DOWNTOWN SPRINGFIELD WATER MAIN ASSESSMENT

SPRINGFIELD WATER AND SEWER COMMISSION
WASHINGTON COUNTY, KENTUCKY

AUGUST 2023

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TABLE OF CONTENTS

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I. INTRODUCTION

Springfield Water and Sewer Commission (SWSC) has contracted with Bell Engineering to conduct a condition assessment of the water main infrastructure within the city limits of Springfield. Most distribution piping installed within the United States from the late 1800s until the late 1960s was manufactured from cast iron. The vast majority of the water system assets within city limits were installed before 1970 and consist primarily of cast iron pipe. Given the age of its system, SWSC wishes to update its infrastructure and replace all lines within the city limits over the next 10 years. SWSC wishes to strategically approach its replacement efforts, first focusing on the most critical assets. In so doing, SWSC can soundly tackle these projects financially, seeking funding from various sources over the next five to 10 years. The results of this condition assessment report will provide the priority information needed.

The infrastructure evaluated, depicted in the following exhibit, is bounded by Hwy. 555 to the north and west, Lebanon Road to the south, and KY 150 to the east. Lines outside of this area were installed predominantly in the 1990s or later and therefore were not considered in this memorandum.

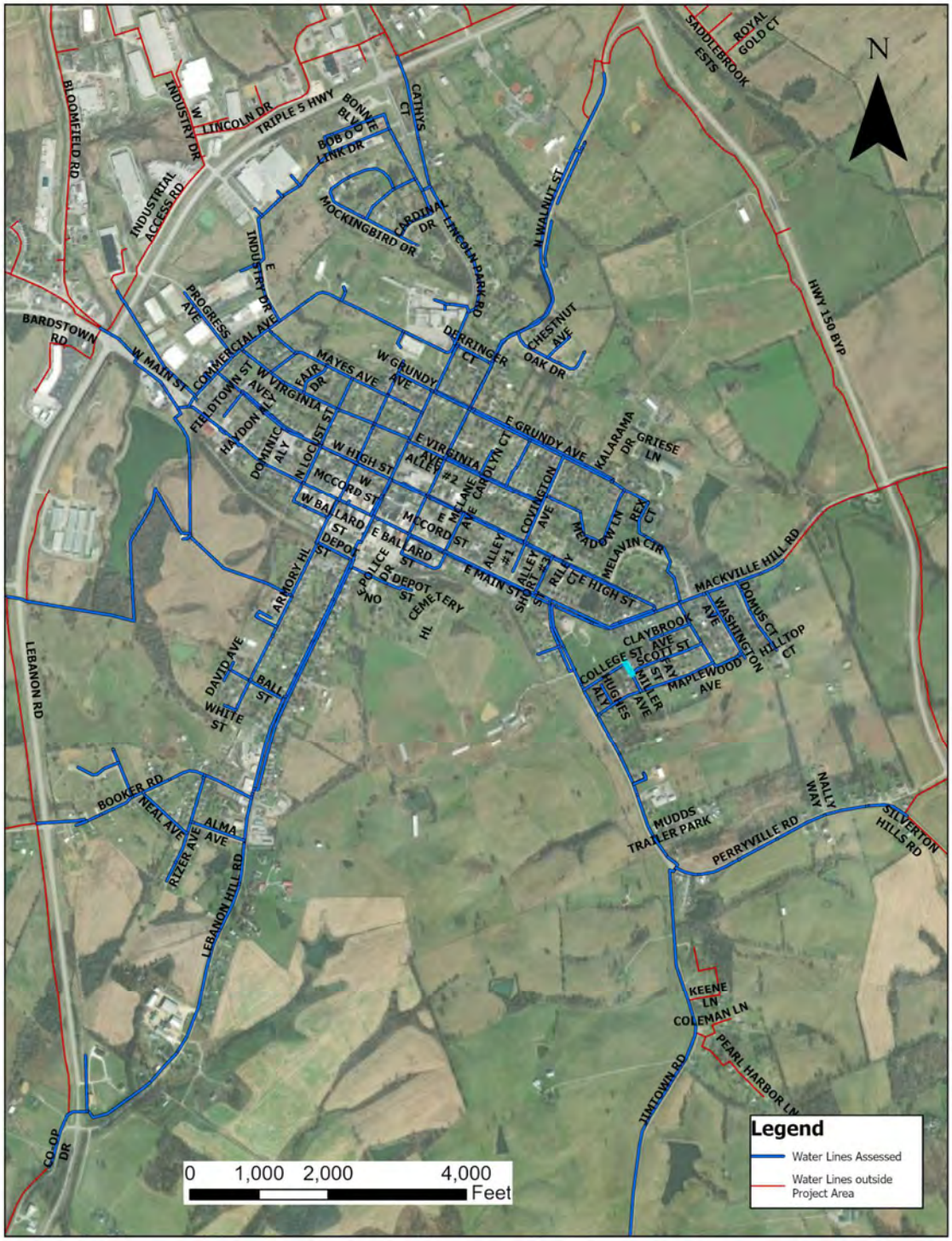


Exhibit 1 Water Lines within the City of Springfield assessed, "Project Area."

II. WATER MAIN ASSESSMENT CRITERIA

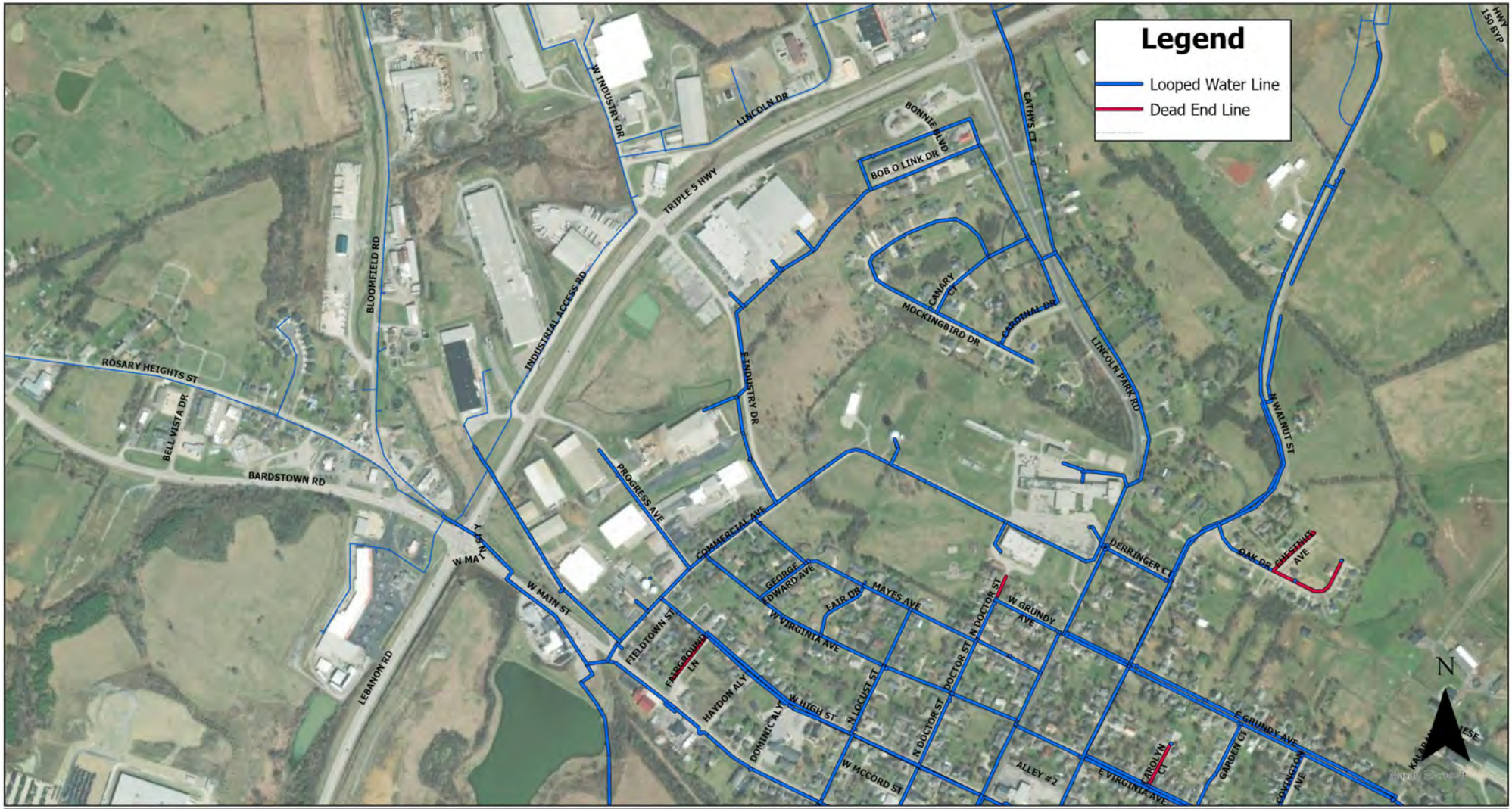
To prioritize the mains which should be targeted for replacement, a rating system was developed using a scoring matrix. The assessment criteria used for the rating system focused on the performance, customer service, and physical age characteristics of a section of the water line. Points were assigned to each section of water line based on the parameters listed in the following table. For this report, a section of a water line is defined as spanning from one street intersection to the next. When two lines existed across the same span, each was considered a separate water line section.

PERFORMANCE CHARACTERISTICS	CUSTOMER SERVICE CHARACTERISTICS	PHYSICAL CHARACTERISTICS
Hydraulic Improvement–Dead End Line	Redundancy Availability	Water Line Age
Hydraulic Improvement–Small diameter mains	Level of Service Importance	
	Break Frequency	

A. Hydraulic Deficiencies–Dead-End Lines

Dead-end lines within water systems are known to be problematic regarding water quality. With little to no flow passing through the line, water stagnation can reduce disinfectant residuals within the pipe, allowing the growth of unwanted pathogens. Ten States Standards states that dead ends shall be minimized by making the appropriate tie-ins whenever practical. Within the urban setting of the project area, all dead-end lines shall be eliminated if possible.

For the scoring matrix, a score of 1 was assigned to lines in the project area that are dead-end lines. See the following two exhibits of the project identifying each line section.



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SPRINGFIELD WATER & SEWER

Date: July 2023

Drawn: BHS

Approved: JSR

Dead End Lines - Springfield North

0 300 600 1,200 US Feet

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SPRINGFIELD WATER & SEWER

Date: July 2023

Drawn: BHS

Approved: JSR

Dead End Lines - South Springfield

B. Hydraulic Deficiencies–Line Size

Over the past several decades, regulators have focused on adequately sizing water lines to ensure water quality is not compromised. Oversizing a water line can drastically decrease water quality as the water age increases. On the contrary, an undersized water line can impact customers' flow and pressure. Ten States Standards states that the minimum size of a water main in a distribution system shall be 3 inches. Sizing lines can be a delicate balance for SWSC's water mains, particularly at dead-end lines and in rural settings. However, the urban, predominantly looped project area permits water to flow freely throughout town. Consequently, water quality issues resulting from oversized lines and limited usage on a section of line are not as much of a concern within the project area.

SWSC does not guarantee fire protection within its system. Nevertheless, fire hydrants are located throughout the project area and are used by the local fire department as a water supply when needed. Ten States Standards states that the minimum size for fire protection is 6 inches. While fire protection is not provided, it is prudent for SWSC to plan for potential issues that may arise from the fire department's use of fire hydrants on lines below 6 inches in diameter. Therefore, it is recommended that water lines within the project area should be sized to be 6 inches in diameter or greater unless feeding a dead end. The increase in installation cost of a 6-inch water line versus a 4-inch or smaller is minimal, while the security provided with the larger line is great.

For the scoring matrix, a score of 2 will be given to any line 3 inches or less, and a score of 1 will be given to 4-inch lines. See the following two exhibits of the project identifying each line section.

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Water Line Size - Springfield North

0 300 600 1,200 US Feet

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SPRINGFIELD WATER & SEWER

Date: July 2023

Drawn: BHS

Approved: JSR

Water Line Size - Springfield South

0 300 600 1,200 US Feet

C. Redundancy

All water fed throughout SWSC's system passes through the project area. The strength of SWSC's system depends on how it will operate in an emergency, such as a water main break. Redundancy is paramount to be able to valve off sections of lines and feed through redundant pipes, primarily along main distribution arteries of SWSC system. SWSC may rely on its various looped connection, assuming they are of sufficient size to carry the flow rate needed to bypass sections of line. As mentioned previously, the need for suitable redundancy further reinforces requiring a minimum line size of 6 inches within the project area.

A score of 1 was assigned to line sections that do not have a parallel line to provide redundancy. See the following two exhibits of the project identifying each line section.

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Redundancy - Springfield North

0 300 600 1,200 US Feet

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Date: July 2023

Drawn: BHS

Approved: JSR

Redundancy - Springfield South

D. Level of Service Importance

SWSC's Water Treatment Plant (WTP) is located within the project area. The high-service pumps at the WTP pump directly into the City pressure zone and its three elevated storage tanks. Water is then distributed from the City Zone into the remaining five pressure zones in the distribution system. SWSC relies on mains within several corridors to feed the outlying zones. These lines' service level is much higher than other lines within the project area, given the more significant impacts a service outage along these lines may cause. The main water line corridors within the project area, which are also used to feed the exterior pressure zones, are as follows:

1. High Street Corridor
2. Main Street Corridor
3. Lebanon Hill Corridor
4. Lincoln Park Corridor
5. Perryville Road Corridor
6. Mackville Road Corridor

A score of 1 to 3 was assigned to lines in the project area based on the number of pressure zones that depend on the line. See the following two exhibits of the project identifying each line section.

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Water Line Level of Service - North

0 300 600 1,200 US Feet

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Drawn: BHS

Approved: JSR

Water Line Level of Service - South

0 300 600 1,200 US Feet

E. Break/Repair Frequency

Ensuring a reliable water source for its customers is a crucial goal for SWSC. In most cases, the direct cost of a water main repair compared to its replacement is less costly. However, the indirect cost caused by a line break should also be weighed when considering the actual cost of a line break. These indirect costs consist of service disruptions to residents, loss of revenue for businesses, non-revenue water loss to SWSC, loss of system pressure and water quality, adverse risks to customers that depend on water, such as schools, doctors' office, laundry mats, etc.), amongst others. Line breaks can be attributed to various factors, such as the related deterioration of the pipe, poor installation, pressure changes, ground settling, corrosive soil, etc.

SWSC personnel have identified sections of lines within the project area that are frequently experiencing line breaks. These water sections are along the High Street and Lebanon Hill corridors. A score of 1 was assigned to these lines identified by SWSC personnel. See the following two exhibits of the project identifying each line section.

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Routine Maintenance - Springfield North

0 300 600 1,200 US Feet

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SPRINGFIELD WATER & SEWER

Date: July 2023

Drawn: BHS

Approved: JSR

Routine Maintenance - Springfield South

F. Water Line Age

Although the increasing age of a pipe can sometimes be directly correlated with the deterioration of the pipe condition, it should not be blindly applied to all pipes. In so doing, one would skew the rating of a pipe by arbitrarily increasing its score on sections of the line that currently provide adequate and reliable service. Available record drawings and as-builts provided by SWSC were compiled to determine the water line age. These records indicate that before 1950, the city of Springfield had water lines installed primarily along Main Street, High Street, Lebanon Hill, Walnut Street, East Virginia, and Covington Avenue. The exact age of these lines is unknown. Most of the water lines on the side streets within City Limits and the second water main along Main Street, High Street, and Lebanon Hill were installed between 1950 and 1970. Where no record drawings were found of water lines, the age of the pipe was listed as "unknown." The age of SWSC infrastructure is predominantly over 70 years; there are numerous records across the country indicating installation of cast iron pipe from the early 1900s in service and operating satisfactorily. Lines should remain in service regardless of their physical attributes until they stop providing the expected level of service. However, the age of the water line should be considered when deciding between two sections of pipe that are similar in the scoring matrix.

See the following two exhibits of the project area identifying each line section by approximate age.

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Water Line Age - Springfield North

0 300 600 1,200 US Feet

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Water Line Age - South Springfield

0 300 600 1,200 US Feet

III. RESULTS

Each line section was scored based on the previously outlined characteristics. It is apparent that line replacement is needed throughout the project area. The highest-scored lines should be replaced before the lower-scored lines. After the assessment, the scoring received for the water lines ranged from zero to five. The following map shows the scoring received for each section of water line in the project area. The corridors which scored higher than other areas are High Street, Main Street, Lincoln Park, and Lebanon Hill. The scoring assigned in the assessment matrix positively identified sections of lines previously identified by SWSC personnel as "troublesome sections of line."

While the scoring matrix provides a non-biased approach to identifying lines to be replaced in each phase, outside factors must also be considered. These factors include taking the means necessary to minimize service interruptions and centralizing construction disturbances in certain areas of town. In addition, water line replacement planning should be coordinated with the City of Springfield streets department to avoid digging up newly paved roads.

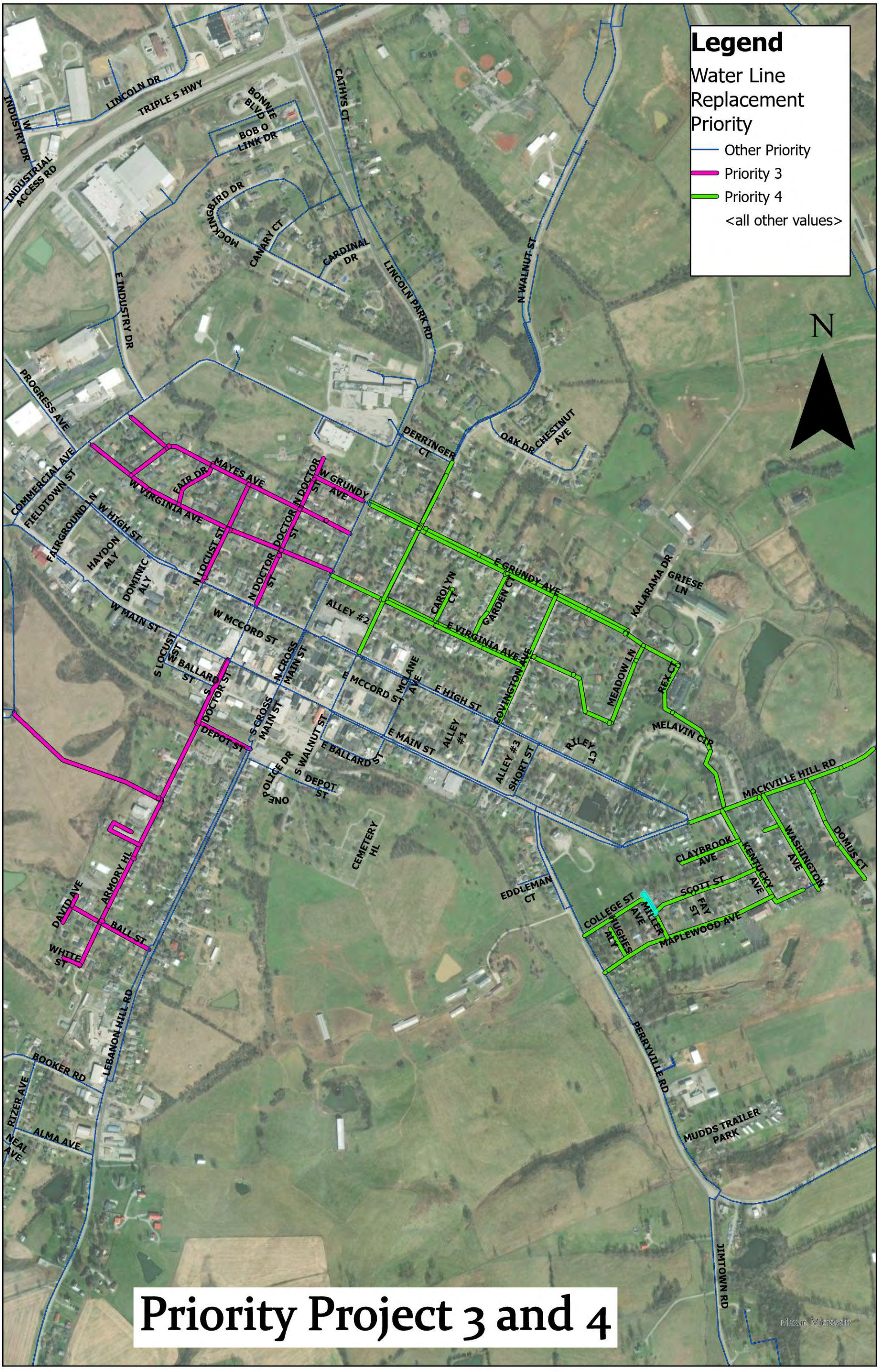
Water Line Assessment Matrix

IV. WATER LINE REPLACEMENT PRIORITY GROUPS AND COST

The end goal for SWSC is to replace its water infrastructure within the project area strategically. Cost is a significant factor limiting the extent of water line replacement completed in a single project. A construction cost ranging from $2,500,000 to $3,000,000 was used to divide the replacement into priority groups. Using this cost range, four (4) priority groups were created to replace water lines within the project area. To provide an estimated budget for the total project cost of each priority group, 25% was added to the construction cost to account for potential funding applications and fees and engineering fees. An additional 10% was included for contingency. The following exhibits provide a map of each priority group. The estimated construction cost and the project cost for each priority group are summarized below:

Priority Group	Estimated Construction Cost	Project Cost (including Engineering and 10% Contingency)
Priority 1	$2,850,000	$3,850,000
Priority 2	$2,600,000	$3,510,000
Priority 3	$2,450,000	$3,310,000
Priority 4	$3,075,000	$4,150,000
Total Cost	**$10,975,000**	**$14,820,000**


Legend
Water Line Replacement Priority
Priority 1
Priority 2
Other Priority
N
W INDUSTRY DR
LINCOLN DR
TRIPLE 5 HWY
BONNIE BLVD
BOB O LINK DR
CATHYS CT
INDUSTRIAL ACCESS RD
MOCKINGBIRD DR
CANARY CT
CARDINAL DR
LINCOLN PARK RD
N WALNUT ST
E INDUSTRY DR
PROGRESS AVE
DERRINGER CT
OAK DR
CHESTNUT AVE
W MAIN ST
COMMERCIAL AVE
FIELDTOWN ST
FAIRGROUNDS LN
W VIRGINIA AVE
FAIR DR
MAYES AVE
W GRUNDY AVE
N DOCTOR ST
W HIGH ST
HAYDON ALY
DOMINIC ALY
N LOCUST ST
E GRUNDY AVE
KALARAMA DR
GRIESE LN
CAROLYN CT
GARDEN CT
ALLEY #2
W MCCORD ST
E VIRGINIA AVE
MEADOW LN
REX CT
S LOCUST ST
W BALLARD ST
S DOCTOR ST
N CROSS MAIN ST
E MCCORD ST
MCLANE AVE
COVINGTON AVE
E HIGH ST
MELAVIN CIR
DEPOT ST
S CROSS MAIN ST
S WALNUT ST
E MAIN ST
ALLEY #1
ALLEY #3
SHORT ST
E BALLARD ST
RILEY CT
POLICE DR
ONE
DEPOT ST
MACKVILLE HILL RD
WASHINGTON AVE
CLAYBROOK AVE
KENTUCKY AVE
CEMETERY HL
EDDLEMAN CT
SCOTT ST
FAY ST
COLLEGE ST
MILLER AVE
HUGHES ALY
MAPLEWOOD AVE
ARMORY HL
DAVID AVE
BALL ST
WHITE ST
LEBANON HILL RD
BOOKER RD
NEAL AVE
RIZER AVE
ALMA AVE
PERRYVILLE RD
MUDDS TRAILER PARK
Priority Project 1 and 2


Legend
Water Line Replacement Priority
Other Priority
Priority 3
Priority 4
<all other values>
N
LINCOLN DR
TRIPLE 5 HWY
W INDUSTRY DR
INDUSTRIAL ACCESS RD
BONNIE BLVD
BOB O LINK DR
CATHYS CT
MOCKINGBIRD DR
CANARY CT
CARDINAL DR
LINCOLN PARK RD
N WALNUT ST
E INDUSTRY DR
PROGRESS AVE
DERRINGER CT
OAK DR
CHESTNUT AVE
COMMERCIAL AVE
FIELDTOWN ST
FAIRGROUND LN
W VIRGINIA AVE
FAIR DR
MAYES AVE
N DOCTOR ST
W GRUNDY AVE
W HIGH ST
HAYDON ALY
DOMINIC ALY
N LOCUST ST
E GRUNDY AVE
KALARAMA DR
GRIESE LN
CAROLYN CT
GARDEN CT
ALLEY #2
W MAIN ST
W MCCORD ST
E VIRGINIA AVE
MEADOW LN
REX CT
S LOCUST ST
W BALLARD ST
S DOCTOR ST
N CROSS MAIN ST
E MCCORD ST
MCLANE AVE
EQUINGTON AVE
E HIGH ST
S CROSS MAIN ST
E MAIN ST
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ALLEY #3
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CEMETERY HL
CLAYBROOK AVE
KENTUCKY AVE
WASHINGTON AVE
DOMUS CT
EDDLEMAN CT
SCOTT ST
COLLEGE ST
MILLER AVE
FAY ST
HUGHES ALY
MAPLEWOOD AVE
DAVID AVE
ARMORY HL
BALL ST
WHITE ST
LEBANON HILL RD
BOOKER RD
RIZER AVE
ALMA AVE
NEAL AVE
PERRYVILLE RD
MUDDS TRAILER PARK
JIMTOWN RD
Maxar, Microsoft
Priority Project 3 and 4

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