Executive Summary

Water Master Plan

for

Lawrence, Kansas

City of Lawrence, Kansas

BMcD Project No. 59410

City P.O. 002109

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City of Lawrence, Kansas

Water Master Plan Executive Summary

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A. General

This document is the Executive Summary for the Lawrence Water Master Plan Technical Memos (TMs) 1 through 10 and discusses the following:

- Existing System;
- Water Demands;
- Water Supply Improvements;
- Water Treatment Improvements;
- Distribution System Improvements; and
- Capital Improvement Plan (CIP).

B. Existing Water System

The Kansas River is the primary supply for the Kaw WTP. Operation of the upstream reservoirs, use of existing water rights, and adequacy of flow are overseen by the Kansas River Water Assurance District for Lawrence and its other members. Water rights for the Kansas River allow an average daily withdrawal of 20.5 MGD and a maximum day withdrawal of 44.9 MGD from the river. Additionally, the six existing wells at Burcham Park have a water right of 1.9 MGD, increasing the total average daily diversion rate to 22.3 MGD from the Kansas River and the alluvium.

Kansas River water is diverted through a single crib type intake and a 30-inch siphon line to the raw water pumping system. Low service pumps convey water to the Kaw WTP. The WTP is a lime softening plant originally built in 1917 and has been expanded over the years to a rated capacity of 17.5 MGD. The plant has two trains of equal capacity. Capacity is limited to 16 MGD due to a hydraulic bottleneck. As the water source is the Kansas River, influent water quality is highly variable; for instance hardness can be as high as 330 mg/L and turbidity can range from 5 to >1000 NTU. Typical potable water hardness is 140 mg/L and alkalinity is > 40 mg/L. There are a number of issues and areas of improvement for the Kaw WTP and associated supply as detailed in TM2.

Clinton Lake is operated by the U.S. Army Corps of Engineers (COE) and is the only water source for Clinton WTP. The lake is also used for flood control, industrial supply, recreation, fish and wildlife, and maintaining minimum stream flow conditions on the Wakarusa and Kansas rivers. Water rights for the City at Clinton Lake are an average annual of 13.3 MGD and a maximum diversion rate of 25 MGD. There are no additional rights available at Clinton and future diversions must come from the Kansas River.

The raw water pump station at Clinton Lake is owned and operated by the City and includes four pumps with a total pumping capacity of approximately 30 MGD, and a rated firm capacity of approximately 20 MGD. Water is conveyed to the Clinton WTP through a single 36-inch concrete raw waterline. Clinton WTP is a lime softening plant and was expanded in 2009 from 10 MGD to 25 MGD with the addition of a 15 MGD treatment train. However, City staff is working with the Kansas Department of Health and Environment (KDHE) to recognize the 25 MGD filter capacity rating. Clinton WTP has items to address with respect to raw water supply redundancy for transmission and pumping as detailed in TM2.

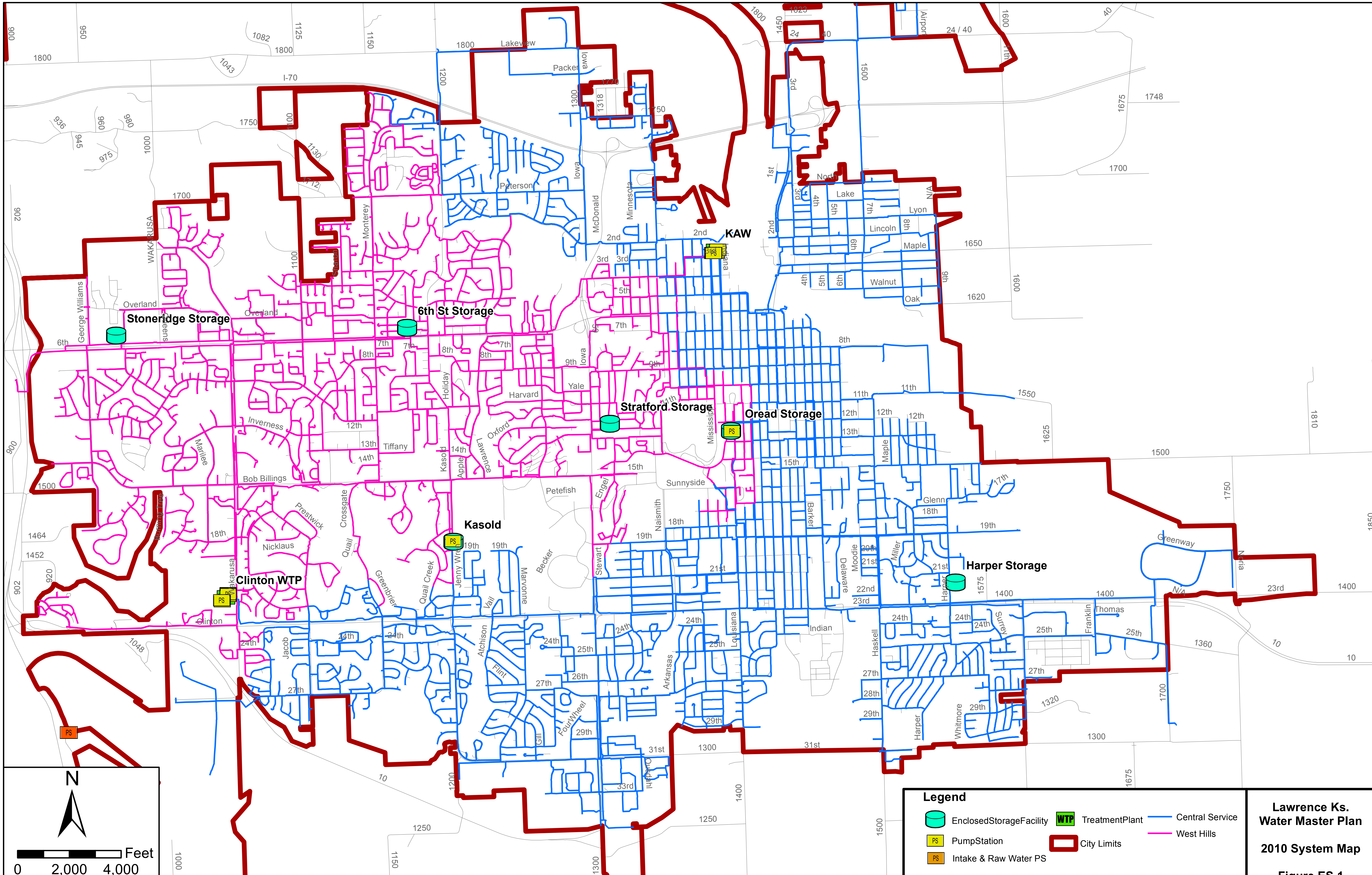
The distribution system covers about 30 square miles, includes two pressure zones, approximately 463 miles of pipe ranging from 2-inch to 24-inch diameter, 19 high service pumps, six storage sites, and two BPSs. A schematic of the existing system is shown in Figure ES1 and illustrates the CS pressure zone the WH pressure zone relationship with the Kaw and Clinton WTPs, the Oread reservoir and BPS, and the 19th and Kasold reservoir and BPS. The Oread and Kasold reservoirs supply the CS pressure zone by gravity and can pump into WH pressure zone. The other tanks are elevated and dedicated to a specific pressure zone. The CS pressure zone ranges in elevation from 810 feet to 950 feet, while the WH pressure zone ranges from 870 feet to 1060 feet. Current issues with respect to water supply, treatment, and distribution are detailed in TM2.

C. Water Demand

Population data was provided by City staff within the Master Plan boundaries for years 2010, 2020, 2030 and build-out. As growth is gradual, population within the water utility service area is less than Master Plan boundary and is summarized below in Table ES1. Review of the data projects a 29 percent increase in population from 2010 to 2030 and a 172 percent increase from 2010 to build-out.

Table ES1: Water Utility Service Area and Master Planning Area Population Forecasts

Year	Utility Service Area	Master Planning Area
2010	92,727	94,564
2020	106,667	113,051
2030	119,529	129,176
Buildout	251,971	251,971


KAW
6th St Storage
Stoneridge Storage
Stratford Storage
Oread Storage
Kasold
Clinton WTP
Harper Storage
I-70
N
Feet
0 2,000 4,000
Legend
EnclosedStorageFacility
TreatmentPlant
Central Service
PumpStation
City Limits
West Hills
Intake & Raw Water PS
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Water Master Plan
2010 System Map
Figure ES 1

The population projections and land usage by meter class are used to distribute customer projections and water use in years 2020, 2030 and build-out. Basic meter classes were then used to assign a simplified land use category to each meter as follows:

- RS = Residential
- MF = Multi-family
- CO = Commercial
- IN = Industrial
- CT = City

The meter class percentages and dry year water use, which includes non-revenue water at 5 percent, are listed in Table ES2 and used to determine a total dry year average day demand of 10.4 MGD based 2010 population and number of meters. The 2010 population of 92,727 people and 31,937 existing meters results in a density of 2.9 people per meter. Water demand is added for other customer classes including KU and wholesale.

Table ES2: Water Use Data for Demand Projections

Meter Class	No. of Meters	Meter Class Percentage[1]	Dry Year Water Use[2] (gpmd)	Avg Day Demand[3] (MGD)
CO	1,797	5.6%	1,365	2.5
CT	185	0.6%	1,890	0.3
IN	78	0.2%	6,300	0.5
MF	743	2.3%	1,260	0.9
RS	29,134	91.2%	194	5.7
Total	**31,937**	**100.0%**	**--**	**9.9**
Average gpmd[4]	**--**	**--**	**310**	**--**
2010 Population[5]	**88,000**		**People/Meter**	**2.8**

Notes:

1. Meter class percentage will remain fixed throughout the study.
2. Dry year water use includes water loss.
3. The average day demand does not include KU or wholesale customers.
4. The average gpmd is based on the average day demand of 10.4 MGD and a total of 31,937 meters.
5. 2010 Population does not include KU student housing.

Demand projections are based on the water usage discussed above. Water usage by meter class and the average day demand projections for 2020, 2030, and buildout for the customer meter count projections are summarized in Table ES3.

Table ES3: Average Day Water Demand Projection Excluding Wholesale

Water Usage Summary			2020		2030		Buildout	
Meter Class	Dry Year Water Use (gpmd)	Meter Class Percentage	Meter Count	Avg Day Demand[1] (MGD)	Meter Count	Avg Day Demand[1] (MGD)	Meter Count	Avg Day Demand[1] (MGD)
CO	1,470	5.6%	2,212	3.3	2,479	3.6	5,226	7.4
CT	2,050	0.6%	228	0.5	255	0.5	538	1.1
IN	7,350	0.2%	96	0.7	108	0.8	227	1.6
MF	1,325	2.3%	915	1.2	1,025	1.4	2,161	2.8
RS	200	91.2%	35,867	7.2	40,192	8.0	84,726	16.3
		Totals:	**39,318**	**12.8**	**44,059**	**14.4**	**92,877**	**29.2**

KU and the City discussed water use projections for KU's Main and West Campuses. Water use has been very stable over the last five years, but future growth increases demand to 110,000 gallons per day (gpd) at the Main Campus and 90,000 gpd at the West Campus by year 2030.

Wholesale and rural water districts are also projecting increases in water use from1.0 MGD in 2010 with projected to increase to 1.37 MGD in 2020 and 1.63 MGD in 2030.

Projected water demands for all seven meter classes are summarized in Table ES4 for years 2020, 2030 and buildout. Review of the table shows the maximum day demand is projected to be 32.7, 36.9, and 71.7 MGD respectively for year 2020, year 2030, and buildout. These values have been approved by the City and are the basis for all water supply, water treatment, and distribution system evaluations. Any changes to these values require reevaluation of the water system.

Table ES4

Projected Water Demands
Lawrence, Kansas

Year	Average Day Demand (MGD)								Maximum Day[1] (MGD)	Maximum Hour[2] (MGD)
	RS	MF	CO	IN	CT	KU	RWD	Total		
2010	**5.83**	**0.98**	**2.64**	**0.57**	**0.38**	**0.58**	**1.00**	**12.0**	**19.5**	**41.9**
2011	5.96	1.00	2.70	0.58	0.39	0.59	1.04	12.3	27.0	42.9
2012	6.10	1.03	2.76	0.60	0.40	0.60	1.07	12.6	27.6	44.0
2013	6.23	1.05	2.82	0.61	0.41	0.61	1.11	12.8	28.3	45.0
2014	6.37	1.07	2.88	0.62	0.41	0.63	1.15	13.1	28.9	46.0
2015	6.50	1.10	2.95	0.64	0.42	0.64	1.19	13.4	29.5	47.0
2016	6.64	1.12	3.01	0.65	0.43	0.65	1.22	13.7	30.2	48.0
2017	6.77	1.14	3.07	0.67	0.44	0.66	1.26	14.0	30.8	49.0
2018	6.90	1.17	3.13	0.68	0.45	0.67	1.30	14.3	31.4	50.0
2019	7.04	1.19	3.19	0.69	0.46	0.68	1.33	14.6	32.1	51.0
2020	**7.17**	**1.21**	**3.25**	**0.71**	**0.47**	**0.69**	**1.37**	**14.9**	**32.7**	**52.1**
2021	7.26	1.23	3.29	0.71	0.47	0.70	1.40	15.1	33.1	52.7
2022	7.35	1.24	3.33	0.72	0.48	0.71	1.42	15.3	33.6	53.4
2023	7.43	1.26	3.37	0.73	0.48	0.72	1.45	15.4	34.0	54.1
2024	7.52	1.27	3.41	0.74	0.49	0.73	1.47	15.6	34.4	54.7
2025	7.61	1.29	3.45	0.75	0.50	0.74	1.50	15.8	34.8	55.4
2026	7.69	1.30	3.49	0.76	0.50	0.75	1.53	16.0	35.2	56.0
2027	7.78	1.31	3.53	0.77	0.51	0.76	1.55	16.2	35.6	56.7
2028	7.87	1.33	3.57	0.77	0.51	0.77	1.58	16.4	36.1	57.4
2029	7.95	1.34	3.60	0.78	0.52	0.78	1.60	16.6	36.5	58.0
2030	**8.04**	**1.36**	**3.64**	**0.79**	**0.52**	**0.79**	**1.63**	**16.8**	**36.9**	**58.7**
Build-out	**16.32**	**2.76**	**7.40**	**1.61**	**1.06**	**0.79**	**2.66**	**32.6**	**71.7**	**114.1**

Notes:

[1]Maximum day to average day ratio is 2.2 for 2011 through buildout.

[2]Maximum hour to average hour ratio is 3.5 for 2011 through buildout.

D. Net Water Need

The net water need is the difference between projected demand and water rights for diversions, and are listed in Table ES5 below. Lawrence has a surplus of water rights through year 2030.

Table ES5: Water Right Needs

Water Component	Year 2020 Amount (MGD)	Year 2030 Amount (MGD)	Buildout Amount (MGD)
Average Day Demand Projection[1]	16.1	18.1	35.2
Average Day Water Right Diversion[2]	38.0	38.0	38.0
Average Day Net Water Need	**21.9**	**19.9**	**2.8**
Maximum Day Demand Projection[1]	35.3	39.9	77.4
Maximum Day Water Right Diversion[2]	74.9	74.9	74.9
Maximum Day Net Water Need	**39.5**	**35.0**	**-2.6**

Notes:

1. Maximum and average day demand projections include 8 percent water loss for treatment through the WTPs and demands for KU and wholesale customers.
2. Maximum and average day diversion right includes rights of the wholesale customers.

Although the City has adequate water rights through year 2030, diversion capacity is lacking. An additional diversion capacity of 3.9 MGD by 2030 and 41.4 MGD by buildout is required to meet maximum day demands. The diversion deficit is projected to start in year 2028. Details on additional diversion capacity are discussed in TM4.

The current WTP capacity is 20.0 MGD from Clinton WTP and 16.0 MGD from Kaw WTP for a total of 36.0 MGD. The existing WTP capacity can be maximized to 42.5 MGD based on 25.0 MGD from Clinton WTP and 17.5 MGD from Kaw WTP. Filter testing and plant improvements are required at both plants to meet these capacities. Based on the 42.5 MGD value, treatment plant capacity is adequate beyond 2030, but as shown in Table ES6, an additional 34.9 MGD of treatment capacity is required to meet the buildout maximum day demand.

As the hydraulic model is an operations and management tool, it can be used to evaluate alternate future development / growth plans as they occur and alternate combinations of additional treatment capacity from Kaw WTP and Clinton WTP.

E. Water Supply Improvements

The Kaw WTP raw water pump station and piping improvements to improve reliability and redundancy and allow for expansion in the future are listed below. Actual capacity is dependent on the ultimate capacity of the Kaw WTP which is limited to 17.5 MGD in the distribution system modeling. Major

Table ES6: Treatment Capacity Needs (Maximum Day)

Water Component	Year 2020	Year 2030	Buildout
	Amount (MGD)	Amount (MGD)	Amount (MGD)
Required WTP Capacity[1]	35.3	39.9	77.4
Maximum Potential Existing WTP Capacity	42.5	42.5	42.5
Net Water Need (Potential Existing WTP Capacity)	**7.2**	**2.6**	**-34.9**
Required WTP Capacity[1]	35.3	39.9	77.4
Current WTP Capacity	36.0	36.0	36.0
Net Water Need (Current WTP Capacity)	**0.7**	**-3.9**	**-41.4**

[1] Required treatment capacity is the maximum day demand projection, including KU and wholesale users, plus an 8 percent adder for WTP losses.

improvements associated with a surface water diversion alternative include the following:

- Replace LSPS No. 1;
- New intake and raw water supply line;
- Raw water piping improvements to provide WTP capacity; and
- Presedimentation basin improvements.

Clinton Lake has no additional available water rights. For this reason, all future diversion must come from the Kansas River. Clinton WTP will also have to be expanded to supply the remainder of the projected buildout demand that Kaw WTP cannot provide. Expansion at Clinton WTP is more conducive by nature of its location to the existing distribution system, land availability, and future growth areas determined by City staff. Based on previous studies, alternate diversion sources are available to provide a redundant supply to Kaw WTP through a series of HCWs and could be evaluated as an alternate diversion source for Clinton WTP.

F. Water Treatment Improvements

A regulatory evaluation was conducted for both Kaw and Clinton WTPs. It reviewed current and anticipated water quality regulations that may impact the City of Lawrence. The review was performed in consideration of the following current and anticipated drinking water regulations:

- Safe Drinking Water Act (SDWA) and its amendments
  - National Primary Drinking Water Regulations (NPDWRs)
    - Microorganisms
    - Disinfection Byproducts
    - Organic Contaminants
    - Inorganic Chemicals
    - Radionuclides
    - Disinfectants
  - National Secondary Drinking Water Regulations (NSDWRs)
  - Arsenic Rule
  - Lead and Copper Rule
  - Radionuclide Rule
  - Radon Rule
  - Filter Backwash Recycling Rule
  - Surface Water Treatment Rule (SWTR)
- Total Coliform Rule (TCR)
- Microbial/Disinfection Byproduct Rules
  - Interim Enhanced Surface Water Treatment Rule (IESWTR)
  - Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)
  - Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)
  - Stage 1 Disinfectants/Disinfection Byproducts Rule (Stage 1 D/DBPR)
  - Stage 2 Disinfectants/Disinfection Byproducts Rule (Stage 2 D/DBPR).
- Unregulated Contaminant Monitoring (UCM) for large and small utilities

Both the Kaw and Clinton WTPs are currently in compliance with these regulations.

A process evaluation was completed at the Kaw WTP to identify treatment limitations, additional testing that may be required, and potential modifications to the existing treatment process and/or addition of new unit processes required for plant operational improvement and/or expanded plant capacity. A similar evaluation was not completed at Clinton WTP. Each treatment process is evaluated and the results are illustrated in Figure ES2. Review of the figure shows individual process capacities range from 12 to 30 MGD and substantial improvements are likely required to increase capacity above 17.7 MGD, which is the firm filter capacity.

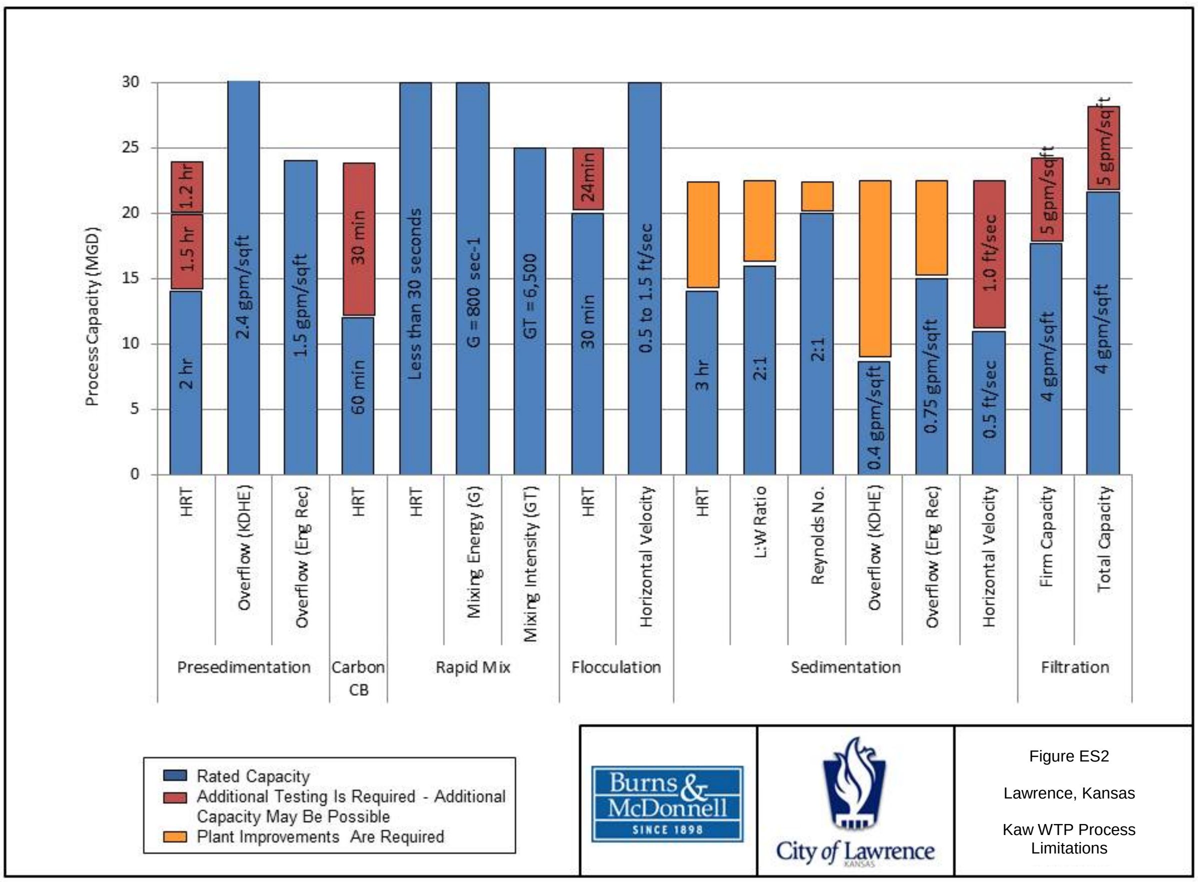


Figure ES2

Lawrence, Kansas

Kaw WTP Process Limitations

The following recommendations are a result of the evaluation to address current and anticipated plant treatment issues:

- Bench scale testing:
  - Evaluate how to improve treatment and lower operating costs;
  - Optimize polymer addition and mixing requirements;

- Optimize the flocculation process to promote greater floc settleability (0.1 to 2.0 mm effective size) such that existing flocculation basin hydraulic detention time of less than 30 minutes can be utilized;
- Evaluate filters to assess the filtration performance to see if additional capacity can be achieved by examining a series of performance indicators and quantitative evaluations;
- Evaluate PAC dose required to achieve various process goals, including the reduction of DOC, TTHM formation potential, and microcystins. Different PAC types should be evaluated and ranked according to performance for each process goal: and
- Evaluate ozone to achieve various process goals, including the reduction of DOC, TTHM formation potential, and microcystins.

G. Distribution System Improvements

The first step determining water distribution system improvements is development of a GIS-based hydraulic model in Bentley WaterGEMS V8i. The City's GIS water system data was imported into the hydraulic model using tools available in the modeling software. The City's topologically correct geometric network of the water system was imported to construct the base model and a series of processes were executed to condense the water system by removing features not critical for hydraulic analysis. The process of condensing the system is known as skeletonization, and allows the system to be modeled accurately while reducing the number of features modeled. The model does not include dedicated fire hydrant lines, dedicated building and/or customer service lines, fire lines, private lines, abandoned lines, or dead end mains of short length with no customer consumption data.

The model is calibrated based on the results of the field testing program and is used to determine water distribution system improvements for years 2010, 2020, 2030, and buildout. SCADA information for the high service pumps, booster pumps and tanks are used to develop diurnal curves for the system and each pressure zone as well as data for the extended period simulations. The results of the diurnal evaluation provide peak hour and minimum hour demand ratios and are incorporated into model scenarios for each year. The diurnal evaluation also provides the system equalization volume and is used in the storage analysis. Fire demands for each year are also evaluated in the model.

Analyses of system storage, WTP high service pumping, and inter-system booster pumping are conducted to determine their ability to meet equalization storage, projected water demands, and identify deficiencies with respect to water supply, storage, pipeline capacity, pumping, pressure, and fire flow. Extended period simulations (EPS) for years 2010, 2020, and 2030 are also evaluated in the model to validate system operation and water age.

The storage factors and maximum day demands based on recent SCADA information and used in the storage analysis for each pressure zone are listed below:

- CS pressure zone storage factor of 13 percent for a year 2030 demand of 17.6 MGD.
- WH pressure zone storage factor of 18 percent for a year 2030 demand of 19.3 MGD.

Based on the maximum day demand of 36.9 MGD, the City currently has a slight storage deficit of 0.2 MG for equalization and emergency volumes through the year 2030. This is based on a new storage capacity at Oread of 1.75 MG. The tank capacity at this site is limited due to width and height restrictions for construction. The final design of Oread should maximize the potential capacity, with 1.75 MG as the minimum. Based on the extended period simulation runs, the storage appears to be adequate for year 2030 demands. Additional storage will be placed in the growth areas or new pressure zones when sufficient demand occurs in those areas.

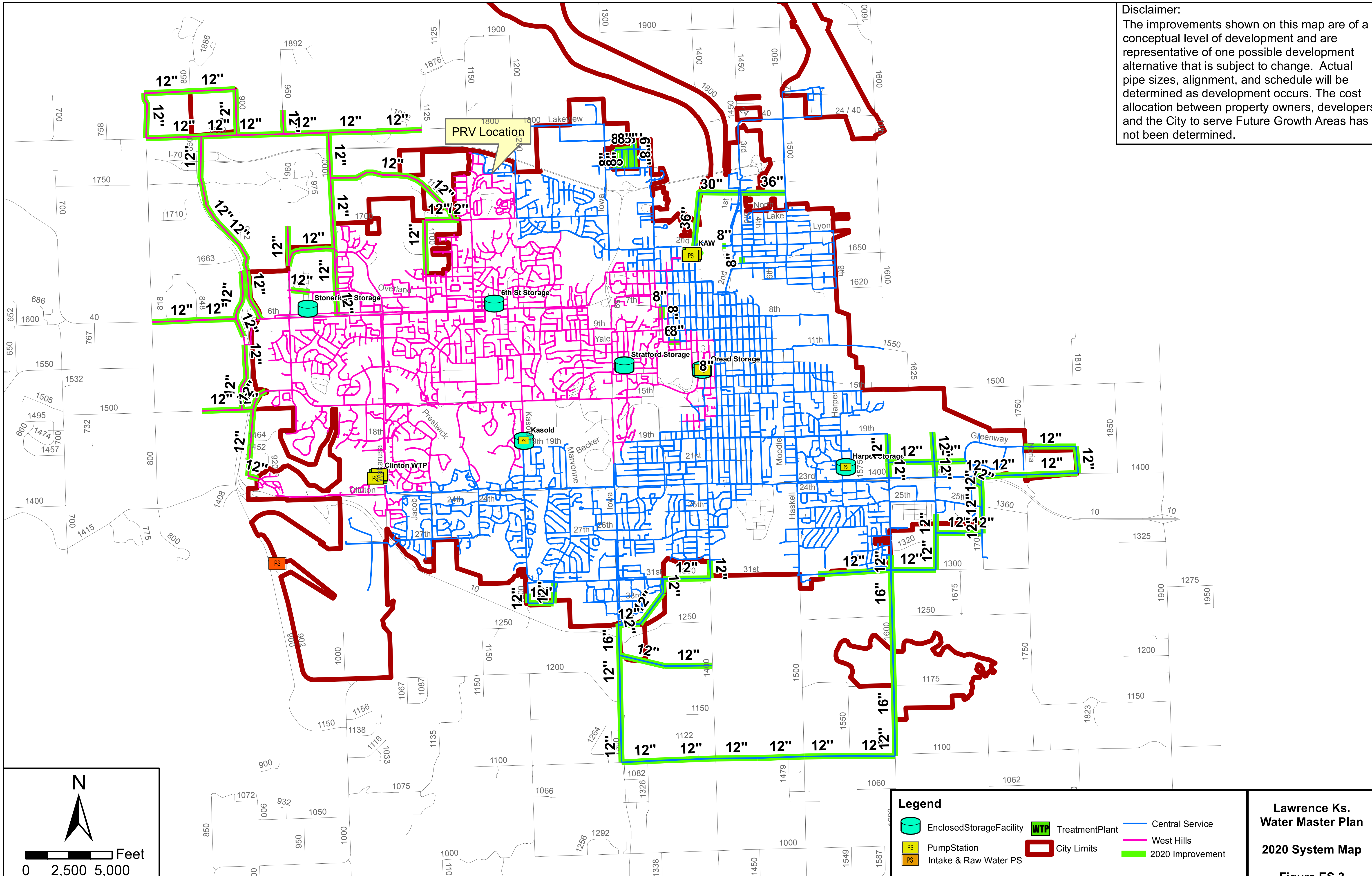
Based on the model runs several pipes were identified for replacement. These include the City small main replacement program and scheduled replacements. A booster pump station located at Harper tank was recommended to maintain system pressures and to assist with turnover in the Harper tank. The addition of a pressure reducing valve between the West Hills and Central Service pressure zones was also recommended to improve pressures and fire flows in the northwestern portion of the Central Service zone. Figures ES3 through ES4 illustrate the system improvements for years 2020 and 2030. These system improvements result in better system pressures, water age, and fire flows.

H. Capital Improvement Plan

Based on improvements required for supply, treatment and distribution to meet projected average day and maximum day demands, cost opinions and scheduled year are developed through year 2030 as listed in Table ES7 and are separated into the following categories and projects:

- Storage & Pumps:
  - Oread storage and pump station,
  - Pump station improvements for 19th and Kasold,
  - Booster station addition at Harper,
  - Tower coatings,

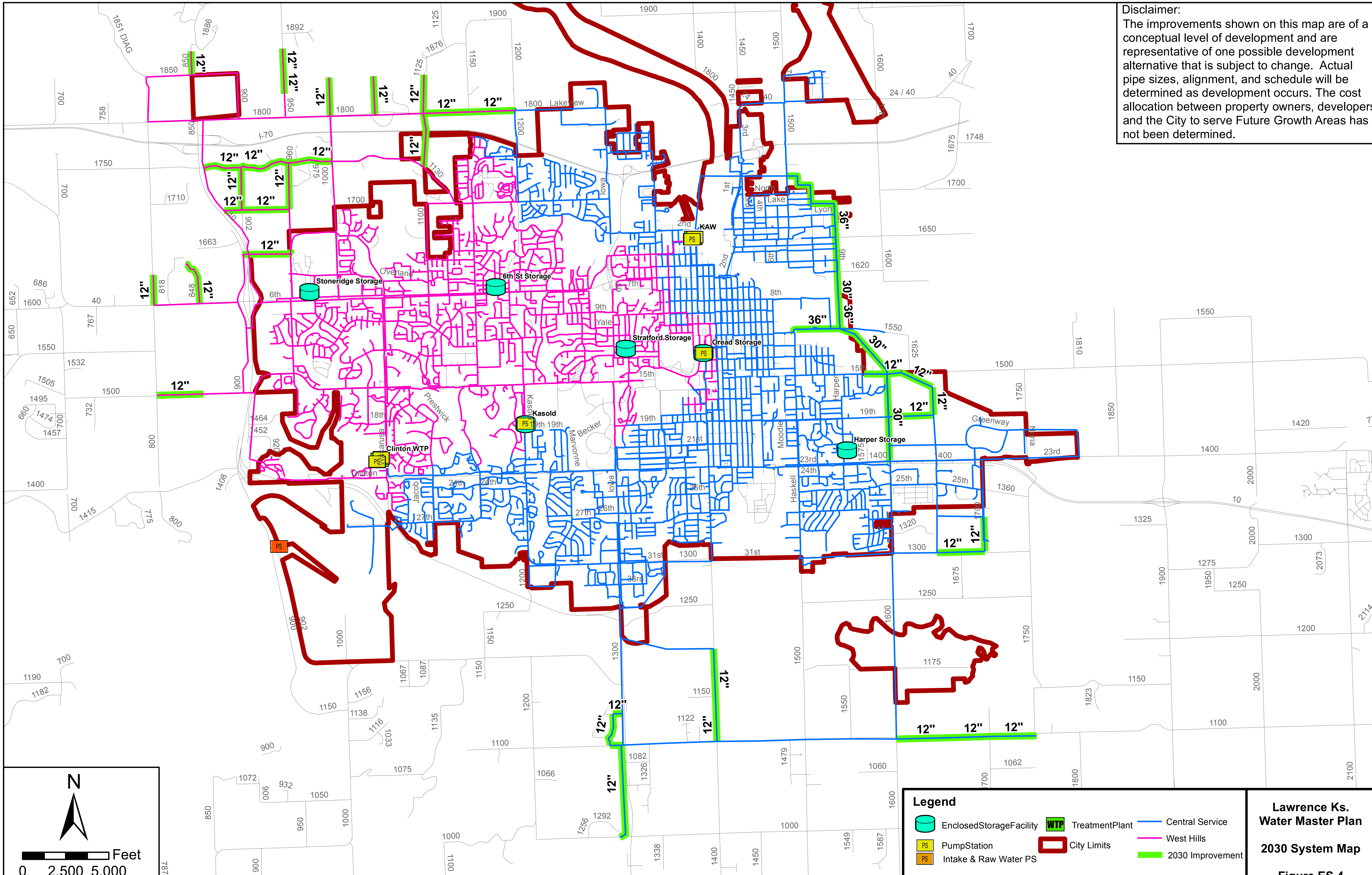
Disclaimer:
The improvements shown on this map are of a conceptual level of development and are representative of one possible development alternative that is subject to change. Actual pipe sizes, alignment, and schedule will be determined as development occurs. The cost allocation between property owners, developers, and the City to serve Future Growth Areas has not been determined.



Lawrence Ks.
Water Master Plan

2020 System Map

Figure ES 3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Stoneridge Storage
6th St Storage
Stratford Storage
Oread Storage
Harper Storage
KAW
Kasold
Clinton WTP
PS
12"
30"
36"
I-70
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PumpStation
Intake & Raw Water PS
TreatmentPlant
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Central Service
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2030 Improvement
Lawrence Ks.
Water Master Plan
2030 System Map
Figure ES 4
N
Feet
0
2,500
5,000

Table ES7
WATER FACILITIES MASTER PLAN
CITY OF LAWRENCE, KANSAS
Preliminary Opinions of Improvement Costs

	Item	Reason for Improvement	2012 Cost Opinion	2013 (1)	2014 (1)	2015 (1)	2016 (1)	2017 (1)	2018 (1)	2019 (1)	2020 (1)	5 Year Period Ending 2025 (1)	5 Year Period Ending 2030 (1)
1	**Storage & Pumps**												
a	Oread Storage & BPS	3	$ 3,604,400	1,248,000	2,704,600								
b	19th & Kasold Pump Station - Pump underground with Building	3	$ 380,000		411,000								
c	Harper Booster Station	3	$ 600,000	624,000									
d	Tower Coatings (Stratford @ 0.5 MG, 6th @ 0.5 MG, Harper @ 0.5 MG, and Ground Storage at Clinton @ 1.5 MG)	3	$ 4,080,000	1,040,000			1,684,600	876,000			985,400		
e	PRV from WH to CS for Fire Flow and Peak Day in CS at I-70, West of Iowa and North	3	$ 70,000							92,100			
f	Automated Meter Reading for Distribution System - (2)	3	$ 8,500,000						8,500,000				
	Subtotal		$ 17,234,400										
2	**Transmission**												
a	Future Growth Areas - (3), (4)	1	$ 37,724,400	5,609,200	3,194,000	3,321,700	3,454,600	3,592,800	3,736,500	3,885,900	4,041,400	8,988,900	10,936,300
b	Kaw 36" WM to North Lawrence (One 30" river crossings) - Phase 1, 2 and 3	1,3	$ 20,860,000	7,836,400							18,236,200		
c	Concrete Main Assessment	3	$ 600,000		648,960								
	Subtotal		$ 59,184,400										
3	**Distribution 8" & Larger**												
a	Pipeline Replacement Program - 2013 to 2030	3	$ 40,475,200	2,338,600	2,432,100	2,529,400	2,630,600	2,735,800	2,845,200	2,959,000	3,077,400	17,334,900	21,090,500
b	Water Main Relocation Program for Road Projects	1	$ 9,927,885	1,985,000	500,000	520,000	540,800	562,400	584,900	608,300	632,700	3,563,800	4,335,900
	Subtotal		$ 50,403,085										
4	**Distribution 8" & Smaller (Potential In-House)**												
a	Small Water Main Replacement Program - Conventional Construction	3	$ 10,450,000	1,358,500	1,412,800	1,469,400	1,528,100	1,589,300	1,652,800	1,718,900	1,787,700		
b	Small Water Main Replacement Program - In-House Design / Construct	3	$ 7,450,000	968,500	1,007,200	1,047,500	1,089,400	1,133,000	1,178,300	1,225,500	1,274,500		
5	**Kaw WTP**												
a	Structural	3	$ 596,000	619,800									
b	Electrical	3	$ 750,000		811,200								
c	Process	2, 3	$ 317,500				166,700					291,400	
d	Microcystin and Taste & Odor, Viral Reduction Treatment Measures - Advanced Oxidation	2	$ 9,150,000	104,000								15,062,300	
e	Annual Plant Improvement Program - $75,000 for Two Years then $300,000	3	$ 4,950,000	75,000	78,000	300,000	312,000	324,500	337,500	351,000	365,000	2,055,900	2,501,500
	Subtotal		$ 15,763,500										
6	**Clinton WTP**												
a	Intake	1, 3	$ 1,660,000		1,297,900	517,400							
b	Electrical	1, 3	$ 755,000			849,300							
c	Process	2, 3	$ 560,000		108,200		187,200				410,600	166,500	
d	Filter Expansion/Process	1, 3	$ 7,500,000								10,264,300		
e	Microcystin and Taste & Odor, Viral Reduction Treatment Measures - Advanced Oxidation	2	$ 9,000,000									14,985,700	
f	Basin Coatings	3	$ 1,130,000					1,374,800					
g	Annual Plant Improvement Program - $75,000 for Two Years then $300,000	3	$ 4,950,000	75,000	78,000	300,000	312,000	324,500	337,500	351,000	365,000	2,055,900	2,501,500
	Subtotal		$ 25,555,000										
7	**Raw Water Supply**												
a	Bowersock Dam Improvements (3)	3	$ 425,000	425,000									
b	HCWs (three at 25 MGD total)	1, 2, 3	$ 17,100,000										34,641,500
c	42 Pipeline to Clinton WTP	1, 2, 3	$ 22,680,000										45,945,500
d	36" Pipeline to Kaw WTP	1, 2, 3	$ 7,300,000										14,788,500
	Subtotal		$ 47,505,000										
	2020 and 2030 Total - Conventional Construction		**$ 226,095,385**	**33,713,000**	**13,676,760**	**9,807,200**	**10,816,600**	**11,380,100**	**17,994,400**	**9,966,200**	**58,401,900**	**64,505,300**	**136,741,200**
	2020 and 2030 Total - In-House Design / Construct		**$ 223,095,385**	**33,323,000**	**13,271,160**	**9,385,300**	**10,377,900**	**10,923,800**	**17,519,900**	**9,472,800**	**57,888,700**	**64,505,300**	**136,741,200**

(1) - 4% Inflation Used to Calculate 2013 to 2030 Costs
(2) - Not Inflated Due to Expected Technology Advances
(3) - Not Inflated Due to Contract
(4)- Cost allocation between property owners, developers and the City for Transmission Mains to serve Future Growth Areas has not been determined.

2013 - 2020 Total - Conventional Construction	**165,756,160**
2013 - 2020 Total - In-House Design / Construct	**162,162,560**

Reason for Improvement
1- Growth
2 - Regulatory
3 - Reliability

- Pressure reducing valve for area north of I-70,
- A fixed network automated reading system.

- Transmission:
  - Future growth related pipelines,
  - 36-inch transmission main from Kaw WTP to area north of I-70,
  - Assessment of concrete mains.
- Distribution 8" & Larger:
  - Replacement of old pipelines and relocation of pipelines associated with road projects.
- Distribution 8" & Smaller:
  - Replacement of 4-inch and smaller pipelines with 8-inch pipelines.
- Kaw WTP:
  - Structural, electrical and process improvements to the plant,
  - Ozone for taste and odor and microcystin,
  - Funds for annual plant improvement program.
- Clinton WTP:
  - Intake pump and electrical capacity and back-up power,
  - Electrical and process improvements to the plant, capacity improvements at the plant,
  - Ozone for taste and odor and microcystin,
  - Basin and equipment coating, and funds for annual plant improvement program.
- Raw Water Supply:
  - Three horizontal collector wells with a capacity of 25 MGD and pipelines to Kaw and Clinton WTPs.

These improvements total $223 million in year 2012 dollars. These dollars are divided by years of application into three periods; 2013 through 2020, 2021 through 2025, and 2026 through 2030. Schedule for the improvements is demand driven. Therefore, if growth occurs at a faster rate, improvements will need to occur sooner than allocated, and if demand increases at a lower rate than expected, growth-related improvements could be delayed. Regulations and reliability/redundancy drive many of these improvements in the future.