3.0 ANALYSIS OF EXISTING SYSTEM

RWD No. 1 has made minor pipeline upgrades over the last 20 years but more will be needed. Replacing old service meters with radio read meters, as the District did between 2018 and 2020, has helped reduce water loss (unbilled water sold) and increase revenue. A gradual replacement of old pipeline, particularly the glue-joint pipe installed in the late 60s, will be a future priority.

3.1 Wholesale Supply

Eskridge supplies water at the south end of RWD No. 1. The elevation of Eskridge's water tower is over 200 feet higher than the District's standpipe, allowing for 70 gpm flow capacity by gravity and eliminating pumping. A control valve located six miles northeast of Eskridge (K-4 & Coyote Rd.) opens and closes based on the water level in the standpipe, as communicated through radio telemetry controls. All District customers south of this valve, totaling 21, are served from the Eskridge water tower. The higher elevations south of this control valve would inhibit the District's standpipe from adequately serving these customers.

The contract with Eskridge, included in Appendix A, expires at the end of 2028. The contract limits the daily volume supplied to 60,000 gallons (30% less than the expected 2023 peak day demand) and a flow rate not to exceed 42 gpm but the City does not enforce this flow limitation. The rate of flow control valve can be manually adjusted and is so routinely by the manager in order to control the water level fluctuation in the standpipe. With the goal of providing only one 10-foot turnover per day in the standpipe, the flow through the control valve is typically set at 30-35 gpm during the winter, 40 gpm on typical days, and up to 50 gpm on high-use days. If necessary, the flow can be increased to the 70 gpm maximum.

The City's rate structure includes a pro-rata allocation of the City's annual operation and maintenance costs, a commodity cost based on production expenses, and a double cost allocation of the reservoir storage cost from the Kansas Water Office marketing contract on Lake Wabaunsee. The combination of these charges total about $4.00 per 1,000 gallons, depending on the monthly usage.

3.2 Distribution System

The District has outgrown a few of the smaller distribution lines at the extremities, where cumulative pressure losses through many miles of pipeline could potentially lead to low pressure under peak instantaneous demands. Our hydraulic model indicates that short-term minimum pressures could potentially be near or below the State standard of 20 psi in several portions of the District, on 2-inch and smaller pipelines, and less than 30 psi in several other areas, affecting dozens of customers. The primary area of concern is the eastern portion of the system.

The pressure delivered to a customer is created by the combination of their home elevation in relation to the water elevation in a storage tank, minus the friction loss that occurs as water moves through the pipe between the tank and their home. In general terms, acceptable friction loss corresponds to flows at or below the values illustrated in Table 3-1.

Table 3-1. Pipeline Friction Loss Targets

Pipe Size	Acceptable Friction Loss at or Below Flow of	Corresponding # of Residents
1” – 1½”	8 gpm	1
2”	15 gpm	5
2½”	25 gpm	15
3”	40 gpm	33
4”	60 gpm	55

Several pipe segments in the distribution system have flows five to ten times these typically-acceptable levels, with most of them being 2-inch and smaller lines. Some are acceptable due to the low elevations they are serving, as adequate pressures are still being delivered; and some are in relatively short stretches where the total friction loss is not critical. Other areas need to be addressed, particularly those at high elevations. Several segments of 2-inch and 3-inch pipe should be upgraded to 4-inch. Proposed improvements in Section 4 will address these areas.

A hydraulic model simulates peak demands commensurate with simultaneous household uses such as washing machines, dishwashers, toilets, showers, etc. The model does not account for customers adjusting typical behavior by leaving these appliances off during peak-demand periods; choosing, for instance, to wash clothes or dishes at a time of less demand. Accordingly, modeled low pressures often reflect a reduction in volume supplied compared to what would typically be desired, while actual pressures may remain above 20 psi. Similarly, low pressures that do occur may be short-lived, as customers adjust their use to accommodate the lack of pressure. This “self-governing” mechanism tends to hide the severity of the problem, as pressures are maintained at the expense of flow. Customers that are used to inadequate volume and pressure may not complain because they have come to accept it.

Figure 3-1 illustrates the detailed results of the 2022 hydraulic analysis. Labeled are predicted peak flows, friction loss per 1,000 feet of pipe, and hydraulic grade lines. The red nodes reflect areas of concern, specifically along small service lines with more than one customer.

Along with these hydraulic limitations, a more pressing concern is the age of some pipeline, particularly the glue-joint PVC, dating back to the original construction. Gasketed PVC joints flex with the movement of soil but glued PVC joints do not. As a result, the pipe internalizes stresses and fatigues at a much higher rate, resulting in frequent breaks, inflated maintenance expense, and high water loss. This pipe is now near the end of its useful life. The magnitude of known glue-joint pipe is illustrated in Figure 3-2 and summarized as follows:

Diam.	Material	Quantity			
3	Cast Iron	14,400	ft.	2.7	miles
0.75	Glue-Joint PVC	400	ft.	0.1	miles
1	Glue-Joint PVC	1,800	ft.	0.3	miles
1.2	Glue-Joint PVC	800	ft.	0.2	miles
1.5	Glue-Joint PVC	68,800	ft.	13.0	miles
2	Glue-Joint PVC	77,800	ft.	14.7	miles
2.5	Glue-Joint PVC	19,600	ft.	3.7	miles
3	Glue-Joint PVC	24,700	ft.	4.7	miles
	Subtotal	*193,900*	*ft.*	*36.6*	*miles*
1	Slip-Joint PVC	1,100	ft.	0.2	miles
1.5	Slip-Joint PVC	4,700	ft.	0.9	miles
2	Slip-Joint PVC	43,500	ft.	8.2	miles
3	Slip-Joint PVC	1,000	ft.	0.2	miles
4	Slip-Joint PVC	77,900	ft.	14.7	miles
6	Slip-Joint PVC	16,200	ft.	3.1	miles
	Subtotal	*144,400*	*ft.*	*27.2*	*miles*
	Total	**546,600**	**ft.**	**103.1**	**miles**

The District reduced the unaccounted for water/water loss with the upgrade to radio-read meters in 2018-2020. However, the older glue-joint PVC pipe will contribute to maintenance concerns and relatively high water loss in the future. The typical goal for annual water loss is 15% and the District is only slightly above that, at 18.4%, so far in 2022. The 20-year average has been 20%, which indicates that the glue-joint PVC pipe has not been a major problem, but nevertheless, a plan should be in place for its gradual replacement.

3.3 Storage

A water storage facility should be sized to allow adequate operational drawdown, meet peak-period demands beyond the supply capacity (equalization storage), and provide emergency storage for fire flows, pipe breaks, or power outages. Typically, a third of the storage is allocated to each of these uses. The total volume usually corresponds closely to an average day demand for the area it serves. Pumping and transmission facilities are typically designed to deliver less than the peak hour demand. For an hour or two every day, it is not uncommon for the water level to continue dropping at times when the tank is supposed to be filling. If a water tower is under-sized, the decrease in stored volume will become critically low and cause low pressures.

With a total storage capacity of 95,000 gallons in the District's 15' x 72' standpipe, a large volume is stored relative to the number of customers served. However, only the water in the top 25 feet is usable, as anything below that would result in pressures below the KDHE-mandated 20 psi. With only 33,000 gallons of usable storage in the top third of the standpipe, and 11,000 gallons being allocated to equalization storage, the District relies on a high flow rate from Eskridge to meet a significant portion of the peak-time high demands. The 70 gpm maximum flow from Eskridge can meet half of the 140 gpm anticipated peak short-term demands by customers. Over a 2-hour period, the total volume deficiency, or the equalization volume required, is 9,000 gallons. The 11,000 gallons provided is 20% greater than the need, meaning the standpipe is adequately sized for the demand and likely will be for at least the next 15 years.

The standpipe is in relatively good physical condition, with only a few minor maintenance needs. The bolted standpipe is constructed with galvanized steel and should continue to be relatively maintenance-free. The smaller abandoned standpipe could be removed at any time, as it provides no value. Appendix B contains the most recent inspection report for the standpipe.

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