MONTANA LEGISLATIVE FISCAL DIVISION

Montana Water and Wastewater Data Collection – Phase 1

Technical Memorandum

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1.0 Introduction

The Legislative Fiscal Division (LFD) of the State of Montana Legislative Branch has been directed to create baseline inventories of select local government infrastructure assets for the eventual use of the data to establish an overall inventory of conditions and funding needs. A statewide baseline inventory of local government drinking water and wastewater system assets does not currently exist in a consolidated format, although a variety of data is available through many different data sources, some of which is not readily accessible. While many individual local government jurisdictions may know the conditions or needs of their own specific assets or these are documented in facility plans, preliminary engineering reports (PERs), or capital improvement plans (CIPs), there is currently no overall inventory at the statewide level to monitor condition or funding needs of those assets.

The LFD hired Great West Engineering (GWE) to complete Phase 1 of the Montana Water and Wastewater Data Collection Project. The purpose of the Phase 1 project is to begin the development of statewide databases for both drinking water and wastewater systems managed by local governments in Montana. The Phase 1 project encompasses two major tasks, which are:

1. Establish a baseline inventory.
2. Identify system types with corresponding system annual replacement costs.

These two tasks are introduced below.

1.1 Baseline Inventory

The Phase 1 project establishes two baseline inventories: one for drinking water systems and one for wastewater systems. Generation of the baseline inventories included establishing applicable lists of public systems in Montana, development of data collection parameters, and development of corresponding data collection procedures. The Phase 1 project was not intended to, nor did it result in complete inventories of all applicable water and wastewater systems in Montana. The purpose of the Phase 1 project is to establish the framework and necessary guidance for future data collection efforts that will be aimed at completing each system inventory focusing on local governments as opposed to privately owned and managed systems. The baseline inventory tasks focused on generating initial lists of systems, identifying system types, developing data collection procedures, and identifying applicable data sources. The baseline inventory is a start to future data collection efforts that will be completed in future project phases.

1.2 Data Evaluation and Cost Analysis of Representative Types

With the baseline inventory and system types identified under the first task of the project, the next task included evaluation of the data to summarize system type classifications at the statewide level. Representative system types were generated from the evaluation, in addition to expected system theoretical total replacement costs. The LFD's end goal is to establish a total system replacement cost for each water or wastewater system and a corresponding target annual investment cost. The calculated annual investment cost can then be compared to a communities' actual water and wastewater infrastructure spending to determine if systems are adequately planning and investing for replacement/upgrades to their systems.

The technical memorandum that follows includes one chapter on water systems, one chapter on wastewater systems, and a final chapter with recommendations for future efforts and next steps. Each chapter documents the methodology and data sources used to establish the baseline inventory and total replacement cost estimate, and analysis of different system types. Data sources, agency contacts, and website/database links are provided in the references section at the end of the document.

2.0 MT Water Systems

2.1 Overview and Definitions

There are several water system classification definitions that are important to understand as systems are summarized at the statewide level. The Montana Department of Environmental Quality (MDEQ) is the regulatory agency responsible for assuring the provision of safe drinking water in Montana's public water systems. A public water system (PWS) is defined as a system that provides water for 25 or more people for more than 60 days a year or has 15 or more service connections. Systems that are classified as public must meet the federal Safe Drinking Water Act (SWDA) regulations, state laws, and are regulated by the MDEQ Public Water Supply Bureau. The term "public" in this sense refers to regulatory requirements and not who owns the system. For example, a water system can be privately owned (such as a business or homeowner's association) and still be classified as a public system that is regulated by MDEQ.

Public water systems are further classified according to MDEQ as follows:

- *Community Water System*: Systems that serve at least 15 service connections used by year-round residents or regularly serve 25 year-round residents. Examples include cities, towns, water districts, residential subdivisions, mobile home courts, nursing homes, and prisons.
- *Non-Community Non-Transient Water System*: Systems that serve at least the same 25 non-residential individuals during six months of the year. Examples include schools and workplaces.
- *Non-Community Transient Water System*: Systems that do not regularly serve at least 25 of the same non-residential people for at least six months of the year. Examples include rest areas, parks, restaurants, campgrounds, and motels.

Each public water system classification has different water quality monitoring and operator certification requirements with community water systems being the most stringent of the three types.

MDEQ does not regulate tribal drinking water systems in Montana. Tribal systems in Montana are regulated by the Environmental Protection Agency (EPA) as part of the EPA's Tribal Drinking Water Program.

2.2 List of Systems

To establish a list of water systems for the baseline inventory, the first step was to evaluate what data was readily available and determine what types of systems should be included in the inventory.

MDEQ maintains a PWS Facilities spatial database that is accessible online. The database consists of point features which represent public water system facility assets such as a well, storage tank, or treatment plant. The database does not include line features and therefore does not include water mains. Each facility point contains a PWS ID, which corresponds to the water system it serves. This database was queried by PWS ID, and the results are summarized below in Table 2-1. As shown, there are 2,309 public water systems in Montana as of May 7, 2025.

Table 2-1 – MT Public Water System Summary

PWS Type	Quantity
Community	786
Non-Community Non-Transient	311
Non-Community Transient	1,212
Total	**2,309**

Based on MDEQ data query performed on 5/7/25

Phase 1 of LFD's inventory effort is intended to encompass community public water systems that are managed by local governments. In other words, these are generally water systems associated with cities, towns, and districts and would exclude private systems such as those managed by a homeowner's association or a private establishment. Table 2-2 presents a summary of community water systems in Montana based on the owner type classification included within the MDEQ database. Of the 786 community water systems in Montana, 231 systems apply to local governments (excluding private and Federal government systems). These 231 systems will be the focus of the baseline inventory for this Phase 1 effort and will be further described within this memorandum.

Table 2-2 – MT Community Public Water System Summary

Owner Type	Quantity	Phase I Inventory
Private	546	0
Local	224	224
Federal Government	9	0
State Government	4	4
Mixed (Private & Public)	3	3
Total	**786**	**231**

Based on MDEQ data query performed on 5/7/25

2.3 Data Evaluation

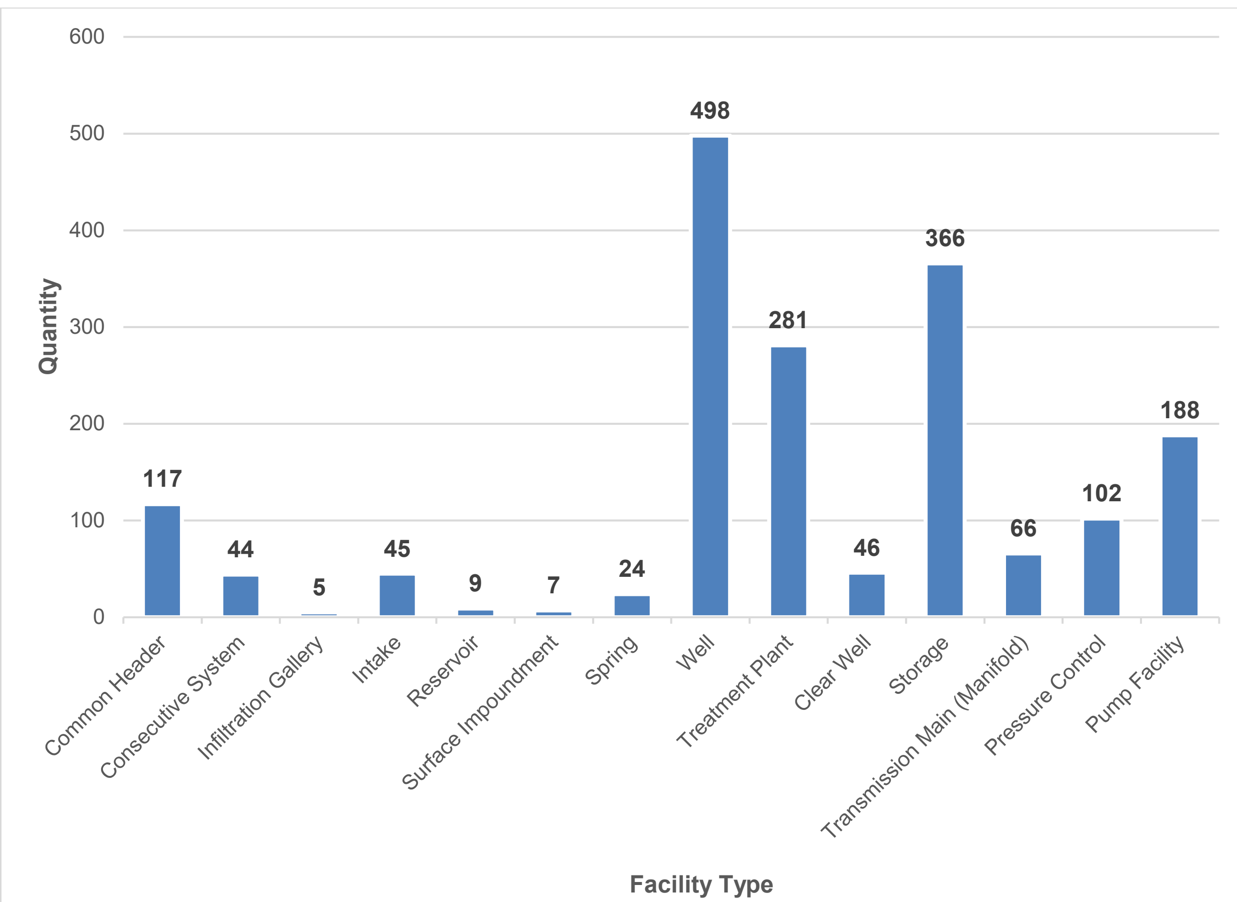
Once the number and type of water systems were determined, the next step was to determine what information would be collected for each water system as part of the Phase 1 inventory effort. A water system is comprised of multiple components such as groundwater wells, surface water intakes, water treatment plants, storage tanks, distribution piping, pump stations, and control valves. Additionally, the level of complexity of each system varies based on factors such as the water source type, raw water quality, topography, and population.

The first approach to establishing data collection parameters was to determine what data is readily available from MDEQ's PWS Facilities database. As mentioned previously, MDEQ's online database consists of point features which represent public water system facility assets such as a well, storage tank, or treatment plant, and each facility point has data associated with it. The first step was to aggregate the data points by water system and determine how many facility types exist per system. This approach resulted in the generation of a spreadsheet of water systems pertaining to the 231 systems in the Phase 1 baseline inventory. The spreadsheet contains a row for each water system with corresponding columns of data that are color-coded by the data source. The water system data spreadsheets are provided in Appendix A.

As shown in Appendix A, the first several columns (columns A-I) of data pertain to general characteristics of each system such as the PWS ID, PWS name, primary source water type, county and city information, and population. The next column grouping (columns J-W) relates to the water system asset types and quantities specific to each water system. For example, the first water system on the list is the Absarokee Water and Sewer District. This water system contains four groundwater wells, three treatment plants, two storage facilities, and one common header (point where multiple wells converge). The MDEQ facility database categorizes a treatment plant as any point in the system where water is treated. In the case of the Absarokee example, the water is treated by adding chlorine, so this shows up as a treatment plant for each of the three wells where chlorine is added to the system. This is typically done within a pump house structure which are generally small buildings that house the groundwater well pump, control panels, piping, and chlorine chemical feed system. In contrast, the City of Cut Bank contains one treatment plant which corresponds to a conventional surface water treatment plant treating raw water from Cut Bank Creek. A conventional surface water treatment plant consists of a series of more complex processes using a variety of equipment such as chemical feed systems, filters, and settling basins. The surface water treatment plant processes are typically housed within a treatment plant building which requires substantially more space than a single pump house structure.

Figure 2-1 summarizes the facility point asset quantities for the 231 public water systems in the Phase 1 baseline inventory. The most common facilities are groundwater wells, storage tanks, treatment plants, and pump stations. Although not shown in Figure 2-1, each water system also contains a distribution system which includes assets such as water mains, valves, fire hydrants, water service connections, and water meters.

Figure 2-1 – Public Water Supply Facility Summary



Due to the variation in water treatment types and complexities, additional data is needed to understand each water system's treatment process. MDEQ maintains data on each water system's treatment objective and treatment technology, although this data is not readily available within the online public facility spatial database. MDEQ was contacted as part of this Phase 1 inventory effort and provided the treatment objective and technology information in spreadsheet format. MDEQ also provided a second set of spreadsheets that summarize each water system's facility data points. These MDEQ spreadsheets are provided for reference in Appendix B.

Additional columns were added to the baseline inventory spreadsheets for treatment objectives and treatment technologies (columns X-Y in Appendix A). Data was populated within these columns using the information provided within MDEQ's additional spreadsheets. The data transfer was not a one-to-one relationship so there was some manual effort required to interpret MDEQ's treatment data, summarize it by water system, and summarize it into a format usable for the baseline inventory. The outcome of this treatment review is shown in the baseline inventory spreadsheet (Appendix A) as a column listing each system's treatment objective (disinfection, corrosion control, iron removal, particulate removal, etc.) and treatment technology (chlorine, chemicals, filtration, etc.). Defining the treatment terms and methodologies in these columns in detail is beyond the scope of work for this inventory effort. In summary, the data in these columns can basically be described as what the system is treating for (column X, treatment objective) and how the system treats (column Y, treatment technology).

Based on review of the data in columns X and Y, several treatment categories were developed and populated for each water system. The treatment categories are listed in column Z and are generally described as follows:

- *Groundwater – No Treatment*: Systems that are served by groundwater but do not provide any treatment. These systems are not required to provide treatment based on their raw water quality and well/aquifer characteristics. They can meet drinking water standards without treatment.
- *Groundwater – Disinfection*: Systems that are served by groundwater and are typically treated using liquid or gaseous chlorine for disinfection.
- *Groundwater – Additional Chemical*: Systems that are served by groundwater and are treated with chemicals in addition to chlorine. These systems add chemicals, such as for corrosion control or iron removal and also disinfect using chlorine.
- *Groundwater – Physical Process*: Systems that are served by groundwater and are treated using a physical process such as pressure filtration. These systems may also treat with chemicals, in addition to disinfection with chlorine.
- *Surface Water – Conventional Filtration*: Systems that are served by surface water and treat using a conventional filtration process consisting of a series of processes including coagulation, flocculation, sedimentation, and filtration.
- *Surface Water – Direct Filtration*: Systems that are served by surface water and treat using a direct filtration process meaning that sedimentation is excluded prior to filtration. This treatment technique generally requires a very stable and clean raw water source to be effective.
- *Surface Water – Slow Sand Filtration*: Systems that are served by surface water and treat using a technique of passing raw water through a bed of sand at low velocity.
- *Surface Water – Alternative Filtration*: Systems that are served by surface water and treat using membrane or cartridge filtration.
- *Surface Water – Unfiltered*: Systems that are served by surface water but do not treat using any filtration process. The only applicable Phase 1 inventory system in this category applies to the Town of Philipsburg. The surface water drinking source in Philipsburg is within a highly protected watershed and the Town has historically been able to operate under a filtration waiver. The Town will likely be required to provide filtration in the near future, however, based on changing water quality.
- *GWUDISW – Filtration*: Systems that are served by Groundwater Under the Direct Influence of Surface Water (GWUDISW). This is a special category reflecting a subsurface water source that

contains or has the potential to contain pathogenic microorganisms that are associated with surface water sources. GWUDISW systems must treat water using a filtration technique.

- *Consecutive Systems*: Consecutive systems are systems that purchase treated water from another system. Consecutive systems therefore only generally possess distribution system components (pipe, valves, pumps etc.) and rely on the upstream system to provide the water source and treatment facilities. There are exceptions to this however, with some consecutive systems providing additional treatment such as disinfection.

Once each Phase 1 system had been assigned a treatment category, the data was evaluated and summarized by population as shown below in Tables 2-3 and 2-4. The "Big Seven" refers to the seven largest cities in Montana which are Billings, Missoula, Great Falls, Bozeman, Butte, Helena, and Kalispell.

Table 2-3 – Water System Treatment Type Summary (All Systems)

Treatment Category	# of Systems	Percent	Minimum Population	Maximum Population	Average Population
Groundwater - No Treatment	64	28%	32	10,460	1,094
Groundwater - Disinfection	56	24%	75	68,200	2,314
Surface Water - Consecutive System	27	12%	40	12,000	1,016
Surface Water - Conventional Filtration	23	10%	167	114,000	13,401
Groundwater - Additional Chemical	21	9%	102	5,585	1,118
Groundwater - Physical Process	16	7%	58	20,008	2,568
Groundwater - Consecutive System	9	4%	25	1,050	232
Surface Water - Alternative Filtration	8	3%	150	56,000	8,019
Surface Water - Direct Filtration	3	1%	750	2,350	1,558
GWUDISW - Filtration	2	1%	250	800	525
Surface Water - Slow Sand Filtration	1	0%	1,000	1,000	1,000
Surface Water - Unfiltered	1	0%	1,360	1,360	1,360
Total	**231**	**100%**			

Table 2-4 – Water System Treatment Type Summary (Without Big Seven)

Treatment Category	# of Systems	Percent	Minimum Population	Maximum Population	Average Population
Groundwater - No Treatment	64	29%	32	10,460	1,094
Groundwater - Disinfection	55	25%	75	7,500	1,116
Surface Water - Consecutive System	27	12%	40	12,000	1,016
Groundwater - Additional Chemical	21	9%	102	5,585	1,118
Surface Water - Conventional Filtration	19	8%	167	10,418	3,696
Groundwater - Physical Process	15	7%	58	5,300	1,406
Groundwater - Consecutive System	9	4%	25	1,050	232
Surface Water - Alternative Filtration	7	3%	150	2,483	1,165
Surface Water - Direct Filtration	3	1%	750	2,350	1,558
GWUDISW - Filtration	2	1%	250	800	525
Surface Water - Slow Sand Filtration	1	0%	1,000	1,000	1,000
Surface Water - Unfiltered	1	0%	1,360	1,360	1,360
Total	**224**	**100%**			

As shown in the summary tables, over 50% of the water systems in Montana are served by groundwater and provide either no treatment or only disinfection with chlorine. Considering all system types and without the Big Seven, most systems serve an average population of around 1,000 people with the exception of conventional filtration surface water plants which serve an average population of approximately 4,000 people.

Table 2-5 further summarizes the systems by treatment category and population groups. Over 50% of the water systems serve communities with populations of 500 or less. The treatment categories with the highest number of systems within each population group are as follows:

- *Population Less than 500*: Groundwater – No Treatment
- *Population 500-1,800:* Groundwater – Disinfection
- *Population 1,800* – 20,000: Surface Water – Conventional Filtration
- *Population Greater than 20,000:* Surface Water – Conventional Filtration

Table 2-5 – Water System Treatment Type Summary by Population Groups

Treatment Category	# of Systems				
	Population Less Than 500	Population 500-1,800	Population 1,800- 20,000	Population Greater than 20,000	Total
Groundwater - No Treatment	43	10	11	0	**64**
Groundwater - Disinfection	31	14	10	1(1)	**56**
Surface Water - Consecutive System	18	6	3	0	**27**
Surface Water - Conventional Filtration	5	2	12	4(2)	**23**
Groundwater - Additional Chemical	11	5	5	0	**21**
Groundwater - Physical Process	5	4	6	1(3)	**16**
Groundwater - Consecutive System	8	1	0	0	**9**
Surface Water - Alternative Filtration	2	3	2	1(4)	**8**
Surface Water - Direct Filtration	0	2	1	0	**3**
GWUDISW - Filtration	1	1	0	0	**2**
Surface Water - Slow Sand Filtration	0	1	0	0	**1**
Surface Water - Unfiltered	0	1	0	0	**1**
Total	**124**	**50**	**50**	**7**	**231**

(1)Missoula
(2)Billings, Butte, Great Falls, Helena
(3)Kalispell
(4)Bozeman

The data collected and evaluated in this section resulted in broad determination of system types based on the type of water source and water treatment methods used. The analysis was conducted using readily available MDEQ data. There is numerous additional data that can be collected for a water system to capture all the assets within a system. Additionally, once all the assets are identified, there is numerous additional data that can be tied to each asset such as size, material type, age, etc. A spreadsheet quickly becomes cumbersome when attempting to account for system assets and a GIS or database format is much more applicable. The last section of this technical memorandum will address the major data gaps identified through this Phase 1 effort as well as identify recommendations for future data collection strategies.

2.4 Cost Analysis

As mentioned in the introduction of this memorandum, LFD aims to determine a theoretical annual replacement cost for each public water system so that communities and the state can assess how much they should be investing in their infrastructure each year on average to fund system replacements. The first step in calculating a system replacement cost is to determine all the assets that make up the system. As discussed in the previous section, some of this data is available through MDEQ (number of wells, storage tanks, etc.). There is no information, however, on the distribution system such as lineal feet and type of pipe or number of fire hydrants. Other missing data relates to types of features, a concrete storage tank versus a welded steel storage tank for example.

Because not everything is known for all 231 systems at this time, GWE selected a small sampling of representative water system types to calculate approximate total and annual replacement costs for different system types. The systems selected are those familiar to GWE based on a history of previous engineering consulting work performed in the community. The estimates were generated by first determining the quantities of assets that make up each water system. Unit costs were then applied to each quantity to determine the total replacement cost of each asset type. The summation of the asset type replacement costs equates to the total replacement cost or current replacement value (CRV) of the entire water system.

LFD currently has an established approach and budgetary process for determining spending levels associated with state-owned buildings. LFD provided background literature on the state-owned building process to GWE for review and potential applicability of similar methods to water and wastewater infrastructure. An article entitled "Crumbling Campuses" by Jack Probasco detailed formulas for determining annual renewal costs for college campus facilities. GWE applied this approach to the calculated CRV of the water systems to determine an annual replacement cost. The process is generally described as follows:

1. Determine the replacement cost of each system asset and subsystem. Subsystems for a water system are generally distribution, storage, supply, and treatment. Examples of assets include water main, fittings, and hydrants within the subsystem of distribution or water wells and well pumps within the subsystem of supply.
2. Calculate the percentage of the total subsystem replacement cost for each asset, denoted as variable "a".
3. Estimate the service life of each system asset, denoted as variable "b".
4. Estimate the percentage to be replaced each design life for each system asset, denoted as variable "c".
5. Calculate the average cost per replacement dollar, "d", for each asset using the formula $d = \frac{a \times c}{b}$.
6. Sum the asset cost per replacement dollar values and multiply by the CRV of the water system to obtain the estimated theoretical recommended annual replacement cost of the entire system.

The process above was executed for seven water systems of different sizes and types within the Phase 1 inventory list, which GWE has engineering experience. Future phases of work can complete cost estimates for more communities. Table 2-6 presents the cost summary for the annual replacement cost reported as a decimal fraction of the total replacement value for the evaluated water systems. The estimated costs are generalized and reference bid tab information for publicly funded projects completed between 2020-2025 with some additional specialized projects from outside this window. Costs are assumed in 2025 dollars. Detailed cost estimates and associated assumptions are provided in Appendix C.

Table 2-6 – Water System Annual Replacement Cost Summary

Water System	Population	Treatment Category	Estimated Total Current Replacement Value (CRV)	Pipe/Distribution Only CRV	Annual Cost per Replacement Dollars	Annual Replacement Cost	Annual Replacement Cost per Person
Town of Dodson	120	Groundwater – No Treatment	$5,613,925	$4,828,925	0.078	$440,483	$3,671
Town of Geraldine	260	Groundwater - Disinfection	$13,752,000	$11,452,000	0.055	$758,936	$2,919
City of Harlem	820	Surface Water – Alternative Filtration	$18,490,350	$10,420,350	0.048	$892,831	$1,089
Town of Ennis	1,400	Groundwater – No Treatment	$21,662,700	$19,462,700	0.070	$1,508,118	$1,077
City of Malta	1,800	Groundwater – Additional Chemical	$38,175,000	$35,194,000	0.073	$2,772,446	$1,540
City of Cut Bank	3,105	Surface Water – Conventional Filtration	$57,914,550	$37,804,550	0.055	$3,188,682	$1,027
City of Havre	9,921	Surface Water – Conventional Filtration	$151,586,500	$112,926,500	0.065	$9,798,247	$988

3.0 MT Wastewater Systems

3.1 Overview

Like water systems, MDEQ has a role in the regulation of public wastewater systems. MDEQ reviews and approves wastewater systems during the design process whenever a new system is constructed or when modifications are made to existing systems. MDEQ also facilitates a permitting process for wastewater systems that discharge treated effluent to surface waters or for those that discharge to the subsurface. Depending on requirements established in the discharge permit, dependent on the receiving water, a system is required to sample and report on certain water quality parameters specific to the wastewater effluent to ensure certain levels of pollutants are not exceeded.

3.2 List of Systems

To establish a list of wastewater systems for the baseline inventory, the first step was to review what data is available through MDEQ. MDEQ's discharge permit information is available for viewing online via the online interactive GIS map. This data set reflects a point feature at the discharge location of every discharge permit outfall and there is associated data for the permit number, permit type, and some other general information regarding the permittee and facility name. The data does not include any information regarding the wastewater facility itself or the type of wastewater treatment system being utilized.

Since little information was available online, a request was made to MDEQ for additional information on wastewater facilities. In response to this request, the MDEQ Water Pollution Control State Revolving Fund (WPCSRF) provided GWE with a spreadsheet of public wastewater treatment facilities in Montana. The spreadsheet appears to be used internally by MDEQ and is periodically updated to track information for each facility, such as the plant type, design population, and flow data, recent upgrade dates, operator contact information, and operations and maintenance (O&M) and technical inspections dating back to 2009. It is unclear how often the information is updated and the version provided to GWE indicated the last update was in October of 2023. The internal MDEQ spreadsheet has more columns and worksheets than are practical to print and include as an appendix to this memorandum.

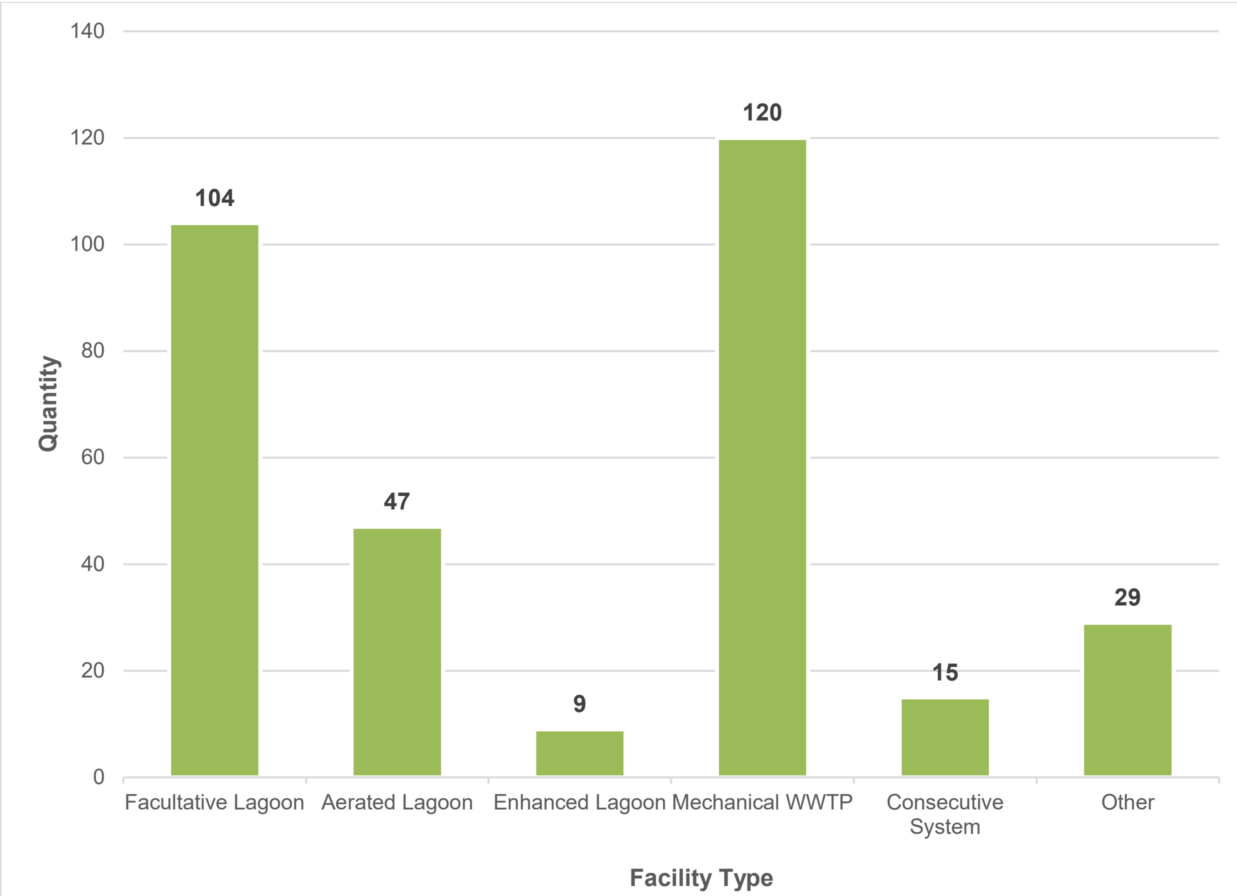
Using the MDEQ internal spreadsheet as a starting point, GWE extracted pertinent information from the MDEQ dataset into a new spreadsheet to create the baseline inventory of wastewater systems for the Phase 1 project. The wastewater baseline inventory spreadsheets are included in Appendix D. The baseline inventory of wastewater systems encompasses 324 systems. The baseline inventory excluded systems classified in MDEQ's spreadsheet as industrial or Hutterite Colony systems, since these systems are likely privately-owned. The MDEQ spreadsheet does not include a data field to indicate system ownership such as was included in the PWS database. Currently, all 324 systems are included in the baseline inventory, however, a review of the data does indicate that some of the systems apply to subdivisions and homeowner's associations which are most likely privately owned systems. Further investigation is needed to determine what wastewater systems are classified as publicly owned versus privately owned systems.

3.3 Data Evaluation

A wastewater system is comprised of multiple components, such as collection systems, including sewer mains, manholes, and lift stations, in addition to a wastewater treatment facility that may or may not discharge effluent (e.g., total retention lagoons), or one that irrigates and does not require a permit. Additionally, the level of complexity of each system varies based on factors such as topography, population, and discharge permit requirements.

The baseline inventory spreadsheet (provided in Appendix D) contains a row for each wastewater system with corresponding columns of data. All the data columns pertain to information from MDEQ's internal spreadsheet, except for one column that was generated by GWE to indicate the treatment plant group. Figure 3-1 summarizes the generalized treatment facility quantities for the 324 wastewater systems in the Phase 1 baseline inventory. Approximately half of the systems are lagoon systems.

Figure 3-1 – Public Wastewater Facility Summary



In order to obtain a more detailed view into the complexity of a wastewater plant, the type of discharge must also be considered. GWE used data for the plant type (column D) and discharge method (column K) to generate categories for the plant type group (column E). The treatment plant/discharge categories are generally described as follows:

- *Mechanical WWTP to Drainfield*: Systems that treat wastewater using a mechanical method (non-lagoon), and discharge wastewater to the subsurface. The majority of systems in this category use an advanced treatment method such as a recirculating sand filter to treat wastewater prior to discharge to the soil absorption system (drainfield). This is the most numerous category (62 systems) within the baseline inventory; however, inspection of the system names and populations indicates this category is likely not applicable to the public systems LFD aims to monitor for funding levels. These systems pertain to subdivisions, homeowner's associations, businesses, and rest areas. Only six of this type of system had population data associated with it but of those six, the populations were less than 250 people. This category will not be considered further in the data evaluation or cost analysis effort for this Phase 1 project.

- *Facultative Lagoon to Surface Water*: Systems that treat wastewater using a facultative lagoon and discharge it to surface water. Facultative lagoons receive oxygen through natural surface aeration and photosynthesis and do not utilize mechanical equipment for aeration. They are the simplest type of system.
- *Mechanical WWTP to Surface Water*: Systems that treat wastewater mechanically using multiple treatment processes (non-lagoon) and discharge to surface water.
- *Facultative Lagoon Total Containment*: Systems that treat wastewater using a facultative lagoon but do not discharge. Total containment lagoons are designed to evaporate all incoming wastewater. Due to the large area required for evaporation, this type of system generally applies to smaller communities.
- *Aerated Lagoon to Surface Water*: Systems that treat wastewater using an aerated lagoon and discharge to surface water. Unlike facultative lagoons, aerated lagoons use mechanical aeration equipment methods including blowers and diffusers to add air/oxygen to the wastewater.
- *Facultative Lagoon to Spray Irrigation:* Systems that treat wastewater using a facultative lagoon and discharge wastewater to an agricultural spray irrigation system. These systems operate as total containment lagoons in the winter months when irrigation cannot occur. Currently, the state does not require effluent irrigation systems to have a discharge permit so long as the community maintains a nutrient management and irrigation plan.
- *Consecutive Systems*: Consecutive systems discharge wastewater to another public system. Therefore, they only possess collection system components (pipe, manholes, etc.) and rely on the downstream system to provide wastewater treatment and discharge.
- *Other*: Systems that are served by other combinations of treatment methods and discharge. The previously mentioned categories represent roughly 75% of the total systems in Montana. Other treatment methods include enhanced lagoons, which are aerated lagoons with some other type of additional tertiary or polishing treatment. Other treatment methods also include septic tank systems. Other discharge methods include infiltration ponds.

Table 3-1 summarizes the treatment categories for wastewater and includes population statistics. All "Big Seven" cities have mechanical treatment plants that discharge to surface water. The last row presents statistics for that treatment category with the "Big Seven" cities removed.

Table 3-1 – Wastewater System Treatment Type Summary

Treatment Category	# of Systems	Percent	Minimum Population	Maximum Population	Average Population
Mechanical WWTP to Drainfield	62	19%	Not Evaluated		
Facultative Lagoon to Surface Water	39	12%	47	3,376	539
Mechanical WWTP to Surface Water	38	12%	70	106,000	12,283
Facultative Lagoon Total Containment	30	9%	37	897	173
Aerated Lagoon to Surface Water	28	9%	182	2,624	978
Facultative Lagoon to Spray Irrigation	25	8%	100	1,081	331
Consecutive System	15	5%	Not Evaluated		
Other Combinations	87	27%	Not Evaluated		
Total	**324**	**100%**			
Mechanical WWTP to Surface Water (w/o Big Seven)	*31*	*NA*	*70*	*10,250*	*3,429*

Lagoon treatment systems serve an average population of less than 1,000 people. Mechanical treatment plants discharging to surface water serve the largest communities with an average population of approximately 3,400 people (excluding the Big Seven).

The data collected and evaluated in this section resulted in a broad determination of system types based on the type of treatment system and discharge method used. The analysis was conducted using data made available from MDEQ upon request. There are numerous additional data points that can be collected for a wastewater system to capture all the assets within a system. Additionally, once all the assets are identified, there are several additional data points that can be tied to each asset, such as size, material type, age, etc. As mentioned regarding water systems, a spreadsheet quickly becomes cumbersome when attempting to account for system assets, and a GIS or database format is much more applicable. The last section of this technical memorandum will address the major data gaps identified through this Phase 1 effort as well as identify recommendations for future data collection strategies.

3.4 Cost Analysis

As mentioned in the introduction of this memorandum, LFD aims to determine a theoretical annual replacement cost as a function of the total replacement cost for each public wastewater system so that the state and communities can determine how much they should be investing in their infrastructure for capital improvements and replacements each year on average. Because there is significant data collection required to obtain full asset lists for all 324 wastewater systems, GWE selected a small sampling of representative wastewater system types to calculate the estimated annual replacement costs. The systems selected are those familiar to GWE based on a history of previous engineering consulting work performed in the community.

The process for determining an annual replacement cost was previously described in Section 2.4 for water systems, and the same approach was used for wastewater system calculations. The estimated costs are generalized and reference bid tab information for publicly funded projects completed between 2020-2025 with some additional specialized projects from outside this window. Costs are assumed in 2025 dollars. Table 3-2 presents the cost summary for the evaluated wastewater systems. Detailed cost estimates and assumptions are provided in Appendix E.

Table 3-2 – Wastewater System Annual Replacement Cost Summary

Wastewater System	Population(1)	Treatment Category	Estimated Total Current Replacement Value (CRV)	Pipe/Collection Only CRV	Annual Cost per Replacement Dollars	Annual Replacement Cost	Annual Replacement Cost per Person
Town of Dodson	120	Facultative Lagoon Total Containment	$9,475,000	$4,090,000	0.078	$737,937	$6,149
Town of Geraldine	260	Facultative Lagoon to Surface Water	$7,326,000	$4,381,000	0.033	$240,580	$925
City of Harlem	820	Aerated Lagoon to Surface Water	$13,260,500	$7,287,000	0.087	$1,148,353	$1,400
Town of Ennis	1,400	Aeriated Lagoon to Surface Water	$12,509,000	$7,026,500	0.068	$845,095	$604
City of Malta	1,800	Aerated Lagoon to Spray Irrigation	$43,243,000	$28,188,000	0.067	$2,891,966	$1,607
City of Cut Bank	3,105	Mechanical WWTP to Surface Water	$53,107,000	$35,107,000	0.093	$4,947,705	$1,593
City of Havre	9,921	Mechanical WWTP to Surface Water	$144,480,000	$116,480,000	0.091	$13,135,146	$1,324

(1)Populations are the same as used for the water system analysis for consistency. Population information within the MDEQ wastewater spreadsheet differs slightly.

4.0 Recommendations

The following narratives reflect recommendations for future data collection and cost analysis efforts with respect to statewide public drinking water and wastewater systems based on what was learned as part of the Phase 1 project.

4.1 List of Systems

LFD's inventory effort aims to focus on public (non-privately owned) community water and wastewater systems. These should generally be systems that serve a city, town, or district. It became apparent during the Phase 1 project that not all districts were listed in MDEQ's PWS database as public community systems. The opposite also became apparent in the wastewater database in that privately-owned systems were being tracked on MDEQ's public wastewater system spreadsheet.

It is recommended that further study be conducted to determine what constitutes a system as publicly owned versus privately owned and how those are determined by MDEQ. It is also recommended that further discussion be given regarding Tribal systems and whether those would fall into the statewide database or how those should be classified. It appears that MDEQ's PWS database excludes some of these systems, but many of them are tracked in MDEQ's wastewater spreadsheet. Another distinction with system ownership are regional water systems such the Dry Prairie and Rocky Boy North Central systems that have their treatment facilities on Tribal lands but serve extensive non-Tribal consecutive systems and rural customers.

4.2 Data Collection

The Phase 1 project revealed that MDEQ tracks data for water and wastewater systems, primarily relating to the water source and treatment methods for drinking water and the treatment method and discharge permitting for wastewater systems. There is a large data gap in system components related to water distribution and wastewater collection, or simply put, the piping and buried components of a system. It is recommended that the next phases of the project include further coordination with DEQ and possibly other state agencies regarding the sources and methods of tracking available data.

It is recommended that future data collection efforts first detail what data is desired. For example, should the state focus on asset identification data or does the data need to capture more detailed information, such as the year of installation, material classification, and other condition information? It would be ideal if each community had a GIS database of all their system assets, which also tracked information such as condition, type, etc. Many communities in Montana do have this information or are working towards creating an asset management system; however, this information is typically held with each community or its consultants and is not publicly available in most cases without extensive research.

Other sources of data are recent studies that communities have completed, whether part of a grant application, preliminary engineering report, facility master plan, or capital improvement plan. These reports, even if outdated, typically have much of the data needed to capture a system's assets and condition. However, the information, while technically public information, is not easy to extract and is not in a database format. State agencies could perhaps develop a form or tracking method to capture the relevant data that is required as part of a preliminary engineering report or grant application. MDEQ could also be another resource for a statewide database as they complete O&M inspections and sanitary surveys of wastewater and water systems, respectively. The next phases of work should consider evaluating the methods of acquiring and compiling existing condition information with state resources.

The following conclusions and recommendations are noted regarding existing data for water and wastewater systems in Montana and modifications to reporting methods to better meet LFD's objectives:

- There is a significant lack of available data for piping and buried infrastructure components of a system. Piping components represent the highest cost of a system's replacement value and are the part of a system that is the least publicly known. It is recommended that the state consider new methods of obtaining additional buried infrastructure condition information from communities, including DEQ/SRF O&M inspections, grant application processes, and/or sanitary survey inspections.
- Some communities have created GIS databases of their infrastructure, but these databases are usually not available for viewing or access by the public. GIS asset management systems are becoming more popular and are the preferred method among the industry for tracking system assets, deficiencies, and repairs.
- Many communities in Montana do not use a GIS database, however, and rely on other systems for tracking assets, which may be a combination of maps and spreadsheets. One method that would encourage communities to start using GIS asset management systems would be to offer state grants for GIS upgrades. This would also allow for better access to more readily available buried infrastructure information.
- As communities desire to replace, repair, or plan for the growth of their infrastructure, an engineering study or evaluation is usually required to apply for state funding or just provide the background planning needed for project development. These studies almost always contain a section within the report which describes a city or town's existing infrastructure and quantifies lineal feet of pipe and/or pipe material/age for example. These reports contain much of the data needed to generate cost estimates and meet the objectives of LFD's data collection effort; however, it would be an extensive effort to try to collect all previous reports and go through them for the needed data. Planning grants are often used to fund CIPs and PERs. The state agencies could require that buried infrastructure and other asset information be provided (and kept in an updated database) with each grant-funded project submittal.
- It is recommended that a future phase of this project involve extensive work with state agencies and local governments so that a consistent reporting method can be generated to better track water and wastewater system assets. The cost estimates generated within this report could be used as guidance to understand what data is needed to determine system replacement costs.
- It is recommended that the state DEQ consider centralizing data that is currently tracked with spreadsheets to a single dataset.
- It is recommended that further study be completed as an extension of this study to further evaluate methods for acquiring existing data (including buried infrastructure), evaluating condition assessments, centralization of the data sets, and coordination with state agencies.

4.3 Cost Estimates

It is recommended that additional review and methodologies be considered for the calculation of system annual replacement costs. The estimates in this Phase 1 project reflect a small sampling of systems using costs based on recent construction bid tab information with several assumptions. It is recommended that more estimates be completed to give a more thorough understanding and range of costs before typical values are assigned to other systems. It is recommended that the next phases of the project complete additional total replacement value estimates for representative public systems. Additional existing condition assessments and research are needed to support cost estimating efforts.

The following observations and conclusions are noted regarding the infrastructure cost estimates provided in this report and infrastructure funding in general:

- These preliminary cost calculations are intended to identify an order of magnitude and range of generalized system costs.
- It is recommended that independent reviews of cost estimating methods and assumptions be conducted (costs using RSMeans construction cost data for example).
- Infrastructure replacement is extremely expensive as shown by calculated CRV and annual replacement costs.
- Collection or distribution (i.e. pipe) buried infrastructure can be over half of the replacement costs and skews the CRV and annual cost estimates.
- Assumptions assume a life expectancy for pipe that most systems go well beyond.
- Annual replacement costs may not always be needed annually but can be set aside in reserve accounts to use for future system upgrades/replacements as they are needed.
- Annual replacement costs may not be truly achievable by a system all on their own, and many smaller systems rely on low interest loans and grant funding. Most systems fund infrastructure improvements using a combination of user rates, reserves, loans, and grants.

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Appendix A
Water System Baseline Inventory Spreadsheets

Appendix B
MDEQ Water System Spreadsheets

Appendix C
Water System Replacement Cost Estimates

Appendix D
Wastewater System Baseline Inventory Spreadsheets

Appendix E
Wastewater System Replacement Cost Estimates