

February 10, 2025

Public Response: Lakeside County Water & Sewer Permit: MTX000307

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The following document is the expert opinion of Hauer Environmental LLC in response to our findings of fact and judgment concerning the ecological impacts of increased nitrogen and phosphorus to nearby surface waters and to the Flathead River and Flathead Lake related to the proposed draft permit for a new Montana Ground Water Pollution Control System (MGWPCS) Domestic Wastewater Treatment and Rapid Infiltration System to service the Lakeside County Water & Sewer District (LCWSD), permit #MTX000307, Flathead County, Montana.

PUBLIC COMMENT

Montana Ground Water Pollution Control (MGWPCS) Permit for:

APPLICANT:	Lakeside County Water & Sewer District
FACILITY NAME:	LCWSD Rapid Infiltration System
LOCATION:	Wiley Dike Rd, Kalispell, MT 59901
PERMIT NUMBER:	MTX000307
PUBLIC NOTICE NO:	MT-24-14
DATE:	December 17, 2024

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Background

The Montana Department of Environmental Quality (MDEQ) recently completed an Environmental Assessment and issued a draft permit for a new Montana Ground Water Pollution Control System (MGWPCS) Domestic Wastewater Treatment and Rapid Infiltration System to service the Lakeside County Water & Sewer District (LCWSD), permit #MTX000307. The proposed project provides sewage disposal in the form of a new Septage Unloading and Pre-Screening Facility and Rapid Infiltration System for the town of Lakeside, Montana and surrounding area residents (Montana Department of Environmental Quality, 2024). The MDEQ determined that the discharge of nitrogen (N) and phosphorus (P) in the effluent from the proposed rapid infiltration system would result in nonsignificant changes in water quality, per 75-5-301 (5)(d), Montana Code Annotated. The MDEQ, therefore determined that there are no significant adverse impacts associated with the Proposed Project.

The applicant proposes to build and operate a wastewater treatment plant. The wastewater generated by the county will undergo treatment and on-site disposal. Wastewater treatment may include use of advanced treatment levels with sequencing batch reactor technology with biochemical nutrient reduction (or similar). DEQ recognizes that in comparison to conventional septic treatment, the proposed treatment system provides a higher level of treatment for nutrients.

The proposed facility will use rapid infiltration basins (Outfalls 001, 002, and 003) to discharge treated wastewater to underlying groundwater. The facility's proposed location is: Township 27N, Range 21W, Section 11N; Flathead County; Latitude: 48.1127610° North, Longitude: -114.225111° West. (Montana Department of Environmental Quality, 2024)

Proposed Sewer District Project and Wastewater Treatment - Lakeside County Water and Sewer District (LCWSD), formed in 1988, provides sewage disposal for the town of Lakeside, Montana, and surrounding area residents. The draft permit reports the collection system is currently a 100% sanitary sewer. Further, the LCWSD serves a population of 1860, 810 households, and 18 business connections (Montana DEQ #MTX000307 Fact Sheet). The proposed project provides a new facility to accept sewage disposal for existing disposal users as well as expanded capacity to accept Septic Tank Septage from the dispersed septic systems in Flathead County.

The new Septage Unloading and Pre-Screening Facility and Rapid Infiltration System, as proposed, will increase the daily flow of wastewater from the facility at an estimated rate of 200,000 gpd (Montana Department of Environmental Quality, 2024). The additional 200,000 gpd of wastewater, as proposed, would be disposed of into Rapid Infiltration



Basins (RIBs); RIB1 80,000 gpd, RIB2 60,000 gpd, and RIB3 60,000 gpd. The RIBs would allow wastewater to be “rapidly” infiltrated into the porous sands underlying each RIB to be dispersed above and into the groundwater aquifer underlying the facility (see Figure 4B above and Figures 5 and 10 in the Montana DEQ #MTX000307 Fact Sheet).

The Montana DEQ Permit #MTX000307 has proposed that the discharge of nitrogen (N) and phosphorus (P) in the effluent from the Proposed Project’s Rapid Infiltration System would result in nonsignificant changes in water quality, (per 75-5-301 (5)(d), Montana Code Annotated).

In response, Hauer Environmental LLC, is providing in the context of Public Comment a review of the peer-reviewed literature, public record, and analyses of the proposed project permitted by MDEQ; specifically in response to the use of rapid infiltration basins (Outfalls 001, 002, and 003) as an effective means to discharge treated wastewater. This review document describes (a) evidence of hydrological connectivity between the receiving groundwater and the downgradient Flathead River and Flathead Lake, (b) the fate and transport of both N and P as limited nutrients in the downgradient Flathead River and Flathead Lake, and (c) the risk and uncertainties to surface water quality and ecological response.

Project Site Geology and Sedimentology

Geological Setting and Post-glacial Flathead Valley – The Flathead Valley lies at the south end of the Rocky Mountain Trench with basement bedrock composed of the Belt Supergroup. This Belt rock defines the valley-fill which is composed of glacial, fluvial, and lacustrine sediments deposited through the Tertiary and Quaternary periods. The Flathead River has played, and continues to play, an integral role in the transport and deposition of sediments north of Flathead Lake (Rose, 2018). In the headwaters of the Flathead River System the Belt bedrock consists of metasedimentary rock approximately 1.4 to 1.5 billion years in age. These pre-Cambrian mudstones contribute low concentrations of ions to solution of ground- and surface waters (Hauer F. R., Stanford, Lorang, Ellis, & Craft, 2007).

The Flathead Valley received multiple glacial advances during the late Pleistocene. The Pinedale glacial advance was the last major expansion of ice that occurred in the Rocky Mountains, including the Flathead Valley, between 30,000 and 10,000 years ago (Rose, 2018). This last advance of the Pleistocene ice sheet deposited the moraine at the south end of Flathead Lake at Polson and shaped the contemporary topography and river drainage patterns of the Flathead River System above Flathead Lake that are primarily composed of post-glacial outwash and moraine deposits. As ice melted and glaciers withdrew from the Flathead Valley, discharge of water from the melting main-lobe glacier of



the Rocky Mountain Trench and the montane glaciers of the North, Middle and South Forks of the Flathead River created a highly braided network of channels in the surficial deposits of the northern half of the Flathead Valley.

The shallow aquifer of the north Flathead Valley sits on an impermeable clay formation and is generally charged at the north end of the valley beginning down-river of the confining reach of Bad Rock Canyon and along the valley floor south of the Whitefish Range (Figure 1). Between the extant Flathead River and the Stillwater and Whitefish Rivers that flow along the west side of the upper Flathead Valley, the valley floor deposits were subjected to expansive channel braiding and sorting of cobbles and gravel (Stanford & Ward, 1988). Via high hydrogeologic interaction between the aquifer and the river, the aquifer discharges in progressively greater volumes into the river channel, spring brooks, ponds, oxbows and other alluvial channels of the paleo- and contemporary floodplain as it is constrained by the finer deltaic sediments at the south end of the valley. Today, in the northern half of the Flathead Valley, the Flathead River remains an expansive network of alluvial-sorted paleochannels hydrologically connected to the main channel extending kilometers in width and 10-20m in depth. The complex lattice of surface and subsurface features of the north Flathead Valley possess high hydraulic conductivity, preferential flow pathways that have been extensively investigated as ecological systems for over 50 yrs (e.g., Stanford & Gaufin, 1974; Hauer & Stanford, 1982; Stanford and Hauer, 1992; Stanford & Ward, 1988; Stanford et al., 1997; Tappenbeck & Ellis, 2011). The interaction between the shallow aquifer and the river is so great that invertebrates from the river have been documented traveling through the interstitial spaces of the aquifer up to 2 kilometers laterally from the river.

During the rapid glacial-melt period of high discharge in the late Pleistocene and early Holocene that created the expansive network of alluvial-sorted paleochannels, Flathead Lake extended as a lacustrine water body north of the current lake's north shore to the vicinity of the valley near and east of Kalispell. The cobble, gravel and coarse-sand alluvial deposits of the northern Flathead Valley are abruptly replaced by deltaic deposits of sand and silts beginning at the break in river slope near the city of Kalispell and continuing south and extending across the valley to the contemporary north shore of Flathead Lake (Figure 2).





Figure 1. (A) Satellite image of the Flathead Valley showing the Flathead River from Bad Rock Canyon to entry into the north end of Flathead Lake. (B) Satellite image in a closer view from Columbia Falls to Kalispell. The highlighted/hatched in red area approximates the post-glacial alluvial floodplain of the river and the zones of paleochannels as surface and subsurface high preferential flow.

The surficial deposits of the southern half of the valley form an approximately 10-15m thick layer of sand and silt overlaying a more tightly compacted clay/silt/fine-sand layer. These surficial sands, that were initially formed as subaqueous deltaic sand deposits were subsequently subjected to extensive cut-and-fill alluviation (Lorang & Hauer, 2017) by the Flathead River after the glacial-melt period as the early Holocene ended and Flathead Lake established its contemporary lake level. Following this glacial-melt period, the Flathead River tortuously meandered through the deltaic sand deposits creating a complex suite of oxbow lakes and scrolled ridges and swales (see Figure 3) before establishing its current channel following the Creston Fault from west to east and then the Flathead (Mission) Fault south into Flathead Lake.

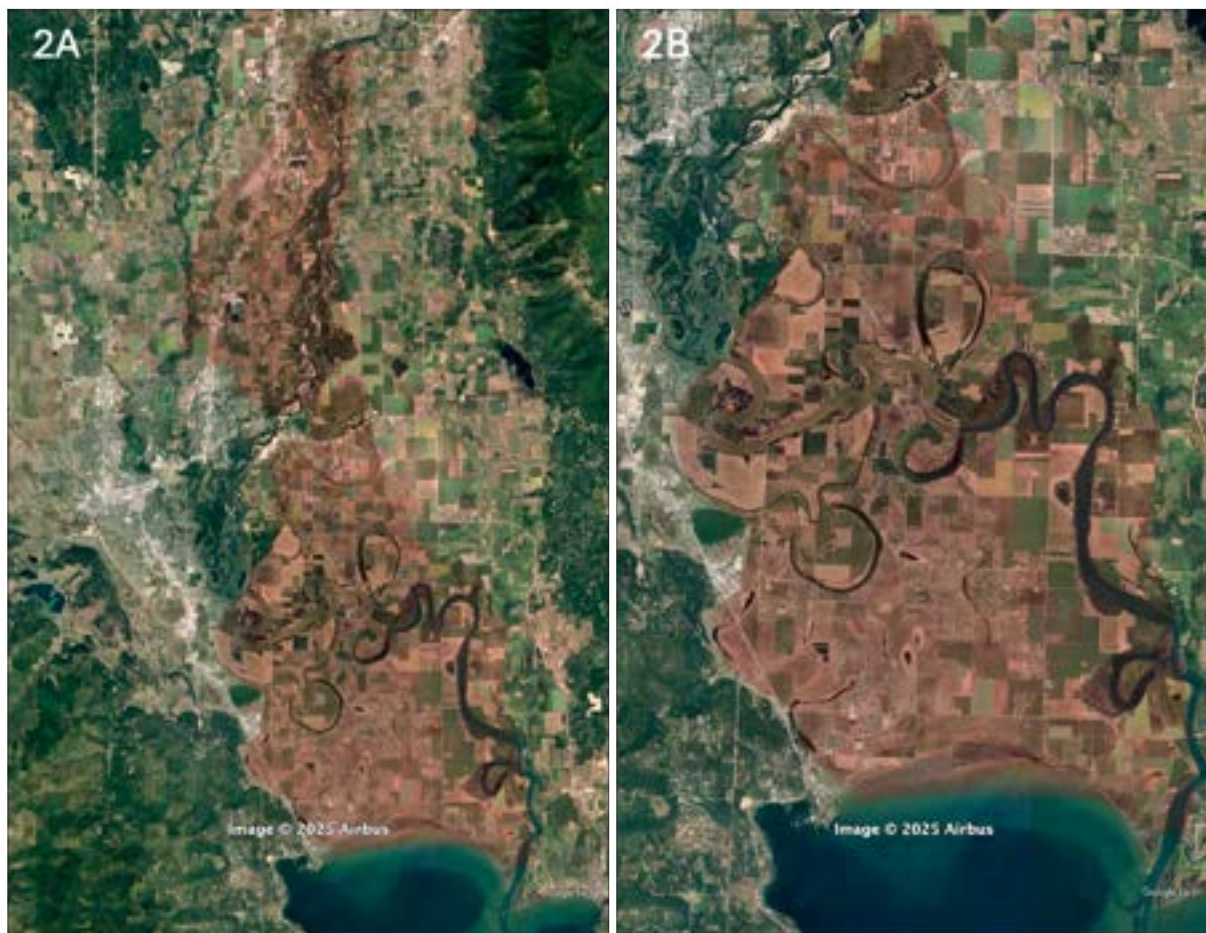


Figure 2. (A) Satellite image of the Flathead Valley showing the Flathead River from Bad Rock Canyon to entry into the north end of Flathead Lake with highlighted/hatched red area approximates the post-glacial alluvial floodplain in the north valley and the area between Kalispell and the north shore of Flathead Lake showing area of post-glacial deltaic sand sediments. (B) Satellite image in a closer view from Kalispell to Flathead Lake. The highlighted/hatched in red area approximates the post-glacial deltaic sediments and subsequent alluvial cut-and-fill paleochannels of the river forming surface and subsurface high preferential flow pathways.



Figure 3. Satellite Image (left) of the lower Flathead Valley between the Flathead River following the Creston Fault from west to east and then the Flathead (Mission) Fault south into Flathead Lake. Surface features in the LIDAR Image (right) show the complexity of the geologic history as the Flathead River tortuously meandered through the deltaic sand deposits creating a suite of oxbow lakes and scrolled ridges and swales. The area in each of the white boxes corresponds to the general area of the Project Site and area illustrated in Figure 4.

Preferential Flow Pathways of the late Pleistocene Flathead Delta - The shallow aquifer of the south Flathead Valley, beginning at the break in river slope near the city of Kalispell and extending across the valley to the contemporary north shore of Flathead Lake, is also hydraulically connected to Flathead River, Flathead Lake, and groundwaters originating in the Salish Range bordering the west side of the valley (Konizenski, Brietkrietz, & McMutrey, 1968). Although the shallow aquifer of the deltaic deposits are less well understood than the alluvial cobble and gravel dominated deposits in the north valley, the deltaic sand deposits and the shallow aquifer of the south valley have been defined as a “deltaic sand aquifer dominated by medium grain sand and silt deposits” (Noble & Stanford, 1986); (Montana Department of Environmental Quality, 2024). The highly complex lattice of alluvially-sorted sands are oriented in arching suites of paleo-channel features expressed at the surface as scrolled ridges and swales. These surface features are strongly coupled to subsurface point bars and sorted-sediment river channels forming preferential flow pathways (Lorang & Hauer, 2017); (Hauer, Lorang, & Gonser, 2022) and are commonly associated with snowmelt dominated hydrographic regimes, as occur in the Flathead River above Flathead Lake (Figure 4) and elsewhere in the northern Rocky Mountains (Rood, et al., 2024).



Figure 4. Arching suites of paleo-channel features expressed at the surface as scrolled ridges and swales. The processes of cut-and-fill alluviation create the point bars and buried channels of sorted sands with high transmissivity rates (i.e., preferential flow pathways) and demarcated here by the red arrows. The white lines approximate the boundary of the Lakeside County Water & Sewer District (LCWSD) Project Site.

Lakeside County Water & Sewer District (LCWSD) Project Site - The Project Site for the proposed MGWPCS Permit No. MTX000307 is located between Ashley Creek, Wiley's Slough, and several ponds in the immediate project area labeled Pond 4 and Pond 7 (Figure 5). Based on the previous studies of the Flathead deltaic geology and hydrogeology (Noble & Stanford, 1986), (Rose, 2018), the site is characterized by a shallow deltaic sands layer. The Permit Application data reports a median depth-to-water of 4.9 meters (~16 ft) with a median depth to the confining clay/silt/sand layer of 8 meters (~30 ft). Thus, the average wetted depth of the shallow aquifer is approximately 4.5 meters (~15 ft). This shallow aquifer is influenced greatly by seasonal fluctuations in discharge occurring in the Flathead River and the rise in lake level in Flathead Lake (Noble & Stanford, 1986); (Rose, 2018). The Project Site is effectively within the hydro-geology complex of the Flathead River/Lake floodplain affecting both water height and flow direction due to interaction with surface waters, which is also presented in the Montana Ground Water Pollution Control System (MGWPCS) Domestic Wastewater Treatment and Rapid Infiltration System to service the

Lakeside County Water & Sewer District (LCWSD), permit #MTX000307 (Montana Department of Environmental Quality, 2024).



Figure 5. Map of the Project Site and surrounding area provided in the MDEQ documentation (Montana Department of Environmental Quality, 2024). The mapping image of the deltaic sediments show prominent surface features of Wiley's Slough, Pond 4 and Pond 7 and the extensions of the surface paleochannels surrounding the Project Site (outlined in red) as well as the current location of Effluent Storage Ponds of the Lakeside County Sewage Treatment Facility. The mapping image also shows the existing effluent ponds and the proposed Rapid Infiltration Basins (RIBs 1, 2 and 3). The orange dotted lines are the 500-foot setback (inner line) and 1/4 mile setback (middle line) and the 1-mile setback (outer line). Monitoring Wells are identified as MW-1 through MW-5.

The MGWPCS documentation presents modeled hydrogeological processes for a homogeneous shallow aquifer based on averages and median values of the slug tests distributed among the 5 monitoring wells (see Figure 5). However, based on extensive research elsewhere in the Flathead (Lorang & Hauer, 2017); (Hauer, Lorang, & Gonser, 2022) and elsewhere in western Montana (Rood, et al., 2024), and following analysis of the Satellite and LIDAR Imagery of the Project Site, we conclude that it is extremely unlikely that the shallow aquifer of the Project Site and surrounding area has homogeneous sand

deposits. Rather, it is extremely likely that the deltaic sand deposits of the shallow aquifer are characterized by very heterogeneous sedimentology and a complex lattice work of high transmissivity preferential flow pathways. Indeed, the sparse data presented in the MDEQ report; high hydraulic conductivity variation between Monitoring Well 1 (average K equals 7.1 ft/day and Monitoring Well 2 (average K equals 392.4 ft/day) (Montana Department of Environmental Quality, 2024) supports our contention of preferential flow pathways and highly heterogeneous anisotropic properties in the described shallow aquifer. The heterogeneous shallow sand deposits and high range in variation in hydraulic transmissivity is common in alluvial aquifers as rates depend upon material and formation (Woessner W., 2017); (Woessner & Poeter, 2024).

Nutrients in Freshwater Ecosystems

Nitrogen Fixation - Nitrogen is one of the primary nutrients critical for the growth and survival of all living organisms. It is a necessary component of many organic molecules including DNA, proteins, and Chlorophyll. Although nitrogen is very abundant in the atmosphere as dinitrogen gas (N_2), it is comparatively inaccessible to living organisms. Indeed, N_2 gas is a very stable compound due to the strength of the triple bond between the nitrogen atoms. For atmospheric nitrogen gas to be available to make proteins, DNA, and other biologically important compounds, it must first be “broken” and then converted into a different and usable form. This is accomplished in the environment by microbial organisms capable of converting dinitrogen gas into ammonia (NH_3); a process referred to as Nitrogen Fixation (see Figure 6). Although most nitrogen fixation is carried out by microbial prokaryotes (i.e., very primitive life forms without a DNA cell nucleus) nitrogen can also be fixed abiotically by lightning or industrial processes. While several higher plant species have symbiotic relationships with nitrogen fixing bacteria, such as legumes and alder, most modern agriculture use industrially based nitrogen fixation, produced as fertilizer. The process of making synthetic fertilizers for use in agriculture by causing N_2 to react with H_2 , known as the Haber-Bosch process, has increased significantly over the past several decades.

Nitrification - Nitrification is the process that converts ammonia (NH_3) to nitrite (NO_2^-) and then to nitrate (NO_3^-). Most nitrification occurs aerobically and is exclusively done by a different suite of microbial prokaryotes than the microbes involved in nitrogen fixation. There are two distinct steps of nitrification. The first step is the oxidation of ammonia to nitrite (NO_2^-), which is carried out by microbes known as ammonia-oxidizers. The second step in nitrification is the oxidation of nitrite (NO_2^-) to nitrate (NO_3^-). This step is carried out by a separate group of microbes known as nitrite-oxidizing bacteria. For complete nitrification, both ammonia oxidation and nitrite oxidation must occur (Figure 6).



Denitrification - Denitrification is the process that converts nitrate (NO_3^-) to nitrogen gas (N_2), thus removing bioavailable nitrogen and returning it to the atmosphere. Unlike nitrification, denitrification is an anaerobic process, occurring mostly in soil and sediments and anoxic zones in lakes and oceans. Similar to nitrogen fixation, denitrification is carried out by a diverse group of microbes (i.e., again primarily prokaryotes), but there is recent evidence that some single-cell eukaryotes are also capable of denitrification (Risgaard-Petersen, et al., 2006). Denitrifiers are chemo-organotrophs and thus must also be supplied with some form of organic carbon (e.g., carbohydrates, proteins, sugars, lipids). Denitrification becomes highly limited if/when organic matter that “feeds” the microbes is insufficient to provide the energy to drive the denitrification process.

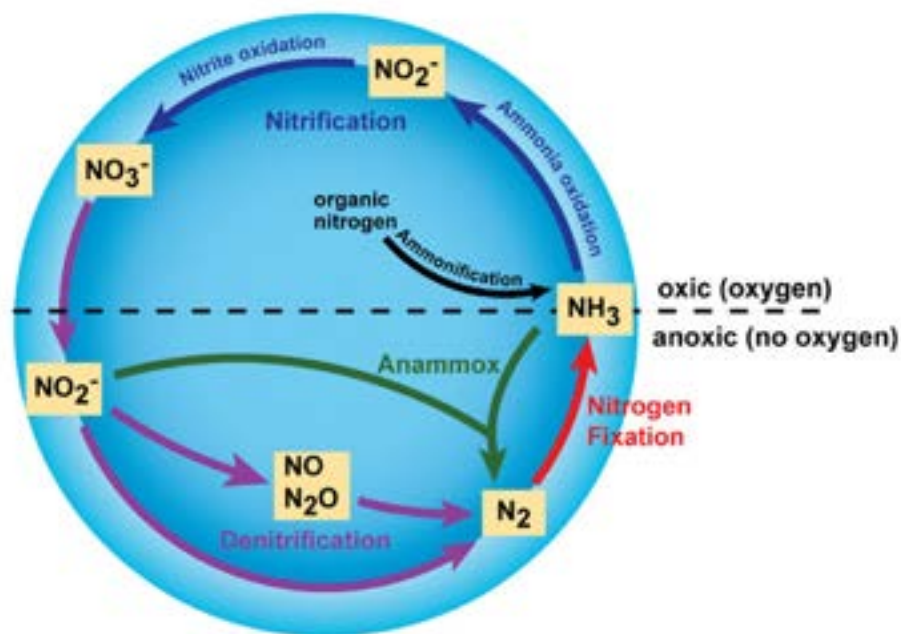


Figure 6. The Nitrogen Cycle illustrating processes of Nitrogen Fixation, Nitrification (ammonification and nitrite oxidation) and Denitrification. The processes of the Nitrogen Cycle occur in obligate oxic conditions (Nitrification) and obligate anoxic condition (Denitrification).

Denitrification is important in that it removes nitrate from the ecosystem and returns it to the atmosphere (N_2 gas). This is particularly important in wastewater treatment and the removal of unwanted nitrates from the wastewater effluent. This is critical to both human health and to the environment. Denitrification reduces the chances that the water discharged from a treatment plant will cause undesirable groundwater or surface water

contamination or unhealthy NO₃ concentrations to subsurface aquifers (e.g., polluting drinking water) or surface waters (e.g., fostering algal blooms).

General Ecological Implications of the Nitrogen Cycle - Many human activities have a significant impact on the nitrogen cycle. Burning fossil fuels, application of nitrogen-based fertilizers, discharge from wastewater treatment, and other activities can dramatically increase the amount of biologically available nitrogen in an ecosystem. Because nitrogen availability often limits the primary productivity of many ecosystems, large changes in the availability of nitrogen often leads to severe alterations of the nitrogen cycle in both aquatic and terrestrial ecosystems.

In freshwater ecosystems (i.e., rivers, wetlands, lakes and nearshore lacustrine systems), increases in nitrogen can lead to harmful algal blooms (HAB) (Howarth, 2008) which then leads to hypoxia (i.e., low oxygen) and even anoxia (i.e., no oxygen) of the waters altering biodiversity, forcing changes in food-web structure, and impacting general habitat leading to broad aquatic system degradation. The addition of bio-available nitrogen into freshwaters can also lead to changes in biodiversity and species composition in algae, invertebrates and fish communities (Hauer, Stanford, & Lorang, 2007). Such changes in turn lead to changes in overall ecosystem integrity (see Federal Clean Water Act (33 U.S.C. §1251 et seq. 1972). More recently, studies have suggested that nitrate pollution may lead to an increased risk of parasitic and infectious diseases among fish and wildlife (Johnson, et al., 2010).

Phosphorus Cycle - The phosphorus cycle is the biogeochemical cycle that involves the movement of phosphorus through the lithosphere, hydrosphere, and biosphere (Figure 7). Unlike the nitrogen cycle, the atmosphere does not play a significant role in the movement of phosphorus because phosphorus and phosphorus-based materials do not readily enter a gaseous phase. Living organisms require phosphorus, a central element of DNA, RNA, and the cellular energy transfer of ADP/ATP. Phosphorus is also a central element in the composition of phospholipids present in cell membranes.

In the lithosphere, phosphorus is an element in long-term storage in rock formations which give up phosphorus to overlying soils. Humans mine phosphorus from rock formations and redistribute phosphorus as apatite for purposes of increasing plant growth and production in agriculture. Plants assimilate phosphorus through absorption of phosphate across cell membranes. To do this the phosphate ions must be dissolved in water. The cells actively “pull” the phosphate ions across their cell membranes into the cell structure of the plant and incorporate it into cellular growth. Phosphate is lost by plants through extra-cellular exudates as part of cell membrane “leakage.” Animals acquire phosphorus through the consumption (i.e., feeding and digestion) of plant material or through other animal sources of a complex food-web. Phosphorus ions leave the animal component of the phosphorus



cycle through excretion and decomposition. Plant and animal contributions through waste products and remains lead to phosphate ion movement dissolved into water as water flows through interstitial space in soils or flowing into running water or lacustrine ecosystems.

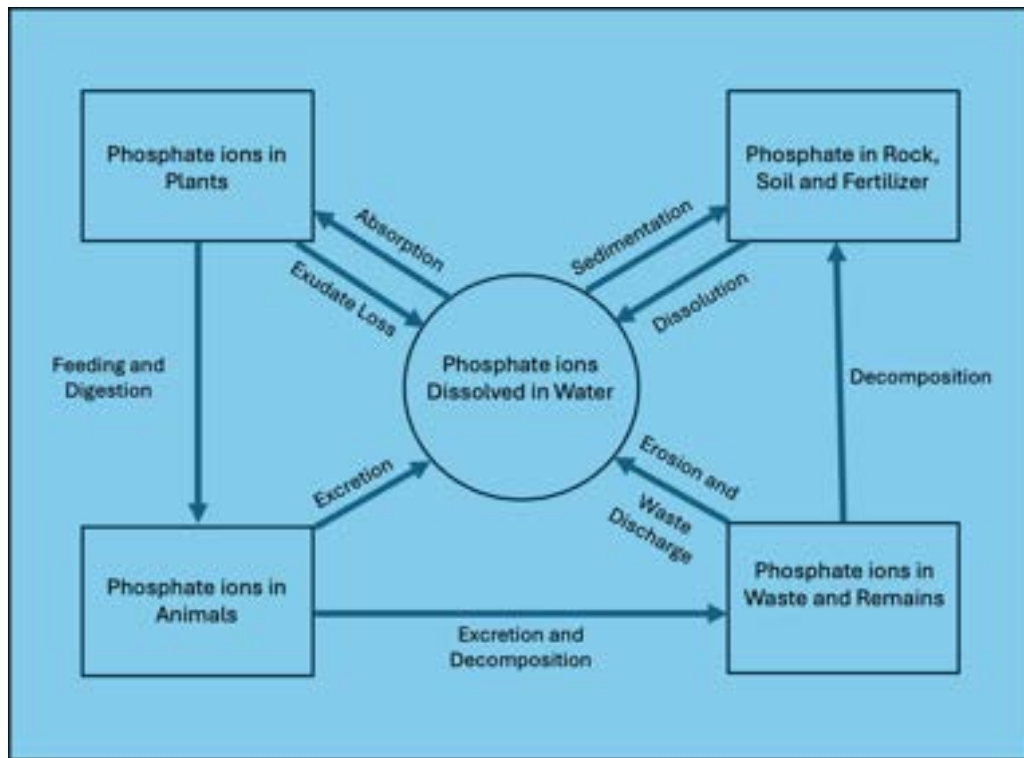


Figure 7. The Phosphorus Cycle illustrates the flow of phosphate ions through the lithosphere, hydrosphere and biosphere and the processes that drive flow and movement between organic and inorganic forms.

General Ecological Implications of the Phosphorus Cycle - On land, phosphorus gradually becomes less available to plants over thousands of years since it is slowly lost in runoff. Many natural systems tightly cycle phosphorus (i.e., very slow leakage from the watershed); however, as disturbances increase due to natural or human activity, phosphorus becomes increasingly mobile to local recycling and is “lost” from the watershed as phosphorus enters streams and is displaced downslope.

Low concentration of phosphorus in freshwater systems reduces plant growth and slows microbial growth. Microorganisms, particularly freshwater algae, act as both sinks and sources of available phosphorus in the biogeochemical cycle. In freshwater systems phosphorus is often a limiting nutrient. In other words, concentrations are often very low and limit growth of primary producers. Indeed, freshwater algae, as well as emergent and

floating plants, are extremely efficient in taking up and sequestering phosphorus leading to over-production and eutrophication of freshwater systems when phosphorus concentrations increase due to disturbances or human caused pollution, such as wastewater outfall.

Ecological Risk and Uncertainties

The Montana Department of Environmental Quality (MDEQ) recently completed its Environmental Assessment and issued a draft permit #MTX000307 requesting public comment. In this section of our expert opinion findings of fact and judgment, we focus on the ecological risks and uncertainties associated with the Project Site geology and sedimentology, the discharge of wastewater into Rapid Infiltration Basins that leach water pathogens, nitrogen, and phosphorus into the underlying shallow deltaic sands aquifer and we provide analysis of potential for significant ecological impacts to surface waters leading to further impairment in the Ashley Creek area and impact to the physical, chemical and biological integrity of the Flathead River/Lake ecosystem (see Federal Clean Water Act 33 U.S.C. §1251 et seq. 1972).

Nutrient Transport and Fate - The permitting fact sheet for MGWPCS Permit No. MTX000307 states nitrogen concentration levels from the Current Wastewater System with Effluent Holding Ponds will be reduced from current levels of approximately 30 mg/L as NO_3 to approximately 8 mg/L. This is to be done through denitrification processes in the “secondary treatment process.” Thus, the MDEQ documents conclude that the wastewater effluent at 8 mg/L would enter the RIBs and infiltrate into the ground and mix with the existing groundwater. This reduction in nitrate from 30 mg/L to 8 mg/L would represent about an 80% reduction from current Lakeside Sewer district disposal from the pond-system that receives surface application on the field to the west of the proposed Project.

While a concentration of 8 mg/L NO_3^- does not exceed the DEQs standards for human health (i.e., 10 mg/L as NO_3^-) described in Table 6 of the document from the DEQ-7 Montana Numeric Water Quality Standards (Montana Department of Environmental Quality, 2019), it does far exceed the total nitrogen concentration 0.11 mg/L of the receiving groundwater sampled from Monitoring Well 5 described in Table 4 of the DEQ fact sheet document (Montana Department of Environmental Quality, 2024).

The data summarized here; however, from the fact sheet for MGWPCS Permit No. MTX000307 is dependent on the likely wrong conclusion that the Project Site is composed of a homogeneous sand deposit, which it almost certainly is not, and that the models used to calculate the rate at which wastewater will move off the site and into surface waters, is



thus also erroneous. Should wastewater seepage from the RIB infiltration system escape the shallow aquifer mixing zones and reach surface waters at or near the 8 mg/L concentration this would far exceed the Numeric Nutrient Standards for Wadeable Streams in Montana Ecoregion 15, the Northern Rockies, which is set at 0.275 mg/L (Suplee & Watson, 2013).

The assumptions made by MDEQ regarding denitrification in the shallow aquifer are likely significantly overestimated. As pointed out above, denitrification is an energy intensive, anaerobic process conducted by microbes requiring organic matter (i.e., microbial chemo-organotrophs). The effluent waters leaching from the RIBs will purposefully be depleted of organic matter (i.e., via BOD reduction) and will carry oxygen into the aquifer. These factors reduce the capacity for denitrification. Indeed, Kolbe et al. (2019) found pronounced decreases of denitrification reactivity in near groundwater table surface waters suggesting that estimates of denitrification used broadly have underestimated the capacity of deep aquifers to remove nitrate, while overestimating nitrate removal in shallow flow paths. Even if we use the permit findings made by MDEQ, the aquifer's characteristics mean that the highly concentrated nitrate-nitrogen wastes that are rapidly infiltrated into the surface groundwater will be discharged to downgradient groundwaters and surface waters with little mixing as waters flow out from the mounded RIBs and without denitrification.

The fate and transport of nitrate is further complicated by the high likelihood of preferential flow pathways, described in detail in the sections above. While it is likely that as wastewater leaves the RIBs there is a hydrogeological propensity to distribute evenly in all directions, this is not the case in heterogeneous deposits, especially where alluvially-sorted deposits in the subsurface foster high transmissivity. Evidence of heterogeneity in the alluvial deltaic sand deposits is most directly seen in Monitoring Well data presented in the fact sheet for MGWPCS Permit No. MTX000307. These data show that especially in the NE quadrant of the Project Site the well logs strongly suggest the well was likely placed in a preferential flow pathway with transmissivity rates observed ~ 500 ft/day. The Satellite and LIDAR Imagery data (see Figure 3), further corroborate the well data and strongly suggest that wastewater could travel rapidly, on the order of a few days, to Wiley's Slough, which has direct surface connection to Ashely Creek and Flathead River. Although the highest transmissivity rates observed were recorded at ~ 500 ft/day, there is at least a reasonable probability that there are preferential flow pathways within the Project Site with even higher flow rates.

These data largely nullify the MGWPCS Permit No. MTX000307 assumptions about wastewater transit time through the Project Site deltaic sediment aquifer to nearby surface waters, the extent of pollutant dilution in the identified mixing zones, the assumed denitrification transformation while waters are in transport away from the Project Site, as



well as assumptions about the timing and concentration of nitrate loading to surface waters, (including Wiley's Slough, and the wetland identified as Pond 4).

Regarding phosphorus, the proposed sewer treatment plant is projected to remove an estimated 70% of the phosphorus load to be discharged from the proposed upgraded Sewage Treatment Facility. The Montana DEQ Fact Sheet document estimates a projected bio-available phosphorus concentration of 1.5 mg/L at the point of entry into the wastewater distribution system of the RIBs. The existing lagoon system has an estimated effluent concentration of bio-available phosphorus of 8 mg/L. The 1.5 mg/L concentration represents a significant reduction in PO_4 ; however, the 200,000 gpd addition to the current lagoon system effluent represents a significant "load" to the receiving shallow groundwater of the facility.

While the decrease in concentration of phosphorus and the increase in the volume of wastewater effluent results in approximately the same PO_4 lbs./day (or Kg/day), the direct injection of bio-available phosphorus via the RIBs, similar to nitrate nitrogen, results in an elevated risk of phosphorus breakthrough into the nearby surface waters including Wiley's Slough, Pond 4, and other nearby surface waterways. The MGWPCS Permit No. MTX000307 assumptions that phosphorus contributions to the aquifer will be mitigated by the long time-period for transit to surface waters, like that of nitrate, are likely false. While clay soils are known to bond to phosphorus, sandy soils, such as those found in the deltaic sands of the shallow aquifer, generally don't share this same property (Muindi, 2019).

Like the case for nitrogen, should wastewater seepage from the RIBs infiltration system escape the shallow aquifer mixing zones, which we have shown to be highly likely, the increased loading of bio-available PO_4 runs a high risk of entering near project surface waters largely unmodified and unattenuated from the point of wastewater discharge into the RIBs.

Flathead-Stillwater TMDL Attainability Analysis – EPA defines a Total Maximum Daily Load (TMDL) as the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. A TMDL determines a pollutant reduction target and allocates load reductions necessary to the source(s) of the pollutant. The surface waters at greatest risk are Wiley's Slough and Pond 4, (which is actually a wetland derived as an oxbow paleo-channel with direct surface connection to Wiley's Slough). Wiley's Slough, in turn, has a direct surface water connection to Ashley Creek and the Flathead River. Nutrient target criteria for the Lower Ashley Creek drainage (MT76O002_030) are consistent with those found throughout the Northern Rockies ecoregion (see Table 1) from the Numeric Nutrient Criteria for Montana's Wadable Streams and Rivers. These targets are established in the



Flathead-Stillwater Planning Area Nutrient, Sediment, and Temperature TMDLs and Water Quality Improvement Plan (2014).

Table 1: Nutrient Targets for the Flathead-Stillwater TMDL Planning Area¹

Parameter	Northern Rockies Level III Ecoregion Target Values
Nitrate	≤ 0.100 mg/L
Total Nitrogen	≤ 0.275 mg/L
Total Phosphorus	≤ 0.025 mg/L

¹ Values from Montana DEQ and U.S. EPA Region 8 (2014)

Using data collected over the preceding decade, Department of Environmental Quality (DEQ) determined that four waterbody segments in the Ashley Creek watershed (one tributary and three Ashley Creek segments) currently do not meet the nutrient water quality standards (Montana DEQ; U.S. EPA Region 8, 2014). Lower Ashley Creek (MT760002-030) was specifically identified with “Nutrient Probable Causes on the 2014 303(d) List.” Thus, the basic assumptions underpinning the Load Allocations for the Flathead Stillwater TMDLs specific to Lower Ashley Creek, MT760002_030, the hydrological surface water unit to which Wiley’s Slough and most surface water in the project proximity have already exceed the target values with average nitrate (NO₃) values at 2.06 mg/L, average total nitrogen (TN) 3.14 mg/L, and total phosphorus (TP) 0.059 mg/L (from Table 5-7 (Montana DEQ; U.S. EPA Region 8, 2014)). These values were based on mean sample values from 2003-2008 and used in the TMDL reference documentation. MDEQ documentation agrees that Ashley Creek segments currently exceed target values. They further state that the target values are established at levels to protect aquatic life and recreation.

It is important to recognize the scientific conclusion, and EPA-approved determination, that Lower Ashley Creek is impaired and still on the State’s 303(d) List for impairments related to exceedances in Nitrate Nitrogen, Total Nitrogen and Total Phosphorus concentrations as well as Chlorophyll-a, which is a bio-indicator of nutrient enrichment. One can therefore only conclude that Lower Ashley Creek has no remaining assimilative capacity for any new additions of those pollutants without first nutrient reduction in those receiving waters.

In this regard, due to special permits for the Kalispell WWTP Waste Load Allocation, “no wastes may be discharged such that the wastes, either alone or *in combination* with other wastes, will violate, or can reasonably be expected to violate, any of the standards”. This permitted action allows for higher TN and TP in Lower Ashley Creek; however, the permit also has benchmark goals of 0.41 and 2.00 mg/L for TP and TN, respectively. Furthermore, the waste load allocation permitting requirements identify reduction values of 30% for TN



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and 44% for TP concentrations within the system. With nutrient loads that already exceed TMDL water quality standards and previously permitted point sources for further nutrient loads where the permits are dependent upon net load reductions, the proposed MGWPCS Permit No. MTX000307 – LCWSD Rapid Infiltration System as currently designed and proposed represent a clear risk for a new point source of TN and TP that will further exceed target values.

As stated above, the sedimentology and alluvial history of the Project Site has a high likelihood of nutrient attenuation failure with wastewater discharges moving far more rapidly into the nearby surface waters than modeled in the proposal. These pollutants, whether entering Pond/wetland 4 with direct surface water connection to Wiley's Slough or entering directly into the Slough, have in turn a direct nexus to Lower Ashley Creek. Also, as explained above regarding likely nutrient concentrations and loads, no meaningful attenuation or dilution is likely before discharging to surface water. The added septage wastewater presents as a new pollutant addition and is likely to cause or contribute to exceedances of numeric nutrient criteria, as well as exceed algal growth parameters and cause other related impairments. The proposed LCWSD discharge would - by itself - exceed the TMDL targets in surface water upon breakthrough, even if it takes over a year (as the Project Proposal model assumes) and certainly if preferential pathways to surface water exist (as per earlier opinion).

Ecological Implications – The implications of risk and uncertainties for the proposed MGWPCS Permit No. MTX000307 – LCWSD Rapid Infiltration System are highly significant. While MDEQ concluded that there would be no significant adverse impacts associated with the Proposed Project, we find that the assumptions regarding the geology and sedimentology of the Project Site, as well as nutrients from the project mixing and being attenuated on site, are very likely over optimistic at best, and if incorrect would result in significant adverse impacts.

The “Flathead-Stillwater TMDL Attainability Analysis,” provide the underpinning Load Allocations for the Flathead Stillwater TMDLs specific to Lower Ashley Creek, MT760002_030, the hydrological surface water within the unit to which Wiley's Slough and most surface water in the project proximity has hydrologic connectivity. It is critically important to recognize the TMDL scientific conclusion, and EPA-approved determination, that Lower Ashley Creek is impaired and remains on the State's 303(d) List for impairments related to Total Nitrogen and Total Phosphorus exceedances, and thus no assimilative capacity remains for any additions of nitrogen or phosphorus pollutants, which directly affect algal production, as well as Chlorophyll- α concentration and O₂ flux.

The MGWPCS Permit No. MTX000307 recognizes that the delta aquifer of the site is hydrologically connected to surface waters with many surface waters within a one-mile



radius of the facility (i.e., Wiley's Slough ¼ mile to the north from the property boundary, Pond/Wetland 4 immediately to the west of the proposed RIBs within the property boundary, and Pond/Wetland 7 a ½ mile southeast of RIB-3)(see Figure 5). As discussed above, the assumptions regarding the mixing and movement of wastewater from the Project Site and radiating away from the RIBs are erroneously assuming a homogeneous sand deposit. However, MGWPCS Permit No. MTX000307 has failed to recognize that the Project Site, indeed the entire area around the project in the southwestern ¼ of the Flathead Valley, is highly heterogeneous. While the contemporary Flathead River channel is 2.3 miles north of the Project Site flowing west to east and then 3.7 miles to the eastern side of the valley and then flowing south into Flathead Lake, the early Holocene Flathead River affected the site through cut-and-fill alluviation creating an extremely heterogeneous array a sediments with linear deposits filled with paleochannels on the surface and in the subsurface.

The MGWPCS Permit No. MTX000307 recognizes that the water table at the Project Site has a small gradient under current conditions; however, the water table will experience mounding because of the wastewater pushing effluent out radially in all directions. Due to the evidence of heterogeneity in the subsurface conditions, it is unlikely that the homogeneous models which describe this mounding effect in the permit are representative of true conditions. The five test wells, MW 1-5, show evidence of this subsurface hydraulic conductivity heterogeneity; however, they do not adequately characterize the current conditions. Additional test wells would be necessary to truly model the shallow aquifer conditions.

Wiley's Slough is "surface connected" to lower Ashley Creek. Ashley Creek was found to be impaired for aquatic life and primary contact recreation (2020 303(d) list). The waters of the Flathead River, as well as waters from the upper Stillwater and Whitefish Rivers, typically have concentrations of nitrate nitrogen (NO_3^-) less than 150 $\mu\text{g/L}$ (0.15 mg/L) and bio-available phosphorus (PO_4) less than 10 $\mu\text{g/L}$ (0.01 mg/L). Indeed, the lower Flathead River near Flathead Lake and waters in Flathead Lake have a typical annual mean nitrate concentration around 40 $\mu\text{g/L}$ (0.04 mg/L) and bio-available phosphorus closer to 5 $\mu\text{g/L}$ (0.005 mg/L). Flathead Lake TMDL targets were largely based on the work done at Flathead Lake Biological Station (Stanford, Ellis, Craft, & Poole, 1997). A 15% reduction in man-caused nitrogen and phosphorus loads, plus a 10 percent margin of safety was proposed as the TMDL.

These wastewater effluents, that would pass through the preferential flow pathways of the shallow aquifer of the Project Site into surface waters represents approximately a 600% increase to the published background nitrate and phosphorus concentrations of Ashley Creek, at the Kalispell airport road to the mouth of the Flathead River (Montana DEQ; U.S.



EPA Region 8, 2014) and a nearly 1000 times increase over the Flathead River/Lake receiving surface waters. Furthermore, these nutrient concentrations significantly exceed the Montana Numeric Water Quality Standards listed in the Circular DEQ-7 water quality standards (Montana Department of Environmental Quality, 2019).

Eutrophication is a leading cause of freshwater impairment of many river and lake ecosystems in the world. Eutrophication is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors especially the nutrients, nitrogen and phosphorus. Algal blooms are strongly linked to nutrient enrichment resulting from anthropogenic activities such as agriculture, industry, and sewage disposal. The most conspicuous effect of eutrophication is the creation of dense blooms of noxious, foul-smelling phytoplankton that reduce water clarity and harm water quality. When dense algal blooms eventually die, microbial decomposition can severely deplete dissolved oxygen, creating hypoxic or anoxic 'dead zones' in water bodies like Wiley's Slough, and the pond/wetland systems near the Project Site.

Based on the MGWPCS Permit No. MTX000307 data provided, we estimate that with a wastewater effluent of 200,000 gpd (i.e., ~757,000 liters per day or 276M liters per year), then approximately 414 kg/yr (~910 lbs./yr) of phosphorus and 2,070 kg/yr (~4554 lbs./yr) of nitrate would enter the project area shallow sediment layer and shallow groundwater system. In light of the mounding of wastewater on the project site and the high potential for direct surface water connection to Wiley's Slough and Ashley Creek and then to the Flathead River, this level of loading of N and P would almost certainly result in significant increase in algal blooms (including *Lemna sp.* [duckweed]) that would directly affect the freshwater ecosystem water quality and ecological integrity of the Flathead River/Lake Ecosystem.

While this estimate has been argued is an overall decrease in net TN and TP for the Flathead River/Lake Basin as distributed septage from Flathead County is proposed to be treated and have nutrient reduction at the sewer treatment plant. The permit proposal does not address the risks involved with concentrating effluent at a previously identified location of impact, the Lower Ashley Creek basin, Stillwater-Flathead River Water Quality Improvement Plan of 2014 (Montana DEQ; U.S. EPA Region 8, 2014).

As identified above, the risks of eutrophication to the surface waters in the immediate area represent environmental threats not identified by the current permit, and likely are in violation of current TMDL permits for Lower Ashley Creek. Indeed, the eutrophication of Ashley Creek, Flathead River and Flathead Lake due to increased nutrient loading will be exacerbated and will contribute to continued nutrient exceedances for those pollutants of concern (Montana DEQ; U.S. EPA Region 8, 2014) with continued non-attainment of



designated uses (i.e., aquatic life, propagation of salmonids and cold-water fisheries, recreational use) for the receiving surface water.

These surface waters that include Wiley's Slough with direct surface nexus to Lower Ashley Creek is at high risk of impact to the surrounding bodies of water especially Lower Ashley Creek, the Flathead River, and potentially extending as far as Flathead Lake. Further effects of eutrophication, described above, would likely impact both the safety of aquatic life as well as the recreational opportunities for Montanans. Health implications could extend to livestock as the toxic effects related to eutrophication are well documented (e.g., Heisler, et al., 2008; Akinawo, 2023). Toxicity from harmful algal blooms, referred to as HAB in most literature, has been demonstrated to have spatial and temporal impacts on downgradient waters (Oliver, Dahlgren, & Deas, 2014).

Thus, the eutrophication of Ashley Creek, Flathead River and Flathead Lake due to increased nutrient loading will be exacerbated and will contribute to continued nutrient exceedances for those pollutants of concern (Montana DEQ; U.S. EPA Region 8, 2014) with continued non-attainment of designated uses (i.e., aquatic life, propagation of salmonids and cold-water fisheries, recreational use) for the receiving surface water.

Summary Opinion/Review of Proposed Project

- Montana DEQ Permit application documentation presents the Project Site as a homogeneous shallow sand layer. However, the Project Site is composed of deltaic sands subjected to cut-and-fill alluvial processes creating heterogeneous paleochannels, oxbows, and suites of ridge-and-swale surface and subsurface deposits.
- Montana DEQ Permit monitoring well data supports our opinion that the LCWSD Rapid Infiltration Basins (RIBs) are sited over a highly heterogeneous sand layer with linear preferential flow ways. Demonstrated hydraulic conductivity rates ranged from about 7 to 500 ft/day, depending on monitoring well location.
- It is our professional opinion that there is clear evidence (e.g., previous studies, satellite imagery, LIDAR imagery) that the receiving delta aquifer of the Project Site is highly heterogeneous and may have many preferential flow pathways. Thus, the receiving delta aquifer is poorly suited for nutrient pollutant assimilation, especially phosphorus or nitrogenous pollutants. Our conclusions here agree with the report findings of HydroSolutions Inc. that the wastewaters may appear within weeks and perhaps even days in surrounding surface waters rather than the Montana DEQ Permit application estimated time frame of years to decades.



- Nitrogen and Phosphorus are often limiting nutrients in freshwater ecosystems. When these elements are “loaded” into freshwaters, the increased concentrations lead to increased productivity of the photosynthetic-base of the food-web. In surface freshwaters, the increased productivity leads to loss of water clarity and increased rates of eutrophication, degraded (impaired) freshwater ecosystems, losses of biodiversity, increased blooms of noxious algae, simplification of the algal community, losses of plankton and invertebrate community structure, losses of preferred fish species, expansion of undesirable fish species, and losses of recreational opportunities.
- Nutrient fate and transport are critical to the suitability of the proposed project. The Montana DEQ Permit application clearly acknowledges the Project Site is surrounded by interconnected surface waters. It is our opinion, based on our understanding of the effects of N and P in freshwater ecosystems and the rates of water flow through preferential flow pathways so prevalent in the Project Site, that the project as currently designed using the local shallow aquifer for direct infiltration of estimated 200,000 gpd of wastewater, presents an unacceptably high risk that highly concentrated nutrient wastes will be discharged to surface waters.
- We further believe that the Montana DEQ Permit application is extremely optimistic about wastewater nutrient attenuation. Aquifer conditions strongly suggest that any dilution, attenuation, or chemical change to nitrate nitrogen or phosphorus is highly unlikely. The nutrient fate and transport condition becomes untenable considering the high likelihood of preferential pathways dominating the site and thus nullify the Montana DEQ Permit application assumptions about (a) transit time, (b) extent of pollutant dilution, (c) assumed chemical transformation, and (d) assumption about concentration and load of wastewater pollutants reaching interconnected surface waters.
- Montana DEQ Permit application asserts that because the wastewater discharge permit is related to gathering diffuse septage from across Flathead County and treating the waste to a higher standard of care, that discharge at the proposed location is nonsignificant because the discharge allegedly represents a “net loss” of nutrient pollutants to Flathead Lake under the Flathead Lake TMDL. This argument collapses if the RIBs and the groundwater infiltrated wastewater system does not perform as proposed. For reasons given above, we believe that there is an exceptionally high probability that the receiving sand aquifer will not perform as proposed. Further, data presented in the Montana DEQ Permit application supports our asserted high level of risk and uncertainty.



- Regarding the ecological impact of probable project failure, it is our opinion that the proposed discharges and consequent nutrient loading on the interconnected surface waters surrounding the Project Site, including nexus with the Flathead River surface waters, the addition of a new municipal-scale wastewater discharge within the shallow Flathead Delta to nearby Lower Ashley Creek creates a significant likelihood of causing or contributing to negative ecological effects in receiving surface waters, including but not limited to eutrophication in Lower Ashley Creek, Flathead River, and Flathead Lake.



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Public Response: Lakeside County Water & Sewer Permit: MTX000307

Expert Opinion: Hauer Environmental LLC

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Qualifications of Authors

F. Richard Hauer, Ph.D.

I was employed as a tenured faculty member at the University of Montana (UM) from 1986 to 2018 (32.5 yrs), now retired with Professor Emeritus status. My primary instruction role at UM was teaching upper-division undergraduate and graduate student courses in Stream and River Ecology and Limnology, and to advise graduate students in their pursuit of advanced degrees, both MS and PhD. My academic home within the university has been Flathead Lake Biological Station, an internationally recognized research center in the field of Freshwater Sciences and where I held the Limnology Endowed Chair from 2001-2016. I am Founding Director of *Systems Ecology*, an intercollegiate graduate program at UM consisting today of over 35 faculty and more than 50 graduate students that emphasize interdisciplinary approaches to understanding biological, physical, chemical, and human processes that shape ecological systems across spatial and temporal scales and the role that humans play in mediating complex socio-ecological interactions. I was also founding Director of both the Montana Institute on Ecosystems (IoE) and the Center for Integrated Research on the Environment. Both research centers, one focused on Montana and the other directed toward environmental issues across the US, are Montana Board of Regents designated research centers executing competitive research in natural and cultural resources.

I have published over 125 peer-reviewed journal articles and book chapters in the fields of stream ecology, river ecology, wetlands ecology and floodplain ecology. The breadth of my work extends from physical processes and interactions of hydrology and geomorphology to biogeochemical processes and cycling, to responses and processes associated with food webs, fisheries and wildlife. I have been awarded the high-honor of “Distinguish Scholar” by the University of Montana for my research and contributions to internationally recognized scholarly work. I have served as President of the Society for Freshwater Science (2003-4) and was awarded status of “Fellow” by the society in 2019. The Society for Freshwater Science is the premiere international scientific association for stream and river ecology and associated wetlands. I have served on numerous USA national-level advisory boards for the US Army Corps of Engineers and the US Environmental Protection Agency.

My research, and that of my students, has been primarily focused on rivers and their associated floodplains and wetlands. This work has been done across a highly diverse, spatially expansive, suite of river systems spanning from Alaska, British Columbia, Alberta, and the western states of the USA, to the Patagonia Region of Chile and Argentina in South America. Finally, I am also senior author and editor of the most widely-used, international book on how to conduct ecology of running waters titled: *Methods in Stream Ecology*, now in its 3rd Edition (2017).

The following is a short Biosketch of education, professional positions held, selected peer-reviewed publications relevant to this review only, other relevant professional activities.



Education:

B.S. 1973 - Michigan State University (Honors – *cum laude*)
M.S. 1975 - Michigan State University (High Honors – *magna cum laude*)
Ph.D. 1980 - University of North Texas (with Highest Honors – *summa cum laude*)

Professional Positions Held:

2023-present President and Partner, Hauer Environmental LLC
2018-present Professor and Director Emeritus, University of Montana
2014-2018 Director, Center for Integrated Research on the Environment (CIRE)
2011-2015 UM Director, Institute on Ecosystems (Founding Director)
2010-2014 Program Director, Systems Ecology Graduate Program (Founding Director)
2008-2011 Montana University System, NSF-EPSCoR Program co-Director
2001-2016 Limnology Endowed Chair, FLBS, University of Montana
1994-2018 Professor, Flathead Lake Biological Station, University of Montana
1989-1994 Research Associate Professor, FLBS, University of Montana
1986-1989 Research Assistant Professor, FLBS, University of Montana
1984-1985 Post-doctoral Research Fellow, University of Alabama
1981-1984 Post-doctoral Research Fellow: Institute of Ecology, University of Georgia
1976-1980 Graduate Fellow/Research Assistant: University of North Texas
1973-1975 Research Assistant: Michigan State University

Selected Peer-reviewed publications specifically relevant to this opinion report:

Selected Book and White-paper Publications

Hauer, F.R., W.W. Moore, C.C. Muhlfeld, S.A. Nagorski, J.S. Richardson, D.E. Schindler, E.K. Sexton, and M.S. Wipfli. 2018. Transboundary rivers of northwestern North America: vulnerable ecosystems in crisis. Wilburforce Foundation White Paper. Pp61.

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PROFESSIONAL AND SCHOLARLY SERVICE

Professional Memberships:

Society for Freshwater Science, International Society of Limnologists, Ecological Society of America, Society of Wetland Scientists, American Association for the Advancement of Science

Professional Service:

Service on National Science Panels:

US Army Corps of Engineers – HGM Wetland Assessment Development Team (1992-2003) Office of Science and Technology Advisory to the White House (1997, 1998)
USEPA Tiered Aquatic Life Use Panel (2001-2004)



February 10, 2025

Public Response: Lakeside County Water & Sewer Permit: MTX000307

Expert Opinion: Hauer Environmental LLC

Science Advisor - Patagonian Ecosystems Investigation Research Center (CIEP)(2006-2012)

Ad Hoc Reviewer for: *Freshwater Science, Ecology, Journal of the North American Benthological Society, Ecological Monographs, Ecological Applications, Canadian Journal of Fisheries and Aquatic Sciences, Canadian Journal of Zoology, Freshwater Biology, Oikos, Wetlands, Ecography, BioScience, Oecologia, Limnology and Oceanography, Transactions of the American Fisheries Society, Fisheries, Archiv fur Hydrobiologie, River Research and Application, Regulated Rivers: Research and Management, National Academy of Science*

Grant Referee for:

National Science Foundation (DEB Ecosystems & Ecology Panels, BioComplexity)

Environment Canada

Norwegian National Science Foundation

UK Environment and Technologies Commission

US Environmental Protection Agency

Finland National Science Institute

State of South Dakota – NSF granting

Special Symposium Organizer: Fifth International Symposia on Regulated Rivers (1991), Flathead Basin Forest Practices Water Quality and Fisheries Symposia (1991), Climate Change in the Rocky Mountains (1998), International Symposium on Mayflies and Stoneflies (2006)

State of Montana: Surface Water Quantity/Quality Steering Committee (1991-92); Water Quality and Sustainable Economic Activity Steering Committee (1996-98), Water Quality and Resource Management Steering Committee (2004-06)

Invited Speaker at Professional Meetings of: Society for Freshwater Science (1983, 1986, 1989, 1992, 1993, 1996, 1998, 2005, 2010, 2016, 2017); American Water Research Association (1992, 2007); Society of Wetland Scientists (1996, 1997, 1998, 1999); American Association of Civil Engineers (1999); Society of Wetland Scientists (2023)



Andrew Hauer, MS

Andrew is a “Contract Professional” at the University of Montana since 2010 and is now a Founding Partner and co-President of Hauer Environmental LLC. He has extensive experience as a project manager, communications director, data analyst, statistics analyst, software engineer, database manager, and IT specialist.

Andrew has a Bachelor of Science in Resource Conservation Management from the University of Montana’s W.A. Franke College of Forestry and Conservation and a Masters of Science in Data Analytics from UM’s College of Business. With an MSBA and a focus on “Big Data” analytics, statistical analysis, and technology.

Andrew has worked on the leadership teams of multiple research and educational centers. During the most recent 5 years he has provided strategic planning, programmatic administration, and analytical leadership at two high visibility research groups: the National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR) and the Numerical Terradynamic Simulations Group (NTSG). These research groups generate massive data for environmental statistical analysis and conservation. Andrew’s data statistical analysis and IT technology expertise has been essential to these successful academic and applied science programs.

At Hauer Environmental, Andrew is the developer and software engineer for all big-data analysis, statistical modeling, and applied data function. His unique perspectives and knowledge working with large data sets and complex statistical analysis of environmental data, coupled with his practical experience in stream, river, and wetland field sciences, fosters innovative solutions to the real-world problems of environmental assessment.

Relevant Projects

- Design and software engineering of rapid assessment approaches to Hydrogeomorphic (HGM) Wetlands Assessment for river ecosystem functional quality assessment.
- Executive board member to organize and facilitate statewide science forums targeting research on the Clark Fork River in western Montana.
- Manage, facilitate, and teach professional development courses on wetland assessment, riparian restoration, and basic stream ecology to the Army Corps of Engineers.
- Develop and administer a five-year \$20M National Science Foundation research grant studying environmental impacts of mining, agriculture, and energy extraction on rivers across the state of Montana.



- Deploy, administer, and analyze award tracking for EPSCoR providing grant metrics and strategic milestone analysis and other data analytics for administration of the grant.
- Conduct spatial data analysis (GIS), mapping, and modeling.
- Develop statistical data modeling tools to measure and visualize Solute Transport in streams and rivers.
- Develop metadata management protocols and tools and administer massive data systems.
- Oversee and coordinate Geographic Information Systems (GIS) and Research tools used by the Upper Clark Fork science community.
- Department of Defense project manager and contractor working on federal lands projects ranging from archeological curation, wetlands management, endangered species conservation, forest management, and prescriptive fire execution.
- Developed and administered a broad spectrum of projects including budget, supervise, and support of field teams, contractors, and other project leaders with 100% project success rate.
- Assisted in launching a downtown science museum (spectrUM) including environmental science related exhibit creation.

Positions Held

- Oct. 2023 – Current
 - *Hauer Environmental LLC*
 - Title: Co-President and Partner
 - Additional Titles: Statistical Analyst, Big Data Analyst, Software Engineer, Project Manager
- June 2012 - Current
 - *Numerical Terradynamics Simulation Group (NTSG) at University of Montana*
 - Title: Special Projects Manager and Systems Administration Officer
- Nov. 2018 – Jan. 2024
 - *Montana NSF Established Program to Stimulate Competitive Research (EPSCoR) at University of Montana*
 - Title: Special Projects Manager and Systems Administration Officer
- Nov. 2019 – Jan. 2024
 - *Upper Clark Fork Working Group (UCFWG)*
 - Title: Communications Director
- June 2013 – Nov. 2018
 - *Center for Integrated Research on the Environment (CIRE) at University of Montana*



- Title: Special Projects Manager and Systems Administration Officer
 - Additional Title: Cyberinfrastructure and Media Manager
- Oct 2011 – Jan 2015
 - *Montana Institute on Ecosystems (IoE) at University of Montana*
 - Title: Data and Media Systems Manager
- Aug. 2010 – May 2012
 - *Montana NSF Established Program to Stimulate Competitive Research (EPSCoR) at University of Montana*
 - Title: Media and Information Specialist

Education

Masters of Science in Data Analytics; College of Business, University of Montana

Bachelors of Science in Natural Resource Conservation Management; W.A. Franke School of Forestry, University of Montana

