BEFORE THE BOARD OF ENVIRONMENTAL REVIEW AND
THE DEPARTMENT OF ENVIRONMENTAL QUALITY
OF THE STATE OF MONTANA

In the matter of the amendment of ARM 17.30.1001, 17.30.1334, 17.36.103, 17.36.345, 17.38.101, and 17.50.819, adoption of New Rule I pertaining to definitions, and the amendment of Department Circulars DEQ-1, DEQ-2, and DEQ-3 regarding setbacks between water wells and sewage lagoons	NOTICE OF AMENDMENT AND ADOPTION (SUBDIVISIONS) (PUBLIC WATER ENGINEERING) (WATER QUALITY) (SOLID WASTE)

TO: All Concerned Persons

1. On December 21, 2018, the Board of Environmental Review and the Department of Environmental Quality published MAR Notice No. 17-404 regarding the public hearing on the proposed amendment and adoption of the above-stated rules at page 2455 of the 2018 Montana Administrative Register, Issue No. 24.

2. The board has amended ARM 17.30.1001 and 17.38.101 exactly as proposed. The board has amended ARM 17.30.1334 exactly as proposed but has updated the citations for authority and implementation to correct an inadvertent omission:

AUTH: 75-5-201, 75-5-401, 75-5-802, MCA
IMP: 75-5-201, 75-5-401, 75-5-802, MCA

3. The department has amended ARM 17.36.103, 17.36.345, and 17.50.819 exactly as proposed.

4. The department has adopted New Rule I (17.30.1702) as proposed, but with the following changes, stricken matter interlined, new matter underlined:

NEW RULE I (17.30.1702) SETBACKS BETWEEN SEWAGE LAGOONS AND WATER WELLS (1) through (4) remain as proposed.

(5) To make the demonstration in (4), the pathogen reduction between the sewage lagoon and the water well must be calculated according to one of the following methods:

(a) METHOD 1 – Travel Time Method - The vertical travel time in the vadose zone for the wastewater to reach groundwater is calculated using the following equation:

~~$t1 = (d)*(\theta) \div (\alpha) \div 365$~~
$t1 = [(d)*(\theta) \div (\alpha)] * 365$

Where:

t1 = vertical travel time (days)

α is total effluent recharge – the maximum allowable leakage rate or actual measured leakage rate if the measured rate is available (in/yr)

θ is volumetric soil moisture (percent)

d is the depth to groundwater (in)

The horizontal travel time in the saturated zone for the wastewater to reach the water well is calculated using the following equations:

~~t2 = (x) ÷ [(K)*(i) ÷ (ne)]~~

t2 = [ne÷(K*i)] * [x – {(Q÷(2*π*K*b*i)) * (ln(1+((2*π* K*b*i*x)÷Q)))}]

Where:

t2 = horizontal travel time (days)

K is hydraulic conductivity of the saturated aquifer (feet/day)

i is hydraulic gradient (feet/~~feet~~ foot)

b is aquifer saturated thickness (feet)

ne is effective porosity (dimensionless)

π is pi, 3.14 (dimensionless)

ln is natural logarithm

Q is the maximum day well demand (feet^3/day)

x is the horizontal distance from the sewage lagoon to the water well (feet). Value is positive when well is downgradient of sewage lagoon, negative if well is upgradient of sewage lagoon.

The total log pathogen reduction from the bottom of the sewage lagoon to the water well is calculated using the following equation:

Pt = (t1 + t2)*0.02

Where:

Pt = Log reduction of pathogens during vertical and horizontal travel

0.02 = log 10 pathogen removal/day

(b) and (c) remain as proposed.

(6) In calculating 4-log pathogen reduction under (4), the following requirements apply:

(a) Hydraulic conductivity must be based on the aquifer material most likely to transmit lagoon discharges to the water well and be determined by one of the following methods:

(i) The maximum hydraulic conductivity value of the aquifer material shown in Table 1. The hydraulic conductivity for aquifer materials not included in Table 1 may be calculated by the applicant using other methods acceptable to the department. The aquifer material must be the most permeable soil layer that is at least six inches

thick and is below the bottom of the sewage lagoon infiltrative surface, as identified in any test pit or borehole. This method may only be used for facilities that are not requesting a source-specific groundwater mixing zone, as defined in ARM 17.30.518.

TABLE 1	
MATERIAL	**HYDRAULIC CONDUCTIVITY (ft/d)**
Basalt (permeable/vesicular)	5,100
Clay	0.025
Clay (unweathered, marine)	0.00054
Coarse sand	2,950 ~~94,500~~
Fine sand	51
Glacial Till	0.72
Glacial Till (fractured)	29.5
Gravel	13,500 ~~201,600~~
Gravelly sand	1,020
Igneous/metamorphic rock (fractured)	76.5
Igneous/metamorphic rock (unfractured)	0.000054
Karst limestone	18,000
Limestone	1.5
Limestone (unjointed, crystalline)	0.30
Loess	0.27
Medium sand	569
Sandstone	1.5
Sandstone (friable)	3.0
Sandstone (well cemented, unfractured)	0.0036
Sandy clay loam	1.4
Sandy silt	0.27
Shale	0.00054
Silt	0.27
Siltstone	0.0036
Silty clay	0.013
Silty sand	45
Tuff	7.2
Very fine sand	21.4

(ii) through (c)(iii) remain as proposed.

(iv) For purposes of defining soil effective porosity and volumetric soil moisture that are used in (5), soils ~~Soils~~ must be described according to the Unified Soil Classification System. The soil description must include information regarding the presence or absence of seasonal saturated conditions. If there is no evidence of

saturated conditions from the test pit, borehole, or other evidence, then the depth to groundwater must be estimated as the bottom of the test pit or borehole.

(d) through (7) remain as proposed.

5. The following comments were received and appear with the board and department's responses:

COMMENT NO. 1: The equation for vertical travel time for wastewater in the unsaturated (vadose) zone in New Rule I(5)(a) is missing the infiltration factor (α) parameter, and appears to replace the infiltration factor with a time parameter, 365 days. Why is the infiltration factor, which is set at a value of 0.5 and is included in a similar equation used by the state of Wyoming, not included in the equation?

RESPONSE: The commenter is correct that the equation in (5)(a) for vertical travel time is different than the equation used by the state of Wyoming. The Wyoming method equation is designed for a subsurface drainfield where precipitation will have an effect on the amount of recharge that mixes with the wastewater. Because this infiltration affects the travel time calculation, the Wyoming method equation includes a 0.5 infiltration factor as an estimate of the percent of precipitation that infiltrates the ground. New Rule I, on the other hand, applies to sewage lagoons that are conservatively assumed to be filled with wastewater and are leaking at the constant design rate regardless of precipitation. Because of that, the equation in (5)(a) was modified from the Wyoming method equation for use with sewage lagoons by removing the 0.5 infiltration factor. The 365-day value in the equation was not used to replace the 0.5 infiltration factor but to convert the equation units from years to days, which was necessary to maintain consistent units between other parameters and equations in New Rule I.

COMMENT NO. 2: The following equation for vertical travel time for wastewater in the unsaturated (vadose) zone in New Rule I(5)(a) is incorrect:

$$t_1 = (d)*(\theta) \div (\alpha) \div 365$$

The 365 (day) value should be multiplied by the product/quotient of the first three variables in the equation instead of being divided into the product/quotient of the first three variables.

RESPONSE: The department agrees that the equation incorrectly divided by 365 instead of multiplying by 365. The equation shown in the comment has been corrected as suggested and is shown below.

$$t_1 = [(d)*(\theta) \div (\alpha)] * 365$$

COMMENT NO. 3: The soil type of Sandy Clay Loam in Table 1in New Rule I is incorrect. The Sandy Clay Loam soil type is from the United States Department of Agriculture (USDA) soil classification system, whereas the other soil types in the table were from the Unified Soil Classification System (USCS). The rule should be revised to include a USCS soil type such as Clay Loam or Sandy Clay instead of Sandy Clay Loam.

RESPONSE: The commenter is correct that the description of Sandy Clay Loam in Table 1 is from the USDA, but the department disagrees that the description is incorrectly included in Table 1. The geologic materials listed in Table 1 are based on published values of hydraulic conductivity from various sources and are not necessarily based on the USCS. Table 1 incorporates many other types of geologic materials that do not have a USCS classification.

Nevertheless, the comment indicates that New Rule I may not be sufficiently clear in its use of the USCS. While Table 1 is based on various sources, (6)(c)(iv) of New Rule I requires that test pit/borehole soils be described using the USCS. To clarify the issue raised by the commenter, the department has modified (6)(c)(iv) by adding the following language at the beginning of the section: "For purposes of defining soil effective porosity and volumetric soil moisture that are used in (5)." This modification does not change the meaning or intent of (6)(c)(iv) but has been added solely to provide clarification.

COMMENT NO. 4: One commenter stated that both the vertical and horizontal travel time equations in New Rule I(5)(a) are incorrect because both equations omitted a variable for the water well pumping rate. The commenter also proposed some effluent rate conversions that would include the water well pumping rate.

RESPONSE: The department agrees that the equation for horizontal travel time should include a variable for the water well pumping rate but disagrees that the variable should be included in the equation for vertical travel time.

The equation for horizontal travel time in (5)(a) should include the well pumping rate to account for the non-linear hydraulic gradient that is created in the groundwater due to the withdrawal of water from the well. The current equation in New Rule I (shown below) uses a linear hydraulic gradient that in many cases does not accurately account for the well pumping rate.

$$t2 = (x) \div [(K)*(i) \div (n_e)]$$

The above equation has been revised in (5)(a) of New Rule I to the following equation that accounts for the well pumping rate. In modifying the equation, the department corrected a typographical error by changing feet to foot to correctly describe hydraulic gradient.

The definitions of the new variables in the revised equation have been added to (5)(a) as shown below.

$$t2 = [ne \div (K*i)] * [x - \{(Q \div (2*\pi*K*b*i)) * (\ln(1+((2*\pi* K*b*i*x) \div Q)))\}]$$

Where:

t2 = horizontal travel time (days)
K is hydraulic conductivity of the saturated aquifer (feet/day)

i is hydraulic gradient (feet/~~feet~~ foot)
b is aquifer saturated thickness (feet)
ne is effective porosity (dimensionless)
π is pi, 3.14 (dimensionless)
ln is natural logarithm
Q is the maximum day well demand (feet^3/day)
x is the horizontal distance from the sewage lagoon to the water well (feet). Value is positive when well is downgradient of sewage lagoon, negative if well is upgradient of sewage lagoon.

On the other hand, the department does not agree that the equation for vertical travel time in (5)(a) needs a variable for the well pumping rate. The vertical travel time equation only accounts for travel in the unsaturated zone. The rate of travel in the unsaturated zone is not impacted by fluctuations in the water table level caused by pumping of the water well, so the well pumping rate is not needed in the vertical travel time equation. The department does not agree that the commenter's suggested rate conversions should be added because the well pumping rate has been directly incorporated into the horizontal travel time equation as described above.

COMMENT NO. 5: The hydraulic conductivity value in Table 1 of New Rule I(6)(a)(i) for gravel material is incorrect. Table 1 has a value of 201,600 feet per day, while most other hydrology books have a maximum value of 10,000 feet per day for clean, well-sorted gravels.

RESPONSE: The department agrees that the hydraulic conductivity value for gravel in Table 1 (201,600 feet/day) is much higher than most published values. That hydraulic conductivity was based on a value from a commonly cited textbook (Freeze and Cherry, 1979). A review of the published data shows the commenter is correct that the gravel hydraulic conductivity value in Table 1 is over ten times larger than other published values and is likely not representative of gravel materials.

The department has modified the value for gravel in Table 1 from 201,600 feet/day to 13,500 feet/day. The department used 13,500 feet/day instead of the commenter's proposed 10,000 feet/day to maintain consistency in Table 1. Specifically, the hydraulic conductivity value of 13,500 feet/day is based on the same calculations for determining the other values in Table 1 as described in the statement of reasonable necessity for New Rule I.

The change in the hydraulic conductivity for gravel also required the department to reexamine the other values in Table 1 to ensure that the values were consistent with each other and to ensure that the Freeze and Cherry textbook did not use any other unusually high values. Table 1 proposed a hydraulic conductivity for coarse sand of 94,500 feet/day. This value is over 10 times higher than other published values for coarse sand and would be erroneously greater than the modified value for gravel. Accordingly, the department has modified the value for coarse sand in Table 1 from 94,500 feet/day to 2,950 feet/day to be internally consistent and to be consistent with published values other than the Freeze and Cherry textbook.

COMMENT NO. 6: Three commenters disagreed with the default 1,000-foot setback distance in New Rule I(3)(a). Two commenters stated that the default 1,000-foot setback was arbitrary and did not account for site-specific conditions. One of these commenters stated that more science should be used to account for variations in groundwater depth and geology, and another stated that the 1,000-foot setback should be reevaluated.

RESPONSE: The department does not agree that the 1,000-foot default setback is arbitrary. The 1,000-foot setback was determined using the pathogen reduction equations in (5)(a). By using those equations and using hydrogeologic conditions that can exist in high hydraulic conductivity and shallow aquifers in Montana, the department determined that a 1,000-foot separation from a sewage lagoon to a water well is needed to provide 4-logs of pathogen inactivation.

The department also does not agree that more scientific methods are needed in New Rule I to determine the correct setback. New Rule I uses site-specific and science-based information (e.g., geology, hydrology, and soil type) to allow reduction of the default 1,000-foot setback to as short as 100 feet by calculating or prescribing the necessary conditions to provide adequate pathogen reduction. In (3)(d), (4), and (5), there are several ways to demonstrate that a shorter setback than 1,000 feet is appropriate, including demonstrating a lack of hydraulic connection between sewage lagoons and water wells due to impermeable geologic layers; demonstrating a lack of hydraulic connection between sewage lagoons and water wells due to groundwater flow directions; and demonstrating adequate pathogen reduction as wastewater migrates through soils. In addition, (3)(b) and (3)(c) allow the reduction of the default setback to 200 feet if there is adequate disinfection of the well water or the sewage lagoon wastewater.

COMMENT NO. 7: Three commenters stated that New Rule I should apply only to domestic wells and should exclude stock and irrigation wells.

RESPONSE: The department generally does not regulate stock or irrigation wells. As part of this joint rulemaking, the department is adopting New Rule I by reference into the subdivision rules, and the board is adopting New Rule I into the public water supply and CAFO rules. New Rule I would therefore not apply to stock or irrigation wells unless department review was otherwise triggered under the subdivision, public water supply, or CAFO rules. If department review was not required under those rules, New Rule I would not apply to stock or irrigation wells. If department review was required under those rules, the department and board disagree that New Rule I should apply only to domestic wells. Additionally, HB 368 required the department to adopt setbacks between sewage lagoons and water wells, which is a defined term in 75-5-102, MCA, that includes all wells, not just domestic wells. Finally, stock and irrigation wells may be converted to domestic uses. Such wells should be protected from lagoon pathogens just like any other domestic well.

COMMENT NO. 8: Two commenters stated that water from wells is necessary for cleaning and maintaining sewage lagoons and, in the case of

agricultural lagoons, for animal care. The default 1,000-foot setback is excessive for this required maintenance and care.

RESPONSE: The department disagrees that the 1,000-foot default setback is excessive. As discussed in response to Comment No. 7, the department generally does not regulate stock or irrigation wells, so New Rule I would not apply to agricultural lagoons and wells unless department review was otherwise required under the subdivision, public water supply, or CAFO rules. Accordingly, New Rule I will not apply to many of the agricultural wells referenced by the commenters. Furthermore, the 1,000-foot setback is a maximum distance that in many situations can be reduced using site-specific information. Where necessary, the 1,000-foot setback minimizes the potential that contaminated water will be used for purposes other than sewage lagoon maintenance.

COMMENT NO. 9: The methods in New Rule I to reduce the default setback are cost prohibitive for stock and irrigation wells.

RESPONSE: The department disagrees. As discussed above in the response to Comment No. 7, New Rule I will only apply to those wells and lagoons that are otherwise subject to department jurisdiction (i.e., under the subdivision, public water supply, or CAFO rules), so New Rule I will not apply to many stock and irrigation wells. For those stock and irrigation wells that need to comply with New Rule I, the rule was written with multiple methods to determine most of the parameters needed to reduce the setback. Multiple methods were included specifically to make lower cost methods available where they are applicable, as discussed in the statement of reasonable necessity.

COMMENT NO. 10: Well drillers can tell the best place to locate a well when they are onsite, which might be closer than 1,000 feet from a lagoon.

RESPONSE: The department disagrees. While a well driller may be able to determine the best location of a well based on logistical considerations (e.g., power sources, pumping distances, elevation issues, adequate water supply, etc.), neither a well driller nor any other professional can determine the subsurface vulnerability of a water well to wastewater contamination without looking at site-specific geologic, hydrologic, and soil conditions.

COMMENT NO. 11: The default 1,000-foot setback would lead to inefficient land uses in populous counties because a significant amount of property would be used up to satisfy the 1,000-foot setback.

RESPONSE: HB 368 required the department to adopt setbacks "to prevent water well contamination." As discussed in the statement of reasonable necessity and these responses to comments, the 1,000-foot default setback was determined to be necessary to protect water wells from lagoon contamination in vulnerable geologic settings. Nevertheless, as discussed throughout these responses, the default 1,000-foot setback may be reduced to as little as 100 feet, depending on site-specific factors. This ability to shorten the default setback provides significant flexibility that did not exist under the previous statutory requirement of 500 feet and would allow denser development where conditions are appropriate. Additionally, the 1,000-foot setback only restricts the location of water wells and sewage lagoons, not

other development or other land uses that do not require a water well. Other required setbacks to the water well do not change based on whether the well is closer to the sewage lagoon, so no additional land acreage is restricted by placing the well further from the sewage lagoon (it only changes the location of the restriction).

COMMENT NO. 12: One commenter stated that this rulemaking should more closely resemble the purpose for which HB 368 was introduced and passed, stating that the purpose of HB 368 was to align department setback requirements with the requirements adopted by the Department of Natural Resources and Conservation (DNRC) Board of Water Well Contractors. The commenter believed that the original draft of the bill would have established a 100-foot setback for both but stated that the department had morphed that idea into a 1,000-foot default setback.

RESPONSE: The department disagrees. The version of HB 368 passed by the legislature removed the statutory 500-foot setback and required the department "to adopt rules establishing setback area requirements between sewage lagoons and water wells to prevent water well contamination." As discussed in the statement of reasonable necessity and throughout these responses, the 1,000-foot default setback was determined to be necessary to prevent water well contamination from lagoon pathogens in vulnerable geologic settings. The department also has communicated with the bill's sponsor throughout the rulemaking process and has received no negative comments from the sponsor. The department notes that New Rule I has also been developed in coordination with similar revisions to DNRC rules to provide consistent setbacks between the two agencies.

COMMENT NO. 13: The toe of a lagoon berm/slope should not be allowed in a flood plain. Even better, there should be several feet separating the toe of the slope and the 100 or even 500-year flood plain.

RESPONSE: Thank you for your comment. Setbacks between lagoons and flood plains are outside the scope of this rulemaking, but the department and board may consider this issue in a future rulemaking. Nevertheless, Standard 51.2 of Department Circular DEQ-2 requires that treatment works structures and electrical and mechanical equipment must be protected from physical damage by the 100-year flood and that flood plain regulations of local, state, and federal agencies must be followed.

COMMENT NO. 14: Although not addressed by HB 368, the same separation rules should apply to lagoons and waterways, creeks, rivers, etc.

RESPONSE: Thank you for your comment. As noted by the commenter, setbacks between lagoons and waterways are outside the scope of HB 368 and this rulemaking. The department and board may consider this issue in a future rulemaking.

Reviewed by:

BOARD OF ENVIRONMENTAL REVIEW

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Certified to the Secretary of State June 11, 2019.