TOWN OF ENNIS

DRAFT WATER SYSTEM PER

CHARTS, GRAPHS & TABLES

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Presented by:

GreatWest ENGINEERING

TOWN OF ENNIS
2022 DRAFT PRELIMINARY ENGINEERING REPORT
WATER SYSTEM
CHARTS-GRAPHS-TABLES

BACKGROUND AND SCOPE

Preliminary Engineering Report Objectives

- What is a Preliminary Engineering Report (PER)
  - Required by regulatory agencies for compliance and funding agencies for grants
  - Defines problem(s)
  - Describes existing system
  - Identifies system deficiencies and evaluates alternatives to address those deficiencies
  - Establishes costs and potential funding scenarios
  - Facilitates public comment

POPULATION AND PLANNING PERIOD

- Planning period is 20 years (Design Year 2042)
- Montana Department of Commerce & US Census Data

TABLE 1
HISTORICAL POPULATION

Year	Ennis	% Annual Increase/Decrease	Madison County	% Annual Increase/Decrease
1980	660	-	5,448	-
1990	773	1.71	5,989	0.99
2000	840	0.87	6,851	1.44
2010	838	-0.02	7,691	1.23
2020	917	0.94	8,623	1.21
Average		0.88		1.22
2042[2]	1,100	1.0		

(1) US Census Bureau

(2) Population of Town at Design Year (2042) estimated from 2020 Census at conservative 1.0% Annual Growth

- 2042 Design Population Estimate– 1,100

HISTORICAL WATER DEMANDS

- Knowing current water demand is necessary to calculate future water needs throughout the planning period.

- Future water demand calculations are based on 2021 well hour meter data, well pumping rates and resulting water source monthly flows. Table 2 summarizes monthly average daily source flows and resulting per capita per day water use.

TABLE 2
2021 WATER USE BASED ON WELL HOUR METER DATA

Month	Total Monthly Source Flow (gallons per day)[1]	Average Daily Source Flow (gallons per day)[1]	Average Per Capita Use (gpcd)[2]
January	6,987,000	225,387	241
February	6,999,000	249,964	267
March	7,617,000	245,710	263
April	7,557,000	251,900	269
May	6,351,000	204,871	219
June	14,667,000	488,900	523
July	16,392,000	528,774	566
August	12,837,000	414,097	443
September	10,740,000	358,000	383
October	7,176,000	231,484	248
November	5,469,000	182,300	195
December	5,598,000	180,581	193
Yearly Total	**111,522,000**		
Average		**305,540**	**326**

Notes:
[1]Based on 2021 well hour meter data.
[2]Based on existing service population of 935

- Average day per capita use = 326 gpcd

- Maximum day per capita use = 683 gpcd (based on highest daily total hour meter usage)

- Maximum day peaking factor = 2.10 (max day/avg day)

PROJECTED WATER DEMANDS

- With a projected population and average per capita use, projected water demands can be made.

TABLE 3
PROJECTED WATER SYSTEM DEMANDS

Year	Estimated Service Population	Average Day Demand		Maximum Day Demand		Peak Hour Demand (gpm)[3]
		(gpd)[1]	(gpm)	(gpd)[2]	(gpm)	
2022	935	305,540	212	639,000	444	636
2027	976	318,176	221	666,608	463	663
2032	1,017	331,542	230	694,611	482	690
2037	1,058	344,908	240	722,614	502	720
2042	1,100	358,600	249	751,300	522	747

Notes:
[1]Based on 326 gpcd
[2]Based on an average day to maximum day factor of 2.1
[3]Based on an average day to peak hour factor of 3

WATER SUPPLY

- Well #2 produces approximately 350 gpm and Well #3 produces approximately 250 gpm.

- Per DEQ standards, the water system must be able to provide the maximum daily demand with the highest capacity pump out of service. The 2042 projected maximum day demand is 522 gpm. With the largest well out of service, only 250 gpm can be provided. An additional 272 gpm of source capacity is needed to meet projected growth and DEQ standards

- Neither well is equipped with chlorination equipment to allow for disinfection of the distribution system should contamination be suspected.

- The water supply is not equipped with a backup power source. In the event of a power outage, the system would need to rely on the storage volume to maintain service to the users. A prolonged power outage could result in the community being without water after less than two full days at average daily flows.

- Neither the new Well #3 site nor the storage tank site have any security fencing. A lack of security fencing makes it difficult to prevent vandalism and ensure safe drinking water for all consumers.

- Rodeo Grounds Well Testing

  - Deep Well (220') – Can produce 150 gpm, which would allow the Town to use 100 gpm. Could likely be completed as a Redundant Well by DNRC definition and process. Water rights permitting may not be needed. This well has already gone through full DEQ approval process.
  - Shallow Well (78') – Produces 90 gpm, which would allow for 60 gpm usage. Was constructed strictly as an observation well for testing purposes. Did not undergo DEQ approval. Unlikely to be considered a Redundant Well due to depth to water bearing formation. Full water rights permitting would be anticipated for any shallow well.
  - Modeling suggests that drilling another deep well roughly 100' away from the existing deep well could potentially yield 105 gpm with a net usable capacity of 75 gpm. Could also likely be completed as a Redundant Well by DNRC definition and process. Water rights permitting may not be needed. This well would need to go through full DEQ approval process.
  - Current water rights limit total pumping rate at any one time to 550 gpm.

WATER STORAGE

- 530,000-gallon on-grade epoxy coated bolted steel tank
  - Constructed in 1995
  - Fair condition, is leaking and due for a recoating

- Water storage is critical for two primary reasons:
  - Provides operational storage
  - Provides fire suppression storage

- Required Storage Capacity:
  - DEQ Circular 1, Chapter 7 requires "minimum allowable storage must be equal to the average day demand plus fire flow demand…where fire protection is provided".
  - Current Scenario:
    - Average Day Demand: 305,540 gallons
    - Fire Flow Demand: 2,500 gpm (commercial) for 2 hours = 300,000 gallons
    - Total Storage Required: 605,540 gallons
  - Future (year 2042) Scenario:
    - Average Day Demand: 358,600 gallons
    - Fire Flow Demand: 2,500 gpm (commercial) for 2 hours = 300,000 gallons
    - Total Storage Required: 658,600 gallons
  - Total storage provided: 530,000 gallons
  - The existing storage capacity is not sufficient to meet current or future demands. An additional 130,000 gallons of storage is needed to meet future demands.

WATER DISTRIBUTION SYSTEM

- In general, the distribution system is well laid out. DEQ-1 requires that "the minimum size of water main for providing fire protection and serving fire hydrants shall be six-inch diameter" and "larger size mains will be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified." A majority of the distribution system is 6-inches or larger. Static pressures in the system range between 100 psi in the downtown area and 75 psi in the southwest portion of the system.

- In order to evaluate the water pressures and flows, data for the existing system was input into a computer hydraulic modeling program called WaterCAD. The computer model is used to identify specific problem areas and to determine the most effective modifications to improve the system. The WaterCAD program uses standard loop equation techniques to solve for flow through the pipe network and determine resulting pressures at the system nodes (pipe junctions) using the Hazen-Williams equation.

- The Hazen-Williams equation uses a coefficient "C", which is based on the roughness of the pipe interior. Standard values can be assumed for different types of materials based on years of pipe service.

- Several computer runs were made using different scenarios. Among the scenarios modeled were: the average daily flow; the peak daily flow; and the peak hourly flow. In addition, the maximum flow (fire flow) that can be obtained from a given location while maintaining a minimum residual pressure of 20 psi throughout the distribution system was determined.

- DEQ 1 requires that "the system must be designed to maintain a minimum normal working pressure of 35 psi and minimum pressure under all conditions of flow (e.g. fire flows, hydrant testing, and water main flushing) must be 20 psi."

- The computer model scenario of average daily demands shows no obvious problems. The model indicates that normal operating pressures are well above 35 psi. Computer runs with peak daily and peak hourly demands yield similar results.

- The system was then modeled for available fire flows throughout the system. These fire flows are modeled concurrently with the future peak daily demand flow. With the exception of a few dead-end mains on the extreme south and east sides of the system, a minimum fire flow of 1,000 gpm is available throughout the system, which is a standard for residential areas. Available fire flows in the commercial area (Main Street) and the school area exceed 2,500 gpm, which meets recommended standards. The identified piping deficiencies are the dead-end mains on the east end of the system.

Gate Valves

- Portions of the distribution system do not have sufficient valves to properly isolate sections of water main and facilitate directional flushing of the system in the event of an emergency

System Leakage

- In April of 2012, a nighttime tank drawdown test was conducted over two consecutive nights. The protocol of the test was to fill the tank at 2:00 am, turn the well pumps off, and then measure the tank level drawdown between 2:00 am and 5:30 am.

- During this time period, very little water usage should be occurring, and it can be assumed that most of the change in the water level in the tank is due to leakage in the distribution system. Both nights that this test was conducted, the water level in the tank dropped 1.7 feet in 3.5 hours. Based on the geometry of the tank, this correlates to a volume of 22,500 gallons and a flow rate over that time period of 107 gpm.

- Recognizing that some usage occurs during the night, it was assumed that 90% of the drawdown during this time period could be attributed to leakage. 90% of 107 gpm is 96 gpm or 138,200 gpd and 50,400,000 gallons per year.

- Common rule-of-thumb: 15% unaccounted-for water is considered acceptable. Based on these numbers, unaccounted for water in Ennis is approximately 45%.

Water Meters

- Individual water service meters are over 25-years old and have likely exceeded their service life. The meters should be replaced to ensure the Town is accurately metering all of the usage by the customers and to maximize the revenue potential.

RECOMMENDED IMPROVEMENTS

Table 4 Town of Ennis Recommended Improvement Program		
ITEM	**DESCRIPTION**	**ESTIMATED COST**
Priority #1	New Water Supply at Rodeo Grounds	$ 925,000
Priority #2A	New 700,000 Gallon On-Grade Glass-Lined Steel Storage Tank	$ 2,587,000
Priority #2B	Existing Tank Recoat and Rehab ($544,000) and New 150,000 Gallon On-Grade Glass-Lined Steel Storage Tank ($1,131,000)	$1,675,000
Priority #3	New Valves in Distribution System	$ 111,000
Priority #4	Add Chlorination at Each Well House	$ 95,000
Priority #5	Security Fencing at Tank Site and Well #3	$ 44,000
Priority #6	Replace 20% of Water Meters	$ 117,000
Priority #7	Install New Backup Generator at Well #2	$ 116,000
Priority #8	Distribution System Improvements (Loop dead-end mains)	$ 1,120,000

POTENTIAL FUNDING SOURCES

- **Target Rate**
  - Median Household Income for Ennis: $46,280
  - 2.3% of MHI for combined water and wastewater: $88.70 per month

- **Estimated Existing Average Residential Monthly Rate**
  - Water: $38.50
  - Wastewater: $45.65
  - Combined: $84.15 (95% of target rate)

- **Grant Programs**
  - Montana Coal Endowment Program (MCEP): Projects that address public health and safety issues. Must be at 100% of target rate minimum to be eligible for up to $500,000; 125% of target is eligible for $625,000; 150% of target is eligible for $750,000. Requires a dollar-for-dollar match.
  - DNRC: Projects that enhance a natural resource. Grants up to $125,000
  - Applications to both of these grant programs are due in the spring of even numbered years.

- **Loan Programs**
  - State Revolving Fund (DEQ and DNRC): 2.5% Interest, 20-year term typical, can go up to 30-years if improvements have that life expectancy. 75% loan forgiveness possible, up to $750,000. Must be at target rate to qualify for loan forgiveness. Approximate user cost per month per $100,000 borrowed is $1.00.

- **American Rescue Plan Act (ARPA) Minimum Allocation Grants (MAG)**
  - Madison County has allocated $225,000 of its MAG funding to Ennis for water system improvements.
  - Appears the Town has $214,133 of its MAG funding available at this time.
  - MAG funding applications are due by November 1, 2022