200 gpd or 26.7 ft3/day for 2-5 bedroom home)
CD =	1.8	mg/L		Phosphorus concentration mg/L in effluent (commonly 10.6 mg/L)
QL =	3	ft3/sec	LB-500	Flow rate in ft3/sec into or out of surface water determined by stream gage (usually 7Q10 low flow)
CL =	0	mg/L		Phosphorus concentration in mg/L in surface water; can typically assume zero since increase is important
Result:	**0.00054**	**mg/L**		Final result must be <0.001 mg/L to be considered nonsignificant phosphorus increase
				Note: effluent phosphorus value of 1.8 mg/L is from EPA (2002) report (Table 3-18).

TRIGGER VALUE CALCULATION FOR ADJACENT TO SURFACE WATER DILUTION ANALYSIS
STANDARD LEVEL 2 ADVANTEX SEPTIC SYSTEM - LIBBY PLANT SITE - OPERATIONS
MONTANORE MINE PROJECT
29-Nov-10

"An analysis of the effect of the proposed drainfield system on the quality of any adjacent surface water is required by ARM 17.36.312 and 17.30.715(1c). The increase in the nutrient concentration in surface water cannot exceed the trigger value (T.V. of 0.01 mg/L nitrate and 0.001 mg/L phosphorus as set forth in Circular DEQ-7"

DILUTION EQUATION:

$$\frac{(QD)(CD) + (QL)(CL)}{QD + QL} < T.V. = \text{nonsignificant}$$

Note: Effluent flow rate (QD) must be multiplied by the number of drainfields in the subdivision.

NITRATE CALCULATION:

	Input	Unit		
	12			Number of drainfields in subdivision
QD =	78	ft3/day		Effluent flow rate from drainfield in ft3/day (commonly 200 gpd or 26.7 ft3/day for 2-5 bedroom home)
CD =	24	mg/L		Nitrate concentration mg/L in effluent (50 mg/L for standard drainfield; 24 mg/L for Level 2 treatment system)
QL =	3	ft3/sec	LB-500	Flow rate in ft3/sec into or out of surface water determined by stream gage (usually 7Q10 low flow)
CL =	0	mg/L		Nitrate concentration in mg/L in surface water; can typically assume zero since increase is important
Result:	**0.08635**	**mg/L**		Final result must be <0.01 mg/L to be considered nonsignificant nitrate increase

PHOSPHORUS CALCULATION:

	Input	Unit		
	12			Number of drainfields in subdivision
QD =	78	ft3/day		Effluent flow rate from drainfield in ft3/day (commonly 200 gpd or 26.7 ft3/day for 2-5 bedroom home)
CD =	1.8	mg/L		Phosphorus concentration mg/L in effluent (commonly 10.6 mg/L)
QL =	3	ft3/sec	LB-500	Flow rate in ft3/sec into or out of surface water determined by stream gage (usually 7Q10 low flow)
CL =	0	mg/L		Phosphorus concentration in mg/L in surface water; can typically assume zero since increase is important
Result:	**0.00648**	**mg/L**		Final result must be <0.001 mg/L to be considered nonsignificant phosphorus increase
				Note: effluent phosphorus value of 1.8 mg/L is from EPA (2002) report (Table 3-18).