CITY OF YAKIMA

2023

WASTEWATER COLLECTION SYSTEM MASTER PLAN

Draft

February, 2023

AKEL
ENGINEERING GROUP, INC.

AKEL
ENGINEERING GROUP, INC.

Smart Planning Our Water Resources

February 1, 2023

City of Yakima
2220 E. Viola
Yakima, WA 98901-9998

Attention: Dana Kallevig
Project Manager, Wastewater Utility Project Manager

Subject: 2023 Wastewater Collection System Master Plan – Draft Report

Dear Dana:

We are pleased to submit the draft report for the City of Yakima Wastewater Collection System Master Plan. The master plan describes the City's wastewater collection system, the planning area characteristics, hydraulic criteria, and the hydraulic model development.

The hydraulic model was used to evaluate the capacity adequacy of the existing wastewater collection system and for recommending improvements to mitigate existing deficiencies and for servicing future growth. The prioritized capital improvement program accounts for growth through the Yakima Urban Growth Area and includes suggested construction triggers for the orderly expansion of the wastewater collection system.

A checklist for compliance with the General Sewer Plan requirements, as stipulated in Section G1-3.2 of the Washington State Department of Ecology Criteria for Sewerage Works Design and WAC 173-240-050(3), is also attached to this letter. This checklist identifies the relevant sections of the General Sewer Plan requirements addressed in this master plan.

We extend our thanks to you, Scott Schafter, Public Works Director; Mike Price, Wastewater Division Manager; Marc Cawley, Wastewater/Stormwater Operations Superintendent; and other City staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
President

Enclosure: Report

7433 N. FIRST STREET, SUITE 103 • FRESNO, CALIFORNIA 93720 • (559) 436-0600 • FAX (559) 436-0622
www.akeleng.com

General Sewer Plan WAC Checklist

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Content of General Sewer Plan per Section G1-3.2 of Washington State Department of Ecology Criteria for Sewerage Works Design and WAC 173-240-050(3) Addressed In the City of Yakima 2022 Wastewater Collection System Master Plan			
No.	**Item Description**	**Chapter/Section**	**Additional Clarification**
(a)	The purpose and need for the proposed plan.	Chapter 1, Sections 1 and 2	
(b)	A discussion of who will own, operate, and maintain the systems.	Chapter 4, Section 1	
(c)	The existing and proposed service boundaries.	Chapter 2, Sections 1 and 8	Figures 1.1, 2.1, 2.15 and 2.16
(d)	Layout map including the following:		
(i)	Boundaries. The boundary lines of the municipality or special district to be sewered, including a vicinity map;	Chapter 2, Sections 1 and 8	Figures 1.1, 2.1, 2.15 and 2.16
(ii)	Existing sewers. The location, size, slope, capacity, direction of flow of all existing trunk sewers, and the boundaries of the areas served by each;	Chapter 4, Sections 1 to 3	Figures 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7 Table 4.1
(iii)	Proposed sewers. The location, size, slope, capacity, direction of flow of all proposed trunk sewers, and the boundaries of the areas served by each;	Chapter 7, Sections 2 and 3	Figures 7.3, 7.4, 7.5, 7.6, 7.7 and 7.8 Tables 7.1, 7.2 and 7.3
(iv)	Existing and proposed pump stations and force mains. The location of all existing and proposed pumping stations and the force mains, designated to distinguish between those existing and proposed;	Chapter 4, Section 4 Chapter 7, Section 4	Figure 4.8 Tables 4.2 and 7.4
(v)	Topography and elevations. Topography showing pertinent ground elevations and surface drainage must be included, as well as proposed and existing streets;	Chapter 2, Section 2	Figures 2.2, 2.3, 2.4, 2.10 and 2.11
(vi)	Streams, lakes, and other bodies of water. The location and direction of flow of major streams, the high and low elevations of water surfaces at sewer outlets, and controlled overflows, if any. All existing and potential discharge locations should be noted; and	Chapter 2, Sections 2 and 3	Figures 2.6, 2.7, 2.8 and 2.9
(vii)	Water systems. The location of wells or other sources of water supply, water storage reservoirs and treatment plants, and the water transmission facilities.	Chapter 2, Section 6 and 7	Figures 2.12 and 2.13
(e)	The population trend as indicated by available records, and the estimated future population for the stated design period. Briefly describe the method used to determine future population trends and the concurrence of any applicable local or regional planning agencies.	Chapter 2, Section 9	Figure 2.19 Tables 2.7, 2.8 and 2.9
(f)	Any existing domestic or industrial wastewater facilities within twenty miles of the general plan area and within the same topographical drainage basin containing the general plan area.	Chapter 4, Section 6	Figure 4.9
(g)	A discussion of any infiltration and inflow problems and a discussion of actions that will alleviate these problems in the future.	Chapter 5, Section 1 Chapter 7, Section 5	Table 7.4
(h)	A statement regarding provisions for treatment, discharge, reuse, and a discussion of the adequacy of the treatment.		
(i)	List of all establishments producing industrial wastewater, the quantity of wastewater and periods of production, and the character of the industrial wastewater insofar as it may affect the sewer system or treatment plant. Consideration must be given to future industrial expansion.	Chapter 4, Section 3 Chapter 5, Sections 1 to 3	Figure 4.7 Tables 4.1, 5.3, 5.11, 5.13
(j)	Discussion of the location of all existing private and public wells, or other sources of water supply, and distribution structures as they are related to both existing and proposed domestic wastewater treatment facilities.	Chapter 2, Sections 6 and 7	Figures 2.12 and 2.13
(k)	Discussion of the various alternatives evaluated, and a determination of the alternative chosen, if applicable.	Chapter 7	
(l)	A discussion, including a table, that shows the cost per service in terms of both debt service and the operation and maintenance costs, of all facilities (existing and proposed) during the planning period.	Chapter 9	Tables 9.1, 9.2 and 9.3
(m)	A statement regarding compliance with any adopted water quality management plan under the Federal Water Pollution Control Act as amended.		
(n)	A statement regarding compliance with State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA), if applicable.		

Acknowledgements

City Council

Janice Deccio, Mayor, District 4

Soneya Lund, Assistant Mayor, District 5

Eliana Macias, District 1

Danny Herrera, District 2

Patricia Byers, District 3

Matt Brown, District 6

Holly Cousens, District 7

Management Personnel

Scott Schafer, Public Works Director

Mike Price, Wastewater Division Manager

Dana Kallevig, Project Manager, Wastewater Utility Project Manager

Randy Meloy, Surface Water Engineer

Marc Cawley, Wastewater/Stormwater Operations Superintendent

Joan Davenport, Community Development Director

Bill Preston, City Engineer

Joseph Calhoun, Planning Manager

Tom Sellsted, Supervising Senior Analyst

Other City Engineering, Planning, and Operations Staff

TABLE OF CONTENTS

PAGE NO.

TABLE OF CONTENTS

PAGE NO.

TABLE OF CONTENTS

PAGE NO.

TABLE OF CONTENTS

PAGE NO.

Figures

TABLE OF CONTENTS

PAGE NO.

TABLE OF CONTENTS

PAGE NO.

Tables

TABLE OF CONTENTS

PAGE NO.

Appendices

TABLE OF CONTENTS PAGE NO.

ABBREVIATIONS

2023 WWCSMP	2023 City of Yakima Wastewater Collection System Master Plan
AACE International	Association for the Advancement of Cost Engineering, International
AAF	Average Annual Flow
ADWF	Average Dry Weather Flow
Akel	Akel Engineering Group, Inc.
AWWF	Average Wet Weather Flow
CCI	Construction Cost Index
CCTV	Closed Circuit Television
cfs	Cubic Feet per Second
CI	Cast Iron Pipe
City	City of Yakima
CIP	Capital Improvement Program
COF	Consequence of Failure
CSWD	Criteria for Sewerage Works Design
DOE	Department of Ecology
d/D	Depth of Flow to Pipe Diameter Ratio
EDU	Equivalent dwelling unit
EIR	Environmental Impact Report
ENR	Engineering News Record
FEMA	Federal Emergency Management Agency
fps	Feet per Second
ft	Feet
gal	Gallon
GIS	Geographic Information Systems
gpd	Gallons per Day
gpm	Gallons per Minute
HGL	Hydraulic Grade Line
hp	Horsepower
hr	Hour
IDF	Intensity Duration Frequency
I&I	Infiltration and Inflow
in	Inch

TABLE OF CONTENTS PAGE NO.

ABBREVIATIONS

IW	Industrial Waste
LOF	Likelihood of Failure
LF	Linear Feet
MDDWF	Maximum Day Dry Weather Flow
MDWWF	Maximum Day Wet Weather Flow
MGD	Million Gallons Per Day
MMDWF	Maximum Month Dry Weather Flow
MMWWF	Maximum Month Wet Weather Flow
NCDC	National Climate Data Center
NRCS	National Resources Conservation Service
O&M	Operations and Maintenance
PACP	Pipeline Assessment Certification Program
PDWF	Peak Dry Weather Flow
PWWF	Peak Wet Weather Flow
RDII	Rainfall Dependent Infiltration and Inflow
R&R	Rehabilitation and Replacement
ROW	Right of Way
SCADA	Supervisory control and data acquisition
sq. ft.	Square Feet
UGA	Urban Growth Area
UIC	Underground Injection Control
Union Gap	City of Union Gap
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
yr	Year

UNIT CONVERSIONS

Volume Unit Calculations

To Convert From:	To:	Multiply by:
acre feet	gallons	325,851
acre feet	cubic feet	43,560
acre feet	million gallons	0.3259

TABLE OF CONTENTS

PAGE NO.

Volume Unit Calculations

To Convert From:	To:	Multiply by:
cubic feet	gallons	7.481
cubic feet	acre feet	2.296×10^{-5}
cubic feet	million gallons	7.481×10^{-6}
gallons	cubic feet	0.1337
gallons	acre feet	3.069×10^{-6}
gallons	million gallons	1×10^{-6}
million gallons	gallons	1,000,000
million gallons	cubic feet	133,672
million gallons	acre feet	3.069

Flow Rate Calculations

To Convert From:	To:	Multiply By:
ac-ft/yr	mgd	8.93×10^{-4}
ac-ft/yr	cfs	1.381×10^{-3}
ac-ft/yr	gpm	0.621
ac-ft/yr	gpd	892.7
cfs	mgd	0.646
cfs	gpm	448.8
cfs	ac-ft/yr	724
cfs	gpd	646,300
gpd	mgd	1×10^{-6}
gpd	cfs	1.547×10^{-6}
gpd	gpm	6.944×10^{-4}
gpd	ac-ft/yr	1.12×10^{-3}
gpm	mgd	1.44×10^{-3}
gpm	cfs	2.228×10^{-3}
gpm	ac-ft/yr	1.61
gpm	gpd	1,440
mgd	cfs	1.547
mgd	gpm	694.4
mgd	ac-ft/yr	1,120
mgd	gpd	1,000,000

EXECUTIVE SUMMARY

This executive summary presents a brief background of the City of Yakima's wastewater collection system, the planning area characteristics, the planning and design criteria, and the hydraulic model development.

The hydraulic model was used to evaluate the capacity adequacy of the existing wastewater collection system and for recommending improvements to mitigate existing deficiencies and for servicing future growth. The prioritized capital improvement program accounts for growth through the Yakima Urban Growth Area.

ES.1 STUDY OBJECTIVES

Recognizing the importance of planning, developing, and financing system facilities to provide reliable wastewater collection service to existing customers and for servicing anticipated growth within the City's Urban Growth Area (UGA), the City initiated this Wastewater Collection System Master Plan (WWCSMP) Update. The WWCSMP also includes a checklist that cross references the requirements of the General Sewer Plan, as stipulated in the Washington State Legislature WAC 173-240-050.

City Council approved Akel Engineering Group to prepare this 2023 WWCSMP Update and a concurrent Stormwater Collection System Master Plan (SWCSMP) Update in January 2020. The 2023 WWCSMP evaluates the City's wastewater collection system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the City. This 2023 WWCSMP is intended to serve as a tool for planning an phasing the construction of future wastewater collection system infrastructure for the projected buildout of the City's service area

The area and horizon for this master plan is based on the Yakima Urban Area Comprehensive Plan 2040 (2040 YUACP). Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan included the following tasks:

- Summarize the City's existing wastewater collection system facilities.
- Document growth planning assumptions and known future developments.
- Summarize the wastewater system performance criteria and design storm event.
- Project future wastewater flows.

- Update and validate the City's hydraulic model based on the City's Geographic Information Systems (GIS).
- Evaluate the capacity adequacy of the wastewater collection facilities to meet existing and projected peak dry weather flows, and peak wet weather flows during the irrigation season.
- Review flow monitoring data and identify areas with high infiltration and inflow (I&I) rates.
- Develop a pipeline risk and condition assessment
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.
- Perform a capacity allocation analysis for cost sharing purposes.
- Develop a 2023 Wastewater Collection System Master Plan Report.

ES.2 INTEGRATED APPROACH TO MASTER PLANNING

The City implemented an integrated master planning approach and contracted the services of Akel Engineering Group to prepare the following documents:

- Wastewater Collection System Master Plan (WWCSMP)
- Stormwater Collection System Master Plan (SWCSMP)

While each of these reports is published as a standalone document, they have been coordinated for consistency with the City's General Plan document. Additionally, each report has been cross referenced to reflect analysis results with the other reports.

ES.3 STUDY AREA

The City of Yakima is located in Yakima County in the south-central part of Washington, approximately 60 miles southeast of Mount Rainier in the Yakima Valley. The City is located approximately 110 miles southeast of the City of Seattle and 171 miles southwest of the City of Spokane. Interstate 82 (I-82) runs in a north-south direction along the eastern side of the City. The City limits currently encompass 27.7 square miles, with an approximate population of 95,500 residents and 29,282 serviced residential, commercial, industrial, and institutional wastewater accounts. **Figure ES.1** displays the City's location.

The City's service area is generally bound to north by the Naches River and Cowiche Creek, to the east by the Yakima River, to the south by Bachelor Creek, and to the west by 96th Street. The general topography of the City slopes from west to east towards the Yakima River.

ES.4 PLANNING AND DESIGN CRITERIA

This report documents the hydraulic design criteria used for evaluating capacity adequacy of the wastewater collection facilities within the Yakima Urban Growth Area. Gravity pipe capacities

Naches

Selah

Yakima

Terrace Hights

Moxee

West Valley

Union Gap

Naches River

Yakima River

12

82

97

24

Pacific Ocean

Washington

Yakima

Oregon

Idaho

Legend

- Study Area
- Moxee
- Naches
- Selah
- Terrace Heights
- Union Gap
- Moxee Annexation Area
- Major Highways
- Streams
- Rivers
- Lakes

Updated: October 1, 2020

0 0.5 1 2 Miles

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig1-1_RLM_100120.mxd

PRELIMINARY

Figure ES.1
Regional Location Map
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

depend on several factors including: material and roughness of the pipe, the limiting velocity and slope, and the maximum allowable depth of flow. The hydraulic modeling software used for evaluating the capacity adequacy of the City's wastewater collection system, InfoSWMM by Innovyze Inc., utilizes the fully dynamic St. Venant's equation which has a more accurate engine for simulating backwater and surcharge, in addition to manifolded force mains. The software also incorporates the use of the Manning Equation in other calculations including upstream pipe flow conditions.

The overall planning and design criteria are documented in **Table ES.1** and were established from the City of Yakima's 2013 Wastewater Collection System Master Plan. This criteria also conforms to the Washington Department of Ecology's (DOE) criteria for Sewage Works Design.

ES.5 WASTEWATER COLLECTION FACILITIES

The City provides wastewater collection services to approximately 29,300 residential, commercial, industrial, and institutional sewer accounts. The City's collection system consists of approximately 339 miles of up to 48-inch gravity sewer pipes, including a separate wastewater collection system for industrial process. The City owns and maintains 10 sewer lift stations that convey flows towards the YRWWTP, as shown on **Figure ES.2**.

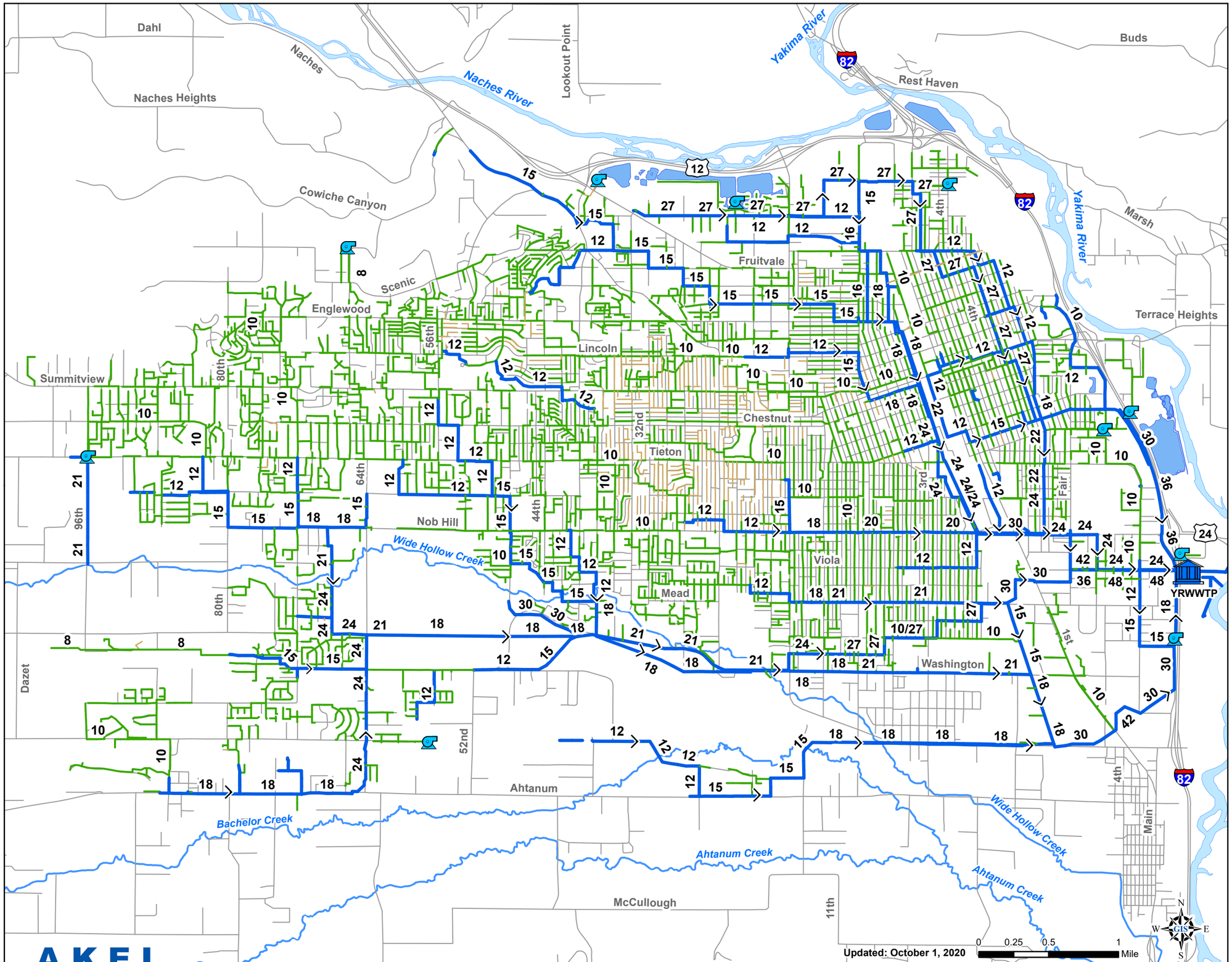
Due to topography, the wastewater collection system is divided into six separate dendritic sewer collection basins, each defining the boundaries of a basin tributary to a wastewater collection trunk system. The following six major basins were delineated and shown on **Figure ES.3**.: 2nd Avenue, Beech Street, Fair Avenue, Nob Hill Boulevard, Rudkin Road, and Washington Avenue.

The City of Yakima also operates a separate wastewater collection system for industrial processes. This system is known as the Industrial Waste Trunk (IW Trunk) and consists of approximately 5.5 miles of gravity pipe ranging from 12-inches to 24-inches in diameter.

ES.6 WASTEWATER FLOWS AND CHARATERISTICS

The wastewater flows collected and treated at the Yakima Regional WWTP vary monthly, daily and hourly. While the dry weather flows are influenced by land use and the irrigation season, the wet weather flows are influenced by the severity and length of storm events. In most wastewater collection systems, the highest flows are usually experienced during the wet weather season and are attributed to infiltration and inflows from storm events. However, in the City of Yakima, the highest wastewater flows are experienced from April to October, when the dry weather flows coincide with the operation of the irrigation system.

In addition to the City of Yakima, the Yakima Regional WWTP collects and treats wastewater flows from the City of Union Gap, the community of Terrace Heights, and the City of Moxee. **Table ES.2** lists tributary historical flows to the Yakima Regional WWTP, from 2012 to 2020. In



Legend

Existing System

- WWTP
- Lift Stations

Pipes by Diameter

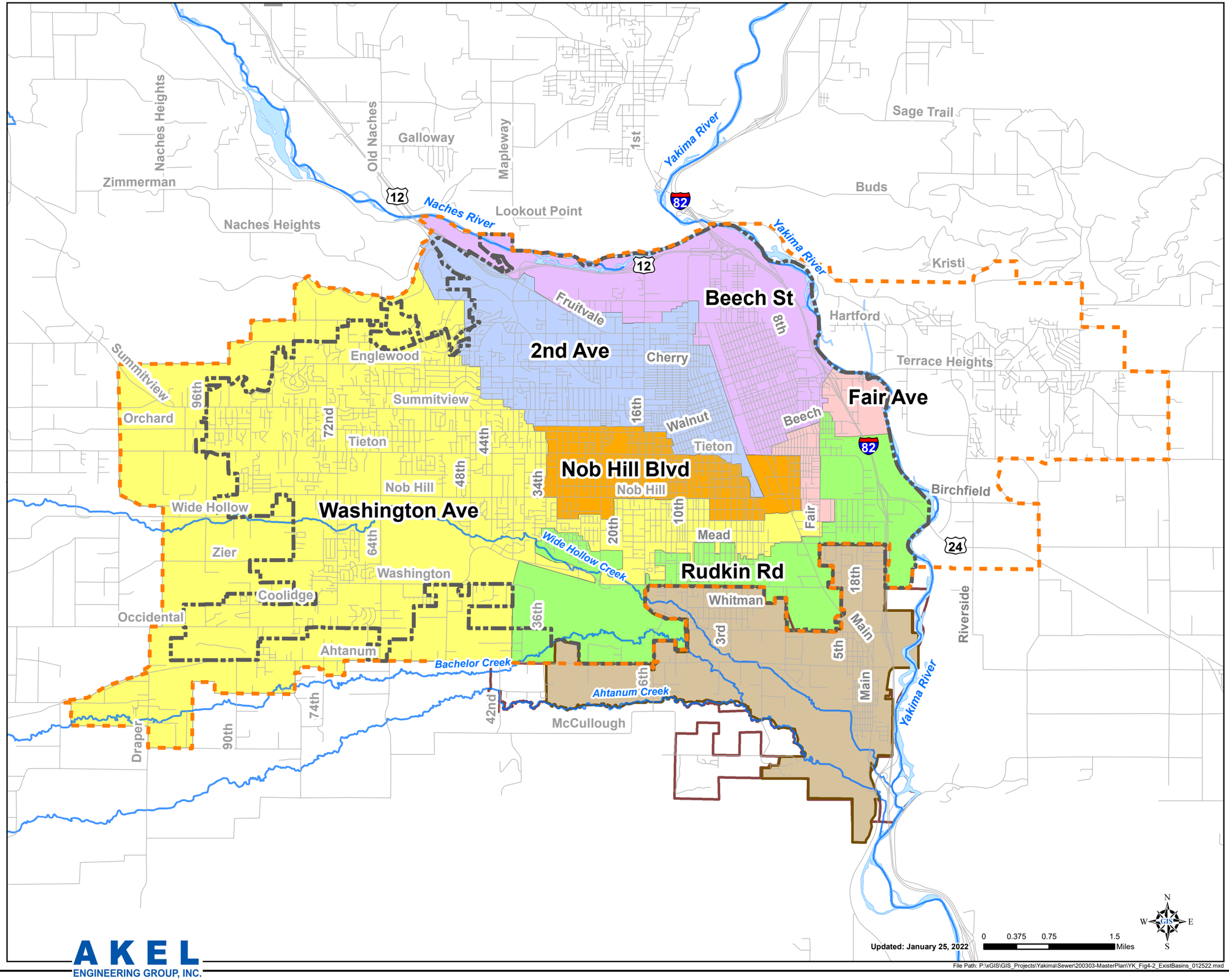
- 6" or Smaller
- 8" to 10"
- 12" or Larger
- Streets
- Streams
- Lakes

PRELIMINARY

Figure ES.2
Existing Wastewater System
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig4-1_ExistWWSys_100120.mxd



Legend

Basins

- 2nd Ave
- Beech St
- Fair Ave
- Nob Hill Blvd
- Rudkin Rd
- Washington Ave
- Yakima City Limits
- Yakima Urban Area
- UnionGap City Limits
- Union Gap Urban Growth Area
- Streets
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure ES.3
Wastewater Collection Basins
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

tw9[ʟaʟb!w¸

tλLJŜfλyŜ / NJλűŜNJλl·

tŜl·ʅ 5Nѽ ² Ŝl·űKŜNJ Cf2ø / NJλűŜNJλl·

5λl·YŜűŜNJ	al·ÈλYdzY ! ff2ølōfŜ ŘK5	
(in)	9ĚλăűλyƎ ¢Ndzyʅă	tN2LJ2ăŜŘ ¢Ndzyʅă
8 to 12	лΦфн	лΦрл
> 12	лΦфн	лΦтр

tŜl·ʅ ² Ŝű ² Ŝl·űKŜNJ Cf2ø / NJλűŜNJλl·

Hydraulic Grade Line (HGL) should be at least o ŦŜŜű below the manhole rim

aλyλYdzY {f2LJŜă Ŧ2NJ DNJl·ØλűètλLJŜă

tλLJŜ {λIS	aλyλYdzY DNJl·RS	/ l·LJl·ŎλűèM	±Ŝf2ŎλűèM
мр	0.0015	1.73	2.30
мс	0.0014	2.05	2.40
му	0.0012	2.81	2.60
нм	0.0010	4.24	2.88
нп	0.0008	6.05	3.14
нт	0.0007	8.28	3.40
ол	0.0006	10.97	3.65
ос	0.0005	17.87	4.12

[λŦű {űl·ûλ2y / NJλűŜNJλl·

[λŦű {űl·ûλ2y / l·LJl·ŎλűèMM

Lift Station capacity shall be sized to meet Peak Wet Weather Flow with largest unit out of service

C2NJŎŜ al·λy / l·LJl·ŎλűèMM

Force main velocity not to exceed 10 ft/s under peak wet weather flow conditions

Notes

1. Pipe friction factor assumed at 0.013.

tw9[LaIb!w¸

tŜℕʎ2Ř	¸l·ʅʎYl· wŜƎʎ2yl·f ² ² ¢t LyŕfdzŜyű [2l·ŘʎyƎă									
	t2LJdzfl·űʎ2y	LyŕfdzŜyű Cf2ǿă óLyŎfdzŘʎyƎ LyŘdzăúℕʎl·f ² l·ăűŜ ¢ℕdzyʅú						LyŕfdzŜyű [2l·ŘʎyƎă ᴹ óLyŎfdzŘʎyƎ LyŘdzăúℕʎl·f ² l·ăűŜ ¢ℕdzyʅú		
		¸l·ʅʎYl· ó52Y ŜăűʎÔ Cf2ǿăú	¸l·ʅʎYl· óLyŘdzăúℕʎl·f ² l·ăűŜ ¢ℕdzyʅú	¢ŜℕʎI·ÔŜ l ŜtƎKűă	¦yl2y DI·LJ	a2ÈŜŜ	¢2úl·f	.h5	¢{{	b l ₙ
	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(lb/day)	(lb/day)	(lb/day)
нлнл										
Average Annual	111,278	6.98	0.24	0.50	0.54	0.22	y◊пт	31,853	33,178	3,118
Maximum Month		8.37	0.41	0.59	0.64	0.23	10.26	40,421	45,172	4,065
нлнр										
Average Annual	119,913	7.41	0.36	0.54	0.56	0.25	9.11	38,165	40,230	3,845
Maximum Month		8.90	0.62	0.63	0.66	0.27	11.09	50,238	56,468	5,224
нлол										
Average Annual	129,238	7.89	0.48	0.58	0.57	0.28	9.80	44,618	47,424	4,584
Maximum Month		9.47	0.84	0.68	0.68	0.30	11.97	60,210	67,933	6,397
нлор										
Average Annual	139,320	8.42	0.60	0.62	0.59	0.32	10.54	51,229	54,774	5,337
Maximum Month		10.10	1.05	0.73	0.70	0.35	12.92	70,352	79,583	7,583
нлпл										
Average Annual	148,648	8.87	0.72	0.66	0.60	0.37	мм◊но	57,683	61,969	6,077
Maximum Month		10.65	1.26	0.78	0.72	0.40	13.81	80,325	91,049	8,755
. dzʎfŘ2dzú										
Average Annual	-	15.42	0.31	1.06	1.75	0.81	мф◊ор	-	-	-
Maximum Month		-	-	-	-	-	-	-	-	-

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes:

1. Projected Influent Loadings based on 2020 per capita loading rates and projected population tributary to the YRWWTP.

2020, the Yakima Regional WWTP treated 7.21 MGD from the City of Yakima, 0.54 MGD from the City of Union Gap, 0.50 MGD from the community of Terrace Heights, and 0.22 MGD from the City of Moxee.

The design flows used in evaluating the capacity adequacy of the wastewater collection system are summarized in **Table ES.3**. The table lists the maximum day and peak hour flows for the dry weather irrigation season and for the wet weather conditions. The peak dry weather flows during the irrigation season and the peak wet weather flows were estimated at 15.8 MGD and 29.9 MGD, respectively. The PDWF-I and PWWF used for designing the wastewater collection system at buildout of the UGA were estimated at 32.1 MGD and 47.2 MGD, respectively.

Currently, the industrial wastewater trunk serves the Noel Canning & Bottling Company, Seneca Foods Corporation, Jewel Apple Ltd., and the Del Monte Foods fruit processing plant. The industrial waste and loadings do not go through the same headworks as the rest of the domestic wastewater flows, but rather have a separate process at the WWTP.

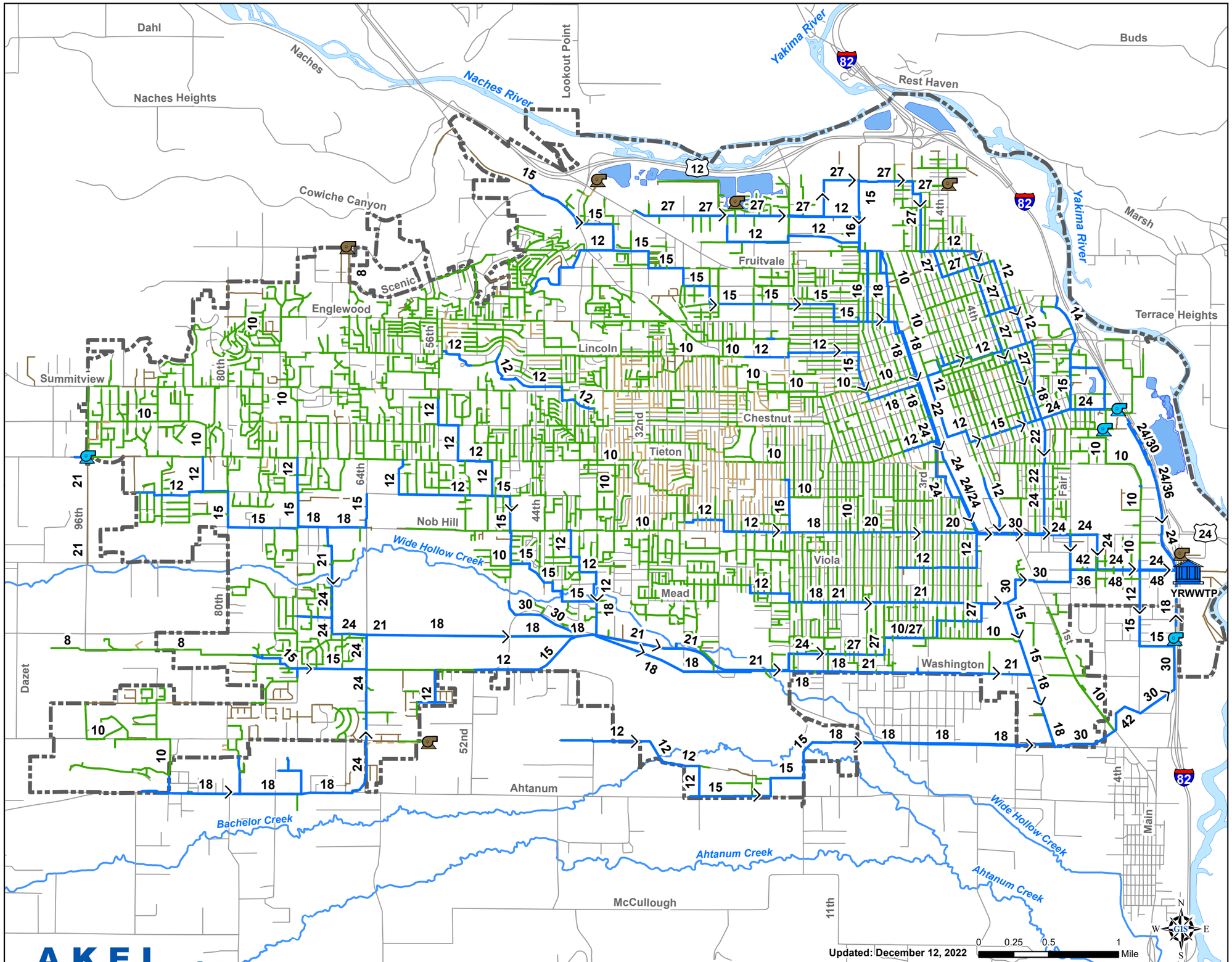
ES.7 HYDRALIC MODEL DEVELOPMENT AND CALIBRATION

The City's hydraulic model combines information on the physical characteristics of the wastewater system (pipelines, lift stations) and operational characteristics (pump curves, set points). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes, including backwater calculations for surcharged conditions.

The City's hydraulic model was initially developed as part of the 2013 Wastewater Collection System Master Plan and most recently updated in 2020 for consistency with the City's latest GIS database. The previous hydraulic model was skeletonized to include pipelines larger than 8 inches. In contrast, the latest hydraulic model includes all pipelines available in the GIS database, as documented in **Table ES.4** and displayed on **Figure ES.4**. The model was populated to include rim elevations at manholes, invert elevations of pipelines, pipe sizes, pipe slopes, pipe lengths, lift station characteristics and pump capacities (curves). The hydraulic modeling software used for evaluating the capacity adequacy of the Yakima wastewater system was InfoSWMM by Innovyze Inc., which utilizes the fully dynamic St. Venant's equation.

Model calibration is an iterative process of comparing the model flows with observations and revising the input parameters until the predicted results are acceptable. This process is intended to instill a level of confidence in the flows that are simulated. The 2020 flow monitoring program captured data at 20 sites during the City's irrigation season.

The calibrated hydraulic model was used as an established benchmark in the capacity evaluation of the existing wastewater collection system. The model was also used to identify improvements necessary for mitigating existing system deficiencies and for accommodating future growth.



Legend

Existing Modeled System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System

- Lift Stations
- Pipes
- Streets
- Yakima City Limits
- Streams
- Lakes

PRELIMINARY

Figure ES.4
Existing Modeled Wastewater System
Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

tw9[LalbǃwˌAKEL ENGINEERING GROUP, INC.

{ǒŜƴl-₦ʎ2 b2¢	5ŜǎǑ₦ʎLJǘʎ2ƴ	Cf2ǿǎ	
		aŀ-Ȅ¢ 5l-è (mgd)	tŜl-ⅼ l 2dz₦ (mgd)
нлнм 9ȄʎǎǘʎƴƎ /2ƴŘʎǘʎ2ƴ {ǒŜƴl-₦ʎ2ǎ			
1	Existing DWF + Irrigation I&I	12.8	15.8
2	Existing WWF (10YR-24HR Design Storm) + Irrigation I&I	17.1	29.9
¦ fǘʎYl-ǘŜ .dzʎfŘ2dzǘ {ǒŜƴl-₦ʎ2ǎ			
3	Buildout DWF + Irrigation I&I	26.2	32.1
4	Buildout WWF (10YR-24HR Design Storm) + Irrigation I&I	30.6	47.2

9/29/2022

Notes:

1. Maximum Day flows are based on max day peaking factors extracted from historical YRWWTP flow data.
2. Peak Hour flows shown are extracted from sewer system hydraulic model and reflect diurnal flow variations and flow attenuation.

Table ES.4 Existing Modeled Pipe Inventory

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Pipe Size (in)	Pipe Length (ft)	(miles)
Gravity Mains		
2"	329	0.1
5"	8,037	1.5
6"	125,599	23.8
8"	1,157,623	219.2
10"	116,697	22.1
12"	99,811	18.9
14"	2,584	0.5
15"	58,756	11.1
16"	5,370	1.0
18"	58,910	11.2
20"	4,552	0.9
21"	20,814	3.9
22"	5,613	1.1
24"	21,008	4.0
27"	32,394	6.1
30"	17,431	3.3
36"	7,441	1.4
42"	2,591	0.5
48"	4,578	0.9
Subtotal	**1,750,138**	**331.5**
Force Mains		
6"	2,511	0.5
18"	2,553	0.5
24"	6,512	1.2
48"	2,054	0.4
Subtotal	**13,630**	**2.6**
Industrial Waste Trunk		
10"	8,008	1.5
18"	6,435	1.2
24"	14,585	2.8
Subtotal	**29,028**	**5.5**
Total	**1,792,796**	**339.5**

AKEL
ENGINEERING GROUP, INC.

12/12/2022

1. Pipeline length extracted from hydraulic model developed by
Akel Engineering Group.

ES.8 CAPACITY EVALUATION

The calibrated hydraulic model was used to evaluate the wastewater collection system for capacity deficiencies during peak dry weather flows for non-irrigation season (PDWF), generally occurring in March, and during the peak dry weather flows for irrigation season (PDWF-I), generally occurring in September. The analysis also documented capacity deficiencies during peak wet weather flows (PWWF), typically occurring in winter months. The criteria used for evaluating the capacity adequacy of the wastewater collection system facilities (gravity mains, force mains, and lift stations) were discussed in Chapter 3 and summarized in **Table ES.1**.

With the exception of few pipe segments, the hydraulic model generally indicates that the wastewater system exhibited adequate performance to service the existing customers during both peak dry weather (irrigation season) and the peak wet weather flows, respectively. This is indicative of a very well planned and maintained wastewater collection system. Future flows were then added to the hydraulic model and the existing system was expanded in order to service future customers outside the current system limits. The proposed improvements for the future system are shown on an overall exhibit on **Figure ES.5**. The master plan also included a capacity evaluation of the following four lift stations: Rudkin Road, Race Street, Sierra Estates, and Beech Street.

ES.9 CONDITION AND RISK ASSESSMENT

Risk assessment and analysis are at the heart of asset management planning and are among the primary tools for identifying and prioritizing renewal and replacement projects with the highest urgency. The results of this process guide optimized decisions on financial planning and are used for choosing where the limited available public funds are more wisely spent.

Risk analysis consists of assessing the probability (or likelihood) of an asset failing and, more importantly, linking it to a consequence if such failure was to occur. This analysis allows the agency to identify existing and future risks that potentially impact the level of customer service and the associated costs. Thus, the risk, also known as the business risk exposure (BRE), is calculated by multiplying the probability or likelihood of failure (LOF) by the consequence of failure (COF).

The probability (or likelihood) of failure analysis allows a prediction of failure timing for a particular asset. Did the asset fail to meet the level of service? Has capacity become inadequate? How is the structural condition? Is the lifecycle cost efficient? A numerical LOF score is assigned to each asset based on this assessment.

The consequence of failure analysis assesses the impact of such failure on the residential or commercial environment, and the resulting anticipated economic loss.

Detail A

Detail B

Detail C

Detail D

Galloway
Lookout Point
Southern
Dahl
Naches River
Naches
Yakima River
Buds
Rest Haven
Naches Heights
Cowiche Canyon
Scenic
Englewood
Summitview
Fruitvale
Lincoln
Chestnut
Tieton
Marsh
Terrace Heights
Keyes
Nob Hill
Wide Hollow Creek
Mead
Viola
Washington
YRWWTP
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
Main
80th
64th
56th
44th
32nd
3rd
1st
4th
11th
52nd
96th
Fair

Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure ES.5
Capacity Improvements
Wastewater Collection System
Master Plan
City of Yakima

Updated: December 21, 2022

0 0.25 0.5 1 Mile

N W GIS E S

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-3_CapImp_122122.mxd

A total of five categories were used to assign numerical scores to each COF and LOF category. The five rating categories include Extreme, High, Moderate, Low, and Very Low. High scores are associated with the Extreme and High rating categories and represent at-risk assets that require immediate attention. Low scores are associated with the Very Low and Low rating categories and may represent new or low-risk assets.

The Risk Assessment Scoring and Action Plan matrix on **Figure ES.6** illustrates how pipelines are classified in the Extreme rating category (red) or High rating category (orange), by combining their LOF and COF scores. The red and orange zone on **Figure ES.6** indicate assets that require immediate attention for renewal or replacement. The yellow zone highlights assets requiring more aggressive monitoring. The green and blue zones require simple monitoring.

ES.10 CAPITAL IMPROVEMENT PROGRAM

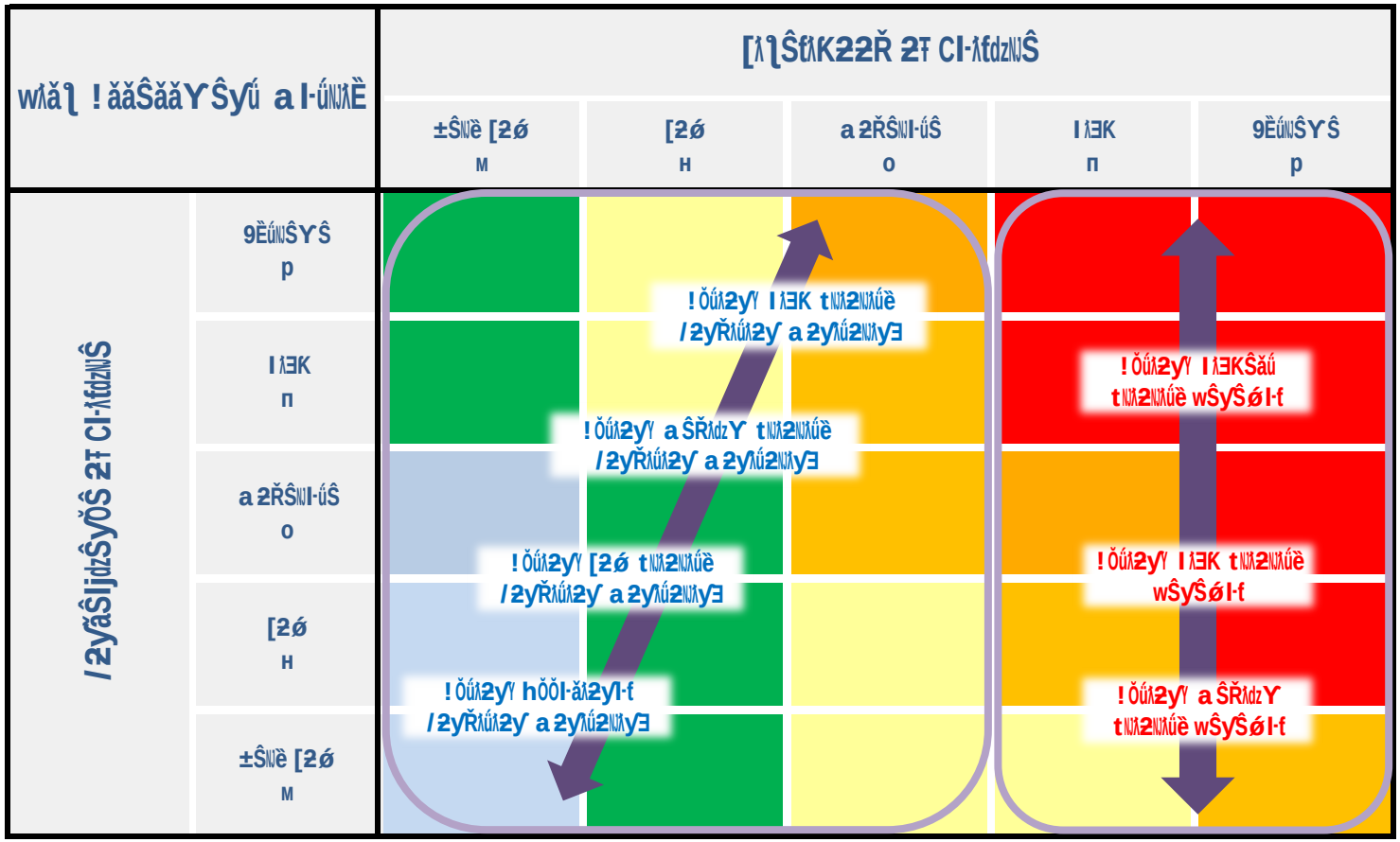
The CIP costs for the projects identified in this master plan for mitigating existing deficiencies and for servicing anticipated future growth throughout the City are summarized in **Table ES.5**. The CIP lists the type of improvement, location, cost, construction triggers, suggested phasing, and cost sharing.

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore construction contingencies were used. The estimated construction costs in this master plan include a **30-percent** contingency allowance to account for unforeseen events and unknown field conditions.

The capital improvement costs also account for project-related costs , comprising of engineering design, project administration (developer and City staff), construction management and inspection, and legal costs. The project related costs in this master plan were estimated by applying an additional **30-percent** to the estimated construction costs.

The capacity improvements are identified and categorized based on their urgency to mitigate existing deficiencies and to serve future growth. The construction triggers for each improvement are described as follows:

- **Improvements to Mitigate Existing System Deficiencies:** These are considered near-term improvements and are intended to mitigate existing capacity deficiencies. This master plan recommends these improvements be scheduled for construction as soon as possible and as fiscal budgets permit.
- **Improvements to Mitigate Future System Deficiencies:** These are intermediate-term and long-term improvements intended to service future developments within the UGA. This master plan included construction triggers, expressed in equivalent dwelling units (EDUs). This trigger is based on remaining capacity in the existing facility planned for future improvement. The remaining capacity is converted to EDUs assuming 190 gpd/EDU.



[9D9b5

tw9[ʟaʟb!w¸

Risk Color Coding

Extreme	High	Moderate	Low	Very Low

Renewal Actions Levels

Highest Priority	High Priority	Medium Priority

Condition Monitoring Levels

High Priority	Medium Priority	Low Priority	Occasional

July 6, 2022

CʌƎdzNJŜ ES.6

wʌǎ] !ǎǎŜǎǎYŜyǘ {ǑŁNJʌyƎ l-yŘ !ǑúʌŁy˙ tfl-y˙

Wastewater Collection System
Master Plan
City of Yakima

¢ŀōƉŜ ES.5 /ŀLJƛǘŀƒ LYLNRØŜYŜyǘ tNRƺNJŀ·Y
Wastewater Collection System Master Plan
City of Yakima

LYLNRØŜYŜyǘ b2ǿ	¢ǿLJŜ 2ŦLYLNRØŜYŜyǘ	{ǘNRŜŜǘ !ŧƛyYŜyǘ	tNRǿŜǘ [ƛYƛǘă	9ĚƛăǘƛyƺtƛLJŜ 5ƛŀ·YŜǘŜNJ	tƛLJŜƛyŜ LYLNRØŜYŜyǘă				LyŧNJŀ·ǘNJdzŎǘdzNJŜ /2ăǘă			/2yǘNJdzŎǘƛ2y ¢NJƛƺƺŜNJă	CdzyŘƛyƺ {2dzNJŎŜ	/ŀLJŀŎƛǘȅ !ŦŦ2ŘŀǘƛŦ2y			
					bŜǿ κ tŀNJŀƭƭŜƭ κ wŜLJƭŀŎŜ	5ƛŀ·YŜǘŜNJ	[Ŝyƺǘƙ	¦yƛǘ /2ăǘ	.ŀăŜƭƛyŜ /2yăǘNJdzŎǘƛ2y /2ăǘ	9ăǘƛYŀǘŜŘ /2yăǘNJdzŎǘƛ2y /2ăǘ	/ŀLJƛǘŀƒ LYLNRØƛ /2ăǘ			҉ .ŜyŜŦƛǘ		/2ăǘ {KŀNJƛyƺ	
														9ĚƛăǘƛyƺCdzǘdzNJŜ	Cdzǘdzre	9Ěƛăǘƛyƺ	CdzǘdzNJŜ
				(in)		(in)	(ft)	($/Unit)	($)	($)	($)	(EDUs)					
² ŀăKƛyƺǘ2y !ØŜydzŜ .ŀăƛy LYLNRØŜYŜyǘă																	
cnǘK !ØŜydzŜk!Kǘŀ-ydzY ¢ǿdzyʅ																	
² !πм	Gravity Main	Gilbert Road	From Hackett Rd to approx. 1,335 ft w/o Hackett Rd	-	New	12	1,350	293	395,000	514,000	668,000	Construct with Development in Wiley area	Other	0%	100%	0	668,000
² !πн	Gravity Main	Gilbert Road	From approx. 1,335 ft w/o Hackett Rd to Wiley Rd	-	New	15	1,350	308	416,000	541,000	703,000	Construct with Development in Wiley area	Other	0%	100%	0	703,000
² !πo	Gravity Main	Wiley Road	From Gilbert Rd to Ahtanum Rd	-	New	15	1,650	308	508,000	660,000	858,000	Construct with Development in Wiley area	Other	0%	100%	0	858,000
² !ππ	Gravity Main	Ahtanum Road	From Wiley Rd to approx. 1,300 ft w/o 90th Ave	-	New	15	4,150	308	1,277,000	1,660,000	2,158,000	Construct with Development in Wiley area	Other	0%	100%	0	2,158,000
² !πр	Gravity Main	Ahtanum Road	From approx. 1,300 ft w/o 90th Ave to approx. 225 ft e/o 90th Ave	-	New	15	1,500	308	462,000	601,000	781,000	Construct with Development in Wiley area	Other	0%	100%	0	781,000
							{ǳōǘ2ǘŀƒ π cnǘK !ØŜydzŜk!Kǘŀ-ydzY ¢ǿdzyʅ		**оĭпруĭллл**	**оĭфтсĭллл**	**рĭмсуĭллл**					**л**	**рĭмсуĭллл**
² ƛŘŜ I2ŦŦ2ǿ ¢ǿdzyʅ																	
² !πу	Gravity Main	Summitview Road	From 1550ft se/o 112th Ave to 102nd Ave	-	New	8	2,050	264	540,000	702,000	913,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	913,000
² !πф	Gravity Main	Summitview Road	From 102nd Ave to Pear Ave	-	New	12	1,450	293	424,000	551,000	716,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	716,000
² !πмл	Gravity Main	Pear Avenue	From Summitview Ave to Orchard Ave	-	New	12	1,300	293	380,000	494,000	642,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	642,000
² !πмм	Gravity Main	Orchard Avenue	From approx. 1,275 ft w/o Hennessy Rd to Hennessy Rd	-	New	10	1,300	286	371,000	482,000	627,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	627,000
² !πмн	Gravity Main	Orchard Avenue	From Hennessy Rd to Pear Ave	-	New	12	1,300	293	380,000	494,000	642,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	642,000
² !πмо	Gravity Main	Pear Avenue	From Orchard Ave to Tieton Dr	-	New	15	1,350	308	416,000	541,000	703,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	703,000
² !πмп	Gravity Main	Tieton Drive	From Pear Ave to approx. 490 ft w/o 96th Ave	-	New	15	800	308	246,000	320,000	416,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	416,000
² !πмр	Gravity Main	96th Avenue	From 1350ft s/o Wide Hollow Rd to Wide Hollow Rd	-	New	10	1,350	286	386,000	502,000	653,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	653,000
² !πмс	Gravity Main	Wide Hollow Rd/Viola Ave/Borley Wy	From 96th Ave to 67th Ave	-	New	24	9,250	374	3,460,000	4,498,000	5,847,000	Construct with Wide Hollow Sewer Extension Project	City	0%	100%	0	5,847,000
² !πмт	Gravity Main	Through field between Nob Hill Blvd and Washington Ave	From 67th Ave to 48th Ave	-	New	24	8,000	374	2,992,000	3,890,000	5,057,000	Construct with Wide Hollow Sewer Extension Project or with 9000 EDUs tributary to Washington Ave and 40th Ave	City	0%	100%	0	5,057,000
[{πм	Lift Station	Summitview Road	102nd Ave	-	New		3 @ 75 gpm		837,000	1,088,000	1,414,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	1,414,000
² !πрс	Gravity Main	Wide Hollow Rd/1-th Ave/Estes Rd/Hennessy Rd	From Midvale Rd to 96th Ave	-	New	8	5,300	264	1,397,000	1,816,000	2,361,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	2,361,000
							{ǳōǘ2ǘŀƒ π ² ƛŘŜ I2ŦŦ2ǿ ¢ǿdzyʅ		**ммĭунфĭллл**	**мрĭотуĭллл**	**мфĭффмĭллл**					**л**	**мфĭффмĭллл**
стǘK !ØŜydzŜ {ǳōπ¢ǿdzyʅ																	
² !πму	Gravity Main	Scenic Drive	From 84th Ave Ext to 80th Ave	-	New	8	1,300	264	343,000	446,000	580,000	Construct with new development / septic conversion	Other	0%	100%	0	580,000
² !πмф	Gravity Main	80th Avenue	From Vista Parkway to Englewood Ave	-	New	8	900	264	237,000	308,000	400,000	Construct with new development / septic conversion	Other	0%	100%	0	400,000
							{ǳōǘ2ǘŀƒ π стǘK !ØŜydzŜ {ǳōπ¢ǿdzyʅ		**рулĭллл**	**трпĭллл**	**фулĭллл**					**л**	**фулĭллл**
² ŀăKƛyƺǘ2y !ØŜydzŜ ¢ǿdzyʅ																	
² !πнл	Gravity Main	Washington Avenue	From approx. 50 ft w/o 40th Ave to approx. 530 ft e/o 40th Ave	18	Parallel	24	600	374	224,000	291,000	378,000	Construct with 9,000 EDUs	City	0%	100%	0	378,000
² !πнм	Gravity Main	Washington Avenue	From approx. 530 ft e/o 40th Ave to approx. 690 ft w/o 36th Ave	18	Parallel	24	150	374	56,000	73,000	95,000	Construct with 1,800 EDUs	City	0%	100%	0	95,000
² !πнн	Gravity Main	Washington Avenue	From approx. 690 ft w/o 36th Ave to approx. 155 ft e/o 36th Ave	21	Parallel	30	900	508	457,000	594,000	772,000	Construct with 1,800 EDUs	City	0%	100%	0	772,000
² !πно	Gravity Main	Washington Avenue	From approx. 155 ft e/o 36th Ave to approx. 75 ft w/o 31st Ave	21	Parallel	30	1,350	508	686,000	892,000	1,160,000	Construct with 9,000 EDUs	City	0%	100%	0	1,160,000
² !πнп	Gravity Main	Washington Avenue	From approx. 75 ft w/o 31st Ave to approx. 205 ft w/o 28th Ave	21	Parallel	30	450	508	229,000	298,000	387,000	Construct with 9,000 EDUs	City	0%	100%	0	387,000
² !πнр	Gravity Main	Washington Avenue	From approx. 205 ft w/o 28th Ave to approx. 175 ft e/o 28th Ave	21	Parallel	30	400	508	203,000	264,000	343,000	Construct with 9,000 EDUs	City	0%	100%	0	343,000
² !πнс	Gravity Main	Washington Avenue	From approx. 175 ft e/o 28th Ave to approx. 280 ft w/o 27th Ave	21	Parallel	30	100	508	51,000	66,000	86,000	Construct with 9,000 EDUs	City	0%	100%	0	86,000
² !πнт	Gravity Main	Washington Avenue	From approx. 280 ft w/o 27th Ave to 27th Ave	21	Parallel	30	300	508	152,000	198,000	257,000	Construct with 9,000 EDUs	City	0%	100%	0	257,000
² !πну	Gravity Main	Washington Avenue	From 27th Ave to approx. 210 ft w/o 24th Ave	21	Parallel	30	1,300	508	660,000	858,000	1,115,000	Construct with 9,000 EDUs	City	0%	100%	0	1,115,000
² !πнф	Gravity Main	Washington Avenue	From approx. 210 ft w/o 24th Ave to 24th Ave	21	Parallel	30	250	508	127,000	165,000	215,000	Construct with 9,000 EDUs	City	0%	100%	0	215,000
² !πол	Gravity Main	Washington Avenue	From 24th Ave to approx. 200 ft w/o 24th Ave	21	Parallel	30	250	508	127,000	165,000	215,000	Construct with 9,000 EDUs	City	0%	100%	0	215,000
² !πом	Gravity Main	Washington Avenue	From approx. 200 ft w/o 24th Ave to approx. 780 ft w/o 16th Ave	21	Parallel	30	1,750	508	889,000	1,156,000	1,503,000	Construct with 9,000 EDUs	City	0%	100%	0	1,503,000

[illegible] ES.5 [illegible]

Wastewater Collection System Master Plan
City of Yakima

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]			[illegible]	[illegible]	[illegible]			
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]		[illegible]	
														[illegible]	[illegible]	[illegible]	[illegible]
				(in)		(in)	(ft)	($/Unit)	($)	($)	($)	(EDUs)					
[illegible]	Gravity Main	Washington Avenue	From approx. 780 ft w/o 16th Ave to approx. 675 ft w/o 16th Ave	21	Parallel	30	100	508	51,000	66,000	86,000	Construct with 3,600 EDUs	City	0%	100%	0	86,000
[illegible]	Gravity Main	Washington Avenue	From approx. 675 ft w/o 16th Ave to approx. 400 ft w/o 16th Ave	21	Parallel	30	300	508	152,000	198,000	257,000	Construct with 3,600 EDUs	City	0%	100%	0	257,000
[illegible]	Gravity Main	Washington Avenue	From approx. 400 ft w/o 16th Ave to 16th Ave	24	Parallel	30	350	508	178,000	231,000	300,000	Construct with 3,600 EDUs	City	0%	100%	0	300,000
[illegible]	Gravity Main	16th Avenue	From Washington Ave to Spokane St	24	Parallel	30	650	508	330,000	429,000	558,000	Construct with 3,600 EDUs	City	0%	100%	0	558,000
[illegible]	Gravity Main	Spokane Street	From 16th Ave to 15th Ave	24	Parallel	30	400	508	203,000	264,000	343,000	Construct with 3,600 EDUs	City	0%	100%	0	343,000
[illegible]	Gravity Main	Spokane Street	From 15th Ave to Pleasant Ave	24	Parallel	30	1,650	508	838,000	1,089,000	1,416,000	Construct with 3,600 EDUs	City	0%	100%	0	1,416,000
[illegible]	Gravity Main	Spokane Street	From Pleasant Ave to 7th St	27	Parallel	30	1,700	508	864,000	1,123,000	1,460,000	Construct with 3,600 EDUs	City	0%	100%	0	1,460,000
[illegible]	Gravity Main	7th Avenue	From Spokane St to Pierce St	27	Parallel	30	650	508	330,000	429,000	558,000	Construct with 10,000 EDUs	City	0%	100%	0	558,000
[illegible]	Gravity Main	Pierce Street	From 7th Ave to approx. 160 ft w/o 6th Ave	27	Parallel	36	500	631	315,000	410,000	533,000	Construct with 10,000 EDUs	City	0%	100%	0.00	533,000.00
[illegible]	Gravity Main	Pierce Street	From approx. 160 ft w/o 6th Ave to 2nd Ave	27	Parallel	36	1,500	631	946,000	1,230,000	1,599,000	Construct with 2,300 EDUs	City	0%	100%	0.00	1,599,000.00
[illegible]	Gravity Main	2nd Avenue	From Pierce St to approx. 345 ft n/o Pierce St	27	Parallel	36	300	631	189,000	246,000	320,000	Construct with 2,300 EDUs	City	0%	100%	0.00	320,000.00
[illegible]	Gravity Main	2nd Avenue	From approx. 345 ft n/o Pierce St to King St	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
[illegible]	Gravity Main	King Street	From 2nd Ave to Voelker Ave	27	Parallel	36	1,750	631	1,104,000	1,435,000	1,866,000	Construct with 2,300 EDUs	City	0%	100%	0.00	1,866,000.00
[illegible]	Gravity Main	Voelker Ave	From King St to approx. 210 ft n/o Baldie Wy	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
[illegible]	Gravity Main	Voelker Ave	From approx. 210 ft n/o Baldie Wy to Mead Ave	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
[illegible]	Gravity Main	Mead Avenue	From Voelker Ave to approx. 375 ft e/o Presson Ln	27	Parallel	36	650	631	410,000	533,000	693,000	Construct with 2,300 EDUs	City	0%	100%	0.00	693,000.00
[illegible]	Gravity Main	Mead Avenue	From approx. 375 ft e/o Presson Ln to approx. 715 ft e/o Presson Ln	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
[illegible]	Gravity Main	City Right of Way	From Mead Ave to approx. 220 ft n/o Mead Ave	30	Parallel	36	400	631	252,000	328,000	426,000	Construct with 10,000 EDUs	City	0%	100%	0.00	426,000.00
[illegible]	Gravity Main	City Right of Way	From approx. 220 ft n/o Mead Ave to Tennant Ln	30	Parallel	36	750	631	473,000	615,000	800,000	Construct with 3,600 EDUs	City	0%	100%	0.00	800,000.00
[illegible]	Gravity Main	Tennant Lane	From approx. 760 ft w/o 1st St to 1st St	30	Parallel	36	800	631	505,000	657,000	854,000	Construct with 3,600 EDUs	City	0%	100%	0.00	854,000.00
[illegible]	Gravity Main	Tennant Lane	From 1st St to Fair Ave	30	Parallel	36	1,350	631	852,000	1,108,000	1,440,000	Construct with 10,000 EDUs	City	0%	100%	0.00	1,440,000.00
[illegible]	Gravity Main	Fair Ave	From Tennant Ln to Viola Ave	30	Parallel	36	450	631	284,000	369,000	480,000	Construct with 10,000 EDUs	City	0%	100%	0.00	480,000.00
[illegible]	Gravity Main	Viola Avenue	From Fair Ave to 12th Ave	36	Parallel	36	650	631	410,000	533,000	693,000	Construct with 10,000 EDUs	City	0%	100%	0.00	693,000.00
						[illegible]			[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
[illegible]																	
[illegible]	Gravity Main	Fremont Way Extension	From 76th Ave to 86th Ave	-	New	12	2,915	293	853,000	1,109,000	1,442,000	Construct with Development in West Valley area	City	0%	100%	0	1,442,000
						[illegible]			[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
[illegible]																	
[illegible]																	
[illegible]	Gravity Main	Cowiche Canyon Road	From 78th Ave to Prospect Wy	-	New	12	4,800	293	1,405,000	1,827,000	2,375,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	23,750	2,351,250
[illegible]	Gravity Main	Vertner Road	From 80th Ave to 66th Ave	-	New	12	4,600	293	1,346,000	1,750,000	2,275,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	22,750	2,252,250
[illegible]	Gravity Main	Prospect Way	From 66th Ave to Cowiche Canyon Rd	-	New	12	2,650	293	775,000	1,008,000	1,310,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	13,100	1,296,900
[illegible]	Gravity Main	Cowiche Canyon Road	From Prospect Wy to approx. 1,225 ft sw/o Powerhouse Rd	-	New	12	3,800	293	1,112,000	1,446,000	1,880,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	18,800	1,861,200
[illegible]	Gravity Main	Powerhouse Road	From Cowiche Canyon Rd to City Reservoir Rd	-	New	12	1,075	293	315,000	410,000	533,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	5,330	527,670
						[illegible]			[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
[illegible]																	
[illegible]	Gravity Main	Jerome Ave, Custer Ave, Cherry Ave	From 18th Ave to 6th Ave	15	Replace	18	3,950	331	1,309,000	1,702,000	2,213,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	22,130	2,190,870
						[illegible]			[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
[illegible]																	

Table ES.5 Capital Improvement Program

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	Existing Pipe Diameter	Pipeline Improvements				Infrastructure Costs			Construction Triggers	Funding Source	Capacity Allocation			
					New/Parallel /Replace	Diameter	Length	Unit Costs	Baseline Constr. Costs	Estimated Constr. Costs	Capital Improv. Costs			% Benefit		Cost Sharing	
														Existing	Future	Existing	Future
				(in)		(in)	(ft)	($/Unit)	($)	($)	($)	(EDUs)					
North Fair Avenue Trunk																	
FA-1	Gravity Main	4th Street	From 4th St (Tamarack Lift Station) to Erickson Lane	-	New	8	1,200	264	316,000	411,000	534,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	32,040	501,960
FA-2	Gravity Main	Erickson Lane	From 4th Street Avenue to I-82	-	New	8	2,825	264	745,000	969,000	1,260,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	75,600	1,184,400
FA-3	Gravity Main	I-82 Ramp EB ROW	From approx. 170 ft n/o Q Street to Erickson Lane	-	New	8	2,175	264	573,000	745,000	969,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	58,140	910,860
FA-4	Gravity Main	I-82 Ramp EB ROW	From Erickson Lane to D Street	-	New	12	2,825	293	827,000	1,075,000	1,398,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	83,880	1,314,120
FA-5	Gravity Main	I-82 Ramp EB ROW	From D St to Lincoln Ave	-	New	12	475	293	139,000	181,000	235,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	14,100	220,900
FA-6	Gravity Main	I-82 Ramp EB ROW	From Lincoln Ave to approx. 75 ft se/o Lincoln Ave	-	New	12	125	293	37,000	48,000	62,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	3,720	58,280
FA-7	Gravity Main	Future Bravo Co. Boulevard	From 8th Street to BNSF Railroad	-	New	8	1,075	264	283,000	368,000	478,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	478,000
FA-8	Gravity Main	Future Bravo Co. Boulevard	From BNSF Railroad to E Street	-	New	8	525	264	138,000	179,000	233,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	233,000
FA-9	Gravity Main	Future Bravo Co. Boulevard	From E St to D St	-	New	8	1,000	264	264,000	343,000	446,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	446,000
FA-10	Gravity Main	D Street	From Future Bravo Co. Boulevard to 950 ft e/o 10th Street	-	New	8	950	264	250,000	325,000	423,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	423,000
								Subtotal - North Fair Avenue Trunk	**3,572,000**	**4,644,000**	**6,038,000**					**267,480**	**5,770,520**
Beech Street Trunk																	
FA-11	Gravity Main	15th Street	From Race St Lift Station to Beech St (Reverse Grade)	-	New	12	1,325	293	388,000	504,000	655,000	Construct for the de-commission of Race Street Lift Station	City	0%	100%	0	655,000
								Subtotal - Beech Street Trunk	**388,000**	**504,000**	**655,000**					**0**	**655,000**
River Road Trunk																	
2A-6	Gravity Main	Clover Lane	From Ackley Rd to River Rd	-	New	27	8,150	432	3,521,000	4,577,000	5,950,000	Construct with Gleed Census-Designated-Place Sewer Extension Project	Other	0%	100%	0	5,950,000
								Subtotal - River Road Trunk	**3,521,000**	**4,577,000**	**5,950,000**					**0**	**5,950,000**
Rudkin Road Basin Improvements																	
Longfibre Road Trunk																	
WA-55	Gravity Main	Pierce Street	From approx. 175 ft w/o Ledwich Ave to approx. 85 ft e/o Longfibre Rd	8	Replace	12	2,000	293	585,000	761,000	989,000	Construct with 117 EDUs	City	0%	100%	0	989,000
								Subtotal - Longfibre Road Trunk	**585,000**	**761,000**	**989,000**					**0**	**989,000**
Rudkin Road Trunk																	
WA-6	Gravity Main	Occidental Road Extension	From 59th Ave to 52nd Ave	-	New	12	2,150	293	629,000	818,000	1,063,000	Construct with development / septic conversion	Other	0%	100%	0	1,063,000
WA-7	Gravity Main	Occidental Road Extension	From 52nd Avenue to approx. 235 ft w/o 47th Ave	-	New	12	1,300	293	380,000	494,000	642,000	Construct with development / septic conversion	Other	0%	100%	0	642,000
RR-1	Gravity Main	Sorenson Road	From approx. 235 ft w/o 47th Ave to 38 Ave	-	New	12	3,250	293	951,000	1,236,000	1,607,000	Construct with Development in Sozo Development Area and or septic conversion of southern lots	Other	0%	100%	0	1,607,000
RR-2	Gravity Main	Rainier Place / Rudkin Road	From South 18th Street to Rudkin Road Lift Station	30	Replace	42	3,200	936	2,995,000	3,894,000	5,062,000	Construct with 4,065 EDUs	City	0%	100%	0	5,062,000
LS-2	Lift Station	Rudkin Road		-	Replace	Replace lower capacity pumps with 2 @ 1,850 gpm Increase firm capacity by 1,300 gpm			4,491,000	5,838,000	7,589,000	Construct with 4,065 EDUs	City	0%	100%	0	7,589,000
								Subtotal - Rudkin Road Trunk	**9,446,000**	**12,280,000**	**15,963,000**					**0**	**15,963,000**
Terrace Heights Improvements																	
Terrace Heights Industrial Waste Trunk																	
TH-1	Force Main	WSDOT WA-24 / YRWWTP	From Riverside Road to YRWWTP	-	New	12	2,800	293	819,000	1,065,000	1,385,000	Construct in tandem with construction of Terrace Heights Industrial Waste Lift Station	Other	0%	100%	0	1,385,000
								Subtotal - Terrace Heights Industrial Waste Trunk	**819,000**	**1,065,000**	**1,385,000**					**0**	**1,385,000**
								Gravity Main Improvement Costs	**48,197,000**	**62,661,000**	**81,459,000**					**373,340**	**81,085,660**
								Force Main Improvement Costs	**819,000**	**1,065,000**	**1,385,000**					**0**	**1,385,000**
								Lift Station Improvement Costs	**5,328,000**	**6,926,000**	**9,003,000**					**0**	**9,003,000**
								Total Improvement Costs	**54,344,000**	**70,652,000**	**91,847,000**					**373,340**	**91,473,660**

AKEL ENGINEERING GROUP, INC.

Notes:

1. Unit Costs are based on the January 2023 20-City ENR CCI of 13,175.
2. Baseline construction costs plus 30-percent to account for unforseen events and unknown conditions.
3. Esimated construction costs plus 30-percent to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs.

1/30/2023

These triggers identify the equivalent number of residential single-family units that can be served by the existing collection system prior to requiring upsizing or parallel relief. Other triggers are associated with specific developments or projects that may alter the routing of sewer flows within the collection system.

- **As Development Occurs:** New infrastructure required to serve future growth to be constructed on an as-needed basis as development occurs.

The costs in this Wastewater Collection System Master Plan were benchmarked using a 20-City national average ENR CCI of 13,175, reflecting a date of January 2023. In total, the domestic wastewater CIP includes approximately 25 miles of pipeline improvements 1 new lift station, and 1 lift station upgrade that will expand the capacity of the existing domestic wastewater collection system, with a project cost totaling over $90.8 million dollars.

CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the City of Yakima's wastewater collection system, the need for this master plan, and the objectives of the study.

1.1 BACKGROUND AND OBJECTIVE

The City of Yakima is located approximately 60 miles southeast of Mount Rainier in Washington. The City is generally bound to the north by the City of Selah, to the east by the unincorporated community of Terrace Heights, to the south by the City of Union Gap, and to the west by the unincorporated area of West Valley (**Figure 1.1**). The City provides wastewater collection services to approximately 29,300 residential, commercial, industrial, and institutional sewer accounts.

The City owns, operates, and maintains the wastewater collection system, which consists of over 339 miles of gravity trunks and force mains, with up to 48-inch pipe sizes, which convey flow to the Yakima Regional Wastewater Treatment Plant (YRWWTP). The City also owns, operates, and maintains approximately 6 miles of industrial sewer trunk that collects flows from industrial processes in the City and conveys them to the YRWWTP.

The YRWWTP provides wastewater treatment capacity for the Cities of Yakima, Union Gap, Moxee, and the unincorporated areas of Terrace Heights. The YRWWTP is a secondary treatment facility with a design capacity of 21.5 million gallons per day (MGD), with a daily average treatment of approximately 7.2 mgd.

Recognizing the importance of planning, developing, and financing system facilities to provide reliable wastewater collection service to existing customers and for servicing anticipated growth within the City's Urban Growth Area (UGA), the City initiated this Wastewater Collection System Master Plan (WWCSMP) Update. The WWCSMP also includes a checklist that cross references the requirements of the General Sewer Plan, as stipulated in the Washington State Legislature WAC 173-240-050.

1.2 SCOPE OF WORK

City Council approved Akel Engineering Group to prepare this 2023 WWCSMP Update and a concurrent Stormwater Collection System Master Plan (SWCSMP) Update in January 2020. The 2023 WWCSMP evaluates the City's wastewater collection system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the City. This 2023 WWCSMP is intended to serve as a tool for planning and phasing the construction of future wastewater collection system infrastructure for the projected buildout of the

Naches

Selah

Yakima

Terrace Hights

Moxee

West Valley

Union Gap

Naches River

Yakima River

12

82

97

24

Pacific Ocean

Washington

Yakima

Oregon

Idaho

Legend

- Study Area
- Moxee
- Naches
- Selah
- Terrace Heights
- Union Gap
- Moxee Annexation Area
- Major Highways
- Streams
- Rivers
- Lakes

Updated: October 1, 2020

0 0.5 1 2 Miles

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig1-1_RLM_100120.mxd

PRELIMINARY

Figure 1.1
Regional Location Map
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

City's service area. The area and horizon for this master plan is based on the Yakima Urban Area Comprehensive Plan 2040 (2040 YUACP). Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan included the following tasks:

- Summarize the City's existing wastewater collection system facilities.
- Document growth planning assumptions and known future developments.
- Summarize the wastewater system performance criteria and design storm event.
- Project future wastewater flows.
- Update and validate the City's hydraulic model based on the City's Geographic Information Systems (GIS).
- Evaluate the capacity adequacy of the wastewater collection facilities to meet existing and projected peak dry weather flows, and peak wet weather flows during the irrigation season.
- Review flow monitoring data and identify areas with high infiltration and inflow (I&I) rates.
- Develop a pipeline risk and condition assessment
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.
- Perform a capacity allocation analysis for cost sharing purposes.
- Develop a 2023 Wastewater Collection System Master Plan Report.

1.3 PREVIOUS MASTER PLANS

The City's most recent wastewater collection system master plan was completed in 2013. This master plan evaluated the wastewater collection system with existing and projected future flows from the planning area and recommended phased improvements to the collection system for a horizon year of 2040. Additionally, the 2013 WWCSMP included the development of the hydraulic model which was used for evaluating the existing system. Improvements were recommended for servicing existing and future growth area, and a corresponding Capital Improvement Program was developed to quantify the corresponding costs.

1.4 RELEVANT REPORTS

These reports were referenced and used in this Master Plan. The following list summarizes relevant reports that were used in the completion of this master planning effort, with a brief description of each document:

- 2013 Wastewater Collection System Master Plan, October 2013 (2013 WWCSMP). This plan issued by Akel Engineering Group, Inc (Akel) documents the wastewater collection system planning and performance criteria; evaluates the collection system under existing and future conditions; and recommends a capital improvement program with an opinion of probable construction cost. This plan provides general guidance for funding, maintenance and operation, implementation of wastewater capital improvements projects up to the 2025 planning horizon.

- Yakima Urban Area Comprehensive Plan 2040, June 2017 (2040 YUACP). This plan was originally drafted by the City of Yakima in 1997, subsequently updated in 2006 and most recently adopted in 2017 to reflect service area changes. This plan sets policies and goals for the development of the Yakima Urban areas up to the 2040 planning horizon.

- Terrace Heights General Sewer Plan Amendment 2005. This plan is intended as a subarea plan for the original YUACP. This plan sets policies and goals for the development of the Terrace Heights Area.

- City of Moxee General Sewer Plan, 2020. The City of Moxee 2020 General Sewer Plan documents the wastewater collection system planning area, evaluates the collection system under existing and future conditions, and recommends a capital improvement program. This plan provides general guidance for operation and implementation of wastewater capital improvements projects up to the 2038 planning horizon.

- City of Union Gap General Sewer Plan, April 2013. The City of Moxee 2013 General Sewer Plan documents the wastewater collection system planning area, evaluates the collection system under existing and future conditions, and recommends a Capital Improvement Program. This plan provides general guidance for operation and implementation of wastewater capital improvements projects up to the 2029 planning horizon.

- Criteria for Sewage Works Design (CSWD), Water Quality Program, August 2009. This report issued by the Washington State Department of Ecology is a guide for the design of sewage collection, treatment, and water reclamation systems. This report also includes a checklist of compliance items required to prepare a General Sewer Plan. (Section G1-3.2).

- Yakima County Regional Stormwater Manual, January 2010 (2010 YCS Manual)**.** This document updates the requirements of the 2004 SWMMEW for hydrologic and hydraulic design criteria, site planning and pollution prevention, runoff treatment design, and flow control and source control measures to meet the regional needs and specifications of Yakima County. The 2010 Yakima County Regional Stormwater Manual included several relevant exhibits that were included in this report and sourced accordingly.

- The Yakima Basalt and Ellensburg Formation of South-Central Washington, 1966 (1966 YBEF). This report was created by the United States Department of the Interior, in conjunction with the Washington State Department of Conservation Division of Water Resources to define the geologic history of the Yakima Basalt and Ellensburg Formation.

- 2013 Stormwater Collection System Master Plan, April 2013 (2013 SWCSMP). This plan issued by Akel documents the stormwater planning and performance criteria; evaluates the stormwater collection system; recommends improvements to address system deficiencies and provides an estimate of capital costs. This plan provides general guidance for funding, maintenance and operation, and implementation of wastewater capital improvements projects.

1.5 REPORT ORGANIZATION

The Wastewater Collection System Master Plan report contains the following chapters:

Chapter 1 – Introduction. This chapter provides a brief background of the City of Yakima's wastewater collection system, the need for this master plan, and the objectives of the study.

Chapter 2 – Planning Area Characteristics. This chapter presents a discussion of the planning area characteristics, soil and topography, floodplains, climate, land use, and brief descriptions of the City's stormwater system, water system, and irrigation system.

Chapter 3 – System Performance and Design Criteria. This chapter presents the City's performance and design criteria which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed collection mains and lift stations.

Chapter 4 – Existing Wastewater Collection Facilities. This chapter provides a description of the City's existing wastewater collection system facilities including the gravity trunks, force mains, lift stations, and sewer basins. The chapter also includes a brief description of the Yakima Regional Wastewater Treatment Plant.

Chapter 5 – Existing and Projected Wastewater Characteristics. This chapter summarizes historical wastewater flows and loadings experienced at the Yakima Regional WWTP and defines flow terminologies relevant to this evaluation. This chapter discusses the existing wastewater flow distribution within each collection basin, and identifies the design flows used in the hydraulic modeling effort and capacity evaluation. This chapter also projects flows and loadings for the Yakima Regional WWTP in 5 year increments to year 2040.

Chapter 6 – Hydraulic Model Development. This chapter describes the development and calibration of the City's wastewater system hydraulic model. Hydraulic network analysis has become an effectively powerful tool in all aspects of wastewater system planning, design, operation, management, and system reliability analysis. The City's hydraulic model was used to

evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

Chapter 7 – Evaluation and Proposed Improvements. This section presents a summary of the wastewater system capacity evaluation during peak dry weather flows and peak wet weather flows for the existing and buildout conditions. The recommended wastewater collection system improvements needed to mitigate capacity deficiencies are also discussed in this chapter.

Chapter 8 – Pipeline Risk and Condition Assessment. This chapter documents the condition and risk analysis for the City of Yakima's wastewater collection system. The following sections include a discussion of: the data utilized to establish risk and criticality, criteria development, results of the risk analysis, and recommended renewal and replacement actions.

Chapter 9 – Capital Improvement Program. This chapter provides a summary of the recommended Capital Improvement Program (CIP) for the City of Yakima's wastewater collection system. The program is based on the evaluation of the City's wastewater collection system and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the City in planning and constructing the collection system improvements through the ultimate buildout scenario. This chapter also presents the cost criteria and methodologies for developing the capacity improvement costs.

1.6 ACKNOWLEDGEMENTS

Obtaining the necessary information to successfully complete the analysis presented in this report, and developing the long term strategy for mitigating the existing system deficiencies and for accommodating future growth were accomplished with the strong commitment and very active input from dedicated team members including:

- Scott Schafer, Public Works Director
- Mike Price, Wastewater Division Manager
- Randy Talbert, Senior Engineer
- Dana Kallevig, Wastewater Utility Project Manager
- Joseph Calhoun, Planning Manager
- Marc Cawley, Wastewater/Stormwater Operations Superintendent

1.7 GEOGRAPHIC INFORMATION SYSTEMS

This master planning effort made extensive use of Geographic Information Systems (GIS) technology, for efficiently completing the following tasks:

- Develop the physical characteristics of the hydraulic model (gravity mains, force mains, and lift stations).

- Allocate existing wastewater loads, as extracted from the billing records, and based on each user's physical address.
- Calculate and allocate future wastewater loads, based on future development's water use.
- Extract ground elevations along the gravity and force mains, from available Digital Elevation Model (DEM) datasets.
- Generate maps and exhibits used in this master plan.

CHAPTER 2 – PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of the planning area characteristics, soil and topography, floodplains, climate, land use, and brief descriptions of the City's stormwater system, water system, and irrigation system.

2.1 STUDY AREA

The City of Yakima is located in Yakima County in the south-central part of Washington, approximately 60 miles southeast of Mount Rainier in the Yakima Valley. The City is located approximately 110 miles southeast of the City of Seattle and 171 miles southwest of the City of Spokane. Interstate 82 (I-82) runs in a north-south direction along the eastern side of the City. The City limits currently encompass 27.7 square miles, with an approximate population of 95,500 residents and 29,282 serviced residential, commercial, industrial, and institutional wastewater accounts. **Figure 1.1** displays the City's location.

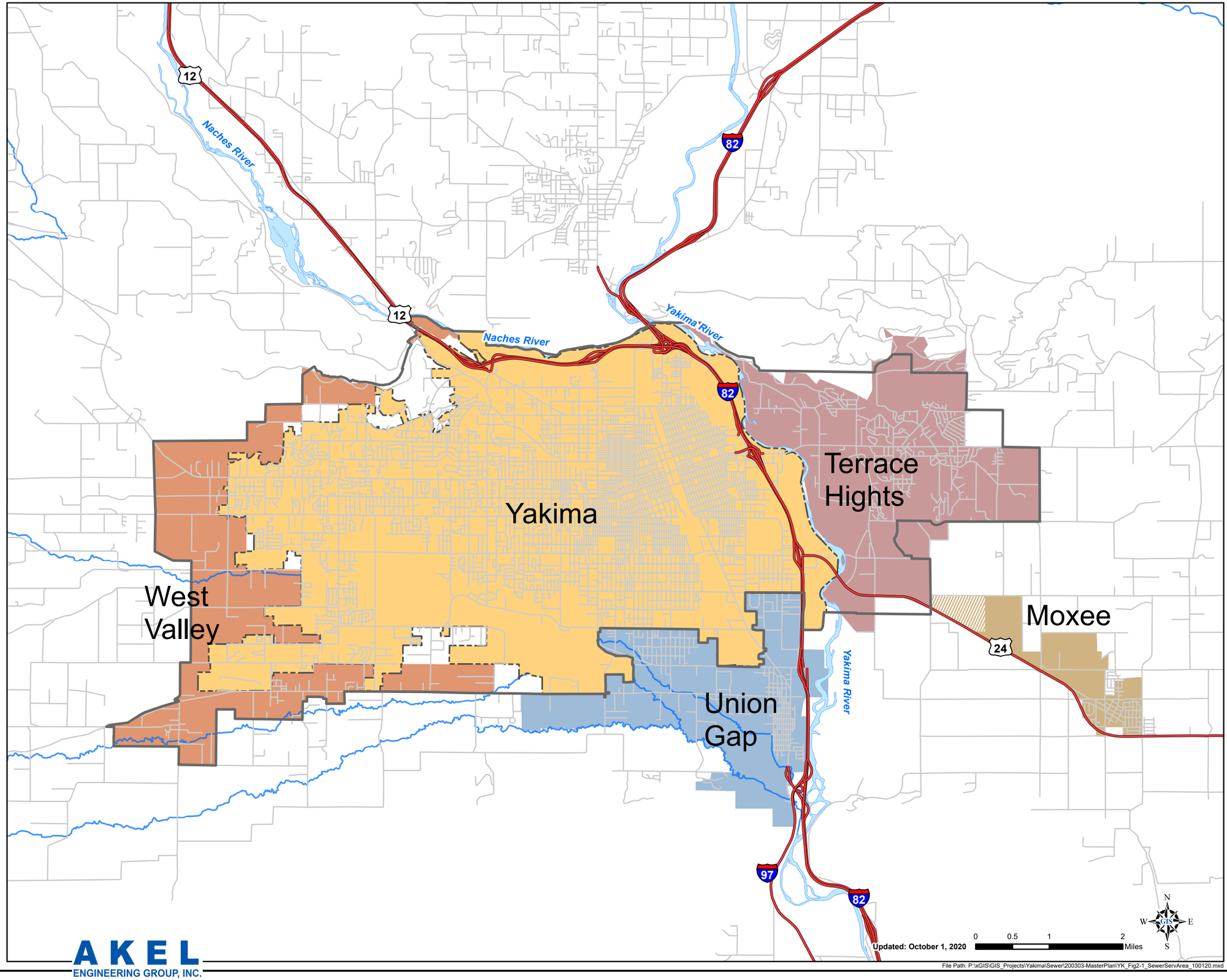
The City's service area is generally bound to north by the Naches River and Cowiche Creek, to the east by the Yakima River, to the south by Bachelor Creek, and to the west by 96th Street. The general topography of the City slopes from west to east towards the Yakima River.

This master plan update includes wastewater flows from the Yakima Urban Growth Area (UGA) which includes: the City of Yakima, Terrace heights, and the unincorporated areas within the Yakima UGA, along with flows from the City of Union Gap and the City of Moxee (**Figure 2.1**). The City is exploring the possibility of expanding wastewater collection services to users not currently connected to the City's wastewater collection system. Users utilizing on-site septic systems were also included in this master plan.

2.2 SOIL AND TOPOGRAPHY

The City of Yakima maintains a rich diversity of geologic and environmental features. The Yakima Valley is bound to the south by Ahtanum Ridge, and the north by the Yakima Ridge. The Yakima River transects both ridges, and is joined by the Naches River at the northeastern boundary of the City limits.

This section includes a general description of the soil and topographical features present in the greater Yakima Valley, including the geology, hydrologic soil classification, habitats, wetlands, and aquifer recharge.



Legend

- Study Area
- Moxee
- Terrace Heights
- Union Gap
- Moxee Annexation Area
- Urban Area Boundary
- Major Highways
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.1
Sewer Service Area
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-1_SewerServArea_100120.mxd

2.2.1 Geology

The City's underlying geology generally consists of basaltic formations historically from the Columbia River Group. The Columbia River Group generally extends from the Pacific Ocean east to the Rocky Mountains in Idaho and northern Wyoming, and from north-central Washington to Central Oregon.

According to the 1966 Yakima Basalt and Ellensburg Formation of South-Central Washington report, the Yakima Basalts are considered to be part of the upper formation of the Columbia River Group, and are dated to the late Miocene and early Pliocene. **Figure 2.2** displays the underlying geology of the City, and indicates that the majority of the City is located on alluvial deposits and terraced deposits. The western portion of the City contains portions of gravel, as well as the Ellensburg Formation.

Additionally, **Figure 2.3** documents the depth to hardpan as extracted from the 2010 YCS Manual.

2.2.2 Hydrologic Soil Classification

Underlying soil conditions were documented in the 2010 YCS Manual, and generally indicate soil suitable for water infiltration (**Figure 2.4**). Soils in the east, near the Yakima River, generally range from type A to type B. Soils in the southern portion of the City, in between Wide Hollow Creek and Ahtanum Creek, are mostly type C, with small areas in the west of the City being a type D.

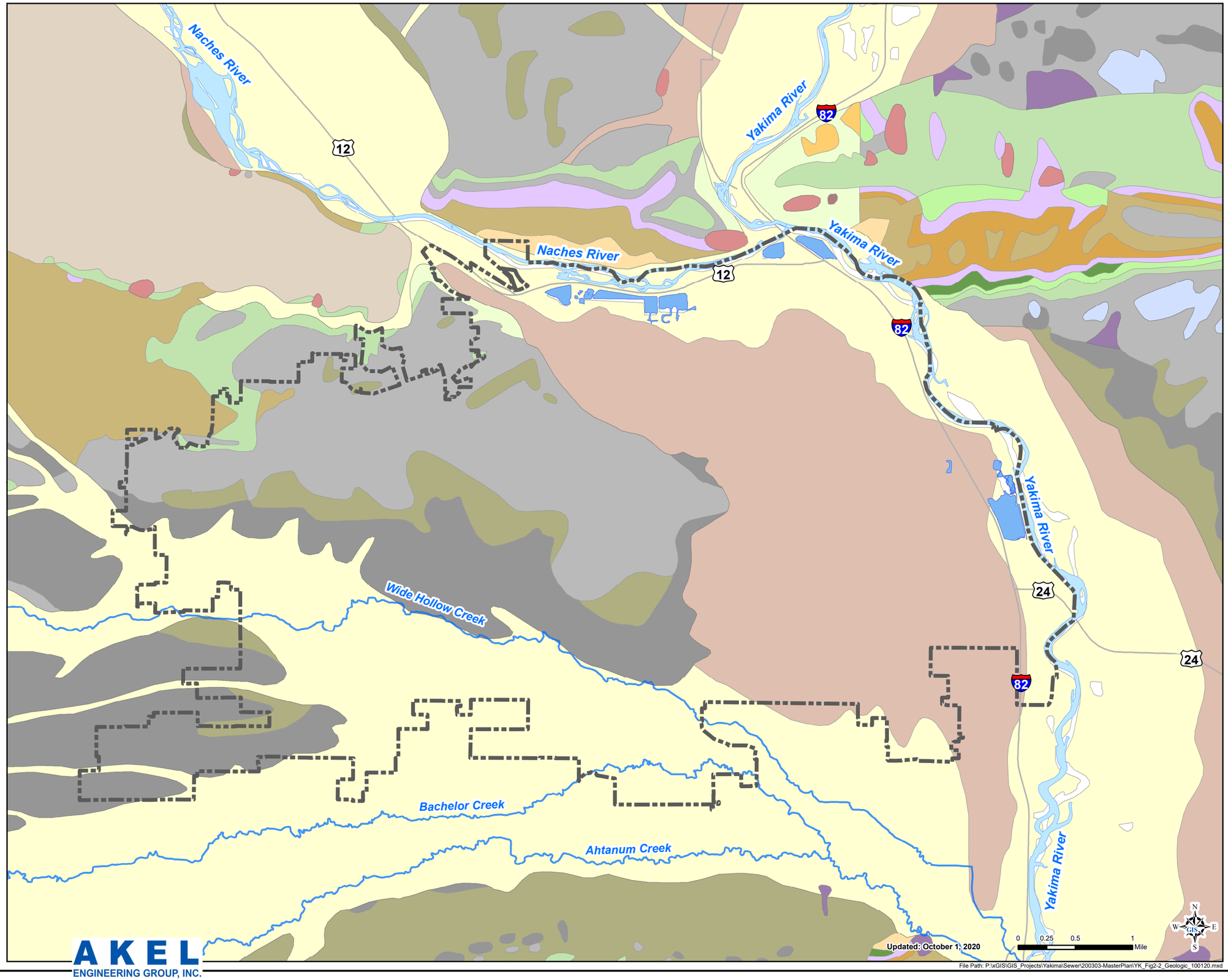
The infiltrative soil classifications of the central and eastern portion of the City are consistent with the alluvial and terraced deposits found in the underlying geology, as discussed in the previous section. This area typically has shallow groundwater and infiltration of groundwater into private basements has occurred at locations within the City, as noted by City staff.

2.2.3 Habitats

The City is home to a diverse array of wildlife habitat, including urban natural open space and riparian zones. These areas are host to an array of wildlife, and include wintering areas for Bald Eagles, as well as habitat for Great Blue Herons and various waterfowl. **Figure 2.5** displays sensitive areas for wildlife. Many of these areas are located within designated wetlands located along the Yakima and Naches River, and Wide Hollow, Ahtanum, and Cowiche Creeks (**Figure 2.6**)

2.2.4 Aquifer Recharge

Groundwater recharge within the City generally occurs along the wetland corridors of the Naches River, Yakima River, Ahtanum Creek, and Wide Hollow Creek. Recharge areas within the City have been identified by the County of Yakima in the 2010 YCS Manual, and are classified as extreme, high, and moderate recharge areas (**Figure 2.7**).



Legend

Geologic Units

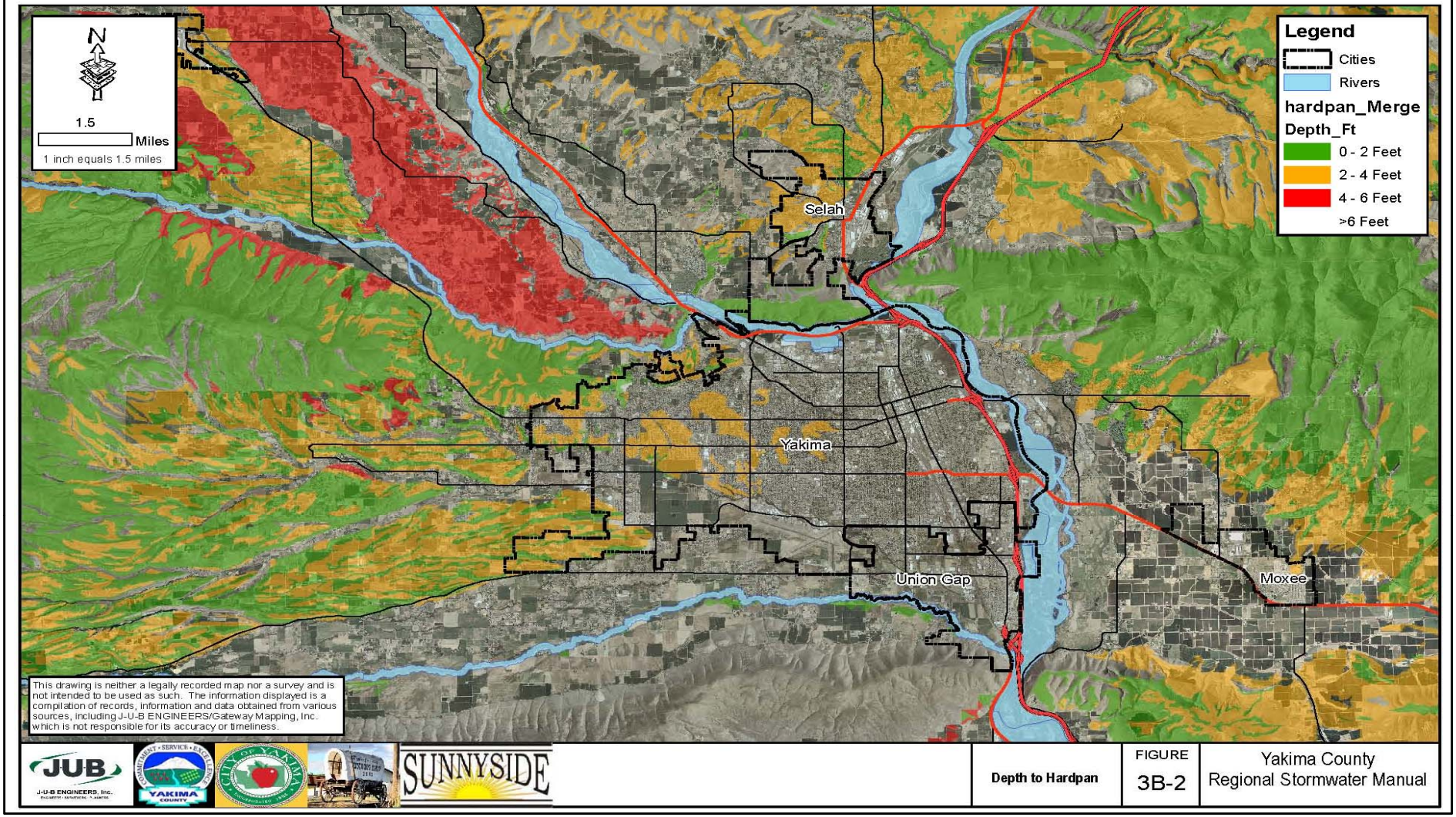
- Alluvial Fan Deposits
- Older Alluvial Fan Deposits
- Alluvium
- Asotin Member
- Ellensburg Formation
- Frenchman Springs Member
- Grande Ronde Basalt
- Landslide Deposits
- Palouse Formation
- Pomona Member
- Priest Rapids Member
- Roza Member
- Saddle Mountains Basalt
- Terraced Deposits
- Thorp Gravel
- Tieton Andesite
- Umatilla Member
- Wanapum Basalt
- Wilbur Creek Member
- Highways
- Yakima City Limits
- Streams
- Rivers
- Lakes

PRELIMINARY

Source: Washington State Department of Natural Resources, Division of Geology and Earth Resources, 2010

Figure 2.2
Geologic Units
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



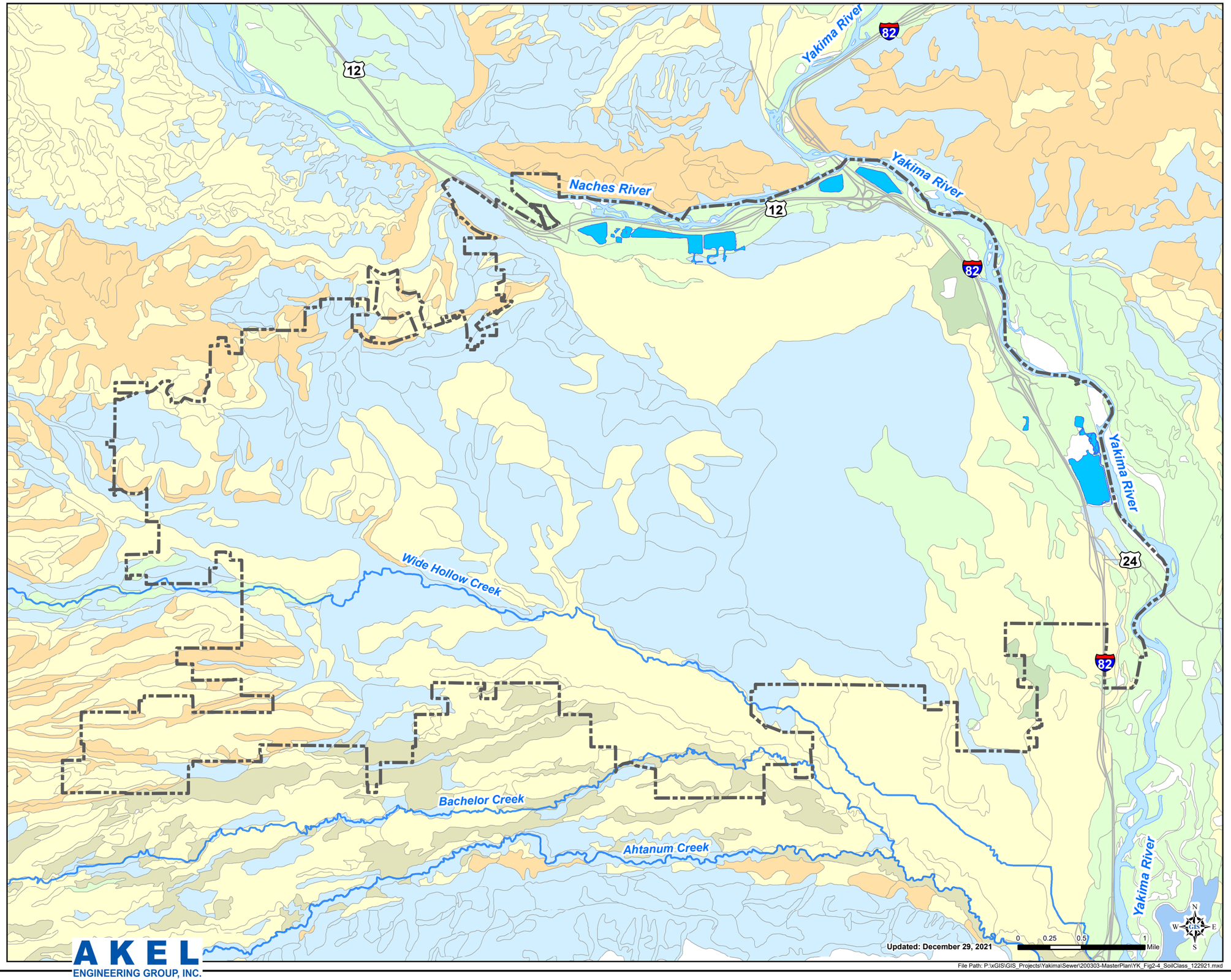
Source: Yakima County Regional Stormwater Manual, 2010.

PRELIMINARY

March 5, 2013

Figure 2.3
Depth to Hardpan
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-4_SoilClass_122921.mxd

AKEL
ENGINEERING GROUP, INC.

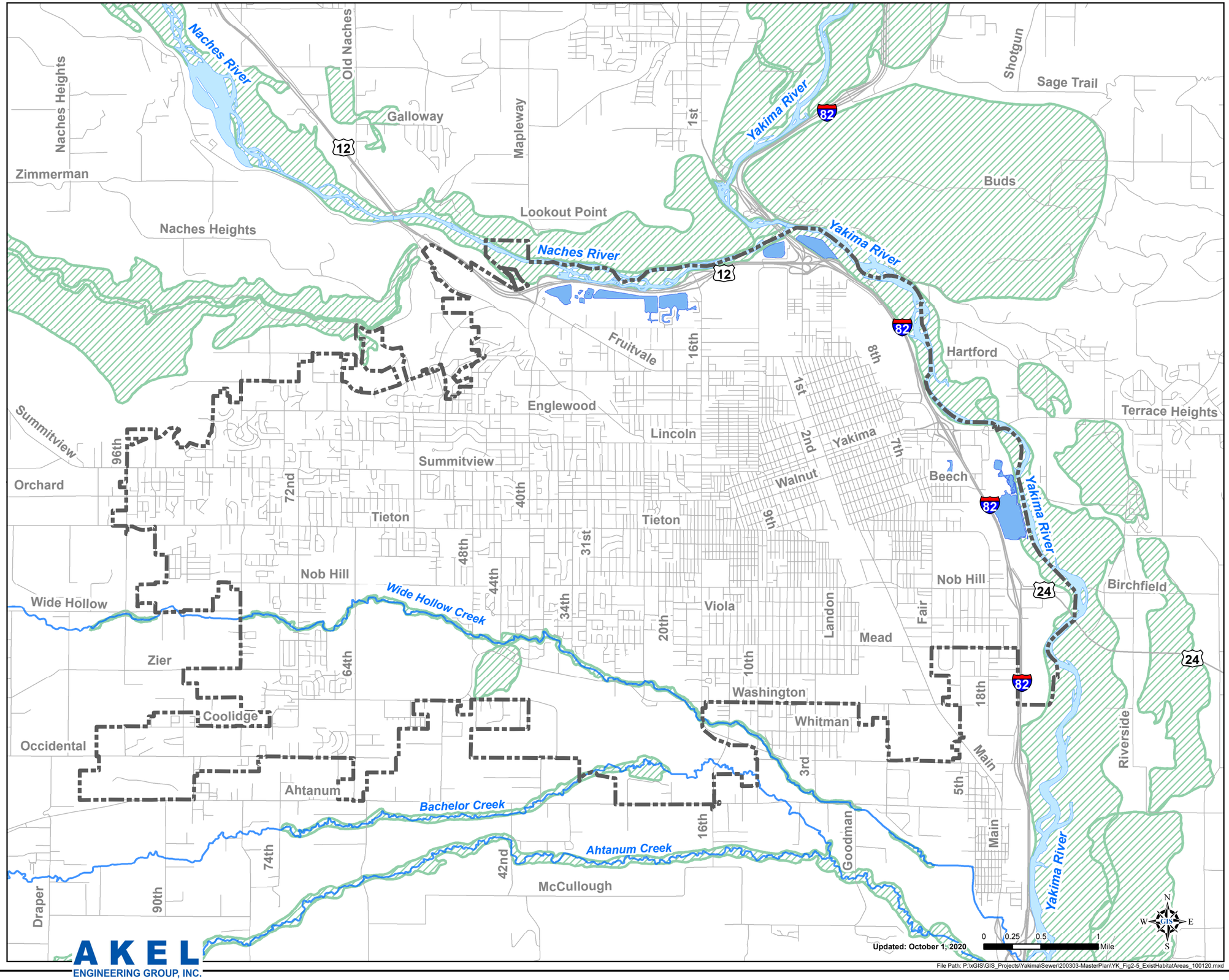
Legend

Hydrological Soil Groups

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Highways
- City Limits
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.4
Hydrological Soil Classification
Wastewater Collection System
Master Plan
City of Yakima



Legend

- Wildlife Habitat Areas
- Streets
- Highways
- Yakima City Limits
- Streams
- Rivers
- Lakes

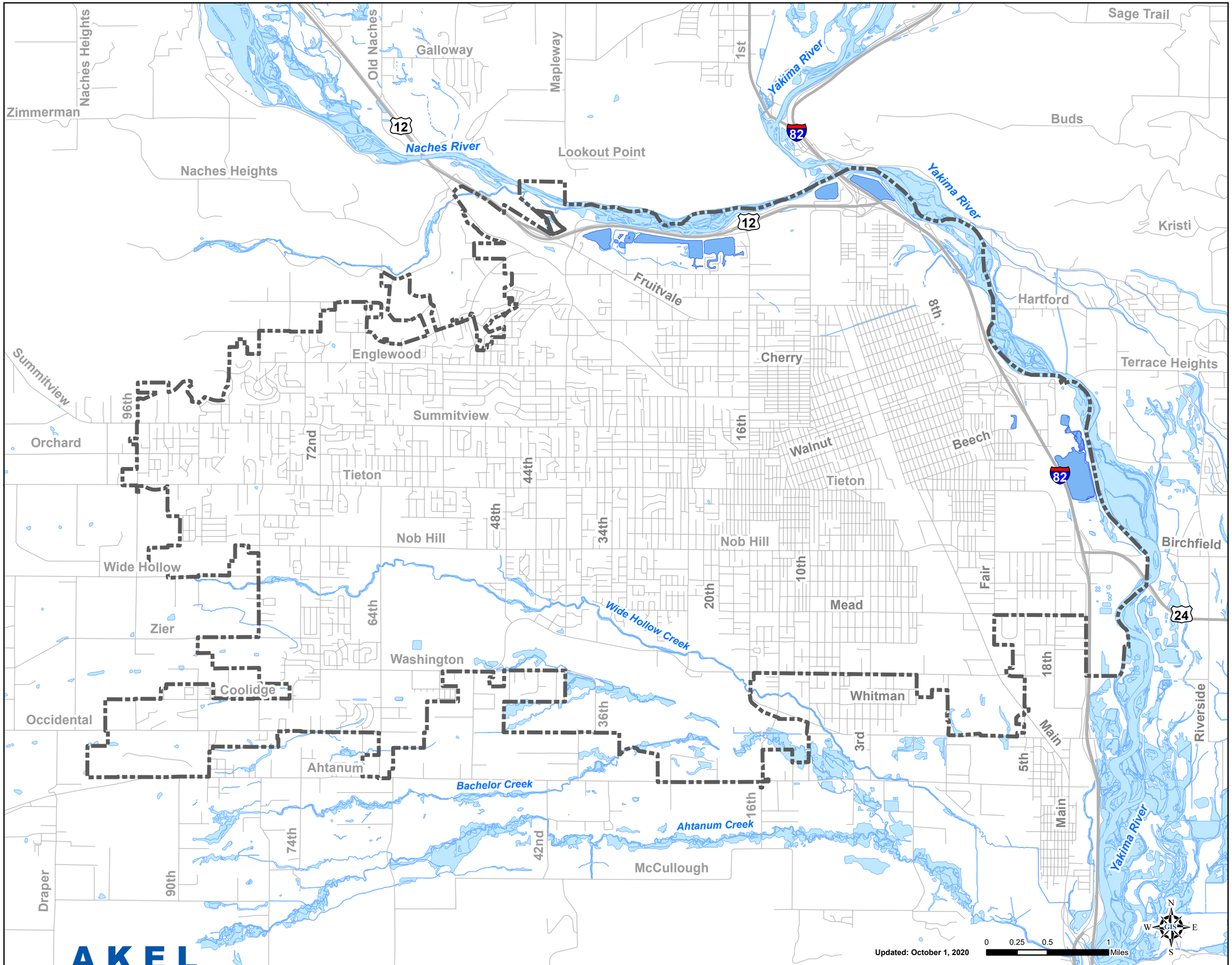
Source: City GIS (Received 03/31/20)

PRELIMINARY

Figure 2.5
Existing Wildlife Habitat Areas

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Updated: October 1, 2020

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-6UrbanAreaWetlands_100120.mxd

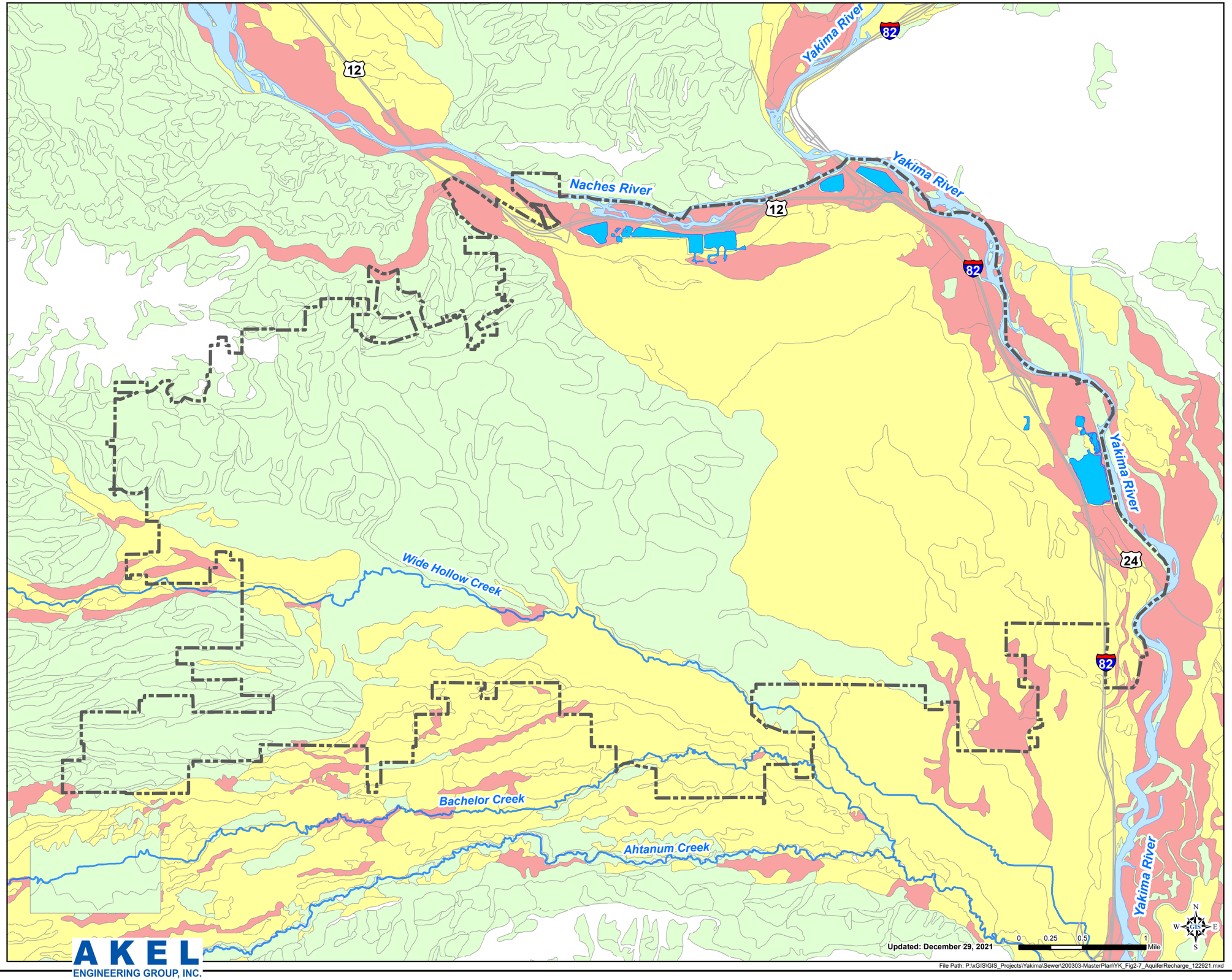
Legend

- Wetlands
- Lakes
- Streets
- Highways
- Yakima City Limits

PRELIMINARY

Figure 2.6
Urban Area Wetlands
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

Critical Aquifer Recharge Areas

- Moderate
- High
- Extreme
- Highways
- City Limits
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.7
Critical Aquifer Recharge Area
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-7_AquiferRecharge_122921.mxd

The 1994 CWSMP notes that areas of the Ellensburg Formation have a large degree of impermeable silty-clays, and is generally a poor aquifer. The 1994 CWSMP also notes that areas within the Ellensburg Formation are estimated to receive groundwater aquifer recharge from runoff infiltration, streambed infiltration, and groundwater upwelling from the underlying basalt layers.

Areas within the Yakima UGA have a relatively high groundwater table. Depth to groundwater can vary from less than 2 feet near the Yakima River, to over 150 feet in the outlying foothills. The 2010 YCS Manual also includes a map delineating areas of high groundwater (depths to groundwater at 6 feet or less), as shown on **Figure 2.8**.

2.3 FLOODPLAINS

Floodplains are important for delineating the extent of water-level rise during major floods. Typically, floodplains are estimated for the historic 100-Year and 500-Year flood. Most of the floodplains for the City are located along the Yakima River, Naches River, and in the low-lying areas near Ahtanum and Wide Hollow Creeks (**Figure 2.9**). Additionally, **Figure 2.9** notes areas in the north and eastern portion of the City that are protected by levees, and which may otherwise lie within the floodplain.

The Federal Emergency Management Agency (FEMA) produces Flood Insurance Rate Maps that show areas that are subject to flooding during major storm events. The flood risk information that is conveyed is based on historical data, including meteorological, hydrological, and hydraulic data for a specified area. The map creation is a result of the 1968 National Flood Insurance Program, aimed at reducing or preventing property owner losses due to flooding by allowing premiums to be paid for those in need of protection.

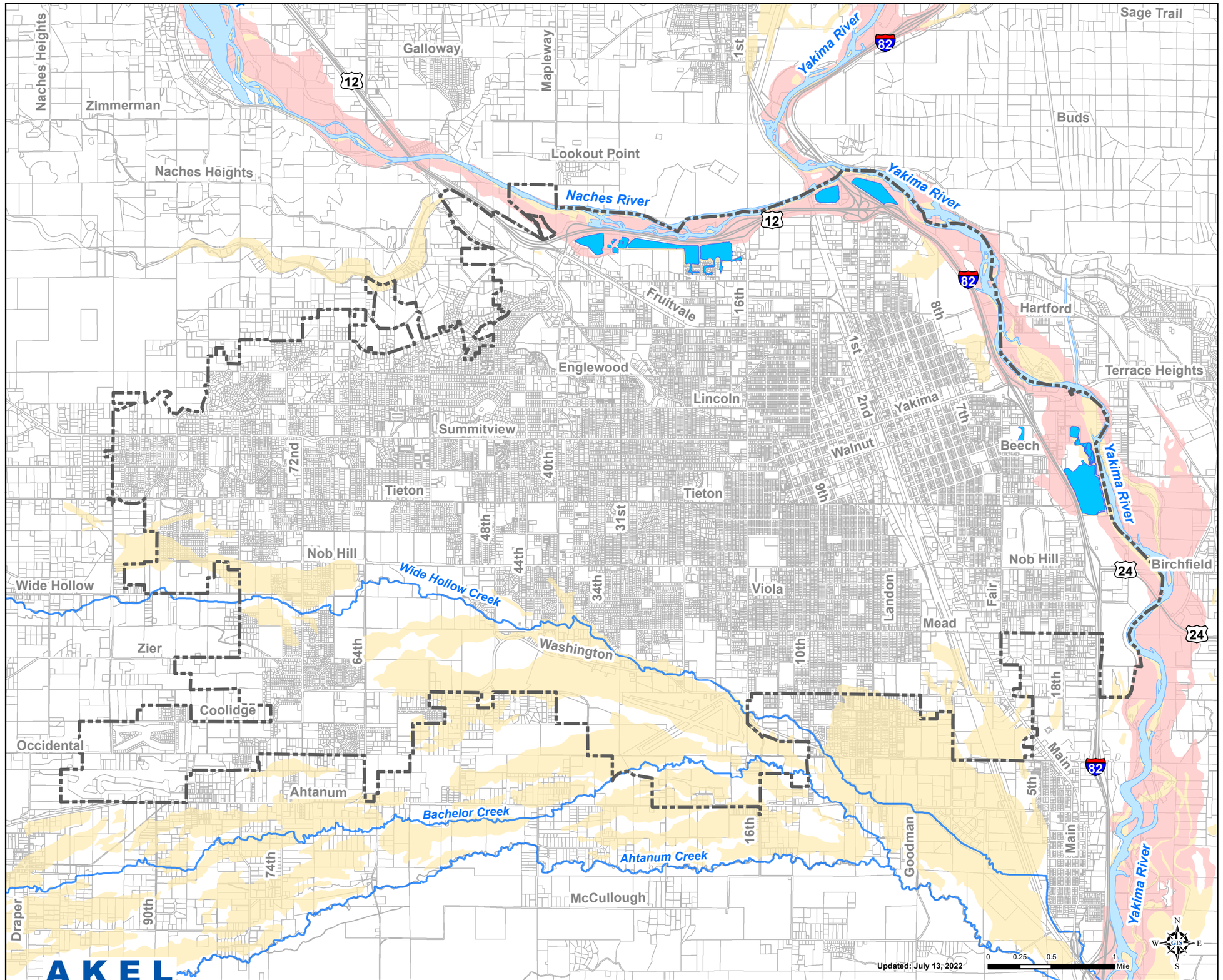
The Upper Yakima River Comprehensive Flood Management Plan, initially published in 1998 by the County of Yakima, was amended in 2007 based on more recent information about the condition of the Yakima River. However, the FEMA mapping in the updated 2007 Plan were based on the 1998 Plan.

The flood boundaries used in this master plan and shown on **Figure 2.9** were obtained from FEMA records dated March 9, 2009.

2.4 CLIMATE

The City of Yakima experiences dry and hot summers and cool winters with light snowfall. Yakima County lies in the rain shadow of the Cascade Mountains which results with Yakima receiving a relatively low amount of annual rainfall.

The City of Yakima receives an average 8.14 inches of total precipitation per year, and 23.3



Legend

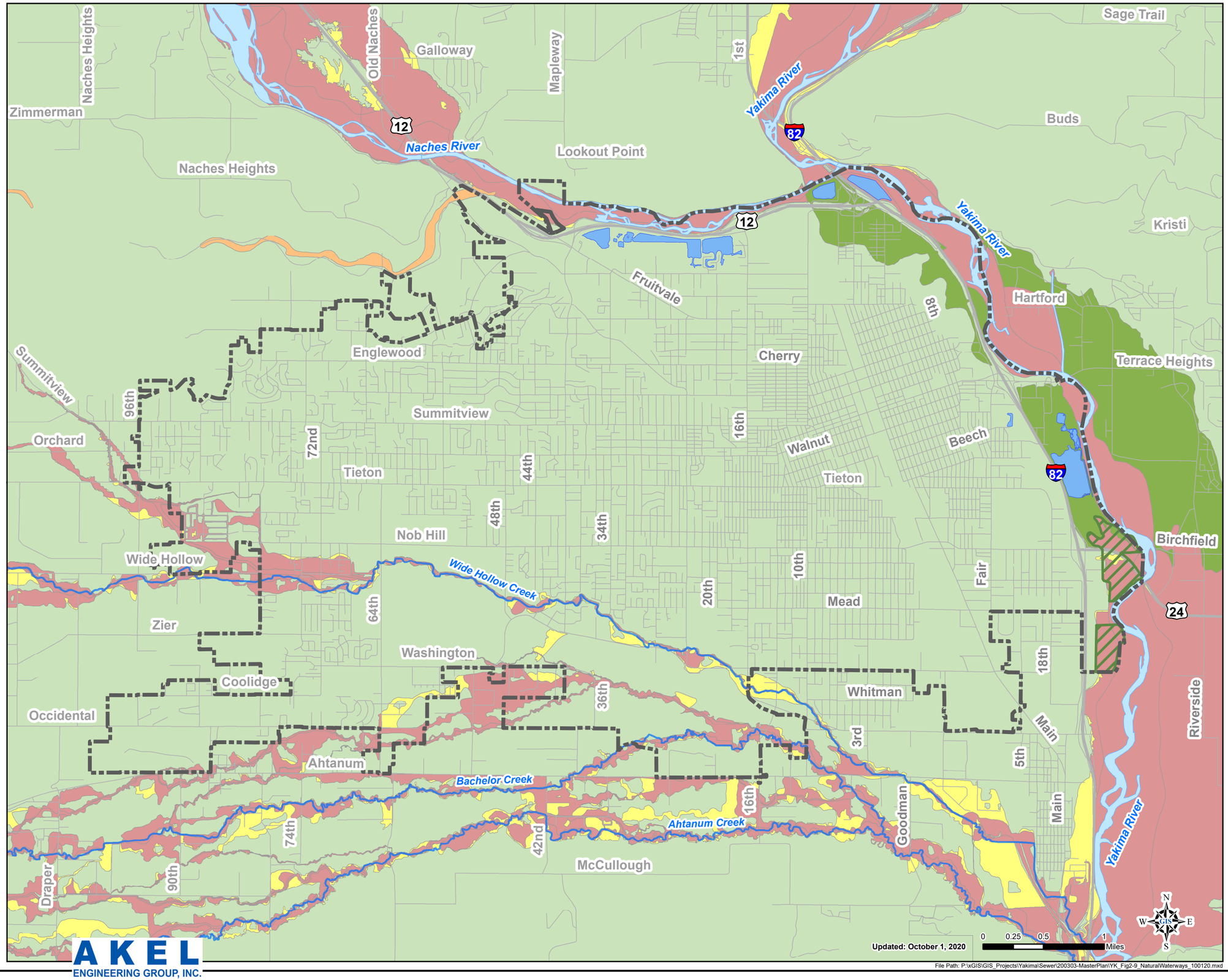
Groundwater Depth

- 2 - 4 Feet
- 4 - 6 Feet
- > 6 Feet
- Parcels
- City Limits
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.8
Depth to Groundwater
Wastewater Collection
System Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-9_NaturalWaterways_100120.mxd

Legend

- Protected by Levee*

FEMA 100 Year Flood Zones

- 1% Annual Flood Chance
- 1% Annual Flood Chance Estimate
- 0.2% Annual Flood Chance
- Protected by Levee
- Area Outside the Floodplain
- Area Not Included
- Streets
- Highways
- Yakima City Limits
- Streams
- Rivers
- Lakes

*Note: Per City staff, area may receive flood protection by existing levee.

PRELIMINARY

Figure 2.9
Natural Waterways
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

inches of snowfall per year. **Table 2.1** lists the average monthly temperature, rainfall and snowfall for the City from 1946 to 2016. The City's wet weather season typically starts in November and concludes in February.

While the City's climate is considered dry, it is subject to short duration storms, also known as cloudbursts, which can produce significant amounts of precipitation in a short period of time. These short duration storms typically occur in the form of thunderstorms during the summer months.

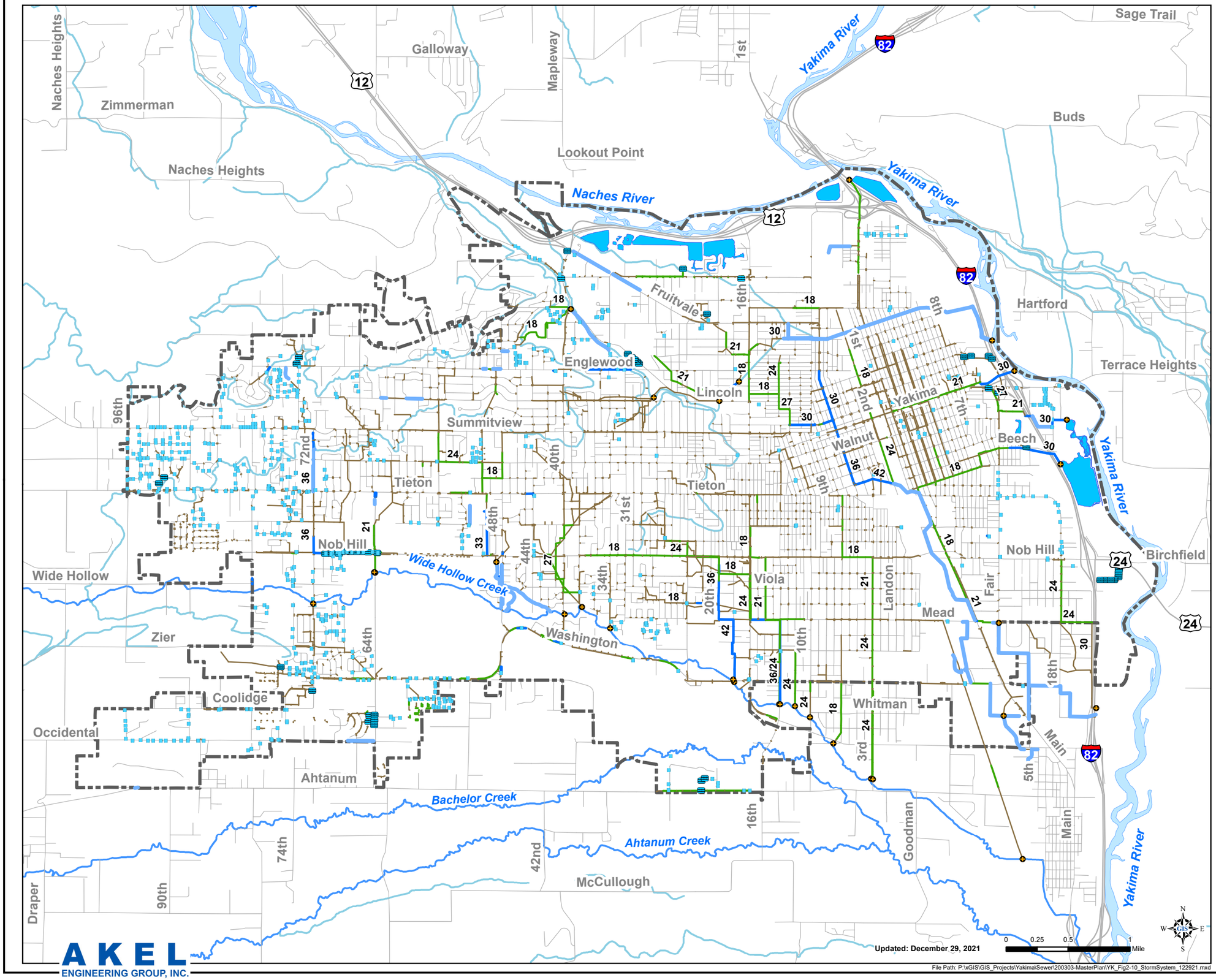
2.5 STORMWATER DRAINAGE SYSTEM

The City operates and maintains a stormwater collection system that covers the majority of the area within the City limits (**Figure 2.10**), as well as some conveyance pipelines that continue south towards the City of Union Gap. Most of the existing stormwater runoff currently discharges in waterways that transect the City, with the majority of runoff tributary to the Yakima River in the east, and Wide Hollow Creek in the south. The average monthly flows for the Yakima River near the City of Yakima from 1996 to 2020 are listed in **Table 2.2**. The highest flows typically occur with the warmer weathers of spring and the lowest flows typically occur during the fall before the winter rains.

The City also maintains drywells and a variety of surface and subsurface infiltration facilities, classified by the Washington State Department of Ecology (DOE) as Underground Injection Controls (UICs). These UICs allow runoff to infiltrate into the groundwater aquifer and are not connected to the City's existing stormwater system.

The City has four major watersheds that collect and convey stormwater runoff within City limits: Yakima Watershed, Wide Hollow Watershed, Ahtanum Watershed, and Naches Watershed, as identified on **Figure 2.11**. Watersheds in the Yakima Urban Area and outlying areas were defined based on the receiving tributary creek or river system, with topographical or physical barriers dictating the limits of the watershed. These watersheds are described as follows:

- **Yakima Watershed:** The Yakima Watershed is approximately 6,275 acres and is generally defined as the area immediately west of the Yakima River, and those areas which contribute runoff to the Fruitvale Canal.
- **Wide Hollow Watershed:** The Wide Hollow Watershed is approximately 42,175 acres, and is the largest watershed in the City, extending west beyond the UGA. This watershed collects runoff from the majority of the City, and conveys flows south to Wide Hollow Creek, which then flows east to its confluence with the Yakima River, in Union Gap.
- **Ahtanum Watershed:** This watershed is located in the south of the City and the projected UGA, and conveys runoff to Ahtanum Creek, before flowing east to its confluence with the



File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-10_StormSystem_122921.mxd

Legend

Existing System

- Outfall
- Drywell/UIC
- Swale

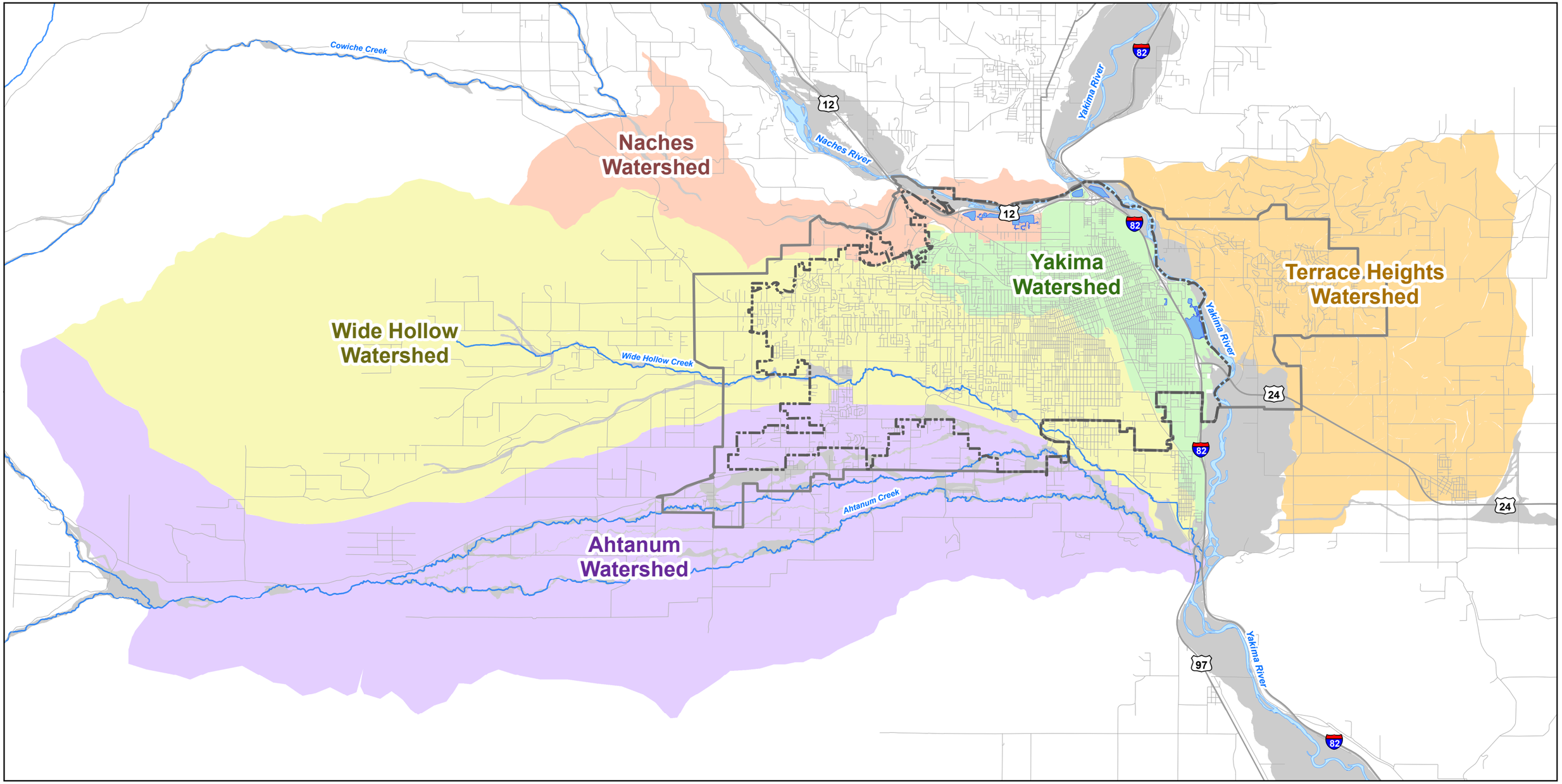
Pipes by Diameter

- 16" or Smaller
- 18" - 27"
- 30" or Larger
- Open Channel
- Streets
- Highways
- City Limits
- Irrigation Canals
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.10
Existing Storm Water System
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

Watersheds

- Ahtanum
- Naches
- Terrace Heights
- Wide Hollow
- Yakima
- Floodplain
- Streets
- Highways
- Yakima City Limits
- Urban Area Boundary
- Streams
- Rivers
- Lakes

Updated: January 21, 2022

0 1.25 2.5 5 Miles

N W GIS E S

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-11Watersheds_012122.mxd

Figure 2.11
Watersheds
Wastewater Collection System
Master Plan
City of Yakima

Table 2.1 Temperature and Precipitation

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Month	Temperature			Precipitation	
	Average Monthly Maximum °F	Average Monthly Minimum °F	Mean Monthly °F	Average Monthly Rainfall (in)	Average Monthly Snowfall (in)
January	37.6	21.0	29.3	1.25	7.90
February	46.1	25.8	35.9	0.76	2.90
March	55.4	29.9	42.6	0.65	1.20
April	63.8	34.7	49.2	0.51	0.00
May	72.6	42.3	57.5	0.57	0.00
June	79.7	49.0	64.3	0.66	0.00
July	87.8	53.3	70.6	0.19	0.00
August	86.4	51.9	69.1	0.30	0.00
September	78.0	44.2	61.1	0.34	0.00
October	64.1	34.8	49.4	0.56	0.10
November	48.2	27.6	37.9	1.01	2.90
December	37.9	22.5	30.2	1.34	8.30
Annual Average	**63.1**	**36.4**	**49.8**		
Annual Total				**8.14**	**23.30**

AKEL ENGINEERING GROUP, INC.

8/15/2021

Note:

1. Source: Western Regional Climate Center (September 1946 to June of 2016).

Table 2.2 Average Monthly Flows for the Yakima River

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Month	Average Yakima River Flow (cfs)
January	2,920
February	3,480
March	3,860
April	4,880
May	6,250
June	5,630
July	3,720
August	3,320
September	2,610
October	1,790
November	2,070
December	2,690

AKEL ENGINEERING GROUP, INC.

8/18/2021

Note:

1. Source: USGS Station 12500450. Data represents average values for 1967-2020. Station is located in the Yakima River above Ahtanum Creek at Union Gap, WA.

Yakima River.

- **Naches Watershed:** The Naches Watershed is approximately 7,200 acres, and generally consists of areas in the north end of the City directly adjacent to the Naches River, as well as areas along Cowiche Creek and Cowiche Canyon, which contribute runoff to the City of Yakima.

The Terrace Heights Watershed, also shown on **Figure 2.11**, is approximately 20,000 acres, and is bound to the west by the Yakima River. Stormwater collection and drainage within this watershed was not included in the 2023 SWCSMP.

2.6 EXISTING WATER SYSTEM

The domestic water for the City of Yakima is supplied from a surface water treatment plant (WTP) located north of the City near Rowe Hill on the Naches River. The WTP has a current capacity of 20 MGD and space for an expansion up to 60 MGD. The WTP receives raw water from the Naches River at the confluence of the Tieton and Naches River by the Bureau of Reclamation through the Wapatox Canal. Water then flows from the canal to the WTP through a 54 inch pipeline.

The City also operates four groundwater wells. These wells are used as a secondary water source only in emergency situations. The wells are located at the Airport, Kiwanis Park, Kissel Park, and Gardner Park.

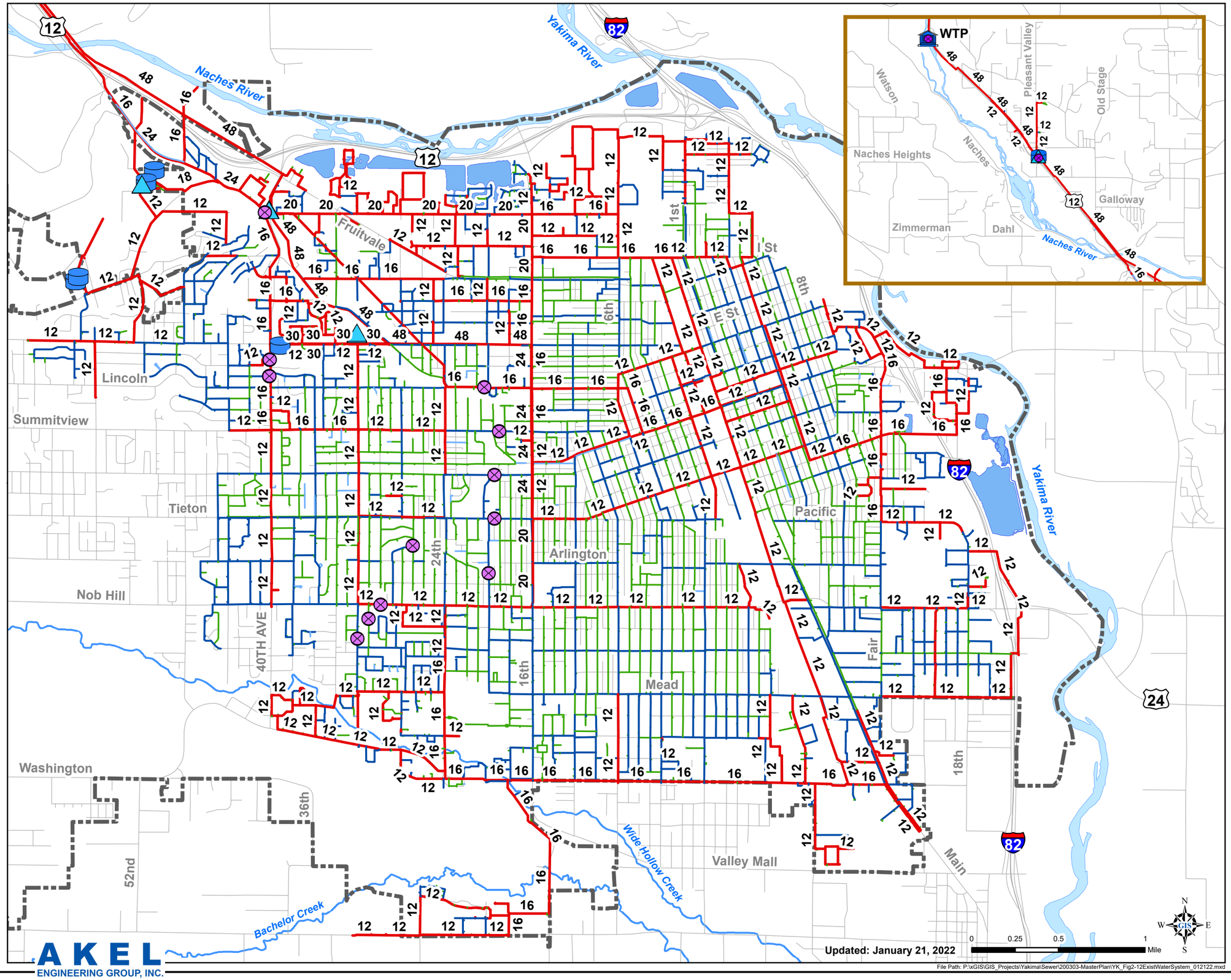
The City's domestic water system is supplied by gravity from the WTP by a 48 inch pipeline. The water system consists of three pressure zones and serves the eastern portion of Yakima (**Figure 2.12**). The water demand for the City in 2020 was 9.4 MGD and is projected to reach 15.2 MGD by 2030.

The surrounding areas are served by one of the following water purveyors:

- **Nob Hill Water Association.** The western portion of the City and the West Valley area is supplied by the Nob Hill Water Association. The City and Nob Hill Water Association maintain three interties that can provide water to both purveyors during an emergency situation.

- **City of Union Gap.** The City of Union Gap is located southeast of the City of Yakima and provides water to most of Union Gap. The City of Yakima serves some areas in the City of Union Gap. There is one emergency intertie between the City and Union Gap that can provide water to Union Gap during an emergency.

- **Yakima County (Terrace Heights area).** Yakima County serves the unincorporated area of Terrace Heights which is located west of the City.



Legend

Existing

- WTP
- Tanks
- Pumps
- Valves

Pipes

- 4" and Smaller
- 6"
- 8"
- 10" and Larger
- Streets
- Highways
- Yakima City Limits
- Streams
- Rivers
- Lakes

Figure 2.12
Existing Water System
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

- **City of Selah.** The City of Selah is north of Yakima, across the Naches River, and outside of the Urban Growth Area.

2.7 EXISTING IRRIGATION SYSTEM

The City of Yakima owns, maintains and operates an irrigation system that is currently serving approximately two thirds of the City's domestic water users (**Figure 2.13**). The City's irrigation needs are partially served by City owned water rights and supplemented by several canal companies. The City's irrigation system serves approximately 10,690 parcels, covering a total area estimated at 2,551 acres of irrigated lands. The remaining accounts within the City use either domestic water for irrigation purposes, own private wells, obtain water directly from Canal companies, or are supplied from a private irrigation system.

The irrigation canals that meander throughout the City may be elevating the depth of the groundwater during the summer irrigation season. Though the Fruitvale Canal is owned and operated by the City of Yakima, the other canals are owned by irrigation districts.

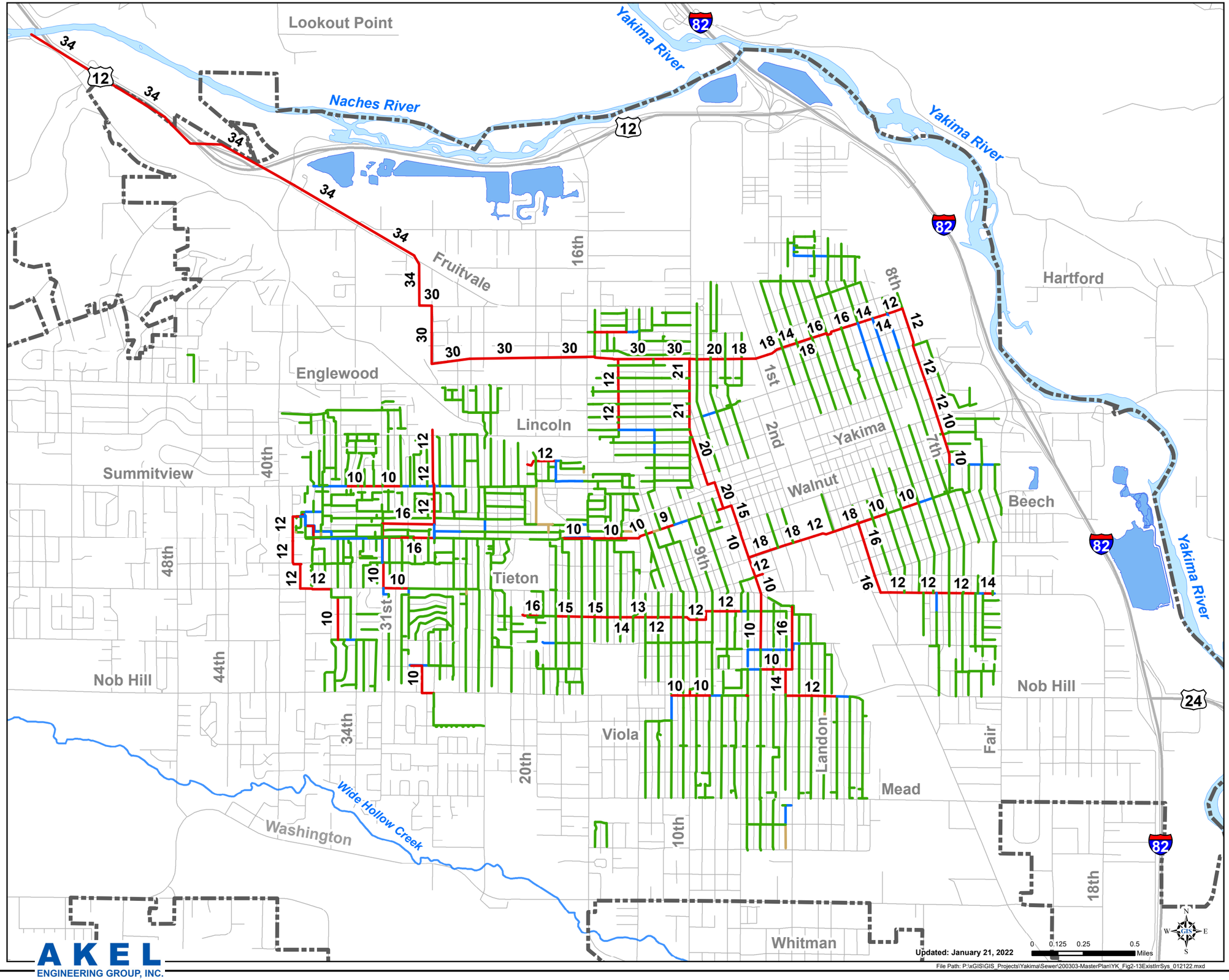
The early segments of the Yakima irrigation system were placed in service in 1912 and included construction of wood stave pipes. These older segments have also been suspected of leaking and contributing to elevated groundwater levels during the summer irrigation season.

In 2003, the City's Irrigation Division embarked on an aggressive rehabilitation and replacement program intended to replace the older segments of pipe and which are suspected of leaking, as recommended in the 1999 Irrigation System Master Plan. The program included 4 phases of high priority repair/replacements of approximately 32 miles of pipes in the General Irrigation System, which is also known as "System 308". The 4th phase of the program was completed in 2012.

The City-operated irrigation system contains blow-off valves to aid in flushing the system during start up, routine flushing, and draining the system at the end of the season. Some of these blow-off valves drain directly into sewer manholes. The City has identified approximately 227 blow-off valves that discharge into the sewer system. These valves range from ½ inch to 3 inches in diameter and are normally exercised every three to four weeks. The normal operating time is five to ten minutes with the approximate discharge being a total of 12,160 gallons per day (gpd). Occasionally, a valve may get stuck open, discharging more water into the sewer system than normal flushing.

2.8 SEWER SERVICE AREAS AND LAND USE

The YRWWTP provides service to areas in the existing Yakima Urban Growth Area (UGA). These areas are the City of Yakima, the City of Union Gap, the Terrace Heights Sewer District, and other unincorporated areas (Yakima County) within the UGA (**Figure 2.1**). In 2008 the City of Moxee entered an agreement between the City of Yakima and the Terrace Heights Sewer District to



Legend

Irrigation Pipes By Size

- Unknown
- 6" or Smaller
- 8"
- 9" or Larger
- Streets
- Highways
- Yakima City Limits
- Streams
- Rivers
- Lakes

Source: City GIS (Received 12/11/11)

Figure 2.13
Existing Irrigation System
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

convey Moxee sewage flows to Terrace Heights, and ultimately to the YRWWTP.

Land use maps reflect the development density a municipality seeks to develop in certain areas, while zoning maps show the actual and allowable uses of land. Zoning codes contain designations for the design and development guidelines for each intended use. The City's zoning map which was provided by City staff shows the zoning for the Yakima UGA as shown on **Figure 2.14**. The land use element will be discussed in the following sections.

2.8.1 Yakima Urban Service Area/Reserve

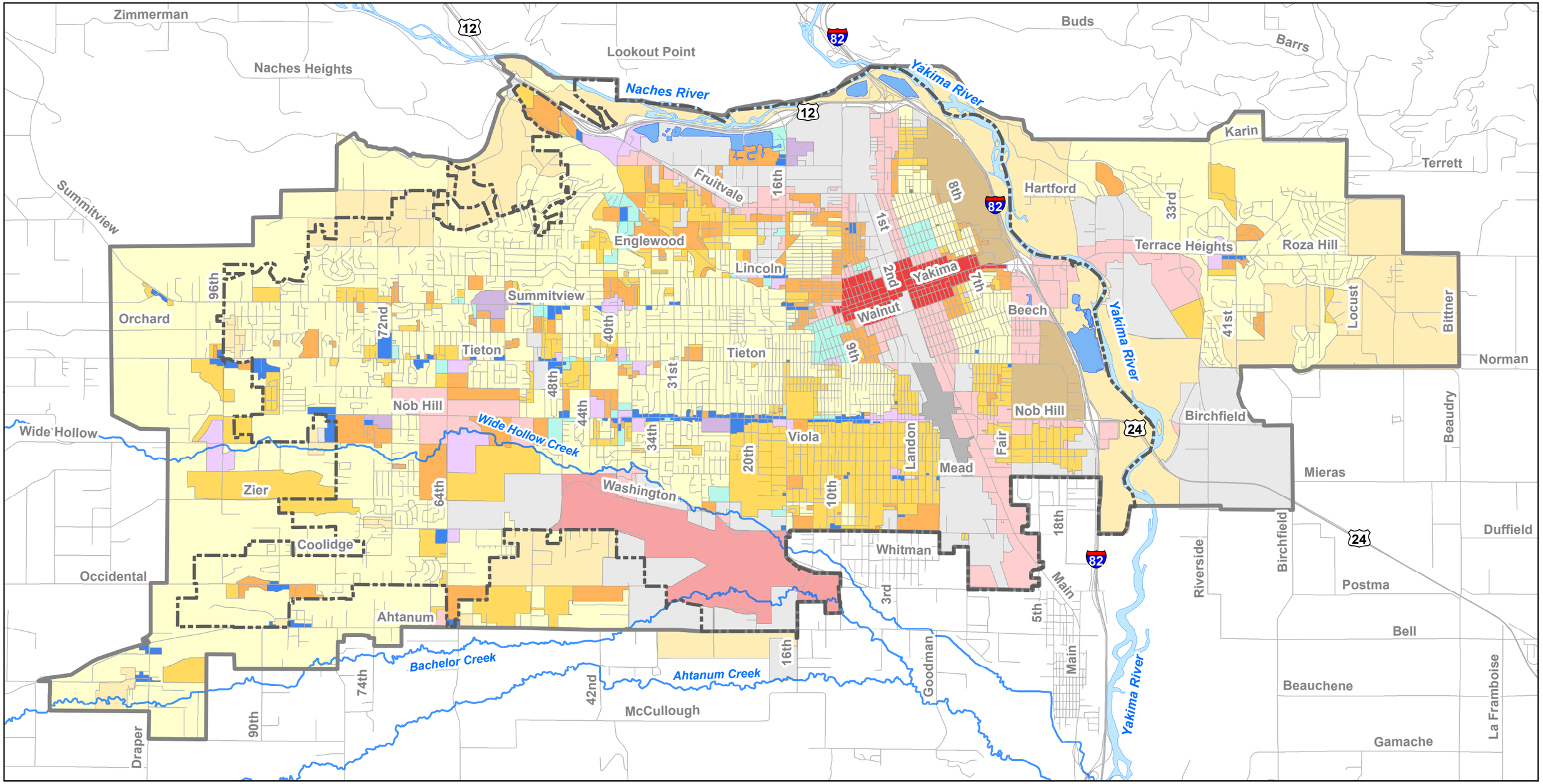
The Yakima Urban Service Area/Reserve includes the City of Yakima and the unincorporated areas in the Yakima UGA on the west side of the City, known as the West Valley. The amount of residential land use will decrease from 8,927 acres in 2020 to 8,762 acres at ultimate or a 2 percent decrease. The amount of non-residential land use will increase from 3,451 acres in 2020 to 3,802 acres at ultimate or a 10 percent increase. The amount of non-flow generating land use will decrease from 7,779 acres in 2020 to 389 acres at ultimate or a 96 percent decrease. **Table 2.3** documents the land use within city limits and in the West Valley for 2020 and ultimate. The existing land use is shown on **Figure 2.15** and the future land use is shown on **Figure 2.16**.

2.8.2 Union Gap Urban Service Area/Reserve

The Union Gap Service Area/Reserve includes the City of Union Gap and the Union Gap UGA. The amount of residential land use will increase from 656 acres in 2020 to 1,373 acres at ultimate or a 109 percent increase. The amount of non-residential land use will increase from 1,188 acres in 2020 to 1,616 acres at ultimate or a 36 percent increase. The amount of non-flow generating land use will increase from 1,261 acres in 2020 to 1,540 acres at ultimate or a 22 percent increase. **Table 2.4** shows Union Gaps' existing and projected land use inventory. No detail of future land use or maps were obtained from Union Gap.

2.8.3 Terrace Heights Service Area/Reserve

The Terrace Heights Service Area/Reserve is an unincorporated area located in the Yakima UGA on the east side of the City of Yakima and is served by the Terrace Heights Sewer District. The amount of residential land use will increase from 1,542 acres in 2020 to 3,269 acres at ultimate or a 112 percent increase. The amount of non-residential land use will increase from 733 acres in 2020 to 2,323 acres at ultimate or a 217 percent increase. The amount of non-flow generating land use will decrease from 2,265 acres in 2020 to 0 acres at ultimate or a 100 percent decrease. **Table 2.5** shows Terrace Heights' existing and projected land use inventory and **Figure 2.17** shows the future land use for Terrace Heights.



Legend

Zoning

- Surburban Residential
- Single Family
- Two Family
- Multiple Family
- Professional Business
- Local Business
- Historical Business
- Small Convenience Center
- Large Convenience Center
- Central Business District
- Central Business District Support/GC
- General Commercial
- Light Industrial
- Heavy Industrial
- Regional Development
- Airport Support
- Yakima City Limits
- Yakima Urban Area
- Streets
- Highways
- Streams
- Rivers
- Lakes

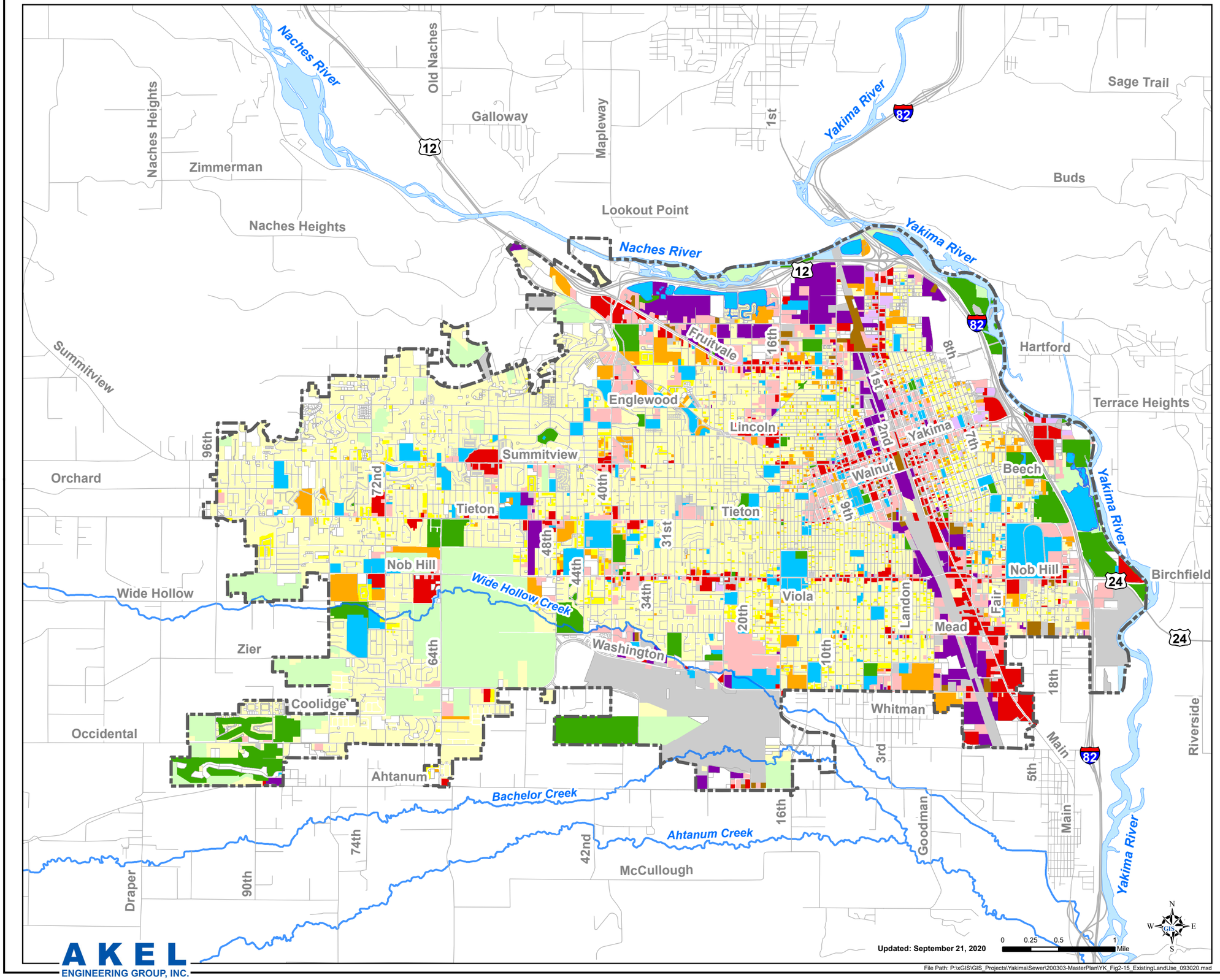
Note: The zoning shapefile was received 3/21/20 and may not be an accurate depiction of current zoning within the City. Zoning should be confirmed with the City of Yakima Planning Department.

Updated: December 29, 2021

0 0.25 0.5 1 Mile

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-14Zoning_122921v2.mxd

Figure 2.14
Zoning
Wastewater Collection System
Master Plan
City of Yakima



Legend

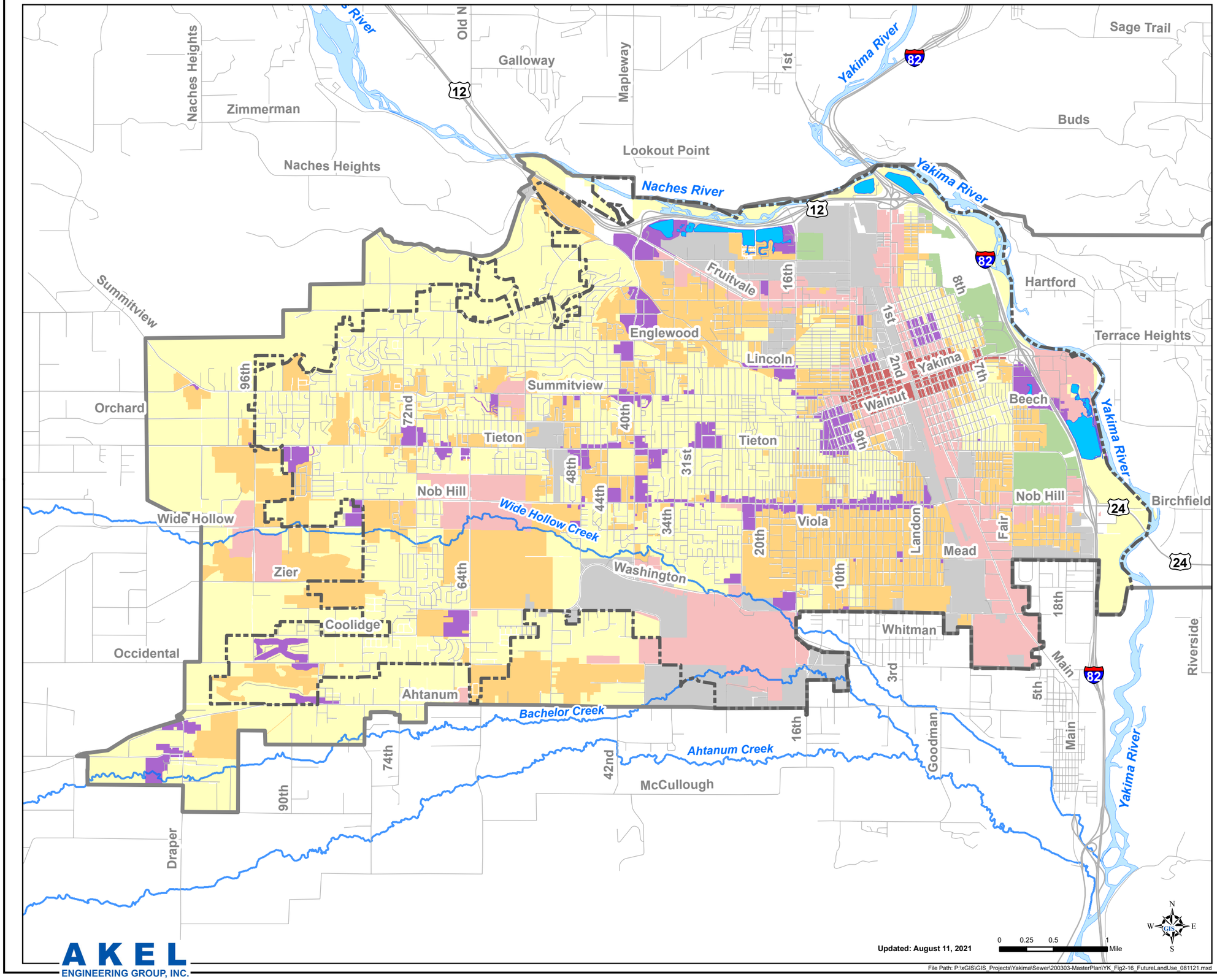
Existing Land Use

- Single Family, Detached
- Single Family, Attached
- Multi-Family/Mobile Home
- Hotel
- Manufacturing Industries
- Transportation, Communication, Utilities
- Wholesale
- Retail Trade/Service
- Offices
- Public/Semi-Public
- Parks and Recreation
- Agricultural, Forestry, Mining
- Vacant/Undeveloped
- Water Area
- Streets
- Highways
- City Limits
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.15
Existing Land Use
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

Future Land Use

(Generalized Categories)

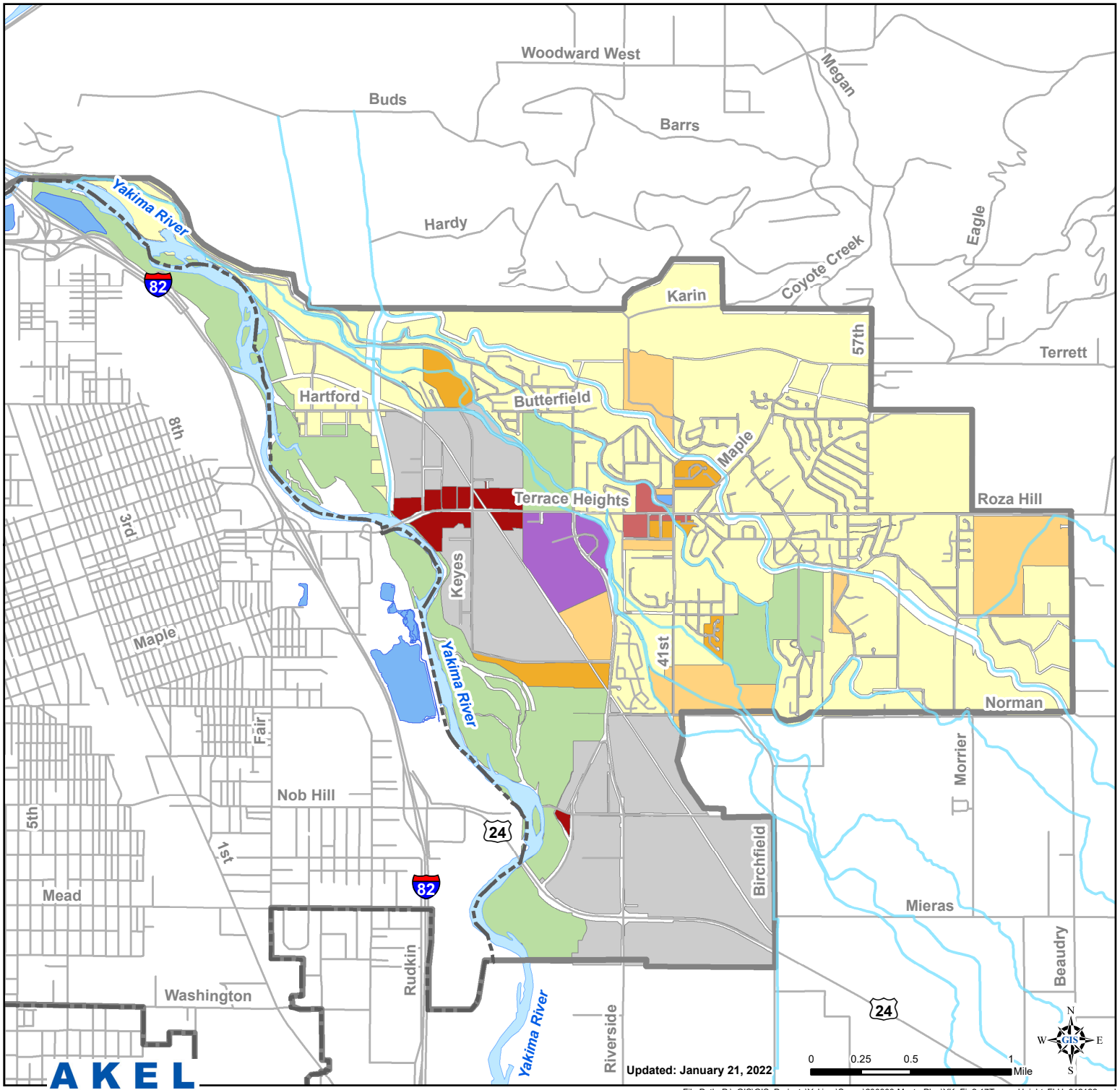
- Low Density Residential
- Mixed Residential
- Industrial
- Community Mixed Use
- Commercial Mixed Use
- Regional Commercial
- Central Business Core Commercial
- Streets
- Highways
- City Limits
- Urban Area Boundary
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 2.16
Future Land Use
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-16_FutureLandUse_081121.mxd



Legend

Future Land Use

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Professional Office
- Neighborhood Commercial
- Large Convenience Center
- Arterial Commercial
- Industrial
- Parks & Open Space
- Streets
- Yakima City Limits
- Yakima Urban Area
- Irrigation Canals
- Rivers
- Lakes

Figure 2.17
Terrace Heights
Future Land Use
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-17TerraceHeightsFLU_012122.mxd

Table 2.3 Land Use Inventory - Yakima UGA

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Land Use Classification	Existing (2020) Land Use Inventory					Ultimate Land Use Inventory[3]		
	Dwelling Units[1] (DU)	2020 Land Use[2] (gr. acres)	Percent of Total (%)	Area within City Limits (gr. acres)	Area Outside City Limits in West Valley (gr. acres)	Dwelling Units	Total Area within UGA (gr. acres)	Percent of Total (%)
Residential								
Single Family Residential	25,878	8,119	40%	5,592	2,527	n/a	8,063	40%
Multi-Family Residential	9,887	808	4%	797	11	n/a	698	3%
Subtotal - Residential	35,765	8,927	44%				8,762	43%
Non-Residential	**35,765**							
Commercial		1,938	10%	1,869	69		1,245	6%
Industrial		63	0%	63	0		61	0%
Institutional		723	4%	636	86		1,768	9%
Hotel		728	4%	577	151		728	4%
Subtotal - Non-Residential		3,451	17%				3,802	19%
Additional Planning Designations								
Low Density Residential		0	0%	0	0		3,491	17%
Mixed Residential		0	0%	0	0		1,649	8%
Regional Commercial		0	0%	0	0		304	2%
Community Mixed Use		0	0%	0	0		255	1%
Commercial Mixed Use		0	0%	0	0		1,372	7%
Central Business Core Commercial		0	0%	0	0		134	1%
Subtotal - Additional Planning Designations		0	0%				7,205	36%
Other - Non-Flow Generating								
Parks and Rec		1,101	5%	1,080	21		266	1%
Agricultural		2,551	13%	1,503	1,048		63	0
Open Space (Water)		915	5%	792	122		60	0%
Vacant		3,212	16%	2,116	1,096		0	0
Subtotal - Other		7,779	39%				389	2%
Total								
		20,157	100%	15,026	5,132		**20,157**	100%

AKEL ENGINEERING GROUP, INC.

8/19/2021

Notes:

1. Residential dwelling unit count data from US Census Bureau American Community Survey.
2. City Land Use based on Parcel Shapefile and Comprehensive Plan Land Use provided by City staff on April 16, 2020.
3. Single-family, multi-family, commercial, and industrial future land uses have been reduced to accommodate future institutional and park land uses.

Table 2.4 Land Use Inventory - Union Gap UGA

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Land Use Classification	Existing (2020) Land Use Inventory[1]			Ultimate Land Use Inventory[3]		
	Dwelling Units[2] (DU)	Land Use (gr. acres)	Percent of Total (%)	Dwelling Units	Total Area within UGA (gr. acres)	Percent of Total (%)
Residential						
Single Family Residential	2,013	558	18%		-	
Multi-Family Residential	223	98	3%		-	
Subtotal	2,236	656	21%		1,373	
Non-Residential						
Commercial		511	16%		-	
Industrial		287	9%		-	
Institutional		142	5%		-	
Park		248	8%		-	
Subtotal		1,188	38%		1,616	
Non-Flow Generating						
Agricultural		409	13%		-	
Open Space (Water)		-	-		-	
Vacant (Other)		852	27%		-	
Subtotal		1,261	41%		1,540	
Total						
		3,105	100%		4,529	

AKEL ENGINEERING GROUP, INC.

12/30/2021

Notes:

1. Union Gap land use based on Parcel Shapefile provided by Yakima City staff on April 16, 2020.
2. Residential dwelling unit count data from US Census Bureau American Community Survey.
3. Union Gap ultimate land use inventory extracted from Union Gap 2013 General Sewer Plan.

Table 2.5 Land Use Inventory - Terrace Heights UGA

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Land Use Classification	Existing (2020) Land Use Inventory[1]			Ultimate Land Use Inventory[3]		
	Dwelling Units[2] (DU)	Land Use (gr. acres)	Percent of Total (%)	Dwelling Units	Total Area within UGA (gr. acres)	Percent of Total (%)
Residential						
Single Family Residential	3,031	1,450	32%		2,804	50%
Multi-Family Residential	574	92	2.0%		465	8%
Subtotal	3,605	1,542	34%		3,269	58%
Non-Residential						
Commercial		313	7%		212	4%
Industrial		32	1%		1,046	19%
Institutional		75	2%		62	1%
Park		313	7%		1,003	18%
Subtotal		733	16%		2,323	42%
Non-Flow Generating						
Agricultural		661	15%			
Open Space (Water)						
Vacant		1,603	35%			
Subtotal		2,265	50%			
Total						
		4,540	100%		5,593	100%

AKEL ENGINEERING GROUP, INC.

12/30/2021

Notes:

1. Terrace Heights land use based on Parcel Shapefile provided by Yakima City staff on April 16, 2020.
2. Residential dwelling unit count data from US Census Bureau American Community Survey.
3. Terrace Heights ultimate land use inventory extracted from Terrace Heights Neighborhood Plan adopted 1999.

2.8.4 Moxee Service Area/Reserve

The Moxee Service Area/Reserve includes the City of Moxee located southeast of the City of Yakima. The amount of residential land use will increase from 244 acres in 2020 to 1,197 acres at ultimate or a 391 percent increase. The amount of non-residential land use will increase from 191 acres in 2020 to 1,154 acres at ultimate or a 504 percent increase. The amount of non-flow generating land use will decrease from 386 acres in 2020 to 0 acres at ultimate or a 100 percent decrease. **Table 2.6** documents the land use inventory for the City of Moxee. The existing land use is shown on **Figure 2.18**.

2.9 CURRENT AND PROJECTED POPULATION

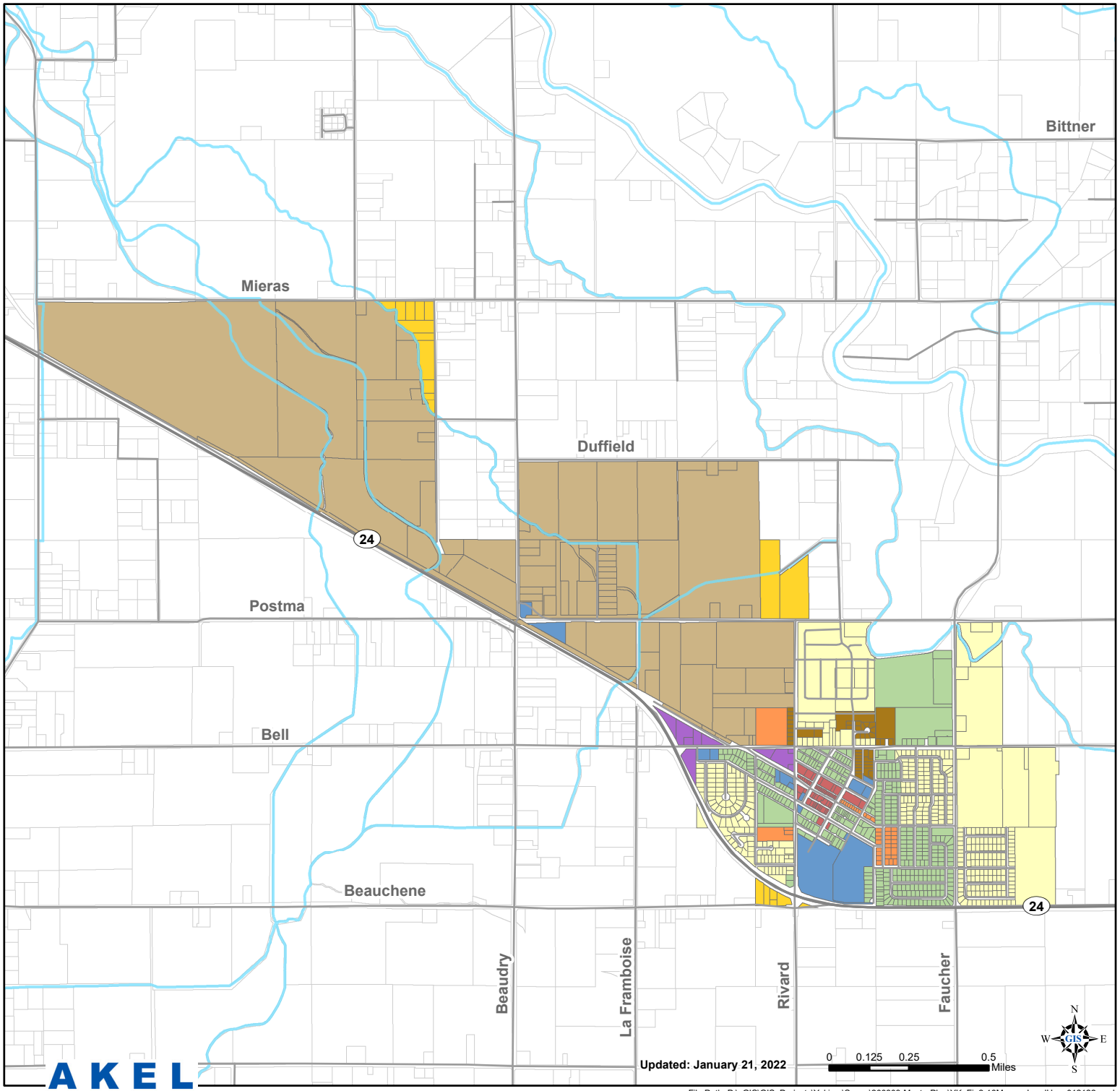
The sizes and capacities of a wastewater collection system are based on the population they serve. Historical population is used to understand trends in wastewater flows and the population projections are used to forecast infrastructure needs for future users.

From 2010 to present, the City of Yakima has observed an average growth rate of approximately 0.6 percent. Continuing this growth trend and consistent with the Yakima County 2015 Preferred Growth Alternative, the City of Yakima is projected to increase their service area population from 95,490 in 2020 to 110,387 in 2040, or a 15.6 percent increase.

For this master plan, an adjusted growth population projection was developed which artificially increases the growth rates in the early years to stay ahead of growth and trigger wastewater infrastructure upgrades ahead of the growth. While the overall average growth rate of 0.6% was maintained, consistent with the county document, the early year growth rate starts at 1.5% and gradually decreases to 0.1% percent per year and the resulting population projections are documented in **Table 2.7** and shown graphically on **Figure 2.19**.

The YRWWTP service area population has seen steady growth since 1960. The population of the service area is expected to grow from 111,278 in 2020 to 148,647 in 2040, or a 34 percent increase. The Moxee and Yakima UGAs are projected to see the greatest increase over the next 20 years.

The Yakima UGA is projected to grow from a population of 95,490 in 2020 to 127,035 people in 2040, a net increase of 31,545 or 33 percent. The Union Gap UGA population is projected to grow from 6,404 in 2020 to 7,151 people in 2040, a net increase of 747 or a 12 percent increase. The Terrace Heights UGA population is projected to grow from 5,119 in 2020 to 6,306 people in 2040, a net increase of 1,641 or 32 percent. The Moxee UGA population is projected to grow from 4,265 in 2020 to 7,701 people in 2040, a net increase of 3,436 or 81 percent. The population projections are summarized in **Table 2.8** and **Table 2.9**.



Legend

Moxee Land Use

- Single Family Residential
- Single Family and Manufactured Homes
- Single and Two Family Residential
- Multi-Family Residential
- Rural Residential
- Public
- Light Industrial
- General Commercial
- Central Business District
- Irrigation Canals
- Parcels
- Streets
- Highway

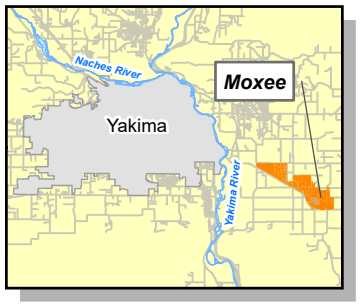
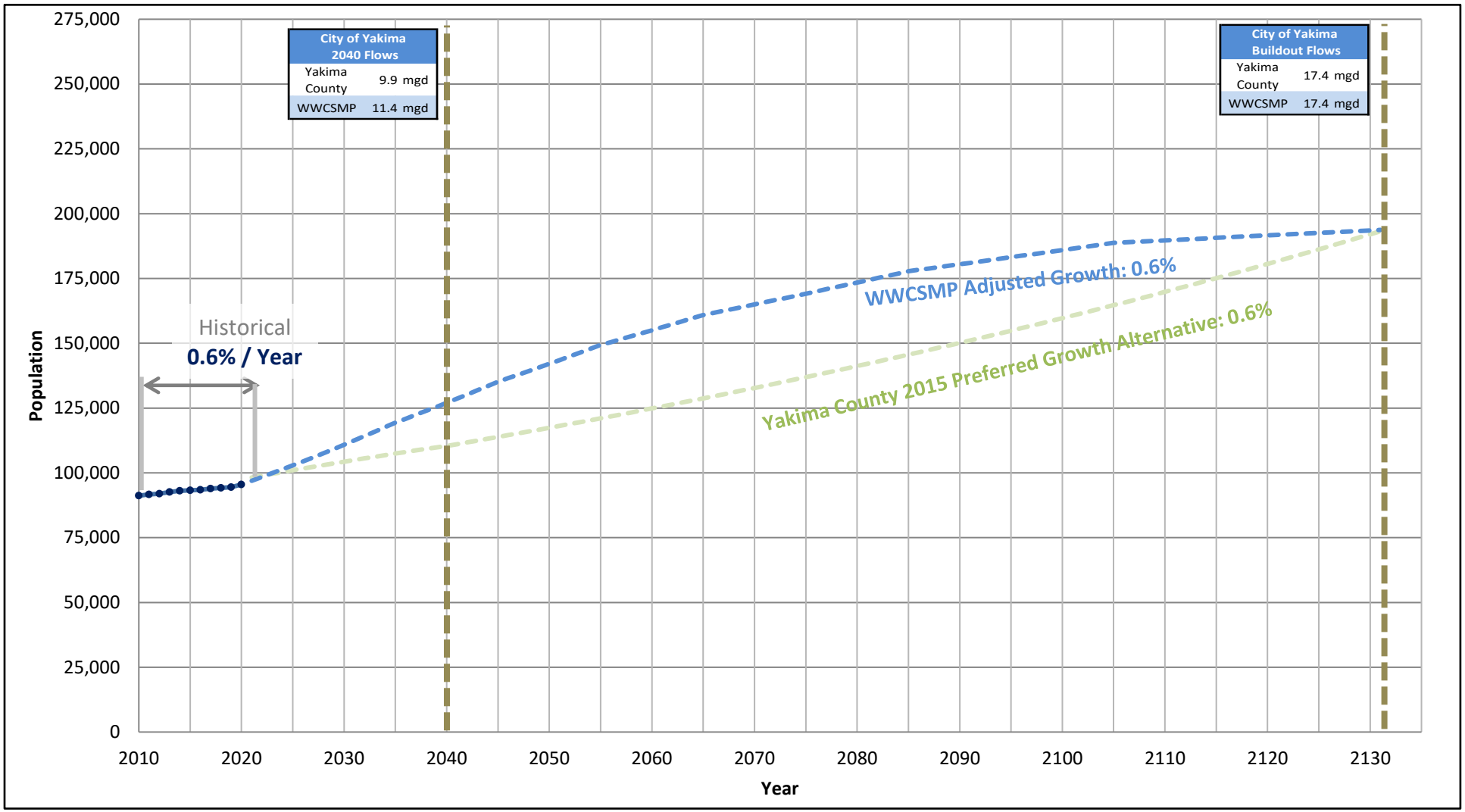


Figure 2.18
Moxee Land Use
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig2-18Moxee_LandUse_012122.mxd



LEGEND

- Historical Population
- Yakima County Growth Report
- WWCSMP Growth Scenario

PRELIMINARY

Notes:
1. WWCSMP Adjusted Growth scenario includes decreasing annual growth rates from 1.5% to 0.1% per year
2. City of Yakima buildout population estimated based on GPLU buildout flow of 17.4 mgd and 90 gpcd.
3. Yakima County populations between 2020 and 2040 extracted from Table 22b in Yakima County 2015 Population and Employment Projection Report.

February 25, 2021

Figure 2.19
City of Yakima Population Projections

Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

Table 2.6 Land Use Inventory - Moxee UGA

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Land Use Classification	Existing (2020) Land Use Inventory			Ultimate Land Use Inventory[3]		
	Dwelling Units[1] (DU)	2010 Land Use (gr. acres)	Percent of Total (%)	Dwelling Units	Total Area within UGA (gr. acres)	Percent of Total (%)
Residential						
Single Family Residential	1,089	235	29%		-	-
Multi-Family Residential	14	9	1%		-	-
Subtotal	1,103	244	30%		1197	51%
Non-Residential						
Commercial		78	10%		209	9%
Industrial		108	13%		792	34%
Institutional		5	1%		153	7%
Park		0.2	0.02%		-	-
Subtotal		191	23%		1154	49%
Non-Flow Generating						
Agricultural		174	21%		-	-
Open Space (Water)		-	-		-	-
Vacant		211	26%		-	-
Subtotal		386	47%		0	
Total						
		821	100%		**2,351**	100%

AKEL ENGINEERING GROUP, INC.

8/19/2021

Notes:

1. Moxee land use based on Parcel Shapefile provided by Yakima City staff on April 16, 2020.
2. Residential dwelling unit count data from US Census Bureau American Community Survey.
3. Moxee land use inventory extracted from City of Moxee 2020 General Sewer Plan.

Table 2.7 Historical and Projected Population (City of Yakima)

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Year	Population[1]	
Historical Population		
2009	90,271	
2010	91,196	
2011	91,630	
2012	91,930	
2013	92,620	
2014	93,080	
2015	93,220	
2016	93,410	
2017	93,900	
2018	94,190	
2019	94,440	
2020	95,490	
Projected Population	WWCSMP Adjusted Growth[2]	Yakima County 2015 Preferred Growth Alternative[3]
2021	96,922	98,210
2022	98,376	98,920
2023	99,852	99,620
2024	101,350	100,311
2025	102,870	100,993
2026	104,413	101,668
2027	105,979	102,335
2028	107,569	102,994
2029	109,182	103,645
2030	110,820	104,288
2031	112,482	104,926
2032	114,170	105,560
2033	115,882	106,189
2034	117,620	106,813
2035	119,385	107,433
2036	120,877	108,043
2037	122,388	108,644
2038	123,918	109,235
2039	125,467	109,816
2040	127,035	110,387

AKEL ENGINEERING GROUP, INC.

2/1/2021

Notes:

1. Population for years 2009-2020 received from City of Yakima 7/7/2020
2. WWCSMP Adjusted Growth reflects decreasing annual growth rates from 1.5% to 0.1% per year for an average annual of 0.6%/year
3. Populations extracted form Yakima County 2015 Population and Employment Projection Report.

Table 2.8 Historical and Projected Population (WWTP Service Area)

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Year	Population				
	Yakima[1]	Union Gap[2]	Moxee[3]	Terrace Heights[4]	Total
Historical Population					
2010	91,196	6,147	3,308	4,455	105,106
2011	91,630	6,153	3,415	4,517	105,715
2012	91,930	6,141	3,505	4,580	106,156
2013	92,620	6,132	3,655	4,644	107,051
2014	93,080	6,130	3,720	4,709	107,639
2015	93,220	6,142	3,810	4,775	107,947
2016	93,410	6,163	3,955	4,842	108,370
2017	93,900	6,165	4,010	4,910	108,985
2018	94,190	6,164	4,020	4,979	109,353
2019	94,440	6,200	4,141	5,048	109,829
2020	95,490	6,404	4,265	5,119	111,278
Projected Population					
2021	96,922	6,447	4,559	5,191	113,119
2022	98,376	6,489	4,692	5,263	114,821
2023	99,852	6,530	4,827	5,337	116,546
2024	101,350	6,571	4,966	5,412	118,298
2025	102,870	6,611	5,108	5,488	120,076
2026	104,413	6,651	5,253	5,564	121,881
2027	105,979	6,690	5,402	5,642	123,713
2028	107,569	6,728	5,555	5,721	125,573
2029	109,182	6,766	5,711	5,801	127,461
2030	110,820	6,803	5,871	5,883	129,377
2031	112,482	6,840	6,035	5,965	131,322
2032	114,170	6,877	6,203	6,048	133,298
2033	115,882	6,913	6,375	6,133	135,303
2034	117,620	6,949	6,552	6,219	137,340
2035	119,385	6,984	6,733	6,306	139,408
2036	120,877	7,019	6,918	6,394	141,208
2037	122,388	7,053	7,107	6,484	143,032
2038	123,918	7,086	7,300	6,575	144,878
2039	125,467	7,119	7,498	6,667	146,750
2040	127,035	7,151	7,701	6,760	148,647

AKEL ENGINEERING GROUP, INC.

2/3/2021

Notes:

1. City of Yakima population based on the following information:
   2010 - 2019: Historical data provided by City staff June 26, 2020.
   2020-2040. WWCSMP Adjusted Growth reflects decreasing annual growth rates from 1.5% to 0.1% per year for an average annual of 0.5%/year
2. City of Union Gap population based on the following information:
   2010 - 2019: Historical data provided by City staff June 26, 2020.
   2020 - 2040: Population extracted from Yakima County Planning Division 2015 Population Projection Report
3. City of Moxee population based on the following information:
   2010 - 2018: Historical data included in City of Moxee 2019 Draft General Sewer Plan
   2020 - 2040: Population extracted from Yakima County Planning Division 2015 Population Projection Report
4. City of Terrace Heights population based on the following information:
   2010 - 2019: Extrapolated from provided population projections assuming a historical 1.4% annual growth rate.
   2020 - 2040: Population projection received from City of Yakima staff. Reflects 1.4% annual growth rate based on moderate growth projection.

Table 2.9 Yakima Wastewater Service Area Population Projections

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Service Area	Population					Population Increase (2020 - 2040)			Households	
	2020[1]	2025[2]	2030[2]	2035[3]	2040[4]	Net Increase	Percent Increase	Annual Increase	Household Conversion Factor[5]	Total Projected New Households
Yakima UGA	95,490	102,870	110,820	119,385	127,035	31,545	33%	1.7%	2.68	11,771
Union Gap UGA	6,404	6,611	6,803	6,984	7,151	747	12%	0.6%	2.90	258
Terrace Heights UGA	5,119	5,488	5,883	6,306	6,760	1,641	32%	1.6%	2.51	654
Moxee UGA	4,265	5,108	5,871	6,733	7,701	3,436	81%	4.0%	3.72	924
Totals	**111,278**	**120,076**	**129,377**	**139,408**	**148,647**	**37,369**	**34%**	**1.7%**		**13,606**

AKEL ENGINEERING GROUP, INC.

9/24/2021

Notes:

1. City of Yakima population based on the following information:
   - 2010 - 2019: Historical data provided by City staff June 26, 2020.
   - 2020-2040. WWCSMP Adjusted Growth reflects decreasing annual growth rates from 1.5% to 0.1% per year for an average annual of 0.5%/year
2. City of Union Gap population based on the following information:
   - 2010 - 2019: Historical data provided by City staff June 26, 2020.
   - 2020 - 2040: Population extracted from Yakima County Planning Division 2015 Population Projection Report
3. City of Moxee population based on the following information:
   - 2010 - 2018: Historical data included in City of Moxee 2019 Draft General Sewer Plan
   - 2020 - 2040: Population extracted from Yakima County Planning Division 2015 Population Projection Report
4. City of Terrace Heights population based on the following information:
   - 2010 - 2019: Extrapolated from provided population projections assuming a historical 1.4% annual growth rate.
   - 2020 - 2040: Population projection received from City of Yakima staff. Reflects 1.4% annual growth rate based on moderate growth projection.
5. Source: Household conversion factors - 2019 Census data

CHAPTER 3 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the City's performance and design criteria which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed collection mains and lift stations.

3.1 HYDRAULIC CRITERIA

The hydraulic evaluation criteria presented in this section (established in the City's 2013 WWCSMP) was reviewed and verified by City staff and conforms to the Washington Department of Ecology's (DOE) criteria for Sewage Works Design.

In addition to applying the City design standards for evaluating hydraulic capacities; this master plan included dynamic hydraulic modeling. The dynamic modeling was a critical and essential element in identifying surcharge conditions resulting from downstream bottlenecks in the gravity sewers.

3.1.1 Gravity Sewers

Gravity sewer capacities depend on several factors including material and roughness of the pipe, the limiting velocity and slope, and the maximum allowable depth of flow. The hydraulic modeling software used for evaluating the capacity adequacy of the City's wastewater collection system, InfoSWMM by Innovyze Inc., utilizes the fully dynamic St. Venant's equation which has a more accurate engine for simulating backwater and surcharge, in addition to manifolded force mains. The software also incorporates the use of the Manning's Equation in other calculations including upstream pipe flow conditions.

Manning's Equation for Pipe Capacity

The Continuity equation and Manning's equation for steady-state flow are used for calculating pipe capacities in open channel flow. Open channel flow can consist of either open conduits or, in the case of gravity sewers, partially full closed conduits. Gravity full flow occurs when the conduit is flowing full but has not reached a pressure condition.

Continuity Equation

$Q = V \times A$

Where:
Q = peak flow, in cubic feet per second (cfs)
V = velocity, in feet per second (fps)
A = cross-sectional area of pipe, in square feet (sq. ft)

Manning's Equation

$V = (1.486\ R^{2/3}\ S^{1/2})/n$

Where:
V = velocity, in feet per second (fps)
n = Manning's roughness coefficient
R = hydraulic radius (area divided by wetted perimeter), ft
S = slope of pipe, in feet per foot

St. Venant's Equation for Pipe Capacity

Dynamic modeling facilitates the analysis of unsteady and non-uniform flows (dynamic flows) within a wastewater collection system. Some hydraulic modeling programs have the ability to analyze these types of flows using the St. Venant equation, which take into account unsteady and non-uniform conditions that occur over changes in time and cross-section within system pipes.

The St. Venant equation is a set of two equations, a continuity equation and a dynamic equation, that are used to analyze dynamic flows within a system. The first equation, the continuity equation, relates the continuity of flow mass within the system pipes in terms of: (A) the change in the cross-sectional area of flow at a point over time and (B) The change of flow over the distance of piping in the system.

Continuity Equation

$$\underset{(A)}{\frac{\partial A}{\partial t}} + \underset{(B)}{\frac{\partial Q}{\partial x}} = 0$$

Where:
t = time
x = distance along the longitudinal direction of the channel
Q = discharge flow
A = flow cross-sectional area perpendicular to the x directional axis

The second equation, the dynamic equation, relates changes in flow to fluid momentum in the system using: (A) Changes in acceleration at a point over time, (B) Changes in convective flow acceleration, (C) Changes in momentum due to fluid pressure at a given point, (D) Changes in momentum from the friction slope of the pipe and (E) Fluid momentum provided by gravitational forces. The dynamic equation is provided below:

Dynamic Equation

$$\underset{(A)}{\frac{\partial Q}{\partial t}} + \underset{(B)}{\frac{\partial}{\partial t}\left(\beta \frac{Q^2}{A}\right)} + \underset{(C)}{gA\frac{\partial y}{\partial x}} + \underset{(D)}{gAS_f} - \underset{(E)}{gAS_o} = 0$$

Where:
t = time
x = distance along the longitudinal direction of the channel
Q = discharge flow
A = flow cross-sectional area perpendicular to the x directional axis
y = flow depth measured from the channel bottom and normal to the x directional axis
S_f = friction slope
S_o = channel slope
β = momentum
g = gravitational acceleration

Use of this method of analysis provides a more accurate and precise analysis of flow conditions within the system compared to steady state flow analysis methods. It must be noted that two assumptions are made for use of St. Venant equations in the modeling software. First, flow is one dimensional. This means it is only necessary to consider velocities in the downstream direction and not in the transverse or vertical directions. Second, the flow is gradually varied. This means the vertical pressure distribution increases linearly with depth within the pipe.

Manning's Roughness Coefficient (n)

The Manning roughness coefficient 'n' is a friction coefficient that is used in the Manning formula for flow calculation in open channel flow. In sewer systems, the coefficient can vary between

0.009 and 0.017 depending on pipe material, size of pipe, depth of flow, root intrusion, smoothness of joints, and other factors.

For the purpose of this evaluation, and in accordance with City standards, an “n” value of 0.013 was used for both existing and proposed gravity sewer pipes unless directed otherwise by City staff based on pipe structural condition. This “n” value is an acceptable practice in planning studies.

Partial Flow Criteria (d/D)

Partial flow in gravity sewers is expressed as a depth of flow to pipe diameter ratio (d/D). For circular gravity conduits, the highest capacity is generally reached at 92 percent of the full height of the pipe (d/D ratio of 0.92). This is due to the additional wetted perimeter and increased friction of a gravity pipe.

When designing sewer pipelines, it is common practice to use variable flow depth criteria that allow higher safety factors in larger sizes. Thus, design d/D ratios may range between 0.5 and 0.92, with the lower values used for smaller pipes. The smaller pipes may experience flow peaks greater than planned or may experience blockages from debris. The d/D criteria used in this analysis are summarized in **Table 3.1**.

During peak dry weather flows (PDWF), the maximum allowable d/D ratio for proposed pipes 12 inches in diameter and smaller is 0.5, and for proposed pipes larger than 12 inches in diameter, the maximum allowable d/D ratio is 0.75. The maximum allowable d/D ratio for all existing pipes (all diameters) is 0.92. The criterion for existing pipes is relaxed in order to maximize the use of the existing pipes before costly pipe improvements are needed.

During peak wet weather flows (PWWF), to avoid premature or unnecessary trunk line replacements, the capacity analysis allowed the d/D ratio to exceed the dry weather flow criteria and surcharge. This condition is evaluated using the dynamic hydraulic model and the criteria listed in **Table 3.1** stipulates that the hydraulic grade line (HGL), even during a surcharged condition, should be at least three feet below the manhole rim elevation.

Minimum Pipe Sizes and Design Velocities

In order to minimize the settlement of sewage solids, it is standard practice in the design of gravity sewers to specify that a minimum velocity of 2 feet per second (fps) be maintained when the pipeline is half-full. At this velocity, the sewer flow will typically result with self-cleaning of the pipe.

Due to the hydraulics of a circular conduit, velocities in pipelines flowing half-full approach that of pipelines flowing nearly full. **Table 3.1** lists the minimum slopes and velocities, varying by pipe size, in accordance with the City’s design standards The design standards also specify minimum pipe sizes, depending on peak dry weather flows, as shown in **Table 3.1**.

Table 3.1 Sewer System Performance and Design Criteria

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Pipeline Criteria		
Peak Dry Weather Flow Criteria		
Diameter	**Maximum Allowable d/D**	
(in)	**Existing Trunks**	**Proposed Trunks**
8 to 12	**0.92**	**0.50**
> 12	**0.92**	**0.75**
Peak Wet Weather Flow Criteria		
Hydraulic Grade Line (HGL) should be at least **3 feet** below the manhole rim		
Minimum Slopes for Gravity Pipes		
Pipe Size	**Minimum Grade**	**Capacity[1]**	**Velocity[1]**
15	0.0015	1.73	2.30
16	0.0014	2.05	2.40
18	0.0012	2.81	2.60
21	0.0010	4.24	2.88
24	0.0008	6.05	3.14
27	0.0007	8.28	3.40
30	0.0006	10.97	3.65
36	0.0005	17.87	4.12
Lift Station Criteria		
Lift Station Capacity		
Lift Station capacity shall be sized to meet Peak Wet Weather Flow with largest unit out of service		
Force Main Capacity		
Force main velocity not to exceed 10 ft/s under peak wet weather flow conditions		

Notes

1. Pipe friction factor assumed at 0.013.

Changes in Pipe Size

When a smaller gravity sewer pipe joins a larger pipe, the invert of the larger pipe is generally lowered to maintain the same energy gradient. One of the methods used to approximate this condition includes placing the 80 percent depth point (d/D at 0.8) from both sewers at the same elevation. For master planning purposes, and in the absence of known field data, sewer crowns were matched at the manholes.

3.1.2 Force Mains and Lift Stations

The Hazen-Williams formula is commonly used for the design of force mains as follows:

Hazen Williams Velocity Equation

$V = 1.32\ C\ R^{0.63}\ S^{0.54}$

Where:
V = mean velocity, fps
C = roughness coefficient
R = hydraulic radius, ft
S = slope of the energy grade line, ft/ft

The value of the Hazen-Williams 'C' varies and depends on the pipe material and is also influenced by the type of construction and pipe age. A 'C' value of 110 was used in this analysis.

The minimum recommended velocity in force mains is at 2 feet per second (fps). The economical pumping velocity in force mains ranges between 3 and 5 fps. A maximum desired velocity is typically around 7 fps and a maximum not-to-exceed velocity is at 10 fps.

The capacities of pump stations are evaluated and designed to meet the peak wet weather flows (PWWF) with one standby pump having a capacity equal to the largest operating unit. The standby pump provides a safety factor in case the duty pump malfunctions during operations, and allows for maintenance.

3.2 DRY WEATHER FLOW CRITERIA

Wastewater unit flow factors are coefficients commonly used in planning level analysis to estimate future average daily wastewater flows for areas with predetermined land uses. The unit factors are multiplied by the number of dwelling units or gross acreage for residential categories, and by the gross acreages for non-residential categories, to yield the average daily wastewater flow projections.

3.2.1 Wastewater Unit Flow Factors Methodology

Wastewater unit factors are developed by using water consumption records and applying a return to sewer ratio for each land use to estimate wastewater flow coefficients. There are several methods for developing the unit factors .This analysis relied on the City's 2019 water consumption billing records, which lists the monthly water consumption per customer account, by land use type, to estimate the unit factors within the service area.

3.2.2 Average Daily Wastewater Unit Flow Factors

Wastewater flow factors were based on water demands as extracted from the City's 2019 water consumption billing records. A return to sewer ratio was applied to each unadjusted water demand factor for individual land uses, and wastewater flows were balanced to the YRWWTP flows. The existing unit factor analysis is shown in **Table 3.2**,

Generally, non-residential land uses return the majority of the water demand to the wastewater collection system. These unit factors were estimated at 90 percent return to sewer ratio. The same concept can be applied to low-, medium-, and high-density residential lots, which were estimated to range from 65 percent to 80 percent return to sewer ratio, respectively. Lastly, unit factors were adjusted to 100 percent occupancy and rounded.

Table 3.2 also lists the recommended unit factors used in this master plan for estimating future flows from undeveloped lands within the City's UGA. The recommended unit factors used for estimating future flows were increased and adjusted to match measured YRWWTP flows provided by City staff

The recommended wastewater unit factors are summarized in **Table 3.3.** This WWCSMP accounted for areas that are currently serviced by septic systems, though they were excluded from the unit flow factor calculations and included as future tributary flows to the wastewater collection system.

3.2.3 Suggested Unit Flow Factors for New Developments

The wastewater unit flow factors used in this master plan are based on wastewater characteristics derived from 2019 water consumption and YRWWTP flow records. During the planning phase of new developments, and as specific land use types become known or are considered, the unit flow factors documented in **Table 3.4** may be used. These unit flow factors for residential and non-residential land use classifications were extracted from the Department of Ecology Criteria for Sewage Works Design. The unit flow factors for institutional land use classification are intended to supplement the criteria provided by the Department of Ecology.

3.2.4 Flow Peaking Factors

The wastewater collection system is evaluated based on its ability to convey peak sewer flows. Peaking factors represent the increase in wastewater flows experienced above the average dry weather flows (ADWF). The various peaking conditions are numerical values obtained from a review of historical data and, at times, tempered by engineering judgment.

The peaking conditions that are significant to hydraulic analysis of the wastewater collection system include:

- Peak Dry Weather Flows (PDWF)

Table 3.2 Wastewater Flow Unit Factor Analysis

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Land Use Classification	Existing Development	2019 Average Daily Water Demand Unit Factors		2019 Average Unit Flow Factors (For Non-Irrigation Season)						Recommended Sewer Unit Factors			
		Annual Consumption	Unadjusted Water Unit Factors	Return to Sewer Ratio	Average Annual Sewer Flows: Unadjusted Sewer Unit Factor	Average Annual Sewer Flows: Balance Using Unit Factor	Sewer Flows at 100% Occupancy: Vacancy Rate[1]	Sewer Flows at 100% Occupancy: Projected Flows at 100% Occupancy		Base Flow Unit Factor	Balance Using Recommended Factor	Adjusted Average Annual Flow Factors: Flows Adjusted to Average Annual	Adjusted Average Annual Flow Factors: Recommended Unit Factor
	(acres)	(gpd)	(gpd/acre)		(gpd/acre)	(gpd)		(gpd/acre)	(gpd)	(gpd/acre)	(gpd)	(gpd)	(gpd/acre)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Residential													
Single Family Residential	8,119	2,547,696	314	0.65	204	1,656,002	2.0%	208	1,689,122	225	1,826,801	2,895,794	375
Multi Family Residential	808	1,244,308	1,540	0.80	1,232	995,446	4.9%	1,292	1,044,223	1,300	1,050,495	1,665,216	2,250
Subtotal - Residential	8,927	3,792,003				2,651,448			2,733,345		2,877,296	4,561,010	
Non-Residential													
Commercial	1,938	1,345,008	694	0.90	625	1,210,507	11.5%	697	1,349,715	700	1,356,440	2,150,192	1,225
Hotel	63	218,324	3,479	0.90	3,131	196,492	0%	3,131	196,492	3,150	197,658	313,322	5,425
Industrial	723	182,543	253	0.90	227	164,288	11.5%	253	183,181	275	198,719	315,004	450
Institutional	728	336,092	462	0.90	415	302,482	0.0%	415	302,482	425	309,413	490,473	725
Subtotal - Non-Residential	3,451	2,081,966				1,873,770			2,031,871		2,062,230	3,268,990	
Other													
Other	1,101	45,532	41	0.00	0	0	0%	0	0	0	0	0	0
Other, Ag & Mines	2,551	223	0	0.00	0	0	0%	0	0	0	0	0	0
Parks and Rec	915	64,593	71	0.00	0	0	0%	0	0	0	0	0	0
Vacant	3,212	15,751	5	0.00	0	0	0%	0	0	0	0	0	0
Subtotal - Other	7,779	126,099				0			0		0	0	0
Total				**2019 Non-Irrigation Season Average Flows**									
	20,157	6,000,069			Estimated Sewer Flows	4,525,218			4,765,216		4,939,526	7,830,000	
					Measured WWTP Flows[2]	**6,692,381**							

AKEL ENGINEERING GROUP, INC.

2/22/2021

Notes:

1. Vacancy rate information based on the following:
   - Single Family Residential: Homeowner vacancy rate per 2016 Draft Yakima Comprehensive Plan, Housing
   - Multi-Family Residential: Rental vacancy rate per 2016 Draft Yakima Comprehensive Plan, Housing
   - Commercial, Industrial: Yakima County 2019 Retail Market Trend Report prepared by CJM Advisors
2. Measured WWTP flows reflect 2019 flow data provided by City staff for the months January-March, November-December

Table 3.3 Recommended Unit Factors

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Land Use Classification	Recommended Factor (gpd/acre)
Residential	
Single Family Residential	475
Multi Family Residential	2,025
Non-Residential	
Commercial	950
Hotel	3,650
Industrial	475
Institutional	525
Additional Planning Designations	
Low Density Residential[1]	475
Mixed Residential[2]	2,025
Regional Commercial[3]	950
Community Mixed Use[3]	950
Commercial Mixed Use[4]	1,550
Central Business Core Commercial[4]	1,550

AKEL ENGINEERING GROUP, INC.

2/22/2021

Notes:

1. Assumed equal to Single Family Residential factor
2. Assumed equal to Multi Family Residential factor
3. Assumed equal to Commercial factor
4. Assumed consistent with 2013 Wastewater Collection System Master Plan

Table 3.4 Suggested Unit Flow Factors for New Developments

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Land Use Type	Units	Average Daily Flow Factor (gpd)	BOD (lb/day)	SS (lb/day)	Flow Duration (hr)
Commercial Flow Factors (Source: CSWD Washington State Department of Ecology[1])					
Dwellings	per person	100	0.20	0.20	24
Schools with showers and cafeteria	per person	16	0.04	0.04	8
Schools without showers and with cafeteria	per person	10	0.025	0.025	8
Boarding schools	per person	75	0.20	0.20	16
Motels at 65 gal/person (rooms only)	per room	130	0.26	0.26	24
Trailer courts at 3 persons/trailer	per trailer	300	0.60	0.60	24
Restaurants	per seat	50	0.20	0.20	16
Interstate or through-highway	per seat	180	0.70	0.70	16
Interstate rest areas	per person	5	0.01	0.01	24
Service stations	per vehicle serviced	10	0.01	0.01	16
Factories	per person per 8-hr shift	15-35	0.03-0.07	0.03-0.07	Operating period
Shopping centers	per 1,000 sqft of ultimate floor space	200-300	0.01	0.01	12
Hospitals	per bed	300	0.60	0.60	24
Nursing Homes	per bed	200	0.30	0.30	24
Homes for the aged	per bed	100	0.20	0.20	24
Doctor's office in medical center	per 1,000 sqft	500	0.10	0.10	12
Laundromats, 9 to 12 machines	per machine	500	0.30	0.30	16
Community college	per student or faculty	15	0.03	0.03	12
Swimming pools	per swimmer	10	0.001	0.001	12
Theaters, drive-in type	per car	5	0.01	0.01	4
Theaters, auditorium type	per seat	5	0.01	0.01	12
Picnic areas	per person	5	0.01	0.01	12
Resort camps, day and night, with limited plumbing	per campsite	50	0.05	0.05	24
Luxury camps with flush toilets	per campsite	100	0.10	0.10	24
Industrial Flow Factors (Source: Metcalf and Eddy)					
Cannery					
Peaches and Pears	gal/ton	4,500			
Apples	gal/ton	2,000			
Other Fruits	gal/ton	3,500 - 8,000			
Vegetables	gal/ton	12,000 - 16,000			
Chemical					
Ammonia	gal/ton	25,000			
Sulfur	gal/ton	2,500			
Food and Beverage					
Beer	gal/ton	3,500			
Meat Packing	gal/ton	5,000			
Milk Products	gal/ton	5,000			
Pulp and Paper					
Pulp	gal/ton	150,000			
Paper	gal/ton	35,000			

Notes:

1. Source: Table G2-2. Design Basis for New Sewage Works

- Peak Wet Weather Flows (PWWF)

Typical values for peaking factors of 2.0 or less are generally used to estimate peak flows at treatment facilities where flow fluctuations are smoothed out during the time of travel in the wastewater collection system, while peaking factors between 3.0 and 4.0 are used to estimate peak flows in the smaller upstream areas of the system where low flow conditions are prone to greater fluctuations.

The Criteria for Sewage Works Designs (CSWD) methodology for determining the peaking factor is based on population. The CSWD provides Figure C1-1, titled *Ratio of Peak Hourly Flow to Design Average Flow*, which can be used for estimating peak flows from new subdivisions. According to the CSWD methodology, the peaking factor should not be less than 2.5.

This master plan developed 24-hour diurnal patterns for dry weather flows based on a flow monitoring program as documented on **Figures 3.1**. These diurnal patterns are comprised of peaking hours meant to simulate the hourly change in flows within the system, averaging a factor of 1.0 over 24 hours. The PDWF is used for evaluating the capacity adequacy of the wastewater collection system, and to meet the criteria set forth in the City standards.

3.3 WET WEATHER FLOW CRITERIA

The wet weather flow criteria accounts for the infiltration and inflows (I&I) that seep into the City's wastewater collection system during storm events.

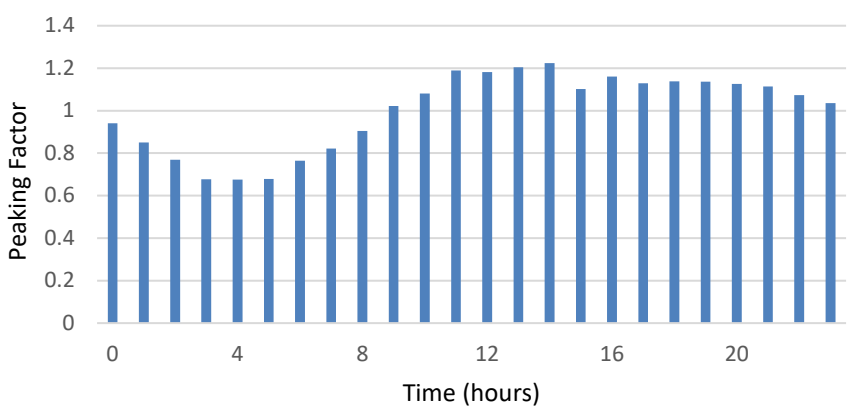
3.3.1 Infiltration and Inflow

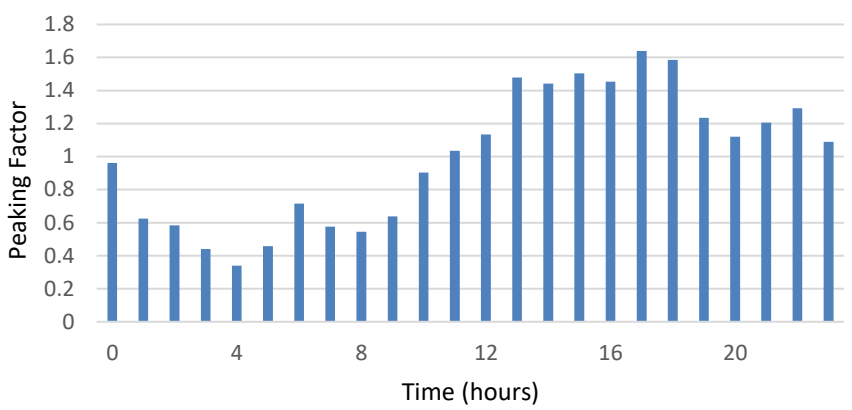
Groundwater Infiltration and Inflow (I&I) is associated with extraneous water entering the wastewater collection system through defects in pipelines and manholes. Infiltration occurs when groundwater rises or the soil is saturated due to seasonal factors such as storm events, leaking canals, or other leaking irrigation facilities which cause an increase in flow in the collection system. The ground water will enter the wastewater collection system through cracks in the pipes or deteriorating manholes. Inflow occurs when surface water enters the wastewater collection

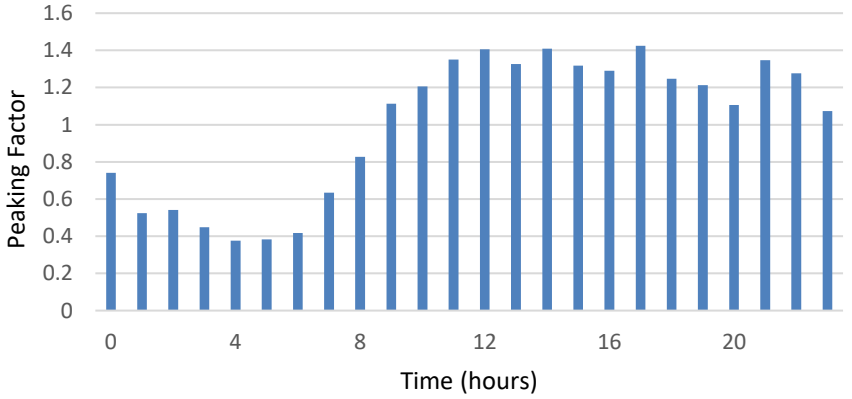
system from storm drain cross connections, manhole covers, or roof/footing drains. **Figure 3.2** was developed by King County, Washington and was included in this chapter to illustrate the typical causes of infiltration and inflow.

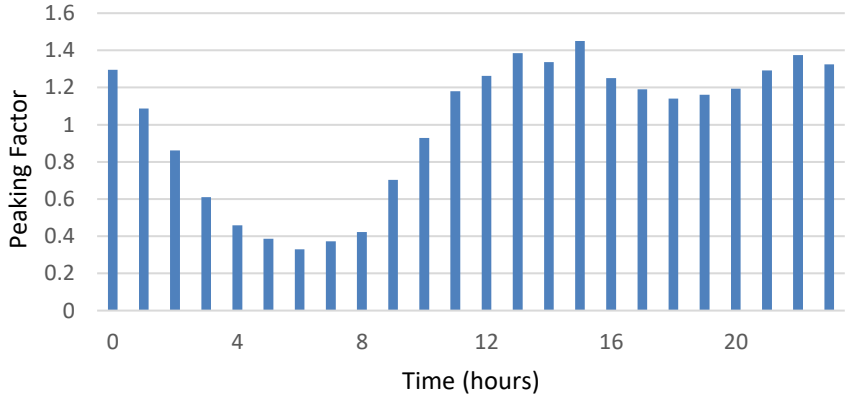
There are several accepted methodologies for estimating infiltrations and inflows (I&I). These include:

- **Methodology 1.** Based on Acreages. In this methodology, factors that may range between 400 and 1,500 gallons per day (gpd) or more are applied to acreages for estimating the I&I component.









LEGEND

Peaking Factor

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix A

August 13, 2021

AKEL ENGINEERING GROUP, INC.

Figure 3.1

Diurnal Patterns

Wastewater Collection System Master Plan

City of Yakima

- **Methodology 2.** Based on Linear Feet of Pipe. In this methodology, factors may range between 12 and 30 or more gallons per day per inch diameter per 100 linear feet (gpd/inch diameter/100LF) are applied to linear feet of gravity sewers.

- **Methodology 3**. Based on a percentage of Average Dry Weather Flows. In this methodology, Infiltration and Inflows (I&I) are calculated based on a percentage of the average dry weather flow.

- **Methodology 4**. Based on flow monitoring data. In this methodology, infiltration and inflows are determined by analyzing flow monitoring data of current and past flow monitoring efforts.

This capacity analysis and master plan based the infiltration and inflow on specific flow monitoring data from each monitored site in the City's flow monitoring program. City-owned monitors were installed, and data was provided by City staff. Thus, the infiltration and inflows presented in this master plan are reasonable and reflect the actual behavior of the wastewater collection system.

3.3.2 Flow Monitoring Program

In 2020 the City performed a temporary flow monitoring program to capture 18 sites during dry weather flow conditions. The flow meter locations are documented in **Table 3.5** and shown graphically on **Figure 3.3**. The flow monitoring data was used in this analysis to calibrate the computer hydraulic model to average dry weather flow conditions.

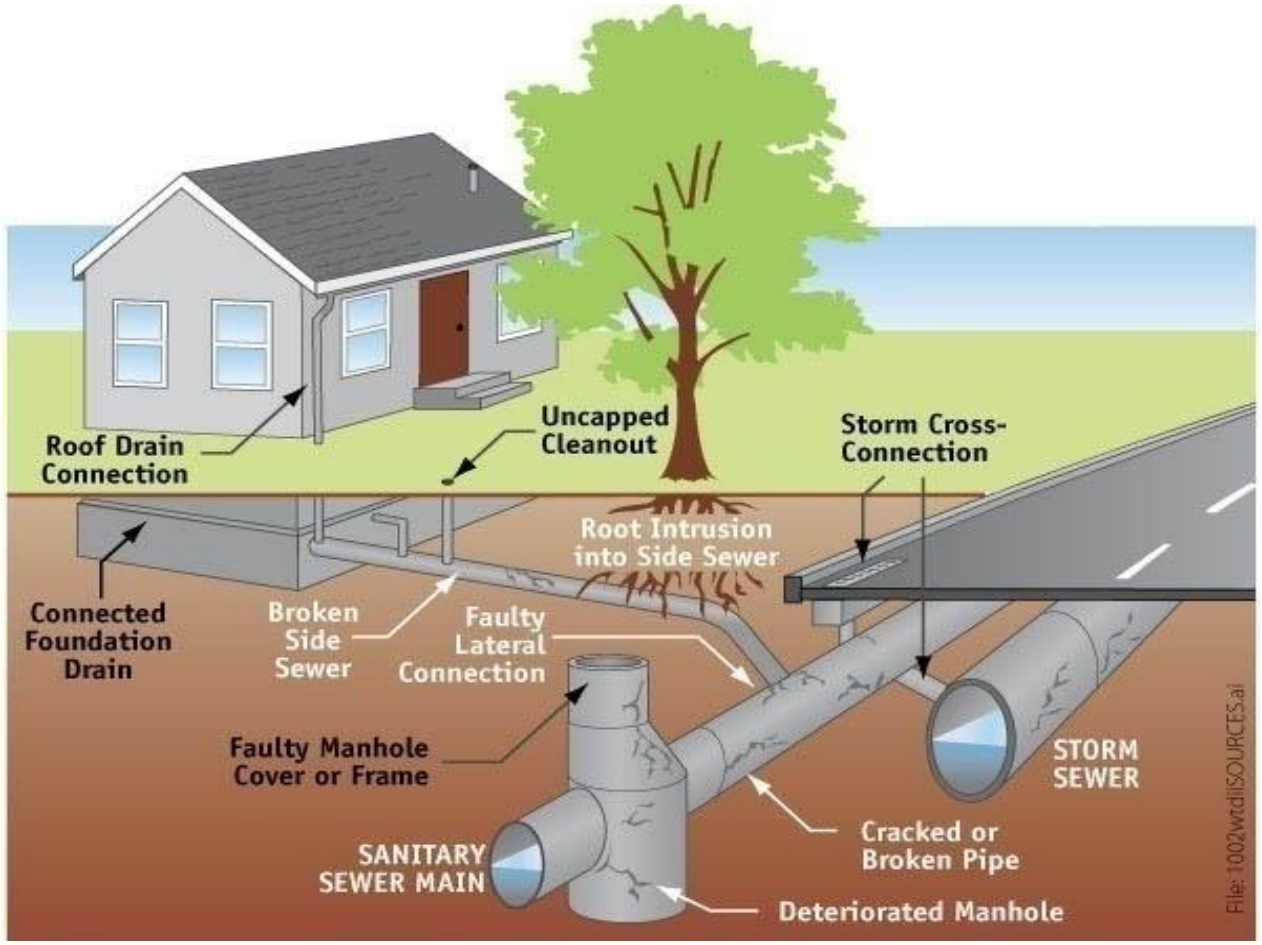
Wet weather flows were not captured during the 2020 temporary flow monitoring period. Therefore, the wet weather response characteristics of the collection system were adopted from the 2013 WWCSMP and the hydraulic model results were compared to the City-provided flow data from the YRWWTP for validation purposes. Historical and recent WWTP flow data was used to analyze the seasonal flow patterns experienced in the City's wastewater collection system and to evaluate the effects of the rehabilitation of the irrigation system on the infiltration and inflows.

3.3.3 10-Year 24-Hour Design Storm

A synthetic design storm is typically used to evaluate the wastewater collection system's response during wet weather flow conditions.

- **10-Year Frequency.** Industry standards include design storms that range between 5-year and 20-year events. Based on current regulatory trends, a 10-year storm event was chosen for the City of Yakima to evaluate the capacity adequacy of the wastewater collection system.

- **24-Hour Duration.** Peak flows from a storm event are usually caused by brief intense rains, that can happen as part of an individual event or as a portion of a larger storm. The 24-hour storm duration is longer than needed to determine peak flow but aids in identifying



Source: King County, WA
http://www.kingcounty.gov/environment/wastewater/II/What.aspx?print=1

LEGEND

Inflow Sources (Black Text)

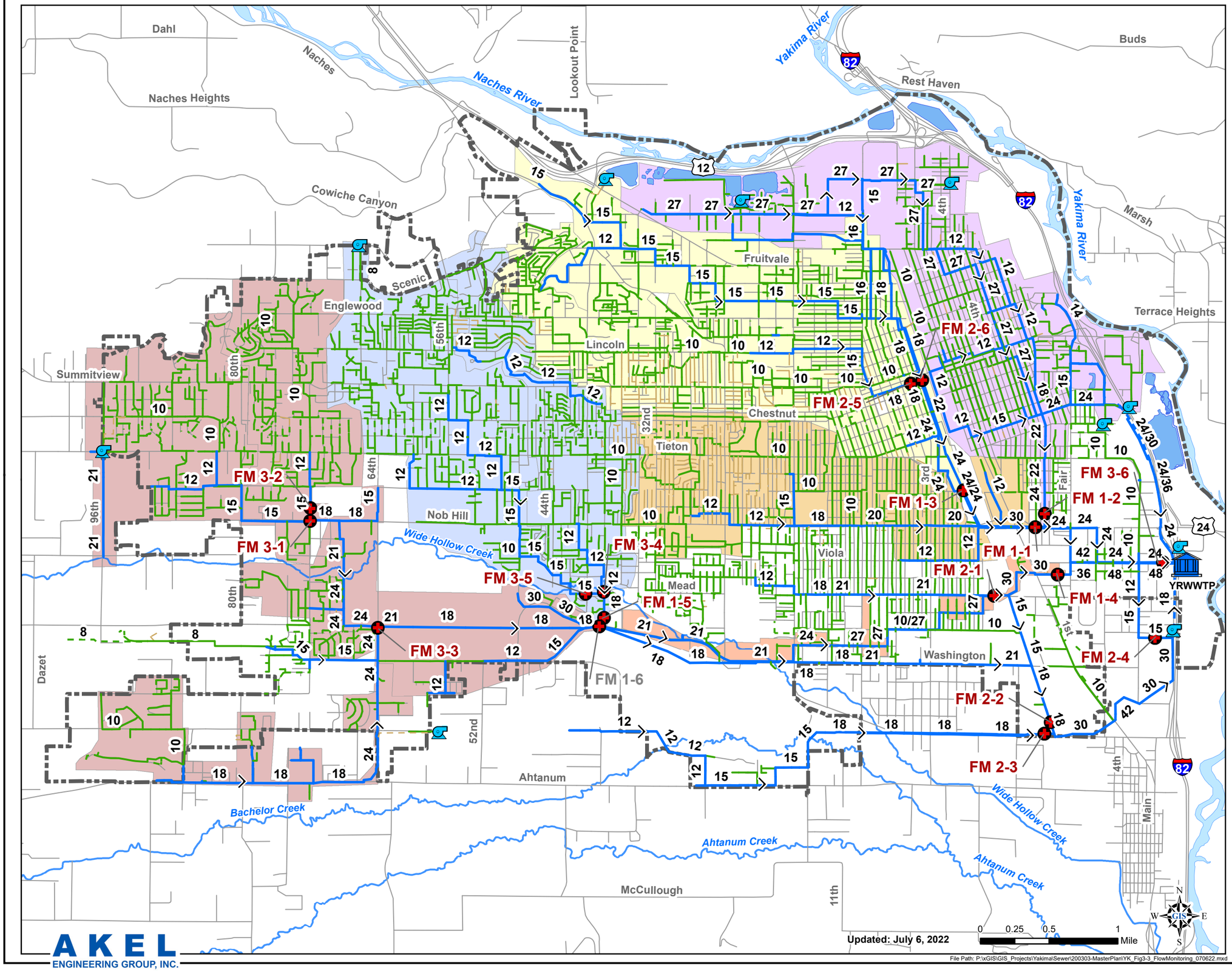
Infiltration Sources (White Text)

PRELIMINARY

Figure 3.2
Infiltration and Inflow Sources
Wastewater Collection System Master Plan
City of Yakima

December 13, 2021

AKEL ENGINEERING GROUP, INC.



Legend

- Flow Meter Locations

Existing System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main
- Streets

Flow Monitoring Basins

- Basin 1-1
- Basin 1-2
- Basin 1-3
- Basin 1-4
- Basin 1-5
- Basin 1-6
- Yakima City Limits
- Streams
- Lakes

PRELIMINARY

Figure 3.3
Flow Monitoring Program
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

Table 3.5 Flow Monitor Sites

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Site ID	GIS Manhole ID[1]	Location Description	Pipe Size[1] (in)	Monitoring Periods From Date	To Date
Monitoring Period 1					
FM 1-1	E43MH43	Nob Hill Blvd between 6th St and 7th St	30 (West)	7/1/2020	7/7/2020
FM 1-2	E43MH30	Alley between 7th St and 8th St, approx. 450' n/o Nob Hill Blvd	24 (North)	6/25/2020	7/2/2020
FM 1-3	E30MH18	Arlington St approx. 300' e/o Landon Ave	24 (North)	6/24/2020	7/1/2020
FM 1-4	E42MH91	Tennant Ln, approx. 450' w/o Fair Ave	30 (West)	7/4/2020	7/7/2020
FM 1-5	W32MH44	Industrial property n/o Washington Ave between 40th Ave and 36th Ave	18 (North)	6/29/2020	7/6/2020
FM 1-6	W32MH90	Washington Ave between 40th ave and 36th ave	18 (West)	6/25/2020	7/2/2020
FM 1-7	E42MH42	Mead Av, approx. 500' e/o Voleker Ave	18 (West)	6/30/2020	7/7/2020
Monitoring Period 2					
FM 2-1	E40MH2A	Industrial property approx. 500' n/o Valley Mall Blvd railroad overpass, e/o Longfibre Rd	21 (North)	6/17/2020	6/23/2020
FM 2-2	E40MH70	Valley Mall Blvd, approx. 1,000 ft east of Longfibre Rd	24 (West)	6/16/2020	6/23/2020
FM 2-3	E63MH20	Lilac Ln, between 18th St and Rudkin Rd	15 (West)	6/17/2020	6/23/2020
FM 2-4	E21MH13	3rd Ave, approx. 200' s/o Yakima Ave	18 (West)	6/17/2020	6/23/2020
FM 2-5	E21MH11	2nd Ave, approx. 150 ft South of Yakima Ave	22 (North)	6/24/2020	6/29/2020
FM 2-6	W21MH17	Intersection of 27th Ave and Lincoln Ave	10 (South)	6/17/2020	6/23/2020
Monitoring Period 3					
FM 3-1	W78MH22	Intersection of 72nd Ave and Nob Hill Blvd	15 (West)	7/9/2020	7/16/2020
FM 3-2	W78MH24	72nd Ave, approx. 450 ft north of Nob Hill Blvd	15 (North)	7/9/2020	7/16/2020
FM 3-3	W80MH10	64th Ave, approx. 100' n/o Terry Ave	24 (South)	7/11/2020	7/16/2020
FM 3-4	W31MH1	Parking lot between Creekside Ct and Wide Hollow Creek	15 (North)	7/9/2020	7/16/2020
FM 3-5	W42MH39	40th Ave, approx. 100 ft n/o Creekside Lp	15 (West)	7/9/2020	7/16/2020
FM 3-6	E64IW45	Viola Ave and w/o Rudkin Rd (Industrial Waste Trunk)	24 (West)	7/9/2020	7/16/2020
FM 3-7	E21IW14	Intersection of Yakima Ave and 2nd Ave	18 (North)	7/9/2020	7/16/2020

Note:

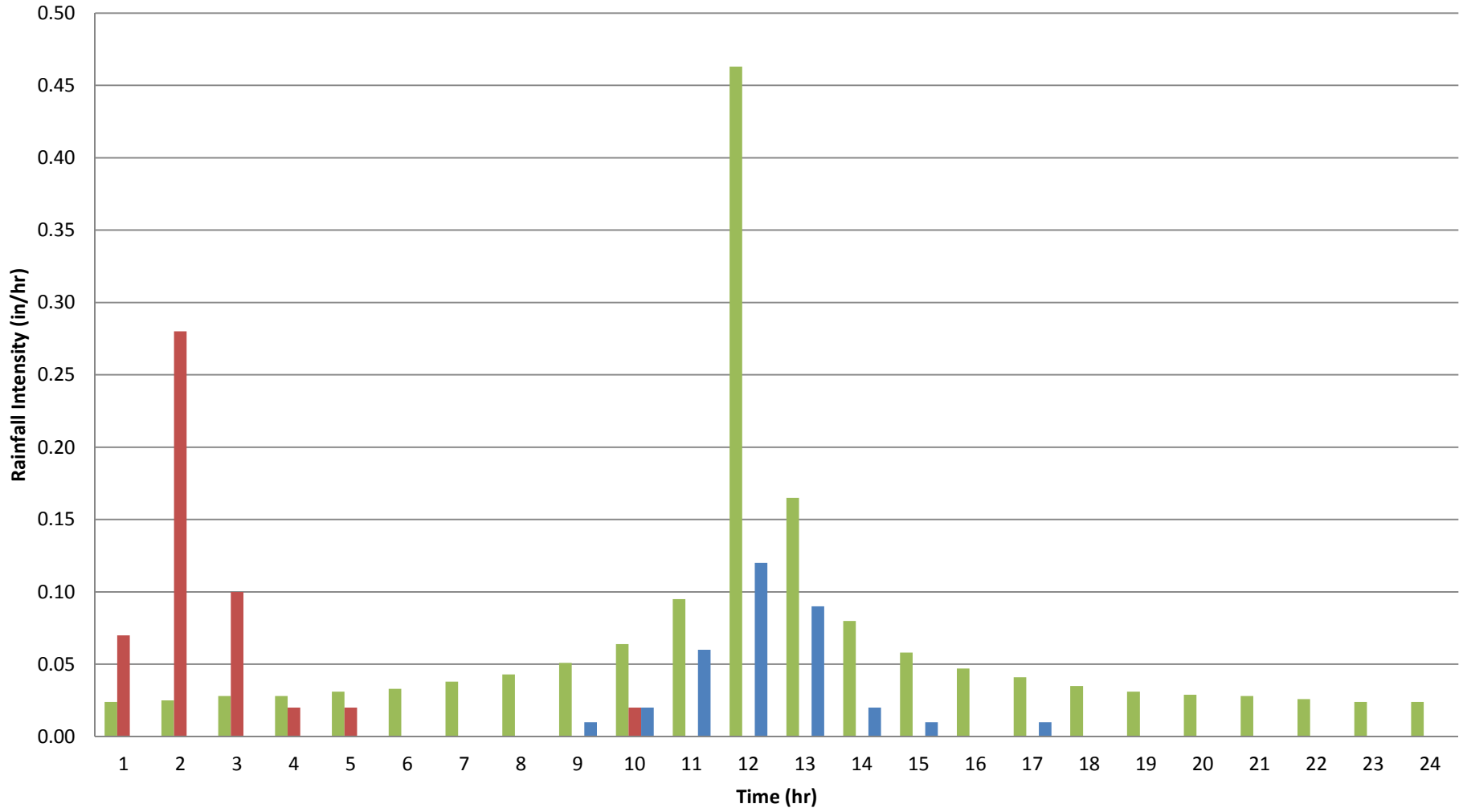
1. The compass direction shown corresponds to the direction from which the pipeline to be metered enters the manhole. Inlet pipes are recommended for meter placement to mitigate the impact of potential turbulence on meter readings.

infiltration and inflow that a wastewater collection system may experience during a storm event.

- **NRCS Type IA Distribution.** The National Resources Conservation Service (NRCS), previously known as the Soil Conservation Service, has developed rainfall distributions for wide geographic regions based on traditional Intensity-Duration-Frequency (IDF) rainfall data. In this methodology, the highest rainfall intensity is placed at the center of the storm. Incrementally lower intensities are placed on alternating sides of the peak. The Type IA distribution is recommended for the Yakima area and was used in this study.

Thus, the 10-year 24-hour design storm, with an NRCS Type IA distribution, was used to evaluate the capacity adequacy of the City's wastewater collection system during wet weather flow conditions. The selected 10-year 24-hour design storm was further compared to historical storm events, between October 2004 and November 2021, as shown in **Table 3.6**. The table lists the total rainfall volume, duration, peak hour intensity, and total monthly rainfall (if available) for each storm event.

Figure 3.4 is intended to show the diurnal comparison between the design storm and two storm events experienced during the 2013 WWCSMP flow monitoring program. The comparison indicates that, based on the NRCS Type IA distribution, the design storm's peak hour value is at 0.46 inches per hour (in/hr), while the September 2006 and April 2006 storms peak were at 0.28 and 0.12 in/hr respectively. This comparison illustrates the more conservative nature of the NRCS Type IA distribution and the relatively small storm events experienced in 2006.



LEGEND

- Design Storm: 10 Year - 24 Hour (1.51 in)
- Historical Storm Event 1: September 15, 2006 (0.51 in)
- Historical Storm Event 2: April 6, 2006 (0.34 in)

February 6, 2013

AKEL ENGINEERING GROUP, INC.

Figure 3.4

10-Year 24-Hour Storm
(Design vs. 2006 Storms)
Wastewater Collection System
Master Plan
City of Yakima

Table 3.6 Storm Events Analysis

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Storm Event	Date	Single Rainfall Event Volume and Duration			Total Monthly Rainfall	
		Volume (inches)	Duration (hours)	Peak Intensity (in/hr)	(inches)	
Historical Rainfall Events						
1	August 18, 1975	1.50	9	0.72	2.47	
2	August 21, 1990	1.70	14	0.42	1.98	
3	October 9, 2004 [1]	0.39	6	0.15	0.61	
4	December 30, 2004 [1]	0.30	8	0.10	1.01	
5	April 23, 2005 [1]	0.45	3	0.23	0.70	
6	November 5, 2005 [1]	0.58	8	0.16	1.60	
7	December 30, 2005 [1]	0.57	17	0.11	2.39	
8	April 6, 2006 [1]	0.34	8	0.12	0.59	
9	September 5, 2006 [1]	0.51	10	0.28	0.55	
10	May 15, 2011	1.45		0.46		
11	November 14, 2020	0.65				
12	November 11, 2021	0.65				
Design Storm						
10-Year	**10-Year 24-Hour**	**1.51**	**24**	**0.46**	←	Selected Design Storm
5-Year	5-Year 24-Hour	1.29	24	0.40		
2-Year	2-Year 24-Hour	0.95	24	0.29		
3-Hour	3-Hour 10-Year	0.77	3	0.26		

AKEL ENGINEERING GROUP, INC.

1/3/2022

Note:

1. Rainfall Events during flow metering period (2004-2006)

CHAPTER 4 – EXISTING WASTEWATER COLLECTION FACILITIES

This chapter provides a description of the City's existing wastewater collection system facilities including the gravity trunks, force mains, lift stations, and sewer basins. The chapter also includes a brief description of the Yakima Regional Wastewater Treatment Plant.

4.1 WASTEWATER COLLECTION SYSTEM OVERVIEW

The City provides wastewater collection services to approximately 29,300 residential, commercial, industrial, and institutional sewer accounts. The City's collection system consists of approximately 339 miles of up to 48-inch gravity sewer pipes, including a separate wastewater collection system for industrial process. The City owns and maintains 10 sewer lift stations that convey flows towards the YRWWTP, as shown on **Figure 4.1**.

A system-wide pipe inventory, listing the total length by pipe diameter, is shown in **Table 4.1**. This table is based on information extracted from the City's GIS and updated to reflect review of construction drawings provided by City staff. The 8-inch diameter pipes account for 65 percent of the total sewer pipe lengths.

4.2 WASTEWATER COLLECTION BASINS AND TRUNKS

Due to topography, the wastewater collection system is divided into six separate dendritic sewer collection basins, each defining the boundaries of a basin tributary to a wastewater collection trunk system. The following six major basins were delineated and shown on **Figure 4.2**.: 2nd Avenue, Beech Street, Fair Avenue, Nob Hill Boulevard, Rudkin Road, and Washington Avenue.

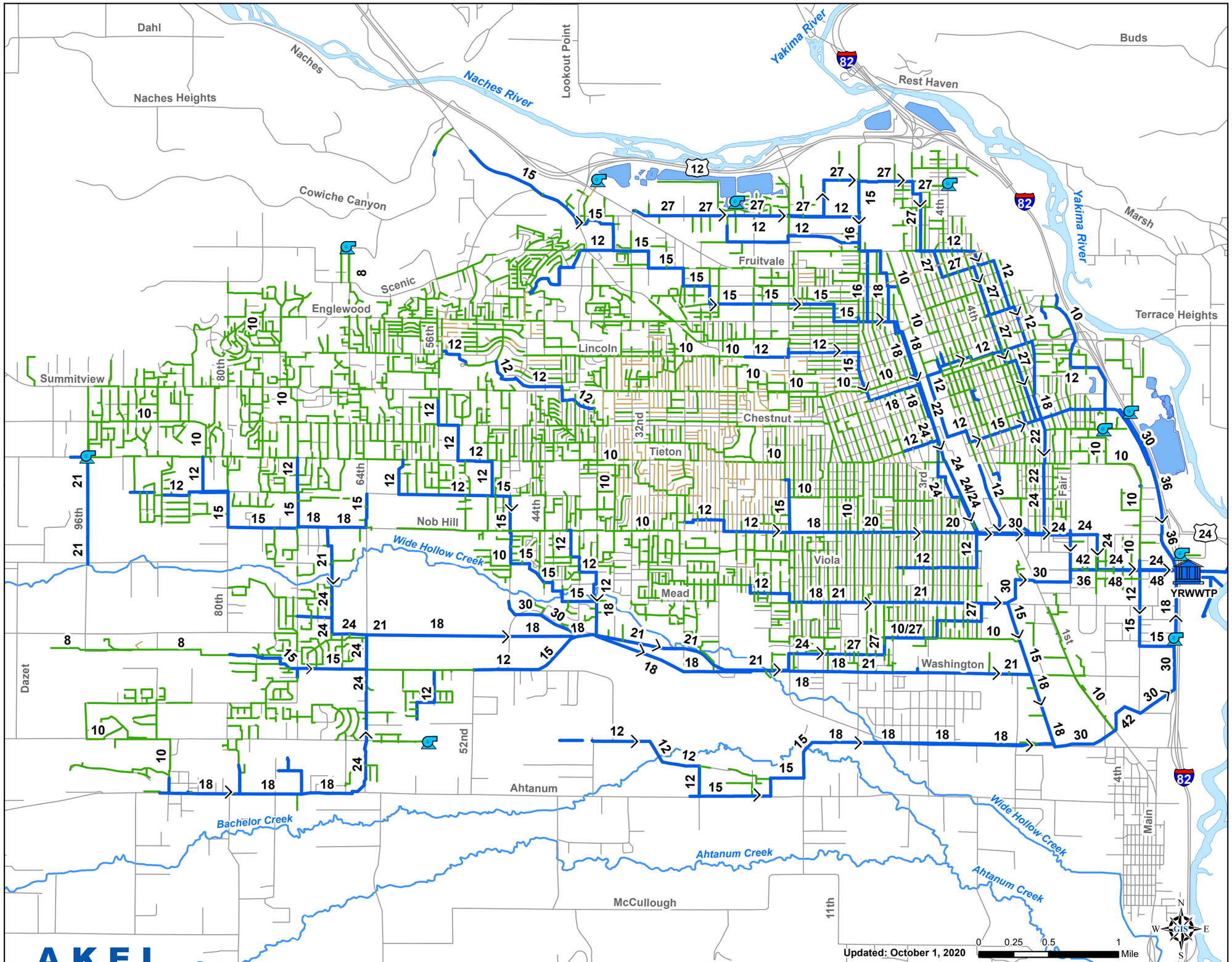
An overall schematic of the sewer basins' trunk system connectivity to the YRWWTP is shown on **Figure 4.3**. A detail of the wastewater collection system trunks converging to the YRWWTP, from each of the six major basins, is shown on **Figure 4.4**.

Each of the six basins is further divided into smaller tributary areas defined by subtrunks. **Figure 4.5** illustrates the connectivity of these subtrunks, while **Figure 4.6** shows their street alignments, color coded to match their corresponding basins.

4.2.1 2nd Avenue Collection Basin

The 2nd Avenue Collection Basin encompasses approximately 2,952 acres in the north-central area of the City. This basin includes the western downtown area, and the area bound to the east by the railroad, the west by 48th Avenue, the north by I Street, and to the south by Yakima Avenue.

The 2nd Avenue Collection Basin contains two trunk systems: 2nd Avenue and 7th Avenue.



Legend

Existing System

- WWTP
- Lift Stations

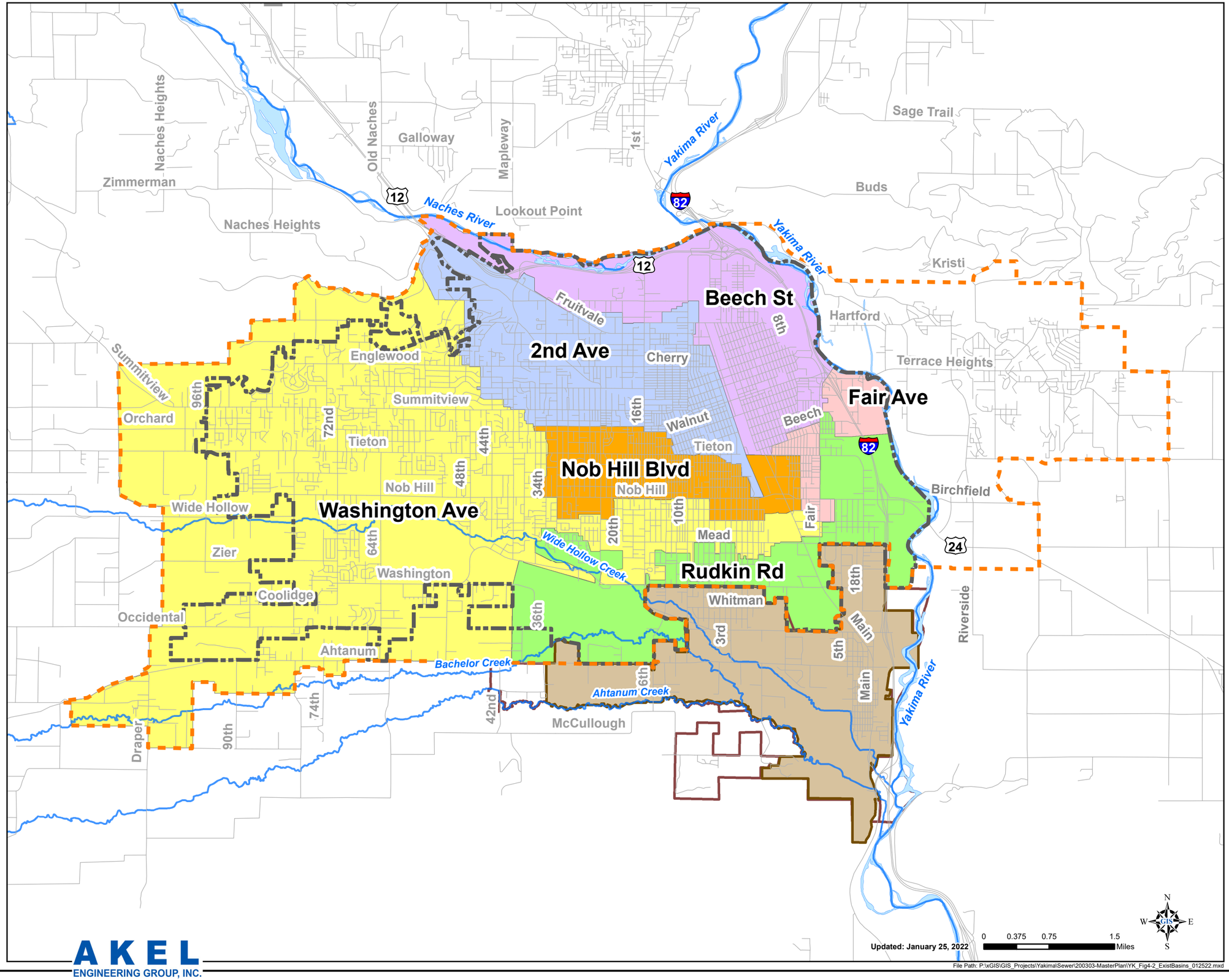
Pipes by Diameter

- 6" or Smaller
- 8" to 10"
- 12" or Larger
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 4.1
Existing Wastewater System
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

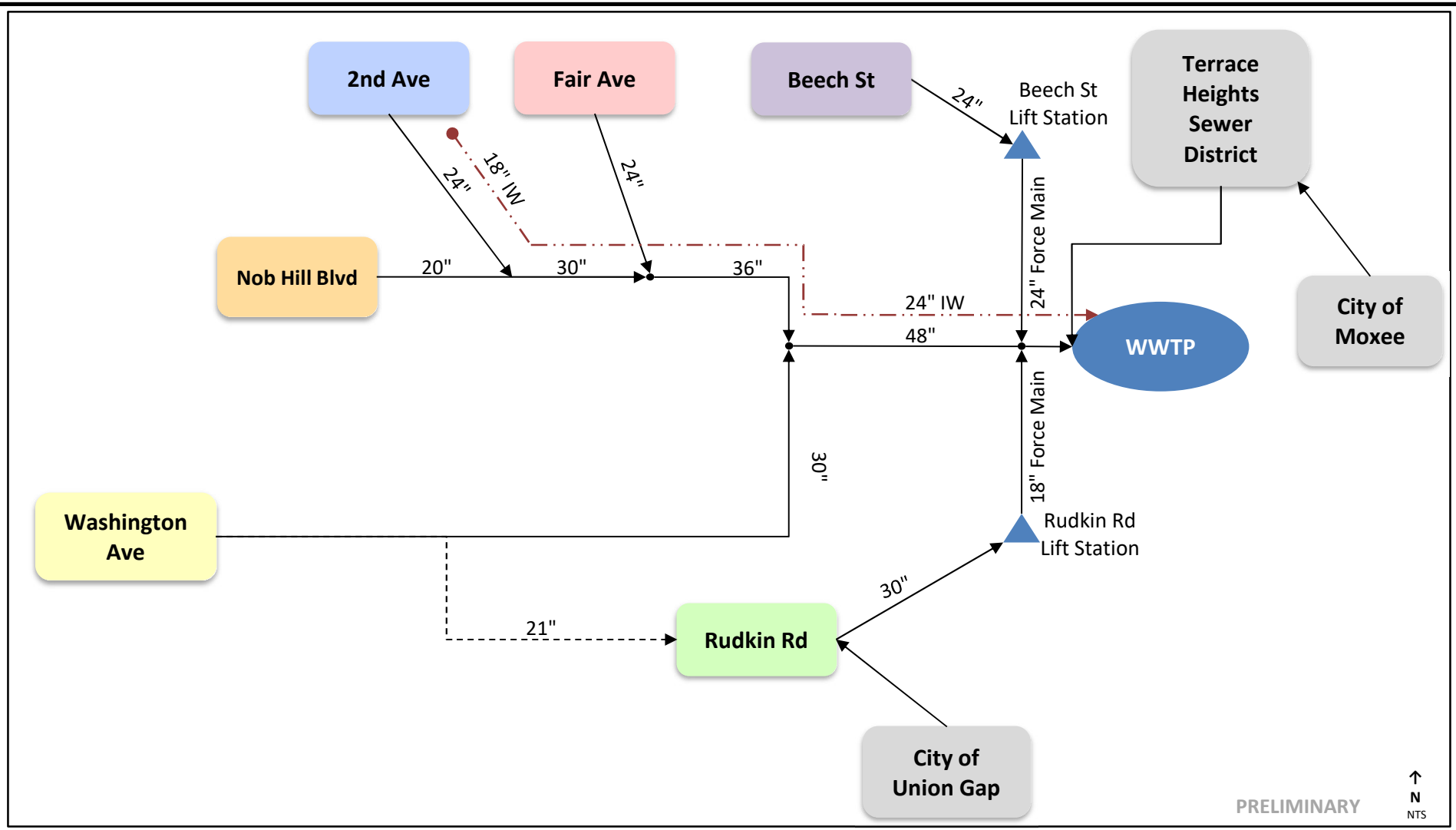
Basins

- 2nd Ave
- Beech St
- Fair Ave
- Nob Hill Blvd
- Rudkin Rd
- Washington Ave
- Yakima City Limits
- Yakima Urban Area
- UnionGap City Limits
- Union Gap Urban Growth Area
- Streets
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 4.2
Wastewater Collection Basins
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



LEGEND

- Fair Ave Basin
- 2nd Ave Basin
- Nob Hill Blvd Basin
- Rudkin Rd Basin
- Washington Ave Basin
- Beech St Basin
- Service Area: Union Gap, Terrace Heights, and Moxee
- Wastewater Trunks
- Industrial Waste Trunk
- Overflow Diversion

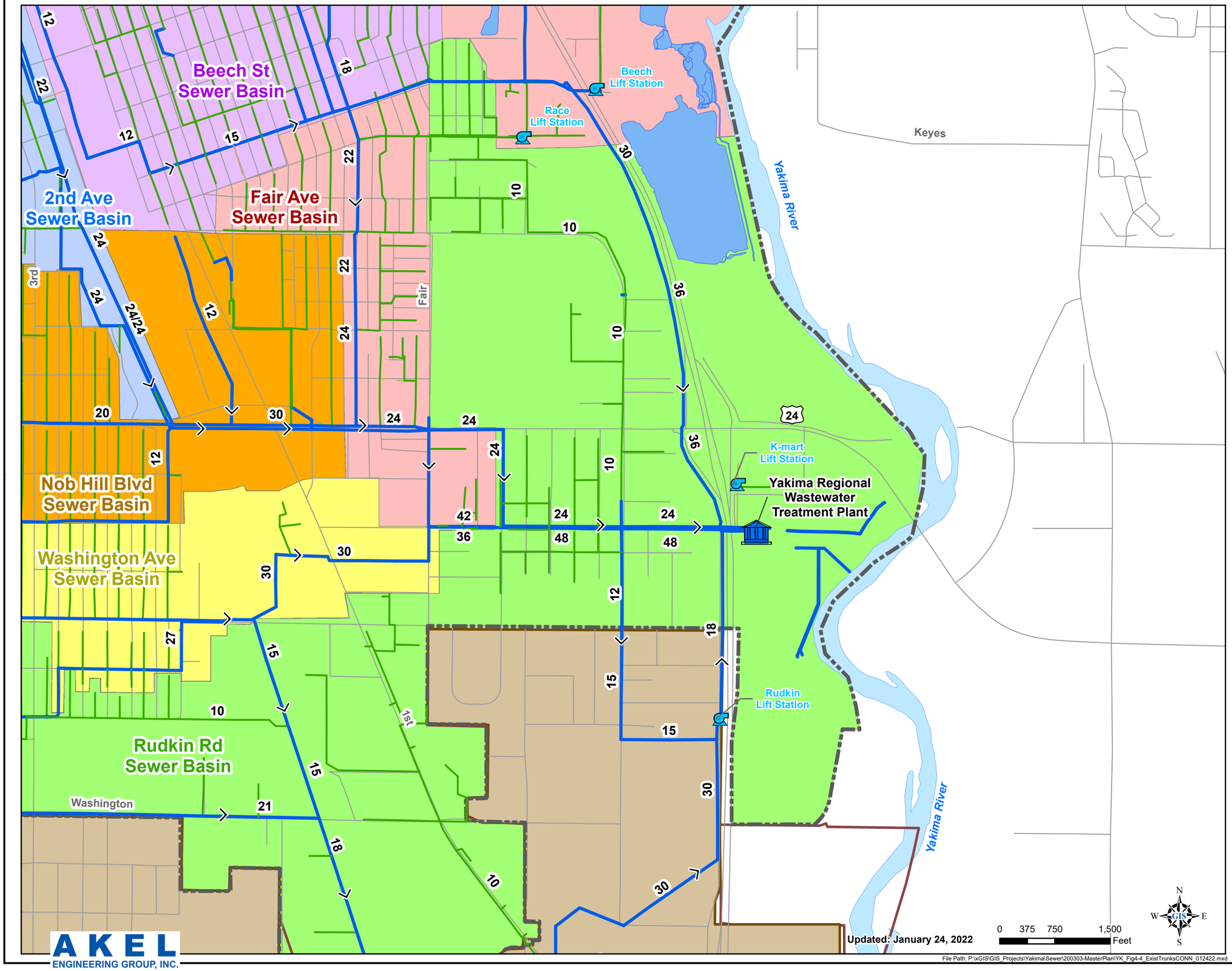
January 21, 2022

Figure 4.3

Sewer Basin Connectivity

Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.



Legend

Existing System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Smaller
- 8" to 10"
- 12" or Larger

Basins

- 2nd Ave
- Beech St
- Fair Ave
- Nob Hill Blvd
- Rudkin Road
- Washington Ave
- UnionGap City Limits
- Union Gap Urban Growth Area
- Streets
- Streams
- Lakes

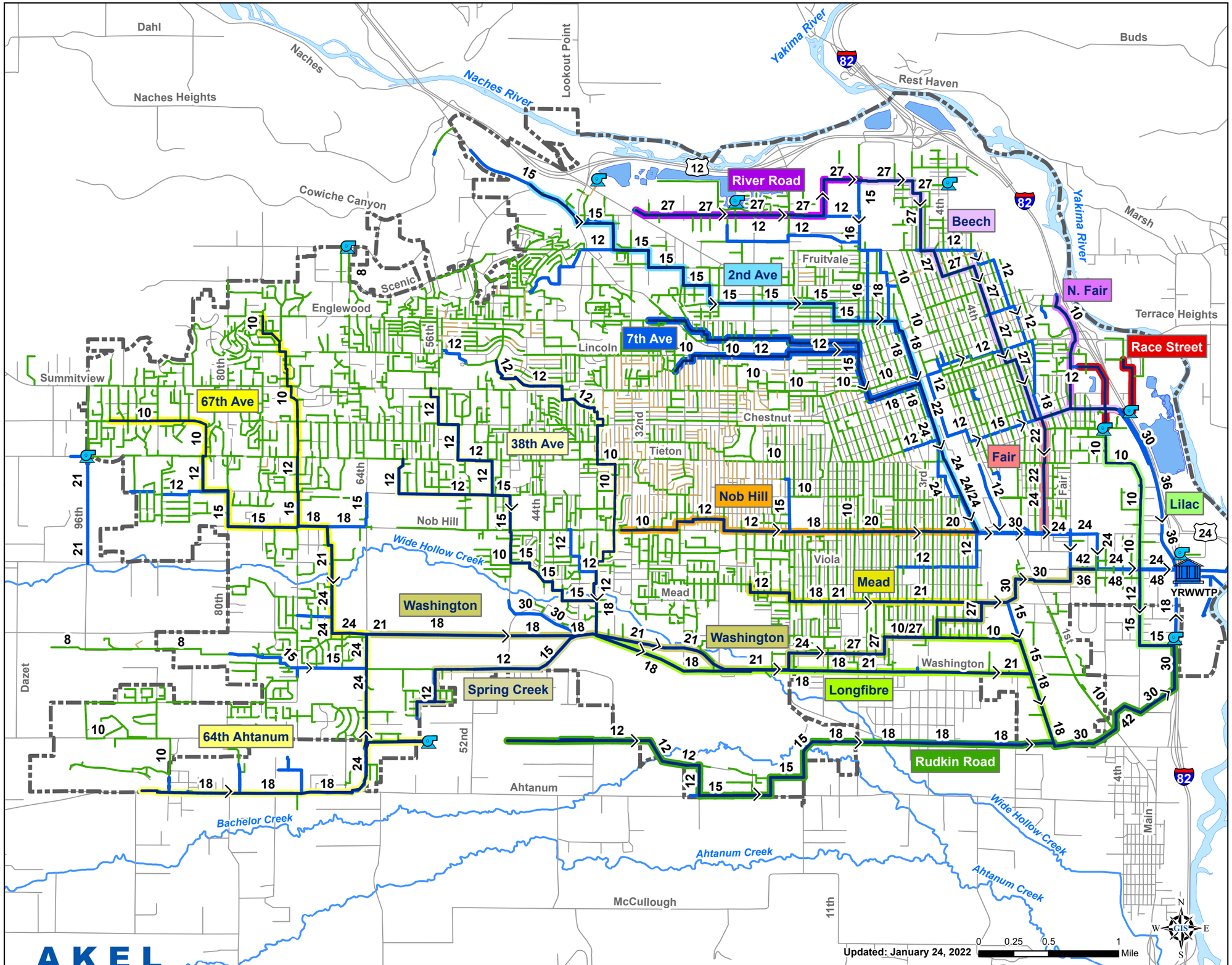
PRELIMINARY

Figure 4.4
Sewer Basin Connectivity Near YRWWTP

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig4-4_ExistTrunksCONN_012422.mxd



Legend

Existing System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Smaller
- 8" to 10"
- 12" or Larger
- Streets
- Streams
- Lakes

Pipe Trunks by Basin

2nd Ave Basin
- 2nd Ave
- 7th Ave

Beech St Basin
- Beech
- N. Fair
- River Road

Fair Ave Basin
- Fair
- Race Street

Nob Hill Basin
- Nob Hill

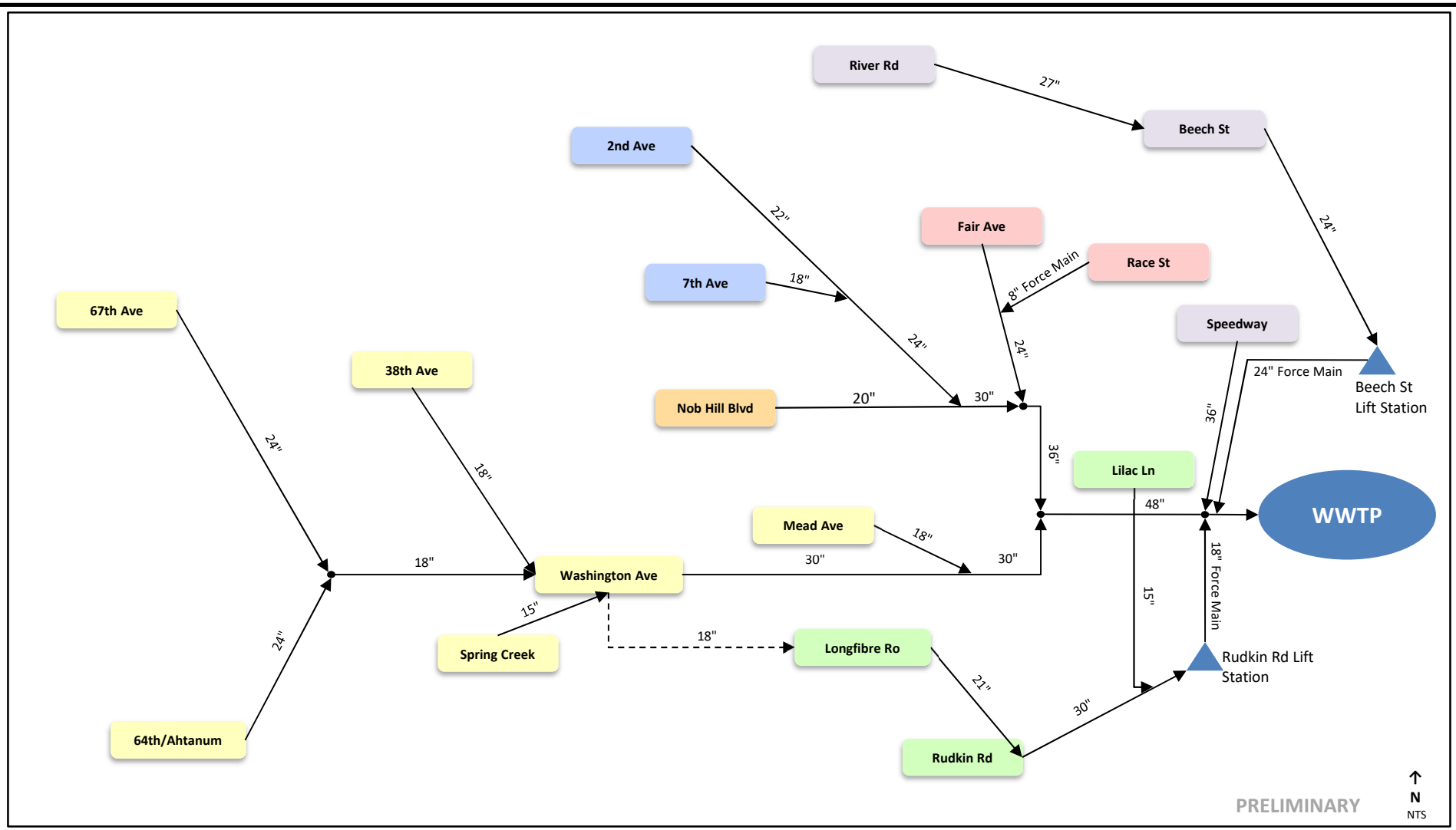
Rudkin Rd Basin
- Lilac
- Longfibre
- Rudkin Road

Washington Ave Basin
- 38th Ave
- 64th/Ahtanum
- 67th Ave
- Mead
- Spring Creek
- Washington

PRELIMINARY

Figure 4.5
Existing Trunk System
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



LEGEND

- Fair Ave Basin
- 2nd Ave Basin
- Nob Hill Blvd Basin
- Rudkin Rd Basin
- Washington Ave Basin
- Beech St Basin
- Wastewater Trunks
- Overflow Diversion

January 21, 2022

Figure 4.6

Sewer Trunk Connectivity

Wastewater Collection System
Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

Table 4.1 Existing Wastewater System Pipe Inventory

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Pipe Diameter	Total Length[2] (ft)	(miles)	Percent of Total (%)
Gravity Mains			
2"	329	0.1	0.02%
5"	7,721	1.5	0.4%
6"	117,738	22.3	6.6%
8"	1,085,316	205.6	60.7%
10"	116,554	22.1	6.5%
12"	96,907	18.4	5.4%
15"	58,756	11.1	3.3%
16"	5,370	1.0	0.3%
18"	58,779	11.1	3.3%
20"	4,552	0.9	0.3%
21"	20,814	3.9	1.2%
22"	5,613	1.1	0.3%
24"	20,978	4.0	1.2%
27"	32,394	6.1	1.8%
30"	17,431	3.3	1.0%
36"	7,441	1.4	0.4%
42"	2,591	0.5	0.1%
48"	3,911	0.7	0.2%
Subtotal - Gravity Mains	1,663,195	**315.0**	**93.1%**

Table 4.1 Existing Wastewater System Pipe Inventory

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Pipe Diameter	Total Length[2] (ft)	(miles)	Percent of Total (%)
Force Mains			
3"	2,054	0.4	0.1%
5"	315	0.1	0.02%
6"	10,372	2.0	0.6%
8"	73,106	13.8	4.1%
18"	2,683	0.5	0.2%
24"	6,543	1.2	0.4%
Subtotal - Force Mains	95,074	**18.0**	**5.3%**
Industrial Waste Trunk			
12"	8,008	1.5	0.4%
18"	6,435	1.2	0.4%
24"	14,585	2.8	0.8%
Subtotal - IW Trunk	29,029	**5.5**	**1.6%**
Total	3,326,390	**339**	100%

AKEL ENGINEERING GROUP, INC.

7/6/2022

Note:

1. The wastewater collection system inventory was extracted from the City's GIS-based hydraulic model developed in February 2012
2. Pipeline lengths exclude industrial trunk pipelines

- **2nd Avenue Sewer Trunk.** The 2nd Avenue Sewer Trunk begins near Power House Road and Highway 12 with a 15-inch gravity pipe and flows southeast to 2nd Avenue. It increases in size to an 18-inch and continues south on 2nd Avenue where it increases to a 22-inch then a 24-inch pipe before it merges with the 30-inch Nob Hill Boulevard Trunk at Nob Hill Boulevard near Ledwich Avenue. The Lakeside Lift Station is located along this trunk system.

- **7th Avenue Sewer Trunk.** The 7th Avenue Sewer Trunk collects flows from the Carriage Hill area. The trunk flows southeast to McKinley Avenue and Lincoln Avenue with pipe sizes ranging from 8 to 12-inches that flow east to a 15-inch pipe in 7th Avenue. The 15-inch pipes continue southeast to an 18-inch pipe that merges with the 2nd Avenue Trunk System.

4.2.2 Beech Street Collection Basin

The Beech Street Collection Basin encompasses approximately 2,814 acres in the northeast side of the City. This basin includes the eastern Downtown area from the railroad tracks to Interstate 82, north of Beech Street. It also includes the area north of I Street, bordered by the Naches River between Fruitvale Boulevard and the railroad tracks.

The Beech Street Collection Basin contains three trunk systems, River Road, N. Fair Avenue, and Beech Street

- **River Road Sewer Trunk.** The River Road Sewer Trunk is a parallel 12-inch and 27-inch trunk system that starts near River Road and Fruitvale Boulevard and ends at 6th Avenue and Tamarack Avenue Extension. The Lake Aspen Lift Station is located along this trunk system.

- **N. Fair Avenue Sewer Trunk.** The N. Fair Avenue Sewer Trunk begins near Fair Avenue and Lincoln Street with a 12-inch gravity trunk. The trunk flows south with a 14-inch gravity pipe and continues south to Spruce Street. The 14-inch pipe continues south to a 15-inch gravity pipe that conveys flows southward to the Beech Street Sewer Trunk near Beech Street and Fair Avenue.

- **Beech Street Sewer Trunk.** The Beech Street Sewer Trunk is a multiple branch sewer trunk system. The main trunk consists of 27-inch gravity pipe that starts near Tamarack Avenue Extension and 6th Avenue and continues southeast to Beech Street near 7th Street. The 27-inch pipe continues northeast to a 24-inch gravity pipe that conveys flows eastward to the Beech Street Lift Station. This trunk picks up flows from the River Road and N Fair Avenue Sewer Trunks. The Tamarack Lift Station is located along this trunk system.

4.2.3 Fair Avenue Collection Basin

The Fair Avenue Collection Basin encompasses approximately 531 acres in the east-central part of the City. This basin includes areas in the south downtown area, bound to the north by Beech Street, to the south by Viola Avenue, to the west by 2nd Street and 7th Street, and to the east by Fair Avenue and 13th Street. It also includes the area north of Race Street, bordered by the Yakima River and N. Fair Street.

The Fair Avenue Collection Basin contains two trunk systems: Race Street and Fair Avenue.

- **Race Street Sewer Trunk.** The Race Street Sewer Trunk begins near Fair Avenue and Spruce Street with an 8-inch gravity trunk. The trunk flows southeast with an 8-inch pipe toward the Race Street Lift Station which pumps flows to a 22-inch gravity pipe in Race Street along the Alley between 7th and 8th Streets. This trunk generally collects the flows north of Race Street, bordered by the Yakima River to the north and east, and N. Fair Street to the west.

- **Fair Avenue Sewer Trunk.** The Fair Avenue Sewer Trunk begins near Beech Street and the Alley between 7th and 8th Streets with a 22-inch gravity trunk and continues south to Nob Hill Boulevard between 7th and 8th Streets where it increases to a 42-inch pipe. The Race Street Lift Station is located along this trunk system.

4.2.4 Nob Hill Boulevard Collection Basin

The Nob Hill Boulevard Collection Basin encompasses approximately 1,419 acres in the central part of the City. This basin includes areas north of Nob Hill Boulevard and south of Yakima Avenue. The western boundary is considered as 34th Avenue with the eastern boundary being considered 6th Street. This basin includes Memorial Hospital, Yakima Valley College and the Nob Hill area. The Nob Hill Boulevard Collection Basin contains one trunk system: Nob Hill Boulevard.

- **Nob Hill Boulevard Sewer Trunk.** The Nob Hill Boulevard Sewer Trunk collects flows from the Memorial Hospital, Yakima Valley College and the Nob Hill area. It starts with a 10-inch gravity pipe near the Memorial Hospital and flows south to Nob Hill Boulevard. The pipe in Nob Hill Boulevard continues east and increases in size to a 12, 18, 20, and finally a 30-inch pipe as it merges with the Fair Avenue Basin. This trunk generally collects the flows north of Nob Hill Boulevard and south of Yakima Avenue between 34th Avenue and 27th Avenue.

4.2.5 Rudkin Road Collection Basin

The Rudkin Road Collection Basin encompasses approximately 2,909 acres in the southeast part of the City. The southern part of the basin is considered the area between Mead Avenue and Valley Mall Boulevard, from the airport to the Rudkin Road Lift Station. The eastern portion is the area north of Mead Avenue to Race Street between Fair Avenue and the Yakima River. This basin includes the Yakima Air Terminal, the County fairgrounds, and the Fairveiw-Sumach area.

The Rudkin Road Collection Basin contains three trunk systems; Longfibre Road, Rudkin Road, and Lilac Lane.

- **Longfibre Road Sewer Trunk.** The Longfibre Road Sewer Trunk begins as an 18-inch overflow pipe at Washington Avenue just east of 10th Avenue. This pipe flows east along Washington Avenue where it increases in size to a 21-inch as it approaches the railroad tracks. A 15-inch trunk from the north collecting flows from Pierce Street merges with the 21-inch and flows south parallel to the railroad tracks in an 18-inch pipe. The 18-inch increases in size to a 21-inch as it intersects with the 30-inch Rudkin Road Trunk.

- **Rudkin Road Sewer Trunk.** The Rudkin Road Sewer Trunk begins southwest of the Yakima Air Terminal and flows east in a 12-inch pipe. The 12-inch increases in size up to a 42-inch pipe before decreasing back to a 30-inch pipe as it flows towards the Rudkin Road Lift Station. This trunk collects flows from the City of Union Gap.

- **Lilac Lane Sewer Trunk.** The Lilac Lane Sewer Trunk begins near Race Street and 13th Street. A 10-inch trunk flows south and increases up to a 15-inch pipe as it connects to the 30-inch Rudkin Road Trunk at Lilac Lane and Rudkin Road. This trunk collects flows from the County fairgrounds, the Fairveiw-Sumach area, and parts of Union Gap.

4.2.6 Washington Avenue Collection Basin

The Washington Avenue Collection Basin encompasses approximately 12,710 acres in the western portion of the City. This basin includes the areas generally west of 34th Avenue and has one central section area along Mead Avenue between Nob Hill Boulevard on the North and Pierce Street to the South. This basin includes the unincorporated West Valley Area.

The Washington Avenue Collection Basin contains six trunk systems: 64th/Ahtanum, 67th Avenue, 38th Avenue, Washington Avenue, Spring Creek, and Mead Avenue.

- **64th/Ahtanum Sewer Trunk.** The 64th/Ahtanum Sewer Trunk begins with an 18-inch pipe near 86th Avenue and Ahtanum Road. The 18-inch pipe flows east toward 64th Avenue where it becomes a 24-inch pipe and continues north to the Washington Avenue Trunk. The Anderson Lift Station is located along this trunk system.

- **67th Avenue Sewer Trunk.** The 67thAvenue Sewer Trunk has two branches. One branch begins at the Sierra Estates Lift Station and flows southeast, and the second branch begins near Englewood and 77th Avenues and flows south. The two branches converge at Nob Hill Boulevard and 72nd Avenue. From here, a 21-inch pipe flows south along 68th Avenue and connects to the Washington Avenue Trunk. The Sierra Estates Lift Station is located along this trunk system.

- **38th Avenue Sewer Trunk.** The 38th Avenue Sewer Trunk has two branches. The first branch starts near Summitview Avenue and 56th Avenue and flows southeast, while the

second branch starts near Lincoln Avenue and 55th Avenue and flows south. These two branches converge at Creekside Loop and flow south in an 18-inch pipe which converges with the Washington Avenue Trunk at Washington Avenue. The Stonehedge Lift Station is located along this trunk system.

- **Washington Avenue Sewer Trunk.** The Washington Avenue Sewer Trunk is the main trunk in the Washington Avenue Basin. This trunk begins with an 18-inch pipe collecting flows from the 64th/Ahtanum and 67th Avenue Trunks near 64th and Terry Avenues. This pipe flows east along Washington Avenue. From 16th and Washington Avenues the trunk flows northeast up to Viola Avenue where it increases to a 48-inch pipe. The 48-inch continues east and flows to the WWTP.

- **Spring Creek Sewer Trunk.** The Spring Creek Sewer Trunk collects flows from the west side of the Airport. It begins with an 8-inch pipe near Wellington Drive and Washington Avenue. The 8-inch flows east, increases to a 15-inch pipe, and merges with Washington Avenue Trunk.

- **Mead Avenue Sewer Trunk.** The Mead Avenue Sewer Trunk collects the flows north of Mead Avenue and south of Nob Hill Boulevard. This trunk starts near Plath Avenue and 18th Avenue and flows east along Mead Avenue. It increases up to a 18-inch pipe as it merges with the Washington Avenue Trunk near Mead Avenue and Voelker Avenue.

4.3 INDUSTRIAL WASTE TRUNK

The City of Yakima operates a separate wastewater collection system for industrial processes. This system is known as the Industrial Waste Trunk (IW Trunk) and consists of approximately 5.5 miles of gravity pipe ranging from 12-inches to 24-inches in diameter. The pipe inventory for the IW Trunk, documented in **Table 4.1**, indicates that 51 percent of its length consists of 24-inch diameter pipes.

The IW Trunk begins at J Street and 23rd Street and flows east in a 12-inch gravity main along J Street and I Street (**Figure 4.7**). Upon reaching Quince Street between 1st and 4th Avenues, the trunk turns south in an 18-inch gravity main along 3rd and 2nd Avenues to Spruce Street. The trunk then increases in size to 24 inches and continues southeast along 2nd Avenue parallel to the railroad tracks. At Nob Hill Boulevard near Ledwich Avenue, the IW Trunk goes east towards Nob Hill Boulevard and continues until 13th Street. The trunk then turns south until Viola Avenue and continues east to the YRWWTP.
The IW Trunk currently services the Noel Canning & Bottling Company, Seneca Foods Corporation, Jewel Apple Ltd., and the Del Monte Foods fruit processing plant, as shown on **Figure 4.7**.

Seneca
Fruitvale
Jewel
Del Monte
Noel Canning
Chestnut
Tieton
Viola
Terrace Heights
Marsh
Yakima River
4th
3rd
Fair
32nd
YRWWTP
12
82
24

Legend

Existing Industrial Users by Average Flow

- 0 - 50,000 gpd
- 100,000 - 150,000 gpd
- 200,000 - 300,000 gpd

Existing System

- WWTP
- Pipes

Industrial Pipelines

- Gravity Pipes
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 4.7
IW Trunk Existing Users
Wastewater Collection System
Master Plan
City of Yakima

Updated: January 20, 2022

0 0.125 0.25 0.5 Mile

N W GIS E S

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig4-7_IWLineExistingUsers_070722.mxd

4.4 LIFT STATIONS

When routing flows by gravity is not possible due to adverse grades, lift stations are used to pump flows. The City currently maintains 10 lift stations located throughout the wastewater collection system, as summarized in **Table 4.2** and shown on **Figure 4.8**.

Table 4.2 lists each lift station with relevant information including: location, rated capacity, type of station, and number of pumps. The pumps at each lift station turn “on” or “off” based on the water levels in the wet well.

The Rudkin Road and Beech Street Lift Stations are the two major lift station in the system while the remaining are smaller in comparison and typically serve small localized developments or areas. These two lift stations were included in the hydraulic model and lift station capacity analysis. The two major lift stations are described below:

- **Rudkin Road.** This lift station is located on Rudkin Road near Lilac Lane. This lift station serves Yakima’s Rudkin Road Basin and the City of Union Gap. The City of Yakima has a pumping capacity allocation of 42.3 percent of the lift stations capacity, while the City of Union Gap was allocated the remaining pumping capacity of 57.7 percent. This lift station contains two 77 horsepower (HP) pumps at 2,700 gpm and two 35 HP pumps at 1,200 gpm for a total capacity of 11.2 mgd and a firm capacity of 7.3 mgd. This list station discharge into an 18-inch force main.
- **Beech Street.** This lift station is located at 1753 E Beech Street. This lift station serves the City’s Beech Street Basin. This lift station contains three pumps at 2,400 gpm each, for a total capacity of 10.4 mgd and a firm capacity of 6.9 mgd. This lift station discharges into a 24-inch force main.

4.5 YAKIMA REGIONAL WASTEWATER TREATMENT PLANT

The Yakima Regional WWTP is a tertiary treatment facility with a design capacity of 21.5 million gallons per day (MGD). The plant is currently operating at an average flow of 7.2 MGD. The treatment facility is located east of Interstate 82 on 22nd Street and Viola Avenue with a street address of 2220 East Viola Avenue.

The original treatment plant was a 2 MGD primary treatment constructed in 1936. Due to decreasing river water quality, in 1965, the plant was equipped with secondary treatment capabilities with a capacity up to 15.4 MGD. In 1972, the plant was upgraded with an activated sludge system. In 1992, geodesic domes were constructed over the trickling filters to reduce odor, and in 2009, an ultraviolet disinfection system was equipped replacing the chlorination disinfection system.

Over the past few years, the City has continued to enhance and upgrade the Yakima Regional WWTP with several new projects, including:

Dahl
Naches
Naches Heights
Naches River
Lookout Point
Yakima River
Buds
Rest Haven
Lakeside Lift Station
Lake Aspen Lift Station
Tamarack Lift Station
Cowiche Canyon
Stonehedge Lift Station
Fruitvale
Scenic
Englewood
Terrace Heights
Marsh
Race Lift Station
Beech Lift Station
Lincoln
Summitview
Sierra Estates Lift Station
Chestnut
Tieton
K-mart Lift Station
Nob Hill
Wide Hollow Creek
Viola
Mead
YRWWTP
Rudkin Lift Station
Anderson Lift Station
Washington
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
Main
80th
96th
64th
56th
44th
32nd
3rd
4th
1st
Fair
52nd
11th
82
12
24

Legend

Existing System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Smaller
- 8" to 10"
- 12" or Larger

Basins

- 2nd Ave
- Beech St
- Fair Ave
- Nob Hill Blvd
- Rudkin Road
- Washington Ave
- UnionGap City Limits
- Union Gap Urban Growth Area
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 4.8
Existing Lift Stations
Wastewater Collection System
Master Plan
City of Yakima

Updated: January 24, 2022

0 0.25 0.5 1 Mile

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig4-8_LiftStations_012422.mxd

AKEL
ENGINEERING GROUP, INC.

Table 4.2 Lift Station Inventory

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Lift Station Information			Wet Well Dimensions [1]				Pumps				Pump Controls			
No.	Location	Type	Diameter (ft)	Length (ft)	Width (ft)	Depth (ft)	Quantity	Capacity (mgd)	Capacity (gpm)	TDH (ft)	Lead On (ft)	Lead Off (ft)	Lag 1 On (ft)	Lag 1 Off (ft)
Tamarack	4th Street and P	Submersible	8.5	n/a	n/a	20.5	2	0.22	150	n/a	7.0	3.0	8.0	2.3
Race Street[2]	15th Street and Race	Submersible	8	n/a	n/a	22.5	2	0.54	375	n/a	7.0	3.0	8.0	3.0
Beech[2,3,4]	1753 E Beech St	Submersible	n/a	13.33	12.8	~11	3	3.46	2,400	45	2.3	0.8	4.5	1.5
Lake Aspen	Aspen	Vacuum	5.5	n/a	n/a	13.5	2	0.11	75	n/a	6.0	3.5	7.0	2.8
Stonehedge	66th and Scenic	Submersible Grinders	8	n/a	n/a	16.0	2	0.22	150	n/a	6.0	3.0	7.0	3.0
Sierra Estates	96th and Tieton	Submersible Grinders	8	n/a	n/a	19.3	2	0.22	150	n/a	6.5	3.0	7.0	3.0
K-Mart	Kmart	Vacuum	4.67	n/a	n/a	17.0	2	0.11	75	n/a	n/a	n/a	n/a	n/a
Lakeside	40th and Fruitvale	Submersible	8	n/a	n/a	19.7	2	0.22	150	n/a	6.0	3.0	7.0	3.0
Rudkin Road[5]	Rudkin Road	Dry-Pit Submersible	27	25.8	8.0	11.1	2	3.89	2,700	n/a	10.4	9.4	10.9	9.8
Rudkin Road[5]	Rudkin Road	Dry-Pit Submersible	27	25.8	8.0	11.1	2	1.73	1,200	n/a	10.0	9.2	11.5	10.0
Anderson	Occidental Road	n/a	8	n/a	n/a	19.0	2	n/a	n/a	n/a	4.0	2.0	4.5	2.0

AKEL ENGINEERING GROUP, INC.

7/07/2022

Notes:

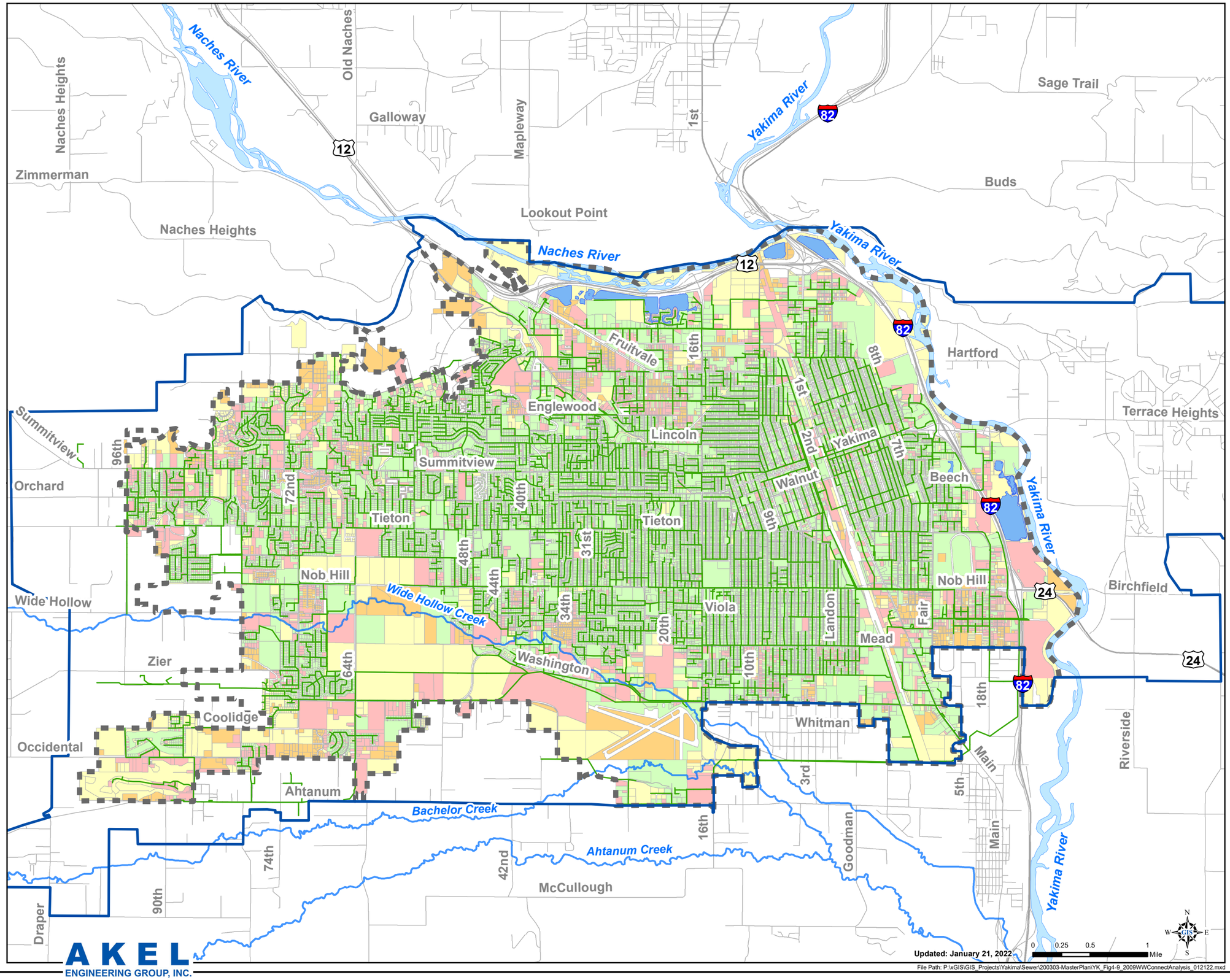
1. Lift station information is based on update received from City of Yakima on 7/9/2020
2. Modeled lift station, all other list stations listed for completeness
3. Depth of wet well reported is from floor to invert of overflow bypass.
4. Reported TDH was for 2500gpm as specified for bypass pumping system while station was offline. Actual TDH may be obtained from pump nameplates or via pump manufacturer based on direct coordination using pump specific SNs.
5. Depth of wet well reported is from floor to centerline of influent pipe in upstream manhole.
6. Blank Values represent unavailable lift station data from the Master Plan data collection process.

- Collecting and trapping methane gas produced from the digesters, for use elsewhere in the plant for fuel.
- Struvite reactor.
- Biogas analysis.
- Design and installation of new boilers.
- Design and installation of a medium or high rate anaerobic system for high strength food process wastewater.
- Design and installation of a biosolids dryer to reduce 8,500 tons of class B biosolids to approximately 1,800 tons of Class A biosolids.

4.6 SEPTIC SYSTEMS AREAS

In 2009, the City developed a GIS exhibit labeled “Wastewater Connection Analysis” that identifies sewered versus non-sewered utility accounts with the City of Yakima (**Figure 4.9**). The figure identified four categories that include one category of sewered properties and 3 categories of non-sewered properties. The categories for non-sewered properties are based on approximate cost for sewered services and the distance away from existing sewer pipes.

- **Category 1:** Properties that have a sewer connection and utility accounts with the City of Yakima,
- **Category 2:** Properties that have no sewer connection and under $5,000 of improvements,
- **Category 3:** Properties that have no sewer connection and have improvements exceeding $5,000 and are more than 200 feet away from a sewer line,
- **Category 4:** Properties that have no sewer connection and have improvements exceeding $5,000 and are within 200 feet away from a sewer line.



AKEL
ENGINEERING GROUP, INC.

Legend

Sewer Analysis

- Properties have a sewer connection & utility account with the City of Yakima
- Properties have no sewer connection & under $5,000 of improvements
- Properties have no sewer connection & have improvements exceeding $5,000 & are more than 200 feet away from a sewer line
- Properties have no sewer connection & have improvements exceeding $5,000 & are within 200 feet away of a sewer line
- Existing Sewer Pipes
- Streets
- Highways
- Yakima City Limits
- Urban Area
- Streams
- Rivers
- Lakes

Source: City GIS (Received 01/03/12)

Figure 4.9
Wastewater Connection Analysis
Wastewater Collection System Master Plan
City of Yakima

CHAPTER 5 – EXISTING AND PROJECTED WASTEWATER CHARACTERISTICS

This chapter summarizes historical wastewater flows and loadings experienced at the Yakima Regional WWTP and defines flow terminologies relevant to this evaluation. This chapter discusses the existing wastewater flow distribution within each collection basin, and identifies the design flows used in the hydraulic modeling effort and capacity evaluation. This chapter also projects flows and loadings for the Yakima Regional WWTP in 5 year increments to year 2040.

5.1 EXISTING FLOWS AND LOADINGS

The wastewater flows collected and treated at the Yakima Regional WWTP vary monthly, daily and hourly. While the dry weather flows are influenced by land use and the irrigation season, the wet weather flows are influenced by the severity and length of storm events. This section includes definitions of flow conditions and loading terminologies relevant to the wastewater system. This section also discusses historical seasonal flows and loadings at the Yakima Regional WWTP, influence of the irrigation system, as well as flows in the industrial waste trunk.

5.1.1 Wastewater Flow and Loading Terminologies

The following terminologies are relevant in discussions of flows in wastewater systems:

- **Irrigation Season.** The irrigation season is defined by the period between April to October and typically coincides with the summer months (dry weather months).
- **Non-Irrigation Season.** The non-irrigation season is defined by the period between November to March and typically coincides with the winter months (wet weather months).
- **Average Annual Flow (AAF).** The average annual flow is the total annual flow, or average monthly flow, for a given year, expressed in daily or other time units. This flow includes the combined average of the average dry weather flow (ADWF-I) and average wet weather flow (AWWF).
- **Average Dry Weather Flow during Irrigation Season (ADWF-I).** The average dry weather flow occurs on a daily basis during the irrigation season, with no evident reaction to rainfall. The ADWF-I also includes the Base Wastewater Flow (BWF), which is defined as the average flow generated by residential, commercial, and industrial users. The flow patterns for these users vary based on land use.
- **Average Wet Weather Flow (AWWF), Non-Irrigation Season.** The average wet weather flow occurs on a daily basis during the non-irrigation season. In addition to the flow

components in the BWF, the AWWF includes infiltration and inflow from storm rainfall events.

- **Maximum Month Dry Weather Flow during Irrigation Season (MMDWF-I).** This maximum month flow occurs during the irrigation season.
- **Maximum Month Wet Weather Flow (MMWWF), Non-Irrigation Season.** This maximum month flow occurs during the non-irrigation season.
- **Maximum Day Dry Weather Flow during Irrigation Season (MDDWF-I).** This is the highest measured daily flow that occurs during the irrigation season.
- **Maximum Day Wet Weather Flow (MDWWF), Non-Irrigation Season.** This is the highest measured daily flow that occurs during the non-irrigation season.
- **Peak Hour Dry Weather Flow (PDWF).** This is the highest measured hourly flow that occurs during the dry weather and non-irrigation season.
- **Peak Hour Dry Weather Flow (PDWF-I).** This is the highest measured hourly flow that occurs during the dry weather and irrigation season.
- **Peak Hour Wet Weather Flow (PWWF).** This is the highest measured hourly flow that occurs during the wet weather season.

The following terminologies are relevant in discussions of loadings in wastewater systems:

- **Biochemical Oxygen Demand (BOD).** BOD is an important water quality characteristic that indicates the organic strength of wastewater. It is a measurement of the amount of Dissolved Oxygen (e.g. utilized oxygen) by the decomposition of organic material, usually over a period of 5 days.
- **Total Suspended Solids (TSS).** TSS is a water quality measurement of the solids present in the wastewater that can be trapped by a filter.
- **Ammonium (NH_4).** Ammonium is a critical nutrient in biological wastewater treatment.

5.1.2 Existing and Historical Flows at YRWWTP – Domestic Wastewater System

Influent flows to the Yakima Regional WWTP from 2012 to 2020 are summarized in **Table 5.1**. This table lists average annual, average day, maximum month and maximum day flows for both irrigation and non-irrigation seasons. The table also lists the peaking factors that are applied to the average annual flow.

Table 5.1 Wastewater Treatment Plant - Historical Flow Data

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Year	Average Annual Flow[1,2]		Seasonal Average			Maximum Month		Maximum Day	
			Irrigation Season[3]		Non-Irrigation Season[4]	Irrigation Season[3]	Non-Irrigation Season[4]	Irrigation Season[3]	Non-Irrigation Season[4]
	AAF	Percent Change	ADWF-I	Percent Change	AWWF	MMDWF-I	MMWWF	MDDWF-I	MDWWF
Historical Flows									
	(MGD)	%	(MGD)	%	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)
2012	9.00		9.49		8.31	10.01	8.72	12.56	9.50
2013	8.93	-0.8%	9.44	-0.5%	8.21	10.86	8.70	11.87	11.38
2014	9.23	3.3%	9.85	4.4%	8.35	11.05	9.21	12.61	10.40
2015	9.24	0.2%	9.63	-2.3%	8.70	10.66	8.96	12.40	10.96
2016	10.49	13.5%	11.12	15.5%	9.60	12.13	10.37	14.04	11.71
2017	9.74	-7.2%	10.03	-9.8%	9.32	11.16	10.63	11.70	14.14
2018	8.41	-13.6%	8.87	-11.5%	7.75	10.24	8.37	10.89	8.99
2019	9.00	7.1%	9.80	10.5%	7.87	11.03	8.51	11.61	9.25
2020	8.47	-5.9%	9.01	-8.1%	7.72	10.44	8.54	12.15	9.35
Historical Peaking Factors (applied to AAF)[5]									
2012	1.00		1.05		0.92	1.11	0.97	1.40	1.06
2013	1.00		1.06		0.92	1.22	0.97	1.33	1.27
2014	1.00		1.07		0.90	1.20	1.00	1.37	1.13
2015	1.00		1.04		0.94	1.15	0.97	1.34	1.19
2016	1.00		1.06		0.91	1.16	0.99	1.34	1.12
2017	1.00		1.03		0.96	1.15	1.09	1.20	1.45
2018	1.00		1.06		0.92	1.22	1.00	1.30	1.07
2019	1.00		1.09		0.87	1.23	0.95	1.29	1.03
2020	1.00		1.06		0.91	1.23	1.01	1.43	1.10
Recommended Peaking Factors									
							1.10	**1.40**	

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes :

1. Source: 2012-2020 WWTP flows provided by City of Yakima staff on February 18, 2021.
2. Flows shown include the community of Terrace Heights and the Cities of Union Gap and Moxee.
3. The wet weather season matches non-irrigation season and reflects the following months: January-March, November-December.
4. The dry weather season matches the irrigation months and reflects the following months: April-October.
5. Peaking Factors are multipliers applied to the Average Annual Flow.
6. Flow Components Definitions

AAF = Average Annual Flow (annual flow, expressed in daily or other time units)
ADWF-I = Average Dry Weather Flow during the Irrigation Season (average flow that occurs on a daily basis during the dry weather season, with no evident reaction to rainfall)
AWWF = Average Wet Weather Flow (average flow that occurs on a daily basis during the wet weather season)
BWF = Base Wastewater Flow (average flow that is generated by residential, commercial, and industrial users)
MMDWF-I = Maximum Month Dry Weather Flow during the Irrigation Season (maximum month flow during the dry weather season)
MMWWF = Maximum Month Wet Weather Flow (maximum month flow during the wet weather season)
MDDWF-I = Maximum Day Dry Weather Flow during the Irrigation Season (highest measured daily flow that occurs during a dry weather season)
MDWWF = Maximum Day Wet Weather Flow (highest measured daily flow that occurs during a wet weather season)

In 2020, the average annual flow at the Yakima Regional WWTP was 8.47 MGD. The average day flows during the irrigation and non-irrigation seasons were 9.01 MGD and 7.72 MGD, respectively. The maximum month flows during the irrigation and non-irrigation seasons were 10.44 MGD and 8.54 MGD, respectively. The maximum day flows during the irrigation and non-irrigation seasons were 12.15 MGD and 9.35 MGD, respectively.

In addition to the City of Yakima, the Yakima Regional WWTP collects and treats wastewater flows from the City of Union Gap, the community of Terrace Heights, and the City of Moxee. **Table 5.2** lists tributary historical flows to the Yakima Regional WWTP, from 2012 to 2020. In 2020, the Yakima Regional WWTP treated 7.21 MGD from the City of Yakima, 0.54 MGD from the City of Union Gap, 0.50 MGD from the community of Terrace Heights, and 0.22 MGD from the City of Moxee.

5.1.3 Existing and Historical Flows at YRWWTP - Industrial Waste Trunk

The City of Yakima also operates a separate industrial waste sewer trunk that currently services the Del Monte fruit processing plant, Jewel Apple plant, Noel Canning and Bottling Company, and Seneca Foods plant.

Canning season for industrial wastewater users typically occurs from June to November with September and October being the peak months. **Table 5.3** lists the historical monthly and total flows recorded during each canning season from 2015 to 2020.

5.1.4 Historical Flow Loadings

Historical flow loadings are recorded and maintained by City staff at the Regional WWTP, and were included in **Table 5.2** for the domestic wastewater system and **Table 5.3** for the industrial waste trunk.

- **Domestic Wastewater System.** The historical water quality characteristics at the Yakima Regional WWTP, including the BOD, TSS, and NH_4 are listed in **Table 5.2**. This table provides annual average loading values and per-capita rates for each year from 2012 to 2020.

- **Industrial Waste Trunk.** The industrial waste trunk flows and loadings do not go through the same headworks as the rest of the wastewater flows, but rather have a separate process at the WWTP. Daily maximum loadings for BOD, TSS and NH_4 are listed in **Table 5.3** and were measured at the WWTP. This table also lists canning season averages and totals for each year from 2015 to 2019.

5.1.5 Irrigation Season Influence on Wastewater Flows

In most wastewater collection systems, peak flows usually occur during the wet weather season due to infiltration and inflows from storm events. However, the City of Yakima experiences peak wastewater flows during the dry weather season due to the operation of the City's irrigation

Table 5.2 Wastewater Treatment Plant - Historical Flow Data

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Year	Population Tributary to YRWWTP	Average Annual Flows[1]					Loadings[2]			Per Capita Flows and Loadings			
		Yakima (mgd)	Union Gap (mgd)	Terrace Heights (mgd)	Moxee (mgd)	Total (mgd)	BOD (lb/day)	TSS (lb/day)	NH_4 (lb/day)	Flow (gpcd)	BOD (lb pcd)	TSS (lb pcd)	NH_4 (lb pcd)
2012	106,156	8.40	-	0.41	0.19	9.00	25,233	20,702	1,685	85	0.24	0.20	0.016
2013	107,051	8.32	-	0.40	0.21	8.93	25,371	21,597	1,765	83	0.24	0.20	0.016
2014	107,639	7.99	0.60	0.45	0.19	9.23	23,373	20,939	1,739	86	0.22	0.19	0.016
2015	107,947	7.97	0.62	0.46	0.20	9.24	20,482	19,316	1,798	86	0.19	0.18	0.017
2016	108,370	9.26	0.56	0.47	0.20	10.49	22,627	21,567	2,034	97	0.21	0.20	0.019
2017	108,985	8.40	0.63	0.51	0.20	9.74	21,077	20,152	1,711	89	0.19	0.18	0.016
2018	109,353	7.17	0.55	0.50	0.18	8.41	21,771	22,561	1,737	77	0.20	0.21	0.016
2019	109,829	7.78	0.53	0.50	0.18	9.00	22,091	23,328	1,832	82	0.20	0.21	0.017
2020	111,278	7.21	0.54	0.50	0.22	8.47	22,994	22,846	2,000	76	0.21	0.21	0.018
				Treatment Plant Design Capacity		**21.50**	**53,400**	**38,600**					

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes :

1. Source: 2012-2020 WWTP flows provided by City of Yakima staff on February 18, 2021.
2. Source: 2012-2020 WWTP loadings provided by City of Yakima staff on June 4, 2020.
3. Flows and Loadings shown include the City of Union Gap, Moxee, and Terrace Heights.

Table 5.3 Historical Industrial Waste Trunk Influent Flows and Loadings (2015-2020)

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Date	Flows[1]			Loadings[2]					
	Monthly Average Flow	Maximum Day Flow	Total Measured Flow for the Month	BOD Daily Max		TSS Daily Max		NH_4 Daily Max	
	(gpd)	(gpd)	(gallons)	(mg/L)	(lb/day)	(mg/L)	(lb/day)	(mg/l)	(lb/day)
2015									
June	205,751	321,008	6,172,527	3,985	6,838	3,456	5,930	548	940
July	160,189	265,163	4,965,848	4,950	6,613	3,160	4,222	736	983
August	335,696	607,722	10,406,565	4,736	13,259	3,760	10,527	1,284	3,595
September	352,270	548,071	10,568,109	5,904	17,346	4,264	12,527	1,472	4,325
October	345,657	493,840	10,715,357	5,900	17,008	5,440	15,682	1,524	4,393
November	222,005	460,120	6,660,145	5,961	11,037	2,754	5,099	1,156	2,140
Canning Season Total	**1,415,816**	**2,374,916**	**43,316,024**	BOD avg (lb/day)	**13,053**	TSS Average (lb/day)	**9,611**	NH_4 Average (lb/day)	**3,087**
2016									
June	218,040	415,183	6,541,196	9,570	17,403	3,380	6,146	602	1,095
July	142,251	266,787	4,409,768	3,827	4,540	1,758	2,086	458	543
August	369,654	588,201	11,459,285	5,562	17,147	3,228	9,952	980	3,021
September	372,451	539,535	11,173,532	5,530	17,178	4,340	13,481	1,400	4,349
October	380,379	555,503	11,791,758	5,532	17,550	4,142	13,140	1,516	4,809
November	217,416	533,778	6,522,473	5,294	9,599	3,600	6,528	1,430	2,593
Canning Season Total	**1,482,151**	**2,483,804**	**45,356,816**	BOD avg (lb/day)	**13,203**	TSS Average (lb/day)	**9,037**	NH_4 Average (lb/day)	**3,063**
2017									
June	133,692	251,880	4,010,751	3,939	4,392	2,585	2,882	650	725
July	179,212	385,401	5,555,568	4,229	6,321	4,650	6,950	832	1,244
August	211,242	436,987	6,548,509	7,365	12,975	5,688	10,021	1,126	1,984
September	335,958	509,089	10,078,738	6,622	18,554	4,890	13,701	1,270	3,558
October	354,619	559,136	10,993,193	7,185	21,250	5,835	17,257	2,040	6,033
November	209,058	493,889	6,271,731	4,692	8,181	3,561	6,209	623	1,086
Canning Season Total	**1,290,089**	**2,384,502**	**39,447,739**	BOD avg (lb/day)	**13,456**	TSS Average (lb/day)	**10,828**	NH_4 Average (lb/day)	**2,781**
2018									
June	229,980	462,372	6,899,395	4,782	9,172	2,940	5,639	720	1,381
July	222,958	376,325	6,911,695	3,162	5,880	2,394	4,452	591	1,099
August	329,531	593,848	10,215,456	6,030	16,572	4,099	11,265	2,376	6,530
September	429,571	654,449	12,887,125	7,530	26,977	5,363	19,214	2,189	7,842
October	450,910	652,166	13,978,225	6,415	24,124	4,093	15,392	1,068	4,016
November	267,071	604,038	8,012,122	5,415	12,061	3,503	7,802	827	1,842
Canning Season Total	**1,700,041**	**2,880,826**	**52,004,623**	BOD avg (lb/day)	**17,123**	TSS Average (lb/day)	**11,625**	NH_4 Average (lb/day)	**4,266**
2019									
June	153,214	285,001	4,596,433	4,319	5,519	3,716	4,748	1,101	1,407
July	191,652	463,241	5,941,218	4,400	7,033	3,320	5,307	748	1,196
August	222,463	489,873	6,896,361	5,046	9,362	4,192	7,778	804	1,492
September	349,807	514,710	10,494,223	4,832	14,097	4,367	12,740	1,006	2,935
October	400,449	562,709	12,413,907	6,284	20,987	5,010	16,732	2,460	8,216
November	166,229	377,791	4,986,872	6,927	9,603	6,225	8,630	620	860
Canning Season Total	**1,330,601**	**2,408,324**	**40,732,581**	BOD avg (lb/day)	**12,216**	TSS Average (lb/day)	**10,237**	NH_4 Average (lb/day)	**2,939**
2020									
June	162,997	315,969	4,889,918	-	-	-	-	-	-
July	160,192	288,211	4,965,939	-	-	-	-	-	-
August	265,107	657,174	8,218,316	-	-	-	-	-	-
September	376,097	581,253	11,282,908	-	-	-	-	-	-
October	413,609	598,021	12,821,870	-	-	-	-	-	-
November	276,221	549,649	8,286,635	-	-	-	-	-	-
Canning Season Total	**1,491,225**	**2,674,308**	**45,575,668**	BOD avg (lb/day)		TSS Average (lb/day)		NH_4 Average (lb/day)	
Average for 2015-2020									
Low Production Season[3]	216,323	415,019	6,644,708	BOD avg lb/day	9,535	TSS avg lb/day	6,527	NH_4 avg lb/day	1,816
High Production Season[4]	380,148	564,040	11,599,912	BOD avg lb/day	19,507	TSS avg lb/day	14,987	NH_4 avg lb/day	5,048
Average Canning Season	290,331	506,889	8,881,115	Yearly BOD avg lb/day	13,810	Yearly TSS avg lb/day	10,268	Yearly NH_4 avg lb/day	3,227

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes:

1. Source: 2015-2020 Industrial Waste Trunk flows provided by City of Yakima staff on February 18, 2021.
2. Source: 2015-2019 Industrial Waste Trunk loadings provided by City of Yakima staff on June 4, 2020.
3. Low Production Season is based on historical records and is typically a combination of months ranging between June and August, and can include November.
4. High Production Season is based on historical records and has been consistently observed during September and October since 2005.

system. Review of monthly records at the Yakima Regional WWTP indicates an increase in flow during the month of April and a similar decrease in flow every October.

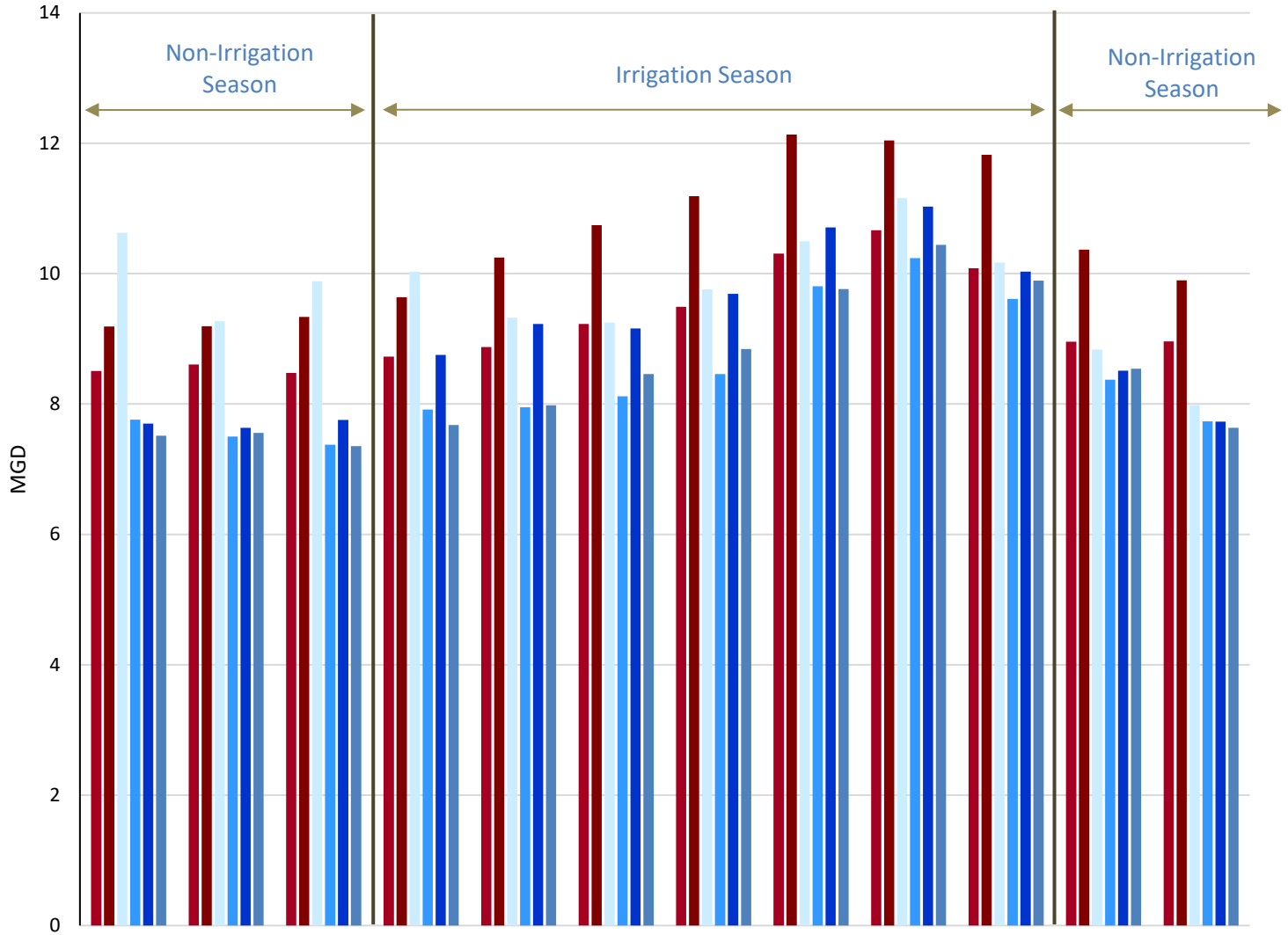
Monthly flows at the Yakima Regional WWTP from 2015 to 2020 are tabulated and graphed on **Figure 5.1**. This figure illustrates the seasonal increase of flows at the plant beginning in April, peaking in September and declining from October to December.

The influence of the irrigation system was further illustrated on **Figure 5.2**. This figure includes a comparison of historical wastewater flows recorded at the Yakima Regional WWTP between 2012 and 2020, during both irrigation and non-irrigation seasons. The figure also documents the annual recorded rainfall, in inches. The additional wastewater flows measured at the plant during the months of April to October can be mostly attributed to the irrigation system.

5.1.6 Existing Wastewater Flow Distribution by Basin

The existing wastewater flows used to calibrate the hydraulic model were based on the City's 2020 sewer billing records, as provided by City staff, and normalized to 2020 flow data at the WWTP. The normalized wastewater flows were spatially allocated in the hydraulic model based on parcel identification numbers from the billing records. A summary of the wastewater flow distribution is presented in **Table 5.4** and is graphically shown on **Figure 5.3**.

- **2nd Avenue Basin.** This basin encompasses 21 percent of the City of Yakima accounts. The basin's 2020 flows are estimated at 1.86 MGD, or 22 percent of the total annual WWTP flows.
- **Beech Street Basin.** This basin encompasses 9 percent of the City of Yakima accounts. The basin's 2020 flows are estimated at 1.24 MGD, or 15 percent of the total annual WWTP flows.
- **Fair Avenue Basin.** This basin encompasses 2 percent of the City of Yakima accounts. The basin's 2020 flows are estimated at 0.16 MGD, or 2 percent of the total annual WWTP flows.
- **Nob Hill Boulevard Basin.** This basin encompasses 17 percent of the City of Yakima accounts. The basin's 2020 flows are estimated at 0.60 MGD, or 7 percent of the total annual WWTP flows.
- **Rudkin Road Basin.** This basin encompasses 5 percent of the City of Yakima accounts, and receives flows from the City of Union Gap through multiple connections. The basin's 2020 flows are estimated at 1.50 MGD, where approximately 0.54 MGD was received from the City of Union Gap. Overall, flows from this basin represent 18 percent of the total annual WWTP flows.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	8.51	8.61	8.48	8.73	8.87	9.23	9.49	10.31	10.66	10.08	8.96	8.96
2016	9.19	9.19	9.34	9.64	10.25	10.74	11.19	12.13	12.04	11.82	10.37	9.90
2017	10.63	9.27	9.88	10.03	9.32	9.25	9.76	10.50	11.16	10.17	8.83	7.98
2018	7.76	7.50	7.38	7.92	7.95	8.12	8.46	9.81	10.24	9.61	8.37	7.73
2019	7.70	7.63	7.76	8.75	9.23	9.16	9.69	10.71	11.03	10.03	8.51	7.73
2020	7.52	7.56	7.36	7.68	7.98	8.46	8.84	9.76	10.44	9.89	8.54	7.63

August 11, 2022

Note: City of Yakima's Irrigation system typically operates from April to October.

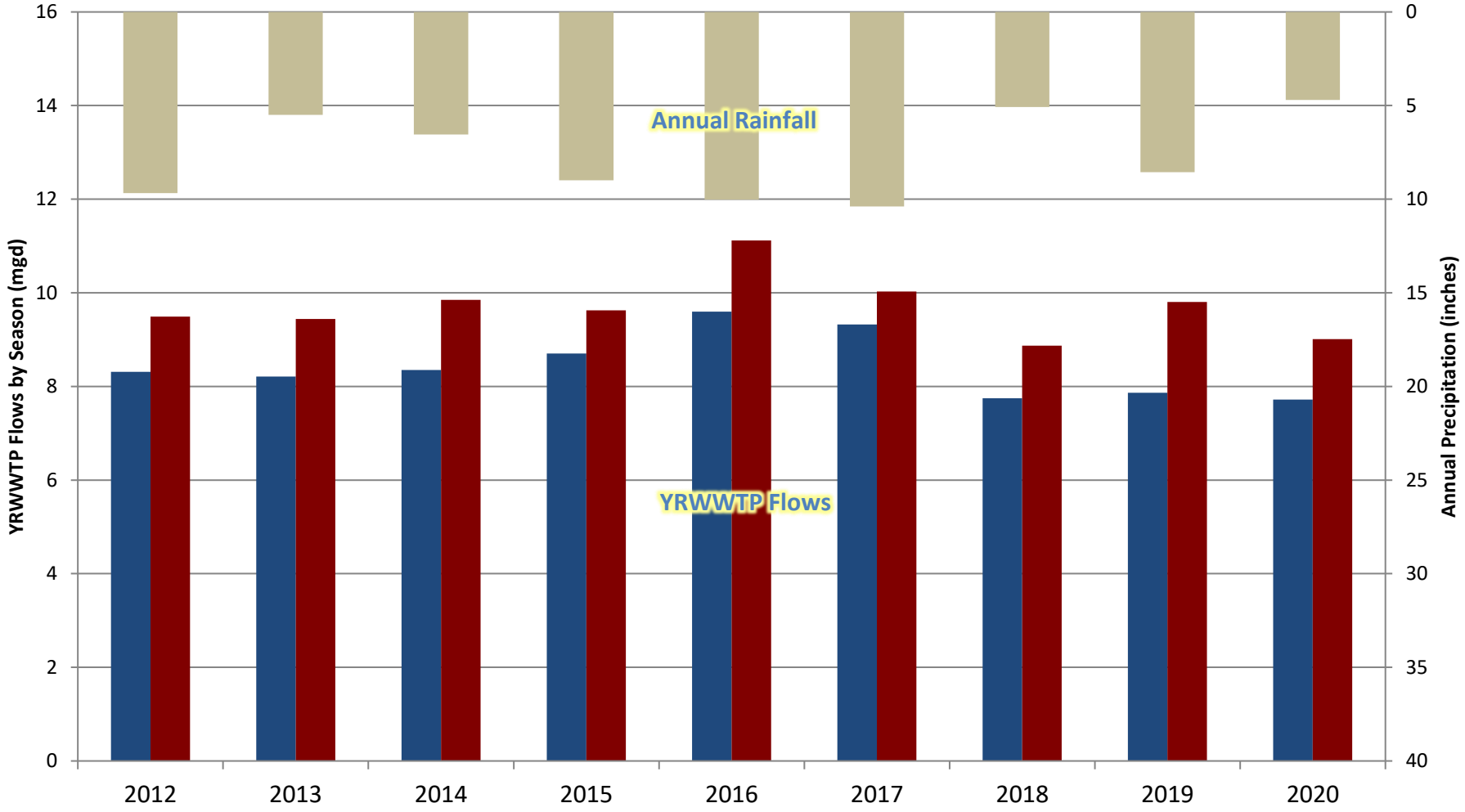
PRELIMINARY

Figure 5.1

YRWWTP Influent Flows

Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.



LEGEND

- Non-Irrigation Season Flows
- Irrigation Season Flows
- Rainfall

Notes:

PRELIMINARY

1. 2012-2020 WWTP flows provided by City of Yakima on 6/4/2020.
2. The wet weather season matches non-irrigation season and reflects the following months: January-March, November-December.
3. The dry weather season matches the irrigation months and reflects the following months: April-October.
4. Flows shown include the City of Union Gap.
5. Annual rainfall data retreived from NOAA on 06/15/2020.

August 11, 2022

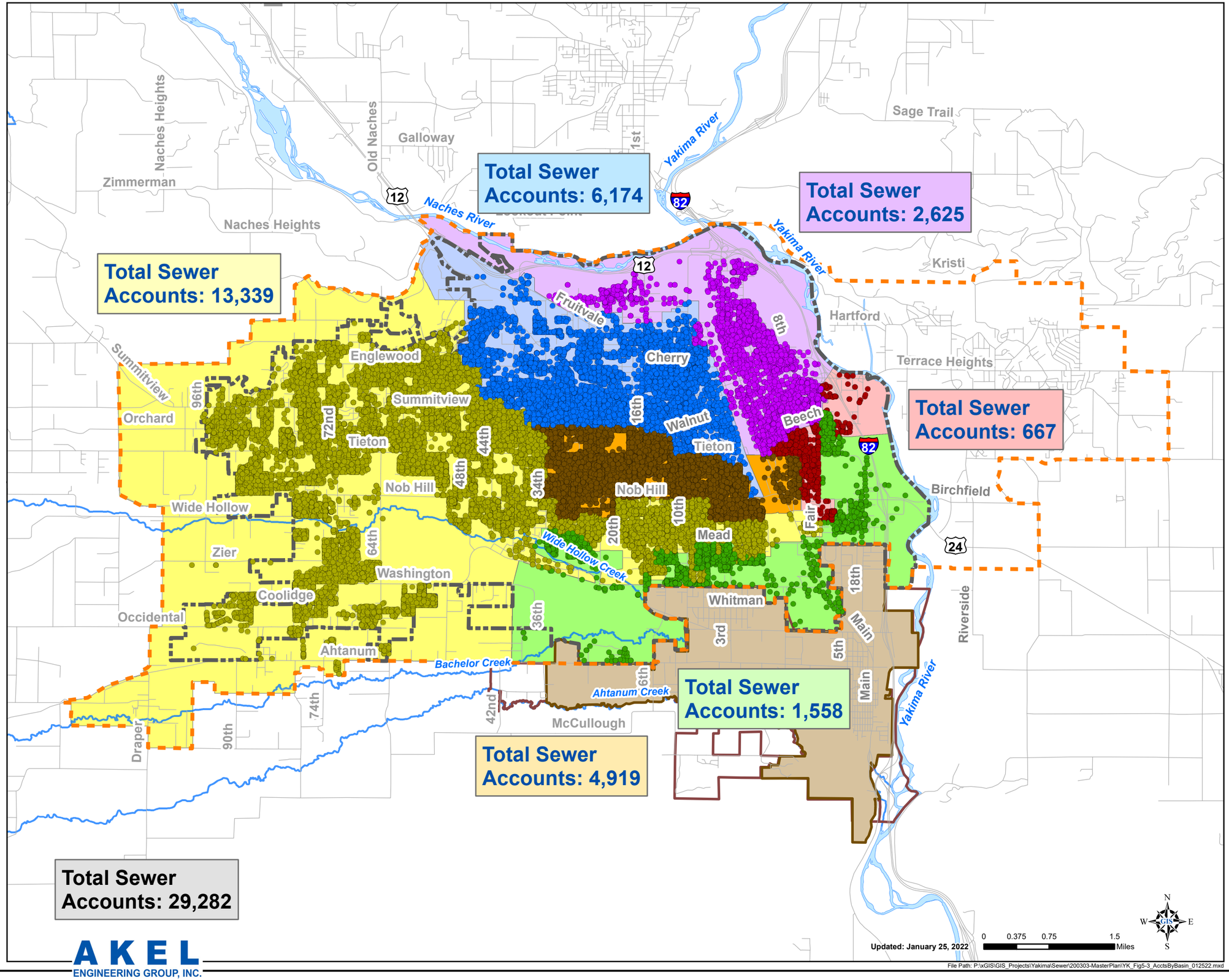
Figure 5.2

Seasonal Yakima Regional WWTP Flows

Wastewater Collection System Master Plan

City of Yakima

AKEL ENGINEERING GROUP, INC.



Legend

Meters by Basin

- 2nd Ave
- Beech St
- Fair Ave
- Nob Hill Blvd
- Rudkin Road
- Washington Ave

Basins

- 2nd Ave
- Beech St
- Fair Ave
- Nob Hill Blvd
- Rudkin Road
- Washington Ave
- Yakima City Limits
- Yakima Urban Area
- UnionGap City Limits
- Union Gap Urban Growth Area
- Streets
- Streams
- Rivers
- Lakes

PRELIMINARY

Figure 5.3
Sewer Accounts by Basin
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

Table 5.4 2020 Wastewater Flow Distribution by Basin - YRWWTP

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Basin	Accounts		Average Annual Flows			
	Number	Percent of Total (%)	Yakima UGA Flows (MGD)	Union Gap, Terrace Heights, and Moxee Flows (MGD)	Total (MGD)	Percent of Total (%)
2nd Avenue	6,174	21%	1.86	0.00	1.86	22%
Beech Street	2,625	9%	1.24	0.00	1.24	15%
Fair Avenue	667	2%	0.16	0.00	0.16	2%
Nob Hill Boulevard	4,919	17%	0.60	0.00	0.60	7%
Rudkin Road	1,558	5%	0.96	0.54	1.50	18%
Washington	13,339	46%	2.08	0.00	2.08	25%
Industrial Waste Trunk	4	0%	0.31	0.00	0.31	4%
Other[1]	n/a	n/a	0.00	0.72	0.72	9%
Total	29,286	100%	7.21	1.26	8.47	100%

AKEL ENGINEERING GROUP, INC.

9/28/2022

Note:

1. Accounts not serviced by the City's wastewater collection system include areas within the community of Terrace heights and the City of Moxee.

- **Washington Ave Basin.** This basin encompasses 46 percent of the City of Yakima accounts. The basin's 2020 flows are estimated at 2.08 MGD, or 25 percent of the total annual WWTP flows.

- **Industrial Waste Trunk Basin.** This basin encompasses less than one percent of the City of Yakima accounts and currently services four food processing plants during the canning season. The basin's 2020 flows are estimated at 0.31 MGD, or 4 percent of the total annual WWTP flows.

The other flows listed in Table 5.4 are estimated at 0.72 MGD or 9 percent of the total annual WWTP flows. These flows are from 2020 records and represent wastewater from the community of Terrace Heights and the City of Moxee.

5.2 BUILDOUT WASTEWATER FLOWS AND LOADINGS

This section documents the buildout flows tributary to the Yakima Regional WWTP. The tributary service areas include the City of Yakima as well as service areas from the City of Union Gap, the community of Terrace Heights, and the City of Moxee.

Historical flow and loading data recorded at the Yakima Regional WWTP (Table 5.2) were used to establish baseline conditions and estimate buildout flows. The following assumptions were applied to project buildout conditions:

- Flow projections for the City of Yakima are based on both the land use method and the population method. The land use method was used to estimate flows within the Yakima UGA, while the population method was used to project intermediate years through 2040. The projections for the intermediate years are intended to assist in the orderly expansion and phasing of potential improvements at the Yakima Regional WWTP.

- Flow projections for the City of Union Gap, the community of Terrace Heights, and the City of Moxee were based on information provided by their respective staff. The information was summarized in tables and verified by the respective staff prior to inclusion in this master plan.

- Though the loadings vary seasonally, the annual unit loadings at the Yakima Regional WWTP from the domestic wastewater system have generally been consistent, as shown in Table 5.2. The unit flow loading listed in Table 5.2 were applied to population projections and used to estimate BOD, TSS, and NH_4 loadings through the year 2040.

5.2.1 City of Yakima Flows

The land use methodology was used to estimate the buildout flows from the City of Yakima Urban Growth Area. Table 5.5 documents the total UGA acreages for residential and non-residential

land use category, and the undeveloped lands designated for urbanization. The undeveloped lands were multiplied by the corresponding unit flow factor to estimate the wastewater flows.

The existing wastewater service area encompasses approximately 12,378 acres and currently generates 8.29 MGD at 100 percent occupancy. For UGA buildout conditions, the projected wastewater service area will encompass approximately 19,768 acres and generate 15.73 MGD of average annual flows at 100 percent occupancy. The UGA was verified with City staff and is consistent with the Yakima Urban Area Comprehensive Plan.

Table 5.5 also includes intermediate wastewater flow projections for 2025, 2030, 2035 and 2040 planning horizons. These projections are based on the population methodology and calculated based on a unit factor of 76 gpcd, which is specific to the City of Yakima.

5.2.2 City of Union Gap Flows

The buildout flows for the City of Union Gap are based on information extracted from the 2013 Union Gap General Sewer Plan (GSP), which includes projections for the year 2014, 2019, 2024 and 2029. However, this master plan projects flows for years that end with either a 0 or 5. As such, the Union Gap flow projections were interpolated from the 2013 GSP projections, and documented in **Table 5.6**. Ultimately, the buildout flows tributary to the Yakima Regional WWTP were estimated at 1.75 MGD in the 2013 GSP.

5.2.3 Community of Terrace Heights Flows

The buildout flows for the community of Terrace Heights are based on information extracted from the 2005 Terrace Heights GSP, which documents buildout system flows tributary to the YRWWTP at 1.06 mgd. The Terrace Heights flow projections were estimated by applying the existing per capita unit factor to the population projections provided by Yakima staff. **Table 5.7** documents the wastewater flow projections from the community of Terrace Heights.

5.2.4 City of Moxee Flows

The buildout flows for the City of Moxee are based on information extracted from the 2020 Moxee GSP, which includes a projected average buildout flow of 0.81 mgd. The Moxee flow projections were estimated by applying the per capita unit factor documented in the 2020 Moxee GSP to the population projections extracted from the 2015 Yakima County Planning Division population projection report. **Table 5.8** documents the wastewater flow projections for the City of Moxee.

5.2.5 Projected Flows and Loadings Tributary to Yakima Regional WWTP at Buildout

The projected wastewater flows tributary to the Yakima Regional WWTP for the City of Yakima, the City of Union Gap, the community of Terrace Heights, and the City of Moxee were estimated and documented in **Tables 5.5**, **5.6**, **5.7**, and **5.8**, respectively. Additionally, the unit loading factors used to project the average annual and maximum month BOD, TSS, and NH_4 from the domestic wastewater system are summarized in **Table 5.9**.

Table 5.5 Existing and Projected Wastewater Flows - Yakima UGA

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Land Use Methodology (For Buildout Projections)									
Land Use Classification	Existing Wastewater Flows	2020 Wastewater Flows (at 100 % Occupancy)				Buildout Yakima UGA Wastewater Flows (at 100% Occupancy)			
		Existing Developed Sewer Areas[1]	Wastewater Unit Factor[2]	2020 Average Annual Flows		Total UGA Area[1]	Wastewater Unit Factor[2]	Total Average Annual Flow	
	(gpd/acre)	(acres)	(gpd/acre)	(gpd)	(MGD)	(acres)	(gpd/acre)	(gpd)	(MGD)
Residential									
Single Family Residential	-	8,119	475	3,856,579	3.86	8,063	475	3,830,083	3.83
Multi Family Residential	-	808	2,025	1,636,348	1.64	698	2,025	1,413,911	1.41
Subtotal - Residential		8,927		5,492,927	5.49	8,762		5,243,994	5.24
Non-Residential									
Commercial	-	1,938	950	1,840,883	1.84	1,245	950	1,182,390	1.18
Hotel	-	63	3,650	229,032	0.23	61	3,650	223,207	0.22
Industrial	-	723	475	343,242	0.34	1,768	475	839,818	0.84
Institutional	-	728	525	382,216	0.38	728	525	382,216	0.38
Subtotal - Non-Residential		3,451		2,795,373	2.80	3,802		2,627,631	2.63
Additional Planning Designation									
Low Density Residential	-	0	-	0	0.00	3,491	475	1,658,001	1.66
Mixed Residential	-	0	-	0	0.00	1,649	2,025	3,339,421	3.34
Regional Commercial	-	0	-	0	0.00	304	950	288,870	0.29
Community Mixed Use	-	0	-	0	0.00	255	950	242,710	0.24
Commercial Mixed Use	-	0	-	0	0.00	1,372	1,550	2,126,848	2.13
Central Business Core Commercial	-	0	-	0	0.00	134	1,550	207,391	0.21
Subtotal - Additional Planning		0		0	0.00	7,205		7,863,242	7.86
Other - Non Flow Generating Areas									
Subtotal - Other Non Flow Generating Areas		7,779	-	-	-	389	-	-	-
Total									
AKEL ENGINEERING GROUP, INC.	**7.21**	20,157		**8,288,301**	**8.29**	20,157		**15,734,867**	**15.73**

9/28/2022

Population Methodology (For Intermediate Year Projections)					
	Existing	Projected			
	2020	2025	2030	2035	2040
Projected Population	95,490	102,870	110,820	119,385	127,035
Wastewater Flows (MGD)[3]	7.21	**7.77**	**8.37**	**9.02**	**9.60**
Per Capita Unit Flow Factor (gpdc)	76	76	76	76	76

Notes:

1. City Land Use extracted from Table 2.3 titled "Land Use Inventory Yakima UGA"
2. Wastewater Unit Factors extracted from Table 3.2 titled "Wastewater Flow Unit Factor Analysis"
3. Intermediate year wastewater flow projections based on existing per capita unit flow factor (gpdc) and population projections for the City of Yakima.

Table 5.6 Historical and Projected Wastewater Flows and Loadings - Union Gap

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Wastewater Loadings		Unit	Extracted From Existing Documents[1,2]					Tributary to Yakima Regional WWTP at Buildout					
			2004 WWFP[1]	Union Gap 2013 GSP[2]				Existing[3,4,5]	Projected[5,6,7]				Buildout[5,8,9]
			1998	2014	2019	2024	2029	2020	2025	2030	2035	2040	
Population													
Sewered Population		Population	-	4,503	5,422	6,565	7,934	6,404	6,611	6,803	6,984	7,151	20,818
Annual Percent Increase		(%)	-	-				-	0.65%	0.58%	0.53%	0.48%	-
Sewered Area		(acres)	-	-	-	-	-	1,844					2,989
Flow													
Average Daily per Capita	Yakima Regional WWTP	(gpdc)	-	175	167	160	154	84	84	84	84	84	84
Domestic Annual Average Flow	Yakima Regional WWTP	(mgd)	-	0.45	0.54	0.66	0.79	-	-	-	-	-	-
Non-Domestic Annual Average Flow	Yakima Regional WWTP	(mgd)	-	0.34	0.36	0.39	0.43	-	-	-	-	-	-
Total Annual Average Flow	Yakima Regional WWTP	(mgd)	-	0.79	0.91	1.05	1.22	**0.54**	0.56	0.57	0.59	**0.60**	**1.75**
Maximum Month	Yakima Regional WWTP	(mgd)	0.76	0.94	1.09	1.26	1.46	0.64	0.66	0.68	0.70	0.72	2.09
Peak Hour	Master Lift Station	(mgd)	1.37	-	-	-	-	-	-	-	-	-	-
	Rudkin Road	(mgd)	1.76	-	-	-	-	-	-	-	-	-	-
BOD													
Maximum Month	Yakima Regional WWTP	(lb/day)	2,442	1,825	2,103	2,438	2,831	2,436	2,514	2,587	2,656	2,720	7,918
TSS													
Maximum Month	Yakima Regional WWTP	(lb/day)	2,276	1,372	1,529	1,772	2,058	1,787	1,844	1,898	1,949	1,995	5,808

AKEL ENGINEERING GROUP, INC.

9/30/2022

Notes:

1. Source: 1998 data extracted from 2004 Wastewater Facility Plan Table 3-14.
2. Source: Data extracted from Union Gap 2013 General Sewer Plan.
3. Source: 2020 Flow data extracted from City of Union Gap meter records received February 18, 2021.
4. Source: Union Gap 2020 existing land use inventory based on Parcel Shapefile provided by Yakima City staff on April 16, 2020.
5. Existing and Projected loadings based on per capita loading rates extracted from Union Gap 2013 General Sewer Plan.
6. City of Union gap population projections extracted from Yakima County Planning Division 2015 Population Projection Report.
7. Projected Flows (2025-2040) estimated using 2020 Average Daily per Capital flow rate and projected population projections.
8. Source: Union Gap Buildout Flows extracted from Table 4.1 of the Union Gap 2013 General Sewer Plan.
9. Buildout population projection estimated using buildout sewer flows and existing 2020 Average Daily per Capita flow rate of 84 gallons per capita per day.

Table 5.7 Historical and Projected Wastewater Loadings - Terrace Heights

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Design Criteria	Units	Extracted From Existing Documents[1,2]											Tributary to Yakima Regional WWTP at Buildout[3,4,5,6,7,8]					
		2004 Water Facilities Plan[1]					2005 General Sewer Plan Amendment[2]											
		1996	2002		2016		2010	2020	2025	2030	2035	2040	2020	2025	2030	2035	2040	Buildout
			3% Growth	10% Growth	3% Growth	10% Growth												
Population and Serviced Area																		
Sewered Population	population	4,715	5,564	7,544	7,544	14,145	4,455	5,119	5,488	5,883	6,306	6,760	5,119	5,488	5,883	6,306	6,760	10,816
Annual Increase	(%)	-	-	-	-	-	-	1.5%	1.4%	1.4%	1.4%	1.4%	-	1.4%	1.4%	1.4%	1.4%	-
Sewered Area	(acres)	1,300	1,570	1,570	2,200	2,200	-	-	-	-	-	-	2,275	2,490	2,720	2,966	3,231	5,593
Dry Weather Flows																		
Per Capita Domestic Flow	(gpdc)	52	66	66	66	66	-	-	-	-	-	-						
Average Daily per Capita	(gpdc)	58	76	75	75	74	-	-	-	-	-	-	98	98	98	98	98	98
Peaking Factor[9]		1.8-3.8	1.8-3.9	1.8-3.9	1.8-3.9	1.8-3.9	-	-	-	-	-	-	2.9	2.9	2.9	2.9	2.9	2.9
Average Annual	(mgd)	0.28	0.42	0.56	0.56	1.04	0.56	0.86	1.06	-	-	-	**0.50**	0.54	0.58	0.62	**0.66**	**1.06**
Wet Weather Flows																		
Infiltration Rate[10]	(gpd/acre)	133	300	300	300	300	-	-	-	-	-	-	-	300	300	300	300	300
Inflow Rate[10]	(gpd/acre)	240	350	350	350	350	-	-	-	-	-	-	-	350	350	350	350	350
Infiltration and Inflow[11]	(mgd)	0.48	1.02	1.02	1.43	1.43	-	-	-	-	-	-	-	1.62	1.77	1.93	2.10	3.64
Maximum Month[12]	(mgd)	0.49	0.97	1.15	1.32	1.92	-	-	-	-	-	-	0.59	0.63	0.68	0.73	0.78	1.25
Peak Day[13]	(mgd)	0.73	1.42	1.69	1.95	2.82	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.86	1.38
Peak Hour	(mgd)	1.28	2.24	2.66	3.04	4.45	-	-	-	-	-	-	-	2.32	2.52	2.73	2.96	5.01
BOD[14]																		
Maximum Day	(lb/day)	1,032	1,217	1,697	1,697	3,096	-	-	-	-	-	-	1,133	1,214	1,302	1,395	1,496	2,393
Maximum Month	(lb/day)	670	791	1,072	1,072	2,010	-	-	-	-	-	-	727	780	836	896	961	1,537
TSS[14]																		
Maximum Day	(lb/day)	887	1,047	1,459	1,459	2,661	-	-	-	-	-	-	974	1,044	1,119	1,200	1,286	2,058
Maximum Month	(lb/day)	704	829	1,155	1,155	2,107	-	-	-	-	-	-	771	827	886	950	1,019	1,630

AKEL ENGINEERING GROUP, INC.

9/28/2022

Notes:

1. Source: Extracted from 2004 Wastewater Facilities Plan (WWFP).
2. Based on Terrace Heights 2005 General Sewer Plan Amendment, city assumes buildout of system with no vacant lands in 2025, with a resulting buildout average annual flow of 1.06 MGD.
3. Source: 2020 Flow data extracted from Community of Terrace Heights meter records received February 18, 2021.
4. Terrace Heights population projections received from City of Yakima staff and reflects a 1.4% annual growth rate based on the moderate growth projections.
5. Terrace Heights existing 2020 land use based on Parcel Shapefile provided by Yakima City staff on April 16, 2020.
6. Terrace Heights ultimate land use inventory (buildout) extracted from Terrace Heights Neighborhood Plan adopted 1999.
7. Buildout population projection estimated using buildout sewer flows and existing 2020 Average Daily per Capita flow rate of 98 gallons per capita per day.
8. Projected sewer areas (2025-2040) estimated via linear interpolation using existing and projected buildout population.
9. A dry weather flow peak hour peaking factor of 2.9 was maintained for consistency with the 2004 WWFP.
10. Infiltration and Inflow rates based on 2004 WWFP as extracted from Dec 31, 1996 - Jan 1, 1997 peak storm event.
11. Infiltration and Inflow (mgd) = (inflow in gpd/acre + Infiltration in gpd/acre) x (Sewered Area in acres) / (1,000,000).
12. Projected Maximum Month flows based on historical monthly peaking factor of 1.18.
13. Projected Peak Day flows based on historical daily peaking factor of 1.3
14. BOD and TSS were based on the per capita distribution for 1996 and projected for 2025 through buildout.

Table 5.8 Historical and Projected Wastewater Loadings - Moxee

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Wastewater Loadings	Units	City of Moxee 2020 General Sewer Plan[1]							Tributary to Yakima Regional WWTP at Buildout[2,3,4,5]					
		2013	2018	2023	2028	2033	2038	Buildout	2020	2025	2030	2035	2040	Buildout
Population and Serviced Area														
Sewered Population	population	3,655	4,020	4,661	5,403	6,263	7,260	-	4,265	4,945	5,732	6,645	7,702	16,896
Annual Percent Increase	(%)	-	2.0%	3.2%	3.2%	3.2%	3.2%	-	-	3.2%	3.2%	3.2%	3.2%	-
Sewered Area	(acres)	-	-	-	-	-	1,616	2,351	821	903	999	1,109	1,237	2,351
Dry Weather Flow														
Average Daily Per Capita	(gpdc)	56	49	48	48	48	48	-	51	50	49	48	48	48
Average Annual Flow	(mgd)	0.21	0.20	0.23	0.26	0.30	0.35	-	**0.22**	0.25	0.28	0.32	**0.37**	**0.81**
Maximum Month Flow[6]	(mgd)	0.217	0.21	0.25	0.28	0.33	0.38	-	0.23	0.27	0.30	0.35	0.40	0.88
Peak Day Flow[7]	(mgd)	0.3	0.32	0.37	0.42	0.49	0.57	-	0.35	0.40	0.45	0.51	0.59	1.30
BOD[8]														
Maximum Month	(lb/day)	-	1,391	1,613	1,869	2,167	2,512	-	1,476	1,711	1,983	2,299	2,665	5,846
TSS[8]														
Maximum Month	(lb/day)	-	1,045	1,212	1,405	1,628	1,888	-	1,109	1,286	1,490	1,728	2,003	4,393

AKEL ENGINEERING GROUP, INC.

9/28/2022

Notes:

1. Source: City of Moxee 2020 General Sewer Plan.
2. Source: 2020 Flow data extracted from City of Moxee meter records received February 18, 2021.
3. City of Moxee population projections extracted from City of Moxee 2020 General Sewer Plan Report.
4. Projected sewer areas (2025-2040) estimated via linear interpolation using existing and projected buildout population.
5. Buildout population projection estimated using buildout sewer flows and existing 2020 Average Daily per Capita flow rate of 48 gallons per capita per day.
6. Projected Maximum Month flows based on historical monthly peaking factor of 1.09.
7. Projected Peak Day flows based on historical daily peaking factor of 1.6
8. BOD and TSS were based on the per capita distribution from the City of Moxee 2020 General Sewer Plan and projected for 2020 through buildout.

Table 5.9 Baseline Per Capita Unit Loadings - Yakima Regional WWTP

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Design Flow Condition	2020 Influent Loadings[1,2]			Average Daily Unit Loadings[3] (Applied to Projected Population)		
	BOD (lb/day)	TSS (lb/day)	NH_4 (lb/day)	BOD (lb pcd)	TSS (lb pcd)	NH_4 (lb pcd)
YKWWTP Loadings						
Average Annual Loadings	22,994	22,846	2,000	**0.21**	**0.21**	**0.018**
Maximum Month Loadings	25,007	27,194	2,119	**0.22**	**0.24**	**0.019**

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes:

1. Source: Influent Loadings provided by City of Yakima staff on June 4, 2020.
2. Loadings exclude the industrial waste trunk.
3. Unit Loadings based on a population of 111,278 serviced by the Yakima Regional WWTP.

5.2.5.1 Projections Excluding Industrial Waste Users

Table 5.10 documents the projected population tributary to the Yakima Regional WWTP from year 2020 to 2040 in 5 year increments. This table also lists corresponding average annual and maximum month flows and loadings. Wastewater flow projections for the ultimate buildout conditions are also summarized on the table.

In 2020, the average annual domestic wastewater flows tributary to the Yakima Regional WWTP were determined to be 8.24 MGD, based on a service population of 111,278. The City of Yakima's average annual flows in 2040 are projected at 10.51 MGD, an increase of 28 percent from 2020 flows. At buildout of the Yakima UGA, average annual flows from the City of Yakima are estimated at 18.63 MGD, an increase of 126 percent from 2020 flows.

Table 5.10 also lists the projected average annual and maximum month BOD, TSS, and NH_4 loadings from year 2025 to 2040 in 5-year increments.

5.2.5.2 Projections Including Industrial Waste Users

Wastewater flow projections and loadings listed in Table 5.11 include both domestic customers (Table 5.10) and industrial waste trunk customers (Table 5.3).

5.3 WASTEWATER COLLECTION SYSTEM DESIGN FLOWS

The design flows most relevant in this capacity analysis include the peak dry weather flow during the irrigations season (PDWF-I) and the peak wet weather flow (PWWF).

- **Peak Dry Weather Flow (PDWF-I).** This is the highest measured hourly flow that occurs during the dry weather and irrigation season. In these scenarios, the capacity adequacy of the existing collection system was based on the hydraulic grade not exceeding the maximum allowable d/D criteria.

- **Peak Wet Weather Flow (PWWF).** This is the highest measured hourly flow that occurs during the wet weather season. During PWWF, a relaxed criteria was used compared to PDWF-I. The hydraulic analysis allowed surcharging to occur during wet weather conditions with the hydraulic grade line (HGL) rising up to three feet below the manhole rim. If the HGL at any time was less than three feet from the manhole rim, the pipe was considered deficient.

5.3.1 Domestic Wastewater Collection System

The design flows used in evaluating the capacity adequacy of the wastewater collection system are summarized in Table 5.12. The table lists the maximum day and peak hour flows for the dry weather irrigation season and for the wet weather conditions. The peak dry weather flows during the irrigation season and the peak wet weather flows were estimated at 15.8 MGD and 29.9 MGD,

Table 5.10 Projected Yakima Regional WWTP Influent Loadings - Excluding Industrial Waste Users

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Period	Yakima Regional WWTP Influent Loadings								
	Population	Influent Flows (Domestic Wastewater System)					Influent Loadings [1] (Domestic Wastewater System)		
		Yakima (Domestic Flows)	Terrace Heights	Union Gap	Moxee	Total	BOD	TSS	NH_4
	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(lb/day)	(lb/day)	(lb/day)
2020									
Average Annual	111,278	6.98	0.50	0.54	0.22	**8.24**	22,994	22,846	2,000
Maximum Month		8.37	0.59	0.64	0.23	9.84	25,007	27,194	2,119
2025									
Average Annual	119,913	7.41	0.54	0.56	0.25	8.75	24,779	24,618	2,155
Maximum Month		8.90	0.63	0.66	0.27	10.46	26,948	29,305	2,283
2030									
Average Annual	129,238	7.89	0.58	0.57	0.28	9.32	26,706	26,533	2,323
Maximum Month		9.47	0.68	0.68	0.30	11.14	29,043	31,583	2,461
2035									
Average Annual	139,320	8.42	0.62	0.59	0.32	9.94	28,789	28,603	2,504
Maximum Month		10.10	0.73	0.70	0.35	11.88	31,309	34,047	2,653
2040									
Average Annual	148,648	8.87	0.66	0.60	0.37	**10.51**	30,717	30,518	2,671
Maximum Month		10.65	0.78	0.72	0.40	12.55	33,405	36,327	2,831
Buildout									
Average Annual	-	15.42	1.06	1.75	0.81	**19.05**	-	-	-
Maximum Month		-	-	-	-	-	-	-	-

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes

1. Projected Influent Loadings based on 2020 per capita loading rates and projected population tributary to the YRWWTP.

Table 5.11 Projected Yakima Regional WWTP Influent Loadings - Including Industrial Waste Users

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Period	Yakima Regional WWTP Influent Loadings									
	Population	Influent Flows (Including Industrial Waste Trunk)						Influent Loadings [1] (Including Industrial Waste Trunk)		
		Yakima (Domestic Flows)	Yakima (Industrial Waste Trunk)	Terrace Heights	Union Gap	Moxee	Total	BOD	TSS	NH_4
	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(lb/day)	(lb/day)	(lb/day)
2020										
Average Annual	111,278	6.98	0.24	0.50	0.54	0.22	**8.47**	31,853	33,178	3,118
Maximum Month		8.37	0.41	0.59	0.64	0.23	10.26	40,421	45,172	4,065
2025										
Average Annual	119,913	7.41	0.36	0.54	0.56	0.25	9.11	38,165	40,230	3,845
Maximum Month		8.90	0.62	0.63	0.66	0.27	11.09	50,238	56,468	5,224
2030										
Average Annual	129,238	7.89	0.48	0.58	0.57	0.28	9.80	44,618	47,424	4,584
Maximum Month		9.47	0.84	0.68	0.68	0.30	11.97	60,210	67,933	6,397
2035										
Average Annual	139,320	8.42	0.60	0.62	0.59	0.32	10.54	51,229	54,774	5,337
Maximum Month		10.10	1.05	0.73	0.70	0.35	12.92	70,352	79,583	7,583
2040										
Average Annual	148,648	8.87	0.72	0.66	0.60	0.37	**11.23**	57,683	61,969	6,077
Maximum Month		10.65	1.26	0.78	0.72	0.40	13.81	80,325	91,049	8,755
Buildout										
Average Annual	-	15.42	0.31	1.06	1.75	0.81	**19.35**	-	-	-
Maximum Month		-	-	-	-	-	-	-	-	-

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes:

1. Projected Influent Loadings based on 2020 per capita loading rates and projected population tributary to the YRWWTP.

Table 5.12 Design Flows

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Scenario No.	Description	Flows	
		Max. Day (mgd)	Peak Hour (mgd)
2021 Existing Condition Scenarios			
1	Existing DWF + Irrigation I&I	12.8	15.8
2	Existing WWF (10YR-24HR Design Storm) + Irrigation I&I	17.1	29.9
Ultimate Buildout Scenarios			
3	Buildout DWF + Irrigation I&I	26.2	32.1
4	Buildout WWF (10YR-24HR Design Storm) + Irrigation I&I	30.6	47.2

AKEL ENGINEERING GROUP, INC.

9/29/2022

Notes:

1. Maximum Day flows are based on max day peaking factors extracted from historical YRWWTP flow data.
2. Peak Hour flows shown are extracted from sewer system hydraulic model and reflect diurnal flow variations and flow attenuation.

respectively. The PDWF-I and PWWF used for designing the wastewater collection system at buildout of the UGA were estimated at 32.1 MGD and 47.2 MGD, respectively.

5.3.2 Industrial Waste Trunk

Existing Industrial Waste Trunk customer flows are shown in **Table 5.13**. These customers include the Noel Canning & Bottling Company, Seneca Foods Corporation, Jewel Apple Ltd., and the Del Monte Foods fruit processing plant.

Existing customers will contribute an average flow of 0.31 MGD. The corresponding maximum day and peak hour design flows were estimated at 0.93 MGD and 1.39 MGD, respectively.

Table 5.13 Industrial Wastewater Trunk - Existing Design Flows

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

No.	Customer Name	Industrial Flows[1] Average Day Flow (gpm)	Maximum Day Flow (gpm)	Peak Hour Flow (gpm)	Peaking Factors Max. Day to Avg Day[2]	Peak Hour to Max. Day[3]
Existing Customer						
1	Del Monte	107.8	272.0	407.9	2.5	1.5
2	Jewel	75.6	234.6	352.0	3.1	1.5
3	Noel Canning	9.0	21.8	32.7	2.4	1.5
4	Seneca	21.6	115.0	172.5	5.3	1.5
	Total	**214**	**643**	**965**	-	-

AKEL ENGINEERING GROUP, INC.

1/17/2023

Notes:

1. Source: Existing Industrial Waste Trunk Users' daily flow data provided by City of Yakima staff on June 7, 2021.
2. Maximum day peaking factors extracted from historical loading data for each user.
3. Peak Hour peaking factor assumed to be 1.5 (Peak Hour Flow = 1.5 x Maximum Day Flow)

CHAPTER 6 – HYDRAULIC MODEL DEVELOPMENT

This chapter describes the development and calibration of the City's wastewater system hydraulic model. Hydraulic network analysis has become an effectively powerful tool in all aspects of wastewater system planning, design, operation, management, and system reliability analysis. The City's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.1 HYDRAULIC MODEL

The City's hydraulic model combines information on the physical characteristics of the wastewater system (pipelines, lift stations) and operational characteristics (pump curves, set points). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes, including backwater calculations for surcharged conditions.

There are several software products released by different manufacturers that can perform the hydraulic analysis satisfactorily. The selection of a particular software depends on user preferences, the wastewater collection system's unique requirements, and the costs for purchasing and maintaining the software.

Innovyze's InfoSWMM (by Autodesk) was selected as the preferred hydraulic modeling software to evaluate the capacity adequacy of the Yakima wastewater collection system. This software utilizes the fully dynamic St. Venant's equation and has a more accurate engine for simulating backwater effects for surcharged conditions. Additionally, this software has the capability to simulate manifolded force mains and incorporate the use of the Manning Equation in other calculations including upstream pipe flow conditions. The St Venant's and Manning's equations are discussed in the System Performance and Design Criteria chapter.

6.2 MODEL DEVELOPMENT

Computer modeling requires the compilation of large numerical databases that enable data input into the model. Detailed physical aspects, such as pipe size, ground elevation, invert elevations, and pipe lengths contribute to the accuracy of the hydraulic model.

Pipes and manholes represent the physical aspect of the system within the model. A manhole is a computer representation of a place where sewer flows may be allocated into the hydraulic system, while a pipe represents the conveyance aspect of the sewer flows. In addition, selected lift station capacity and design head settings were also included into the hydraulic model.

The City's hydraulic model was initially developed as part of the 2013 Wastewater Collection System Master Plan and most recently updated in 2020 for consistency with the City's latest GIS database. The previous hydraulic model was skeletonized to include pipelines larger than 8

inches, as shown on **Figure 6.1**. In contrast, the latest hydraulic model includes all pipelines available in the GIS database, as documented in **Table 6.1** and displayed on **Figure 6.2**.

Developing the latest hydraulic model included digitizing and quality control, and updating sewer flow allocation.

6.2.1 Digitizing and Quality Control

The City's latest GIS database was used as the primary data source to update the hydraulic model pipelines and manholes along with as-builts for recent construction. A data gap assessment was performed to identify discrepancies or missing information related to pipeline inverts and manhole ground elevations and revealed the majority of the previously un-modeled pipelines (less than 10-inches) do not have pipeline or manhole invert data. These discrepancies were resolved by assuming typical pipeline slopes (**Table 3.1**) and using the City's 1 foot Digital Elevation Model (DEM). It should be noted that cleanouts, private infrastructure, and abandoned pipelines were excluded from the hydraulic model.

The project team consisting of City staff and Akel Engineering staff implemented a thorough quality control program to address each discrepancy and develop a GIS-based hydraulic model. The updated hydraulic model contains approximately 340 miles of sewer pipelines as documented in **Table 6.1**.

6.2.2 Load Allocation

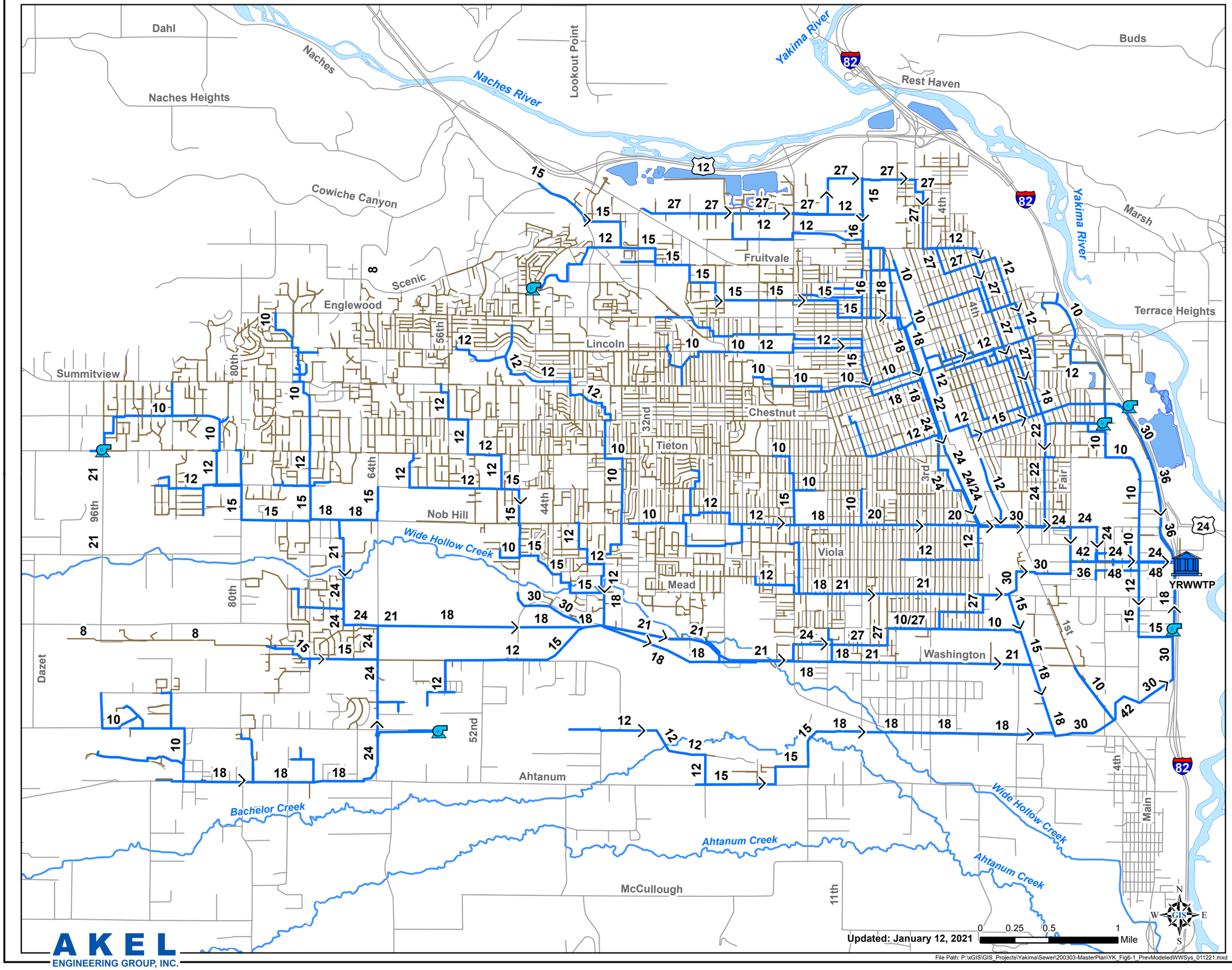
Load allocation consists of assigning sewer flows to the appropriate manholes (nodes) in the model. The goal is to distribute the loads throughout the model to best represent actual system response.

The 2020 sewer billing records received from the City were linked with the parcel dataset using a unique Assessor Parcel Number. Subsequently, flows from the sewer billing records were normalized to 2020 WWTP flows and spatially allocated to nearest hydraulic model node. The collection system was broken down into basins, which aided in the allocation of flows to the correct sewer trunk.

6.3 MODEL CALIBRATION

Model calibration is an iterative process of comparing the model flows with observations and revising the input parameters until the predicted results are acceptable. This process is intended to instill a level of confidence in the flows that are simulated.

Calibration can be performed for steady state conditions, which model the peak hour flows, or for dynamic conditions (24 hours or more). Dynamic calibration consists of comparing the model predictions to diurnal operational changes in the wastewater flows. The City's hydraulic model was calibrated for dynamic conditions.



Legend

Existing System

- WWTP
- Lift Stations
- Pipelines Previously Modeled
- Pipelines not in Previous Model
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 6.1
Previously Modeled Pipelines
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

Dahl
Naches
Naches Heights
Naches River
Lookout Point
Yakima River
Buds
Rest Haven
Cowiche Canyon
Scenic
Englewood
Fruitvale
Lincoln
Chestnut
Tieton
Summitview
Nob Hill
Wide Hollow Creek
Mead
Viola
Marsh
Terrace Heights
YRWWTP
Washington
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
Main
Updated: December 12, 2022
0 0.25 0.5 1 Mile
N W GIS E S
File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig6-2_ExistModeledWWSys_121222.mxd

Legend

Existing Modeled System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System

- Lift Stations
- Pipes
- Streets
- Yakima City Limits
- Streams
- Lakes

PRELIMINARY

Figure 6.2
Existing Modeled Wastewater System
Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

Table 6.1 Existing Modeled Pipe Inventory

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Pipe Size (in)	Pipe Length (ft)	Pipe Length (miles)
Gravity Mains		
2"	329	0.1
5"	8,037	1.5
6"	125,599	23.8
8"	1,157,623	219.2
10"	116,697	22.1
12"	99,811	18.9
14"	2,584	0.5
15"	58,756	11.1
16"	5,370	1.0
18"	58,910	11.2
20"	4,552	0.9
21"	20,814	3.9
22"	5,613	1.1
24"	21,008	4.0
27"	32,394	6.1
30"	17,431	3.3
36"	7,441	1.4
42"	2,591	0.5
48"	4,578	0.9
Subtotal	**1,750,138**	**331.5**
Force Mains		
6"	2,511	0.5
18"	2,553	0.5
24"	6,512	1.2
48"	2,054	0.4
Subtotal	**13,630**	**2.6**
Force Mains		
12"	8,008	1.5
18"	6,435	1.2
24"	14,585	2.8
Subtotal	**29,028**	**5.5**
Total		
	1,792,796	**339.5**

AKEL ENGINEERING GROUP, INC.

12/12/2022

1. Pipeline length extracted from hydraulic model developed by Akel Engineering Group.

In wastewater collection systems, and when using dynamic hydraulic modeling to evaluate the impact of wet weather flows, it is common practice to calibrate the model to the following three conditions:

- Peak dry weather flows.
- Peak wet weather flows from storm rainfall Event No. 1.
- Peak wet weather flows from storm rainfall Event No. 2.

After the model is calibrated to these conditions, it is benchmarked and used for evaluating the capacity adequacy of the wastewater collection system, under dry and wet weather conditions. The following sections summarize historical and current calibration efforts.

6.3.1 2013 Model Calibration

The City's 2013 Master Wastewater Collection System Master Plan included a comprehensive flow monitoring program that captured data at 22 sites, and covered the following periods:

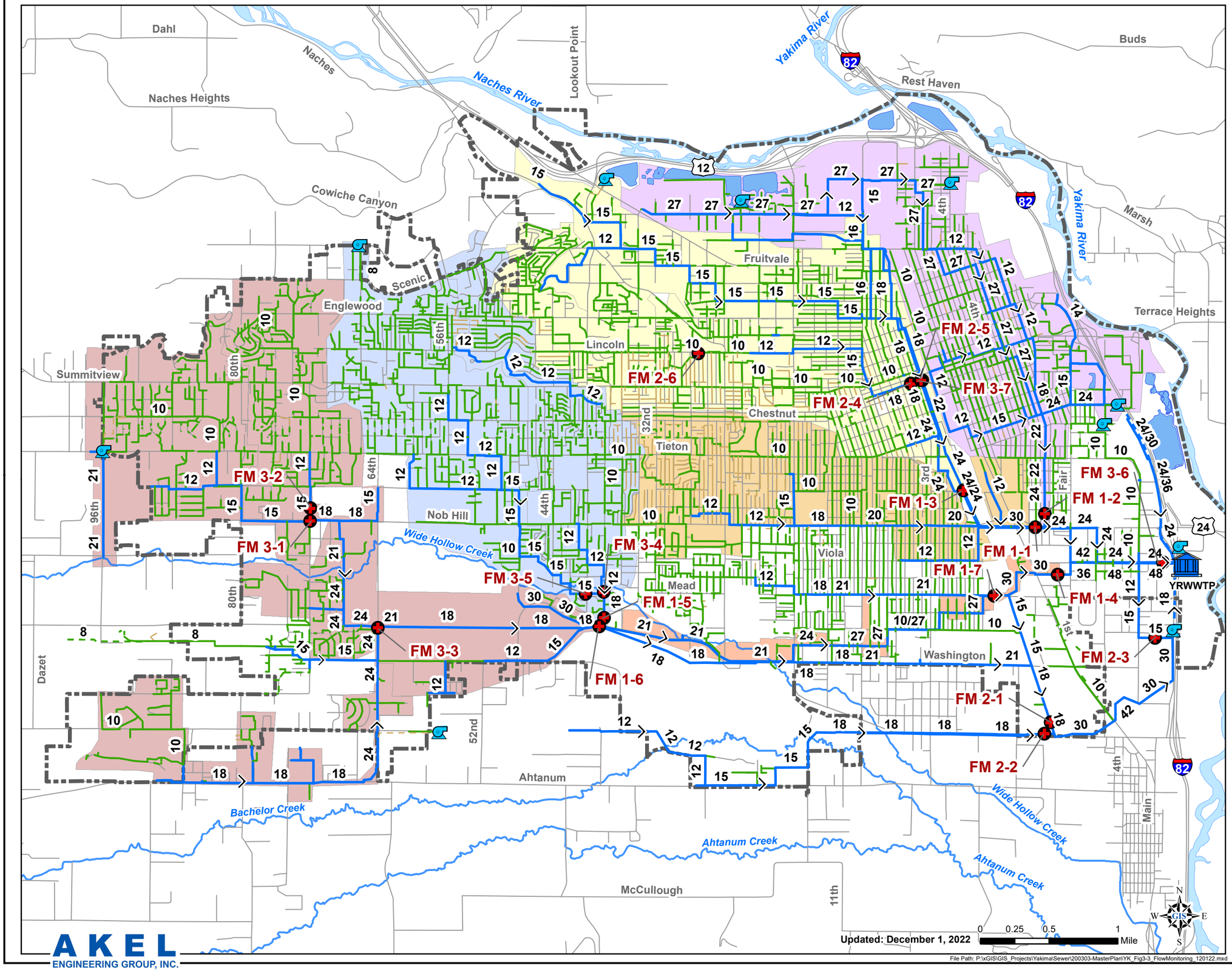
- Flow Monitoring Program Year 1: September 2004 through May 2005
- Flow Monitoring Program Year 2: March 2006 through October 2006
- Flow Monitoring Program Year 3: March 2007 through November 2007

The historical flow monitoring data from three consecutive years indicated that the wastewater collection system experiences high flows during the irrigation season. As such, the previous hydraulic model was calibrated for four calibration conditions: 1) low flow season, 2) peak irrigation season, 3) peak wet weather flows from storm rainfall on September 5, 2006, and 4) peak wet weather flows from storm rainfall on April 6, 2006.

6.3.2 2020 Model Calibration

Due to the City's collection system experiencing high wastewater flows during the irrigation season, the 2020 flow monitoring program captured data at 20 sites from June 2020 through July 2020. The flow monitoring program data was extracted from the flow monitoring software and reviewed for quality control purposes. The selected meter sites are documented in **Table 6.2**, which lists the GIS identification number, location, monitored pipe size, and the monitoring period. The subbasins tributary to each site are delineated on **Figure 6.3**. The flow monitor connectivity schematic is also provided on **Figure 6.4**.

The GIS-based hydraulic model was then calibrated for peak irrigation season flows. The hydraulic model flows for the non-irrigation season were also adjusted based on the WWTP flows



Legend

- Flow Meter Locations

Existing System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main
- Streets

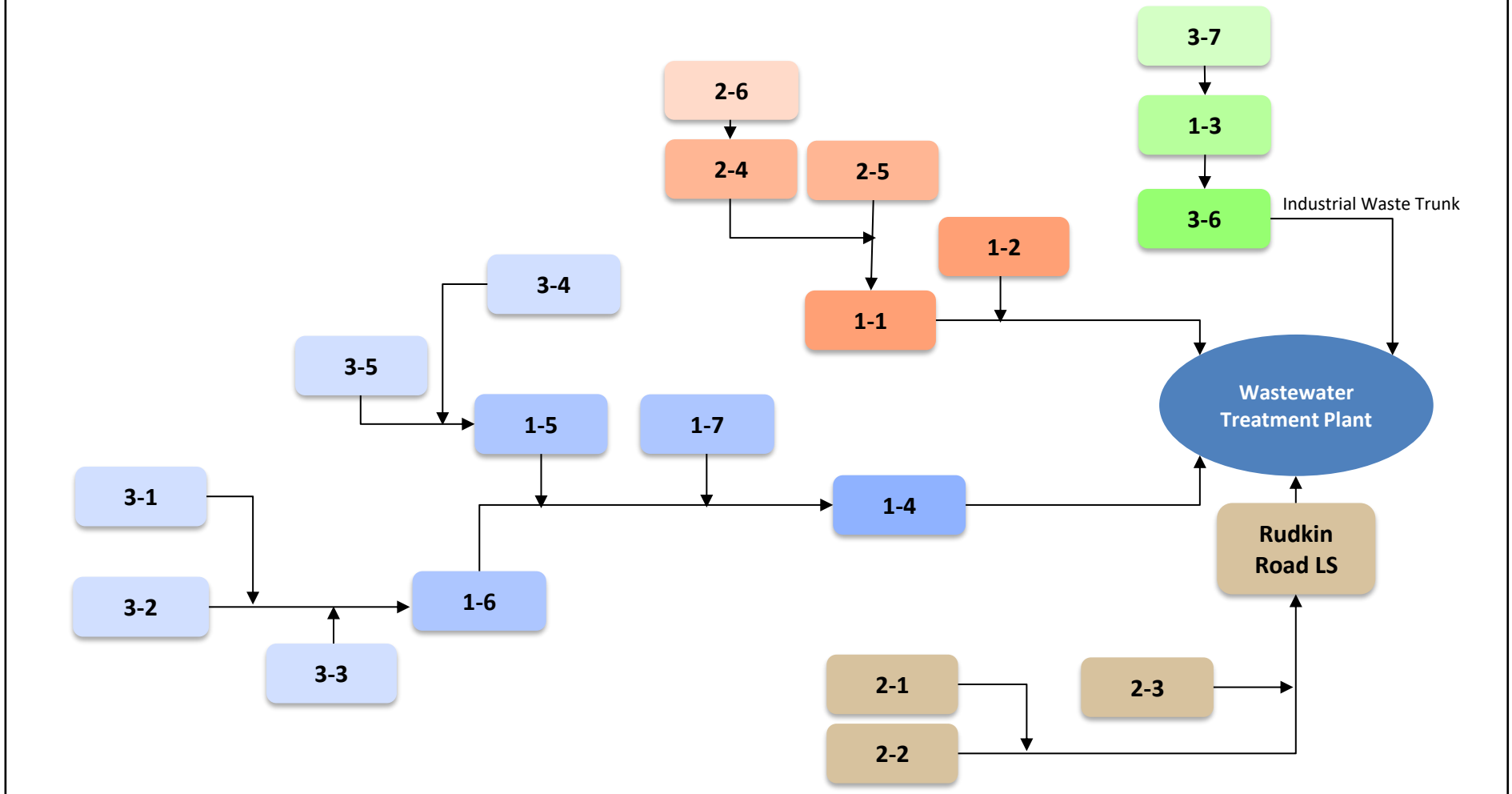
Flow Monitoring Basins

- Basin 1-1
- Basin 1-2
- Basin 1-3
- Basin 1-4
- Basin 1-5
- Basin 1-6
- Yakima City Limits
- Streams
- Lakes

PRELIMINARY

Figure 6.3
Flow Monitoring Program
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



LEGEND

2-1 Sewer Tributary Area

Sewer Trunks

PRELIMINARY

Note:

1. City of Yakima operates a seprate wastewater collection system (Industrial Waste Trunk) for industrial processes.

December 12, 2022

Figure 6.4

Flow Monitor Schematic

Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

Table 6.2 Flow Monitor Sites

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Site ID	GIS Manhole ID[1]	Location Description	Pipe Size[1] (in)	Monitoring Periods From Date	To Date
Monitoring Period 1					
FM 1-1	E43MH43	Nob Hill Blvd between 6th St and 7th St	30 (West)	7/1/2020	7/7/2020
FM 1-2	E43MH30	Alley between 7th St and 8th St, approx. 450' n/o Nob Hill Blvd	24 (North)	6/25/2020	7/2/2020
FM 1-3	E30IW26	Arlington St approx. 300' e/o Landon Ave	24 (West)	6/24/2020	7/1/2020
FM 1-4	E42MH91	Tennant Ln, approx. 450' w/o Fair Ave	30 (West)	7/4/2020	7/7/2020
FM 1-5	W32MH44	Industrial property n/o Washington Ave between 40th Ave and 36th Ave	18 (North)	6/29/2020	7/6/2020
FM 1-6	W32MH90	Washington Ave between 40th ave and 36th ave	18 (West)	6/25/2020	7/2/2020
FM 1-7	E42MH42	Mead Av, approx. 500' e/o Voleker Ave	18 (West)	6/30/2020	7/7/2020
Monitoring Period 2					
FM 2-1	E40MH2A	Industrial property approx. 500' n/o Valley Mall Blvd railroad overpass, e/o Longfibre Rd	21 (North)	6/17/2020	6/23/2020
FM 2-2	E40MH70	Valley Mall Blvd, approx. 1,000 ft east of Longfibre Rd	24 (West)	6/16/2020	6/23/2020
FM 2-3	E63MH20	Lilac Ln, between 18th St and Rudkin Rd	15 (West)	6/17/2020	6/23/2020
FM 2-4	E21MH13	3rd Ave, approx. 200' s/o Yakima Ave	18 (West)	6/17/2020	6/23/2020
FM 2-5	E21MH11	2nd Ave, approx. 150 ft South of Yakima Ave	22 (North)	6/24/2020	6/29/2020
FM 2-6	W21MH17	Intersection of 27th Ave and Lincoln Ave	10 (South)	6/17/2020	6/23/2020
Monitoring Period 3					
FM 3-1	W78MH22	Intersection of 72nd Ave and Nob Hill Blvd	15 (West)	7/9/2020	7/16/2020
FM 3-2	W78MH24	72nd Ave, approx. 450 ft north of Nob Hill Blvd	15 (North)	7/9/2020	7/16/2020
FM 3-3	W80MH10	64th Ave, approx. 100' n/o Terry Ave	24 (South)	7/11/2020	7/16/2020
FM 3-4	W31MH1	Parking lot between Creekside Ct and Wide Hollow Creek	15 (North)	7/9/2020	7/16/2020
FM 3-5	W42MH39	40th Ave, approx. 100 ft n/o Creekside Lp	15 (West)	7/9/2020	7/16/2020
FM 3-6	E64IW45	Viola Ave and w/o Rudkin Rd (Industrial Waste Trunk)	24 (West)	7/9/2020	7/16/2020
FM 3-7	E21IW14	Intersection of Yakima Ave and 2nd Ave	18 (North)	7/9/2020	7/16/2020

Note:

1. The compass direction shown corresponds to the direction from which the pipeline to be metered enters the manhole. Inlet pipes are recommended for meter placement to mitigate the impact of potential turbulence on meter readings.

recorded in March 2020. The calibration process was iterative and included the following conditions:

- Peak dry weather flows – irrigation season (calibrated based on 2020 Flow Monitoring Program)
- Peak dry weather flows – non-irrigation season (calibrated based on 2020 WWTP flows)

The peak wet weather flow calibration is consistent with the 2013 Wastewater Collection System Master Plan and based on storm rainfall events from September 5, 2006, and April 6, 2006.

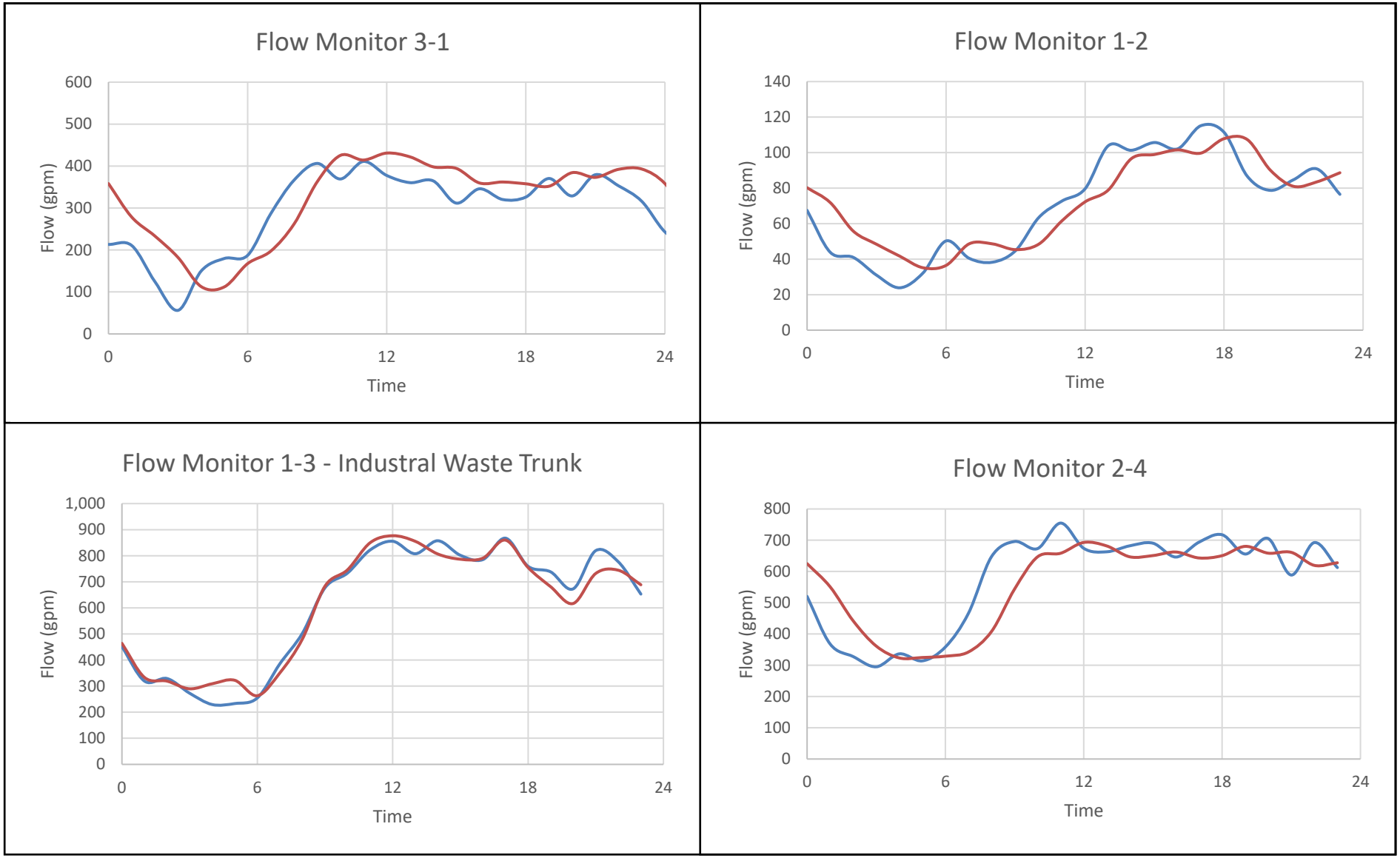
The calibration results for each flow monitoring site are documented in **Appendix A**. These results indicate the calibration effort yielded reasonable comparisons between the flow monitoring data and the hydraulic model predictions at the 22 sites. Representative extracts from **Appendix A** are included on **Figures 6.5**. These extracts show a comparison of observed and modeled flows at each flow monitoring site.

The IWT flow monitors were installed during separate monitoring periods, indicating a variance in flows on the calibration exhibits. This discrepancy is due to the Industrial Waste processes occurring during the monitoring period. This WWCSMP will determine the capacity adequacy of the IWT by applying the Industrial User flows identified in Section 5.3.2 – Industrial Waste Trunk.

6.3.3 Use of the Calibrated Model

The calibrated hydraulic model was used as an established benchmark in the capacity evaluation of the existing wastewater collection system. The model was also used to identify improvements necessary for mitigating existing system deficiencies and for accommodating future growth.

This valuable investment will continue to prove its value to the City as future planning issues or other operational conditions surface. It is recommended that the model be maintained and updated with new construction projects to preserve its integrity.



LEGEND

Flow Monitor Data

Model Data

PRELIMINARY

Figure 6.5

Model Flow Verification

Wastewater Collection System Master Plan

City of Yakima

AKEL ENGINEERING GROUP, INC.

CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

This section presents a summary of the wastewater system capacity evaluation during peak dry weather flows and peak wet weather flows for the existing and buildout conditions. The recommended wastewater collection system improvements needed to mitigate capacity deficiencies are also discussed in this chapter.

7.1 EXISTING WASTEWATER SYSTEM CAPACITY EVALUATION

The calibrated hydraulic model was used to evaluate the wastewater collection system for capacity deficiencies during peak dry weather flows for non-irrigation season (PDWF), generally occurring in March, and during the peak dry weather flows for irrigation season (PDWF-I), generally occurring in September. The analysis also documented capacity deficiencies during peak wet weather flows (PWWF), typically occurring in winter months.

The criteria used for evaluating the capacity adequacy of the wastewater collection system facilities (gravity mains, force mains, and lift stations) were discussed in Chapter 3 and summarized in **Table 3.1**. The most critical design flows used for capacity evaluation were based both the irrigation and wet weather seasons, as documented in **Table 5.12**.

With the exception of few pipe segments, the hydraulic model generally indicates that the wastewater system exhibited adequate performance to service the existing customers during both peak dry weather (irrigation season) and the peak wet weather flows, as displayed graphically on **Figure 7.1** and **Figure 7.2**, respectively.

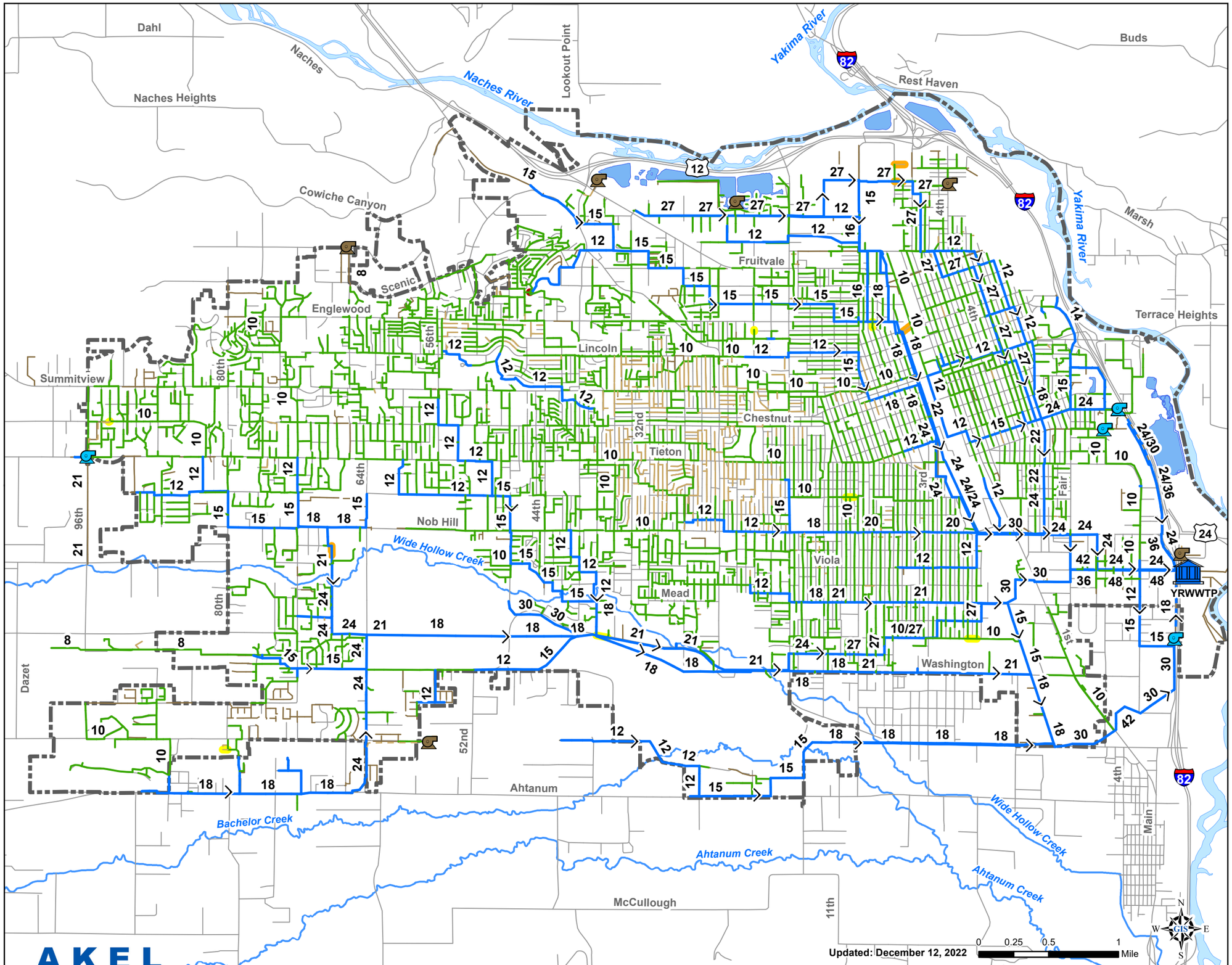
7.1.1 Peak Dry Weather Flows during the Irrigation Season

The existing design flow at the Yakima Regional WWTP for the peak dry weather condition (irrigation season) was estimated at 15.8 MGD, as documented in **Table 5.12**. During this simulation, the maximum allowable d/D ratio was 0.5 for pipes 12-inch or smaller and 0.75 for pipes larger than 12-inches. For existing pipes, the maximum allowable d/D ratio was relaxed to 0.92 (full pipe capacity), to prevent unnecessary pipe replacements.

The hydraulic model results indicate that the existing wastewater collection system is adequately sized for peak dry weather flows (irrigation season), as shown on **Figure 7.1**. The hydraulic model results show that majority of the pipes in the collection system are generally less than 75% full.

7.1.2 Peak Wet Weather Flows

The existing design flow at the Yakima Regional WWTP for the peak wet weather condition was estimated at 29.9 MGD, as documented in **Table 5.12**. During this simulation, the pipelines were allowed to surcharge with a minimum freeboard requirement of three feet. Therefore, a pipeline is



Legend

Existing Modeled System

- WWTP
- Lift Stations

Pipes by Diameter

- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Pipe d/D

- d/D > 0.90
- d/D 0.80 - 0.90
- d/D 0.75 - 0.80

Existing Non-Modeled System

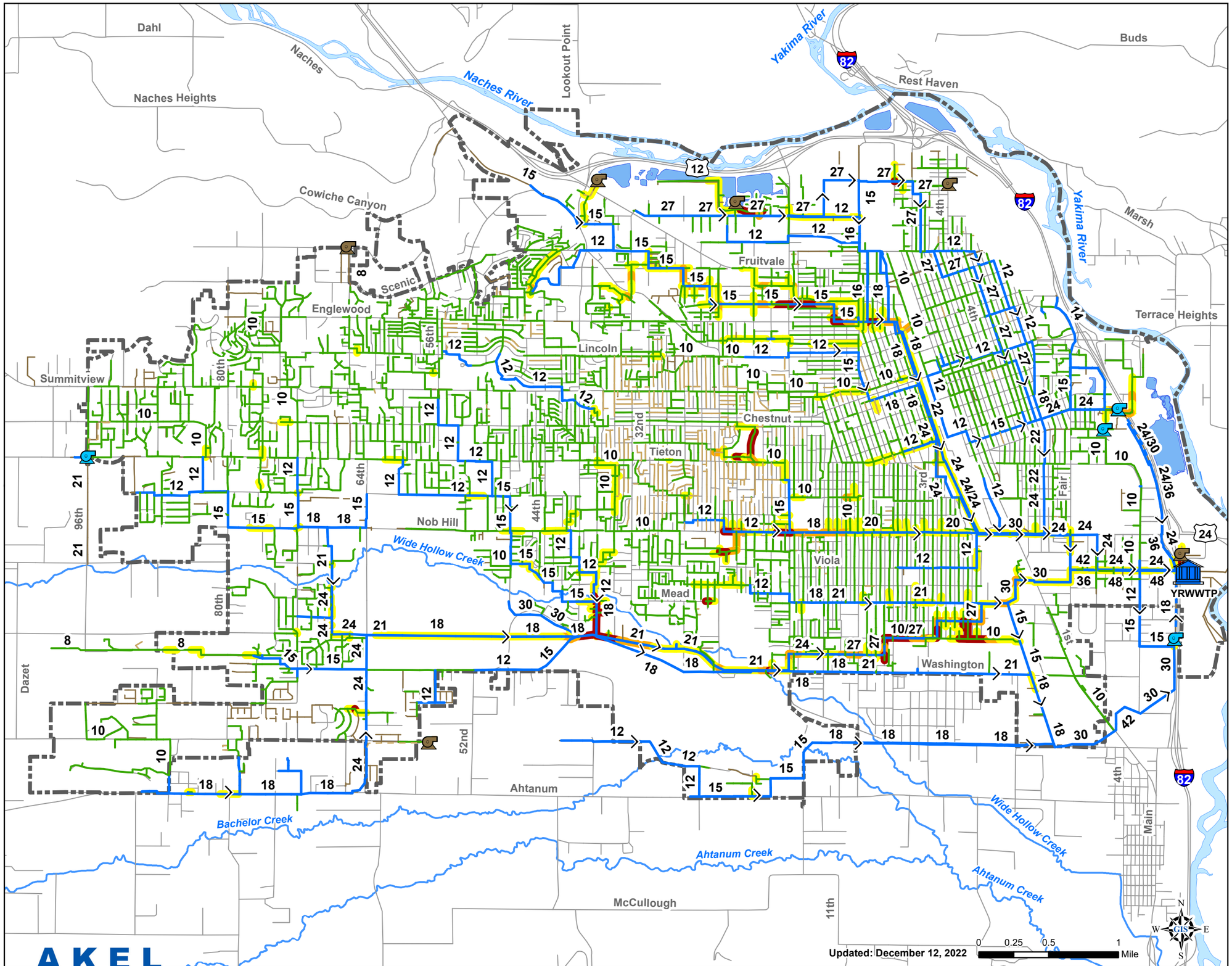
- Lift Stations
- Pipes
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 7.1
Existing Wastewater System Analysis for PDWF

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

Surcharging Manhole
- Within 3 ft of Rim Elevation

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Pipe d/D
- d/D > 0.9
- d/D 0.75 - 0.9
- d/D 0.50 - 0.75

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Yakima City Limits
- Streams
- Lakes

PRELIMINARY

Figure 7.2
Existing Wastewater System Analysis for PWWF

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

considered deficient if the Hydraulic Grade Line (HGL) is less than three feet below the manhole rim elevation. This criterion is typically implemented to minimize the risk of overflows.

The hydraulic model results under peak wet weather conditions are documented on **Figure 7.2**. The capacity evaluation results indicate the existing collection system has adequate capacity to accommodate the existing PWWFs.

7.2 ULTIMATE BUILDOUT CAPACITY EVALUATION AND IMPROVEMENTS

The ultimate buildout capacity improvements needed to service the projected flows from the Yakima Urban Growth Area are summarized in **Table 7.1**, and graphically shown on **Figure 7.3**. For each pipeline improvement, **Table 7.1** lists the assigned improvement number, the street alignment, project limits, existing pipe diameter, new pipe diameter, and pipe length. Additional detailed mapping of each improvement is displayed on Detail A to D in **Appendix B**.

The development of the Urban Growth Area requires the expansion of the wastewater collection system to include future trunks, as shown on **Figure 7.4**.

7.2.1 Construction Triggers

The majority of the growth in the City of Yakima will require expansion of the wastewater collection system. To assist City staff in planning and phasing the construction of the pipeline improvements, **Table 7.1** includes construction triggers for each project. These triggers were developed based on remaining available capacities in the existing wastewater collection system. The construction triggers are expressed in equivalent dwelling units (EDUs) and quantify the residential capacity that can be routed before triggering a deficiency. Non-residential flows should be accounted for by converting them to EDUs.

The construction of specific developments is assumed to be the trigger in undeveloped areas or areas where remaining capacities cannot be used to identify the flow triggers (e.g. Wide Hollow area, Wiley area, Boise Mill Cascade area, etc.).

7.2.2 Washington Avenue Basin and Trunk System

The hydraulic analysis of the modeled Washington Avenue Basin indicates several improvements are needed to increase the capacity of the existing system and to provide service to future developments. These improvements are listed in **Table 7.1** and discussed in this section, grouped into the following trunk systems: 64th Avenue/Ahtanum Trunk, Wide Hollow Trunk, 67th Avenue Trunk, Washington Avenue Trunk, and Freemont Way Trunk.

64th Avenue/Ahtanum Trunk

- **WA-1.** Construct a new 12-inch gravity sewer in Gilbert Road from Hackett Road to approximately 1,335 ft west of Hackett Road. The construction trigger for this improvement

Detail A

Detail B

Detail C

Detail D

Galloway
Lookout Point
Southern
Dahl
Naches River
Naches
Yakima River
Buds
Rest Haven
Naches Heights
Cowiche Canyon
Scenic
Englewood
Fruitvale
Lincoln
Chestnut
Tieton
Summitview
Terrace Heights
Keyes
Marsh
Nob Hill
Wide Hollow Creek
Viola
Mead
Washington
YRWWTP
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
80th
64th
56th
44th
32nd
3rd
Fair
1st
4th
Main
52nd
11th
96th

Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 7.3
Capacity Improvements
Wastewater Collection System
Master Plan
City of Yakima

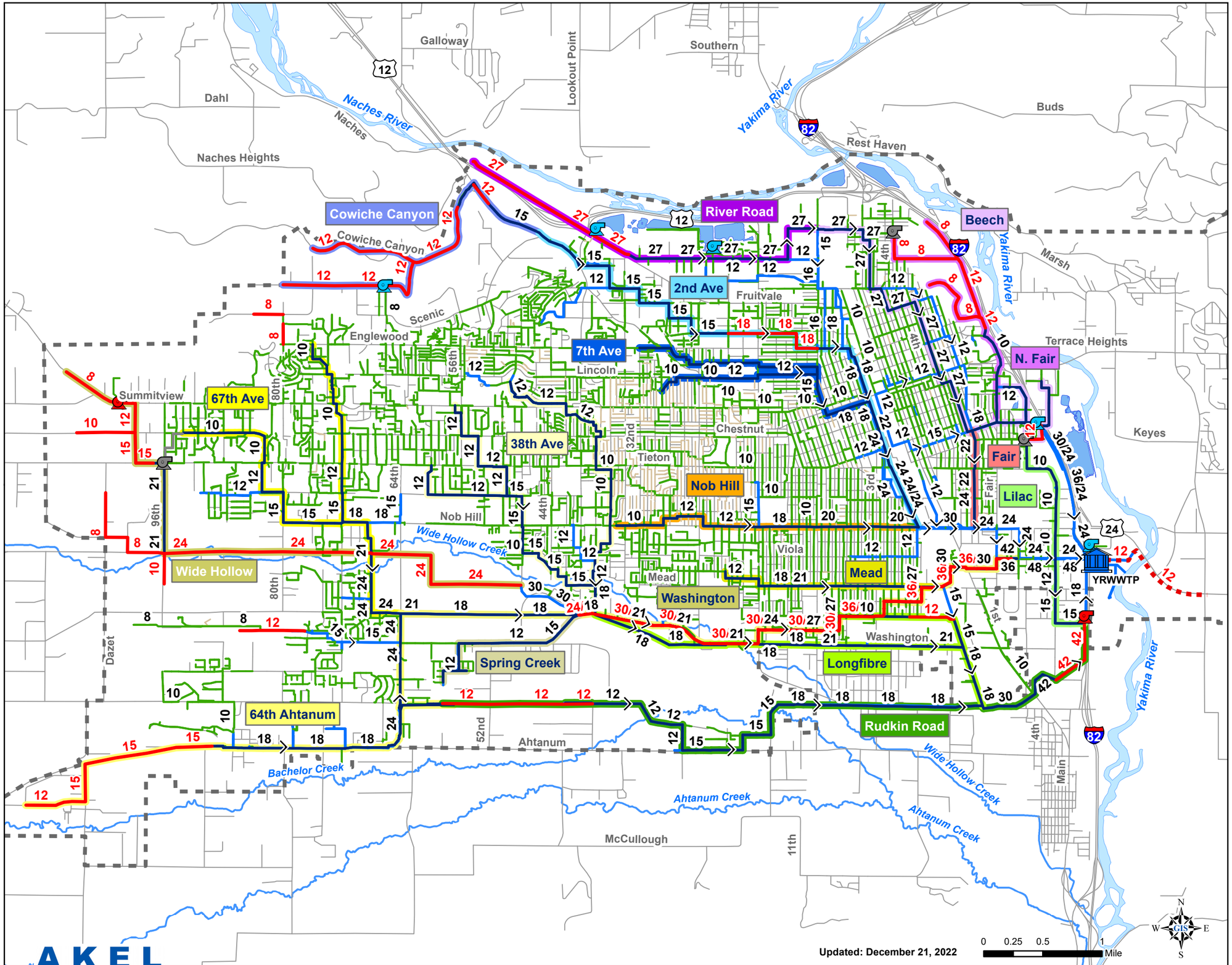
Updated: December 21, 2022

0 0.25 0.5 1 Mile

N W GIS E S

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-3_CapImp_122122.mxd



Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Pipes

Existing System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Smaller
- 8" - 10"
- 12" or Larger

2nd Ave Basin
- 2nd Ave
- 7th Ave
- Cowiche Canyon

Fair Ave Basin
- Fair

Beech St Basin
- Beech
- N. Fair
- River Road

Nob Hill Basin
- Nob Hill

Rudkin Road Basin
- Lilac
- Longfibre
- Rudkin Road

Washington Ave Basin
- 38th Ave
- 64th/Ahtanum
- 67th Ave
- Mead
- Spring Creek
- Washington
- Wide Hollow

- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 7.4
Future Trunk System
Wastewater Collection System
Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-4_FutTrunks_122122.mxd

Table 7.1 Proposed Capacity Improvements for Future Users

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	New, Parallel, or Replace	Existing Pipe Diameter (in)	New Pipe Replacement Diameter (in)	Length (ft)	Construction Triggers (EDUs)
Washington Avenue Basin Improvements								
64th Avenue/Ahtanum Trunk								
WA-1	Gravity Main	Gilbert Road	From Hackett Rd to approx. 1,335 ft w/o Hackett Rd	New	-	12	1,350	Construct with Development in Wiley area
WA-2	Gravity Main	Gilbert Road	From approx. 1,335 ft w/o Hackett Rd to Wiley Rd	New	-	15	1,350	Construct with Development in Wiley area
WA-3	Gravity Main	Wiley Road	From Gilbert Rd to Ahtanum Rd	New	-	15	1,650	Construct with Development in Wiley area
WA-4	Gravity Main	Ahtanum Road	From Wiley Rd to approx. 1,300 ft w/o 90th Ave	New	-	15	4,150	Construct with Development in Wiley area
WA-5	Gravity Main	Ahtanum Road	From approx. 1,300 ft w/o 90th Ave to approx. 225 ft e/o 90th Ave	New	-	15	1,500	Construct with Development in Wiley area
Wide Hollow Trunk								
WA-8	Gravity Main	Summitview Road	From 1550ft se/o 112th Ave to 102nd Ave	New	-	8	2,050	Construct with Development in Wide Hollow area
WA-9	Gravity Main	Summitview Road	From 102nd Ave to Pear Ave	New	-	12	1,450	Construct with Development in Wide Hollow area
WA-10	Gravity Main	Pear Avenue	From Summitview Ave to Orchard Ave	New	-	12	1,300	Construct with Development in Wide Hollow area
WA-11	Gravity Main	Orchard Avenue	From approx. 1,275 ft w/o Hennessy Rd to Hennessy Rd	New	-	10	1,300	Construct with Development in Wide Hollow area
WA-12	Gravity Main	Orchard Avenue	From Hennessy Rd to Pear Ave	New	-	12	1,300	Construct with Development in Wide Hollow area
WA-13	Gravity Main	Pear Avenue	From Orchard Ave to Tieton Dr	New	-	15	1,350	Construct with Development in Wide Hollow area
WA-14	Gravity Main	Tieton Drive	From Pear Ave to approx. 490 ft w/o 96th Ave	New	-	15	800	Construct with Development in Wide Hollow area
WA-15	Gravity Main	96th Avenue	From 1350ft s/o Wide Hollow Rd to Wide Hollow Rd	New	-	10	1,350	Construct with Development in Wide Hollow area
WA-16	Gravity Main	Wide Hollow Rd/Viola Ave/Borley Wy	From 96th Ave to 67th Ave	New	-	24	9,250	Construct with Wide Hollow Sewer Extension Project
WA-17	Gravity Main	Through field between Nob Hill Blvd and Washington Ave	From 67th Ave to 48th Ave	New	-	24	8,000	Construct with Wide Hollow Sewer Extension Project or with 9000 EDUs tributary to Washington Ave and 40th Ave
LS-1	Lift Station	Summitview Road	102nd Ave	New	-	3 @ 75 gpm		Construct with Development in Wide Hollow area
WA-56	Gravity Main	Wide Hollow Rd/1-th Ave/Estes Rd/Hennessy Rd	From Midvale Rd to 96th Ave	New	-	8	5,300	Construct with Development in Wide Hollow area
67th Avenue Sub-Trunk								
WA-18	Gravity Main	Scenic Drive	From 84th Ave Ext to 80th Ave	New	-	8	1,300	Construct with new development / septic conversion
WA-19	Gravity Main	80th Avenue	From Vista Parkway to Englewood Ave	New	-	8	900	Construct with new development / septic conversion
Washington Avenue Trunk								
WA-20	Gravity Main	Washington Avenue	From approx. 50 ft w/o 40th Ave to approx. 530 ft e/o 40th Ave	Parallel	18	24	600	Construct with 9,000 EDUs
WA-21	Gravity Main	Washington Avenue	From approx. 530 ft e/o 40th Ave to approx. 690 ft w/o 36th Ave	Parallel	18	24	150	Construct with 1,800 EDUs
WA-22	Gravity Main	Washington Avenue	From approx. 690 ft w/o 36th Ave to approx. 155 ft e/o 36th Ave	Parallel	21	30	900	Construct with 1,800 EDUs
WA-23	Gravity Main	Washington Avenue	From approx. 155 ft e/o 36th Ave to approx. 75 ft w/o 31st Ave	Parallel	21	30	1,350	Construct with 9,000 EDUs
WA-24	Gravity Main	Washington Avenue	From approx. 75 ft w/o 31st Ave to approx. 205 ft w/o 28th Ave	Parallel	21	30	450	Construct with 9,000 EDUs
WA-25	Gravity Main	Washington Avenue	From approx. 205 ft w/o 28th Ave to approx. 175 ft e/o 28th Ave	Parallel	21	30	400	Construct with 9,000 EDUs
WA-26	Gravity Main	Washington Avenue	From approx. 175 ft e/o 28th Ave to approx. 280 ft w/o 27th Ave	Parallel	21	30	100	Construct with 9,000 EDUs
WA-27	Gravity Main	Washington Avenue	From approx. 280 ft w/o 27th Ave to 27th Ave	Parallel	21	30	300	Construct with 9,000 EDUs
WA-28	Gravity Main	Washington Avenue	From 27th Ave to approx. 210 ft w/o 24th Ave	Parallel	21	30	1,300	Construct with 9,000 EDUs
WA-29	Gravity Main	Washington Avenue	From approx. 210 ft w/o 24th Ave to 24th Ave	Parallel	21	30	250	Construct with 9,000 EDUs
WA-30	Gravity Main	Washington Avenue	From 24th Ave to approx. 200 ft w/o 24th Ave	Parallel	21	30	250	Construct with 9,000 EDUs
WA-31	Gravity Main	Washington Avenue	From approx. 200 ft w/o 24th Ave to approx. 780 ft w/o 16th Ave	Parallel	21	30	1,750	Construct with 9,000 EDUs
WA-32	Gravity Main	Washington Avenue	From approx. 780 ft w/o 16th Ave to approx. 675 ft w/o 16th Ave	Parallel	21	30	100	Construct with 3,600 EDUs
WA-33	Gravity Main	Washington Avenue	From approx. 675 ft w/o 16th Ave to approx. 400 ft w/o 16th Ave	Parallel	21	30	300	Construct with 3,600 EDUs
WA-34	Gravity Main	Washington Avenue	From approx. 400 ft w/o 16th Ave to 16th Ave	Parallel	24	30	350	Construct with 3,600 EDUs

Table 7.1 Proposed Capacity Improvements for Future Users

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	New, Parallel, or Replace	Existing Pipe Diameter (in)	New Pipe Replacement Diameter (in)	Length (ft)	Construction Triggers (EDUs)
WA-35	Gravity Main	16th Avenue	From Washington Ave to Spokane St	Parallel	24	30	650	Construct with 3,600 EDUs
WA-36	Gravity Main	Spokane Street	From 16th Ave to 15th Ave	Parallel	24	30	400	Construct with 3,600 EDUs
WA-37	Gravity Main	Spokane Street	From 15th Ave to Pleasant Ave	Parallel	24	30	1,650	Construct with 3,600 EDUs
WA-38	Gravity Main	Spokane Street	From Pleasant Ave to 7th St	Parallel	27	30	1,700	Construct with 3,600 EDUs
WA-39	Gravity Main	7th Avenue	From Spokane St to Pierce St	Parallel	27	30	650	Construct with 10,000 EDUs
WA-40	Gravity Main	Pierce Street	From 7th Ave to approx. 160 ft w/o 6th Ave	Parallel	27	36	500	Construct with 10,000 EDUs
WA-41	Gravity Main	Pierce Street	From approx. 160 ft w/o 6th Ave to 2nd Ave	Parallel	27	36	1,500	Construct with 2,300 EDUs
WA-42	Gravity Main	2nd Avenue	From Pierce St to approx. 345 ft n/o Pierce St	Parallel	27	36	300	Construct with 2,300 EDUs
WA-43	Gravity Main	2nd Avenue	From approx. 345 ft n/o Pierce St to King St	Parallel	27	36	350	Construct with 2,300 EDUs
WA-44	Gravity Main	King Street	From 2nd Ave to Voelker Ave	Parallel	27	36	1,750	Construct with 2,300 EDUs
WA-45	Gravity Main	Voelker Ave	From King St to approx. 210 ft n/o Baldie Wy	Parallel	27	36	350	Construct with 2,300 EDUs
WA-46	Gravity Main	Voelker Ave	From approx. 210 ft n/o Baldie Wy to Mead Ave	Parallel	27	36	350	Construct with 2,300 EDUs
WA-47	Gravity Main	Mead Avenue	From Voelker Ave to approx. 375 ft e/o Presson Ln	Parallel	27	36	650	Construct with 2,300 EDUs
WA-48	Gravity Main	Mead Avenue	From approx. 375 ft e/o Presson Ln to approx. 715 ft e/o Presson Ln	Parallel	27	36	350	Construct with 2,300 EDUs
WA-49	Gravity Main	City Right of Way	From Mead Ave to approx. 220 ft n/o Mead Ave	Parallel	30	36	400	Construct with 10,000 EDUs
WA-50	Gravity Main	City Right of Way	From approx. 220 ft n/o Mead Ave to Tennant Ln	Parallel	30	36	750	Construct with 3,600 EDUs
WA-51	Gravity Main	Tennant Lane	From approx. 760 ft w/o 1st St to 1st St	Parallel	30	36	800	Construct with 3,600 EDUs
WA-52	Gravity Main	Tennant Lane	From 1st St to Fair Ave	Parallel	30	36	1,350	Construct with 10,000 EDUs
WA-53	Gravity Main	Fair Ave	From Tennant Ln to Viola Ave	Parallel	30	36	450	Construct with 10,000 EDUs
WA-54	Gravity Main	Viola Avenue	From Fair Ave to 12th Ave	Parallel	36	36	650	Construct with 10,000 EDUs
Fremont Way Trunk								
WA-57	Gravity Main	Fremont Way Extension	From 76th Ave to 86th Ave	New	-	12	2,915	Construct with Development in West Valley area
2nd Avenue Basin Improvements								
Cowiche Canyon Road Trunk								
2A-1	Gravity Main	Cowiche Canyon Road	From 78th Ave to Prospect Wy	New	-	12	4,800	Construct with development / septic conversion in Cowiche Canyon area
2A-2	Gravity Main	Vertner Road	From 80th Ave to 66th Ave	New	-	12	4,600	Construct with development / septic conversion in Cowiche Canyon area
2A-3	Gravity Main	Prospect Way	From 66th Ave to Cowiche Canyon Rd	New	-	12	2,650	Construct with development / septic conversion in Cowiche Canyon area
2A-4	Gravity Main	Cowiche Canyon Road	From Prospect Wy to approx. 1,225 ft sw/o Powerhouse Rd	New	-	12	3,800	Construct with development / septic conversion in Cowiche Canyon area
2A-5	Gravity Main	Powerhouse Road	From Cowiche Canyon Rd to City Reservoir Rd	New	-	12	1,075	Construct with development / septic conversion in Cowiche Canyon area
2nd Avenue Trunk								
2A-7	Gravity Main	Jerome Ave, Custer Ave, Cherry Ave	From 18th Ave to 6th Ave	Replace	15	18	3,950	Construct with development / septic conversion in Cowiche Canyon area
Beech Street Basin Improvements								
North Fair Avenue Trunk								
FA-1	Gravity Main	4th Street	From 4th St (Tamarack Lift Station) to Erickson Lane	New	-	8	1,200	Construct with Development in Boise Mill Cascade area
FA-2	Gravity Main	Erickson Lane	From 4th Street Avenue to I-82	New	-	8	2,825	Construct with Development in Boise Mill Cascade area
FA-3	Gravity Main	I-82 Ramp EB ROW	From approx. 170 ft n/o Q Street to Erickson Lane	New	-	8	2,175	Construct with Development in Boise Mill Cascade area
FA-4	Gravity Main	I-82 Ramp EB ROW	From Erickson Lane to D Street	New	-	12	2,825	Construct with Development in Boise Mill Cascade area
FA-5	Gravity Main	I-82 Ramp EB ROW	From D St to Lincoln Ave	New	-	12	475	Construct with Development in Boise Mill Cascade area
FA-6	Gravity Main	I-82 Ramp EB ROW	From Lincoln Ave to approx. 75 ft se/o Lincoln Ave	New	-	12	125	Construct with Development in Boise Mill Cascade area

Table 7.1 Proposed Capacity Improvements for Future Users

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	New, Parallel, or Replace	Existing Pipe Diameter (in)	New Pipe Replacement Diameter (in)	Length (ft)	Construction Triggers (EDUs)
FA-7	Gravity Main	Future Bravo Co. Boulevard	From 8th Street to BNSF Railroad	New	-	8	1,075	Construct with Development in Bravo Co. Boulevard area
FA-8	Gravity Main	Future Bravo Co. Boulevard	From BNSF Railroad to E Street	New	-	8	525	Construct with Development in Bravo Co. Boulevard area
FA-9	Gravity Main	Future Bravo Co. Boulevard	From E St to D St	New	-	8	1,000	Construct with Development in Bravo Co. Boulevard area
FA-10	Gravity Main	D Street	From Future Bravo Co. Boulevard to 950 ft e/o 10th Street	New	-	8	950	Construct with Development in Bravo Co. Boulevard area
Beech Street Trunk								
FA-11	Gravity Main	15th Street	From Race St Lift Station to Beech St (Reverse Grade)	New	-	12	1,325	Construct for the de-commission of Race Street Lift Station
River Road Trunk								
2A-6	Gravity Main	Clover Lane	From Ackley Rd to River Rd	New	-	27	8,150	Construct with Gleed Census-Designated-Place Sewer Extension Project
Rudkin Road Basin Improvements								
Longfibre Road Trunk								
WA-55	Gravity Main	Pierce Street	From approx. 175 ft w/o Ledwich Ave to approx. 85 ft e/o Longfibre Rd	Replace	8	12	2,000	Construct with 117 EDUs
Rudkin Road Trunk								
WA-6	Gravity Main	Occidental Road Extension	From 59th Ave to 52nd Ave	New	-	12	2,150	Construct with development / septic conversion
WA-7	Gravity Main	Occidental Road Extension	From 52nd Avenue to approx. 235 ft w/o 47th Ave	New	-	12	1,300	Construct with development / septic conversion
RR-1	Gravity Main	Sorenson Road	From approx. 235 ft w/o 47th Ave to 38 Ave	New	-	12	3,250	Construct with Development in Sozo Development Area and or septic conversion of southern lots
RR-2	Gravity Main	Rainier Place / Rudkin Road	From South 18th Street to Rudkin Road Lift Station	Replace	30	42	3,200	Construct with 4,065 EDUs
LS-2	Lift Station	Rudkin Road		Replace	-	Replace lower capacity pumps with 2 @ 1,850 gpm Increase firm capacity by 1,300 gpm		Construct with 4,065 EDUs
Terrace Heights Improvements								
Terrace Heights Industrial Waste Trunk								
TH-1	Force Main	WSDOT WA-24 / YRWWTP	From Riverside Road to YRWWTP	New	-	12	2,800	Construct in tandem with construction of Terrace Heights Industrial Waste Lift Station

is the development in the Wiley area.

- **WA-2.** Construct a new 15-inch gravity sewer in Gilbert Road from approximately 1,335 ft west of Hackett Road to Wiley Road. The construction trigger for this improvement is the development in the Wiley area.
- **WA-3.** Construct a new 15-inch gravity sewer in Wiley Road from Gilbert Road to Ahtanum Road. The construction trigger for this improvement is the development in the Wiley area.
- **WA-4.** Construct a new 15-inch gravity sewer in Ahtanum Road from Wiley Road to approximately 1,300 ft west of 90th Avenue. The construction trigger for this improvement is the development in the Wiley area.
- **WA-5.** Construct a new 15-inch gravity sewer in Ahtanum Road from approximately 1,300 ft west of 90th Avenue to approximately 225 ft east of 90th Avenue. The construction trigger for this improvement is the development in the Wiley area.

Wide Hollow Trunk

- **WA-8.** Construct a new 8-inch gravity sewer in Summitview Road from 1,550 ft east of 112th Avenue to 102nd Avenue. The construction trigger for this improvement is the development in the Wide Hollow area.
- **WA-9.** Construct a new 12-inch gravity sewer in Summitview Road from 102nd Avenue to Pear Avenue. The construction trigger for this improvement is the development in the Wide Hollow area.
- **WA-10.** Construct a new 12-inch gravity sewer in Pear Avenue from Summitview Avenue to Orchard Avenue. The construction trigger for this improvement is the development in the Wide Hollow area.
- **WA-11.** Construct a new 10-inch gravity sewer in Orchard Avenue from approximately 1,275 ft west of Hennessy Road to Hennessy Road. The construction trigger for this improvement is the development in the Wide Hollow area.
- **WA-12.** Construct a new 12-inch gravity sewer in Orchard Avenue from Hennessy Road to Pear Avenue. The construction trigger for this improvement is the development in the Wide Hollow area.
- **WA-13.** Construct a new 15-inch gravity sewer in Pear Avenue from Orchard Avenue to Tieton Drive The construction trigger for this improvement is the development in the Wide Hollow area.

- **WA-14.** Construct a new 15-inch gravity sewer in Tieton Drive from Pear Avenue to approximately 490 ft west of 96th Avenue. The construction trigger for this improvement is the development in the Wide Hollow area.

- **WA-15.** Construct a new 10-inch gravity sewer in 96th Avenue from 1350 ft south of Wide Hollow Road to Wide Hollow Road. The construction trigger for this improvement is the development in the Wide Hollow area.

- **WA-16.** Construct a new 24-inch gravity sewer in Wide Hollow Road/Viola Avenue/Borley Way from 96th Avenue to 67th Avenue. The construction trigger for this improvement is the Wide Hollow Sewer Extension Project.

- **WA-17.** Construct a new 24-inch gravity sewer in the field between Nob Hill Boulevard and Washington Avenue from 67th Avenue to 48th Avenue. The construction trigger for this improvement is the Wide Hollow Sewer Extension Project or 9,000 EDUs.

- **LS-1.** Construct a new lift station near the intersection of Summitview Road and 102nd Avenue with 3 pumps rated for 75 gpm each. This improvement is required to convey wastewater to downstream areas located at a higher elevation. The construction trigger for this improvement is the development in the Wide Hollow area.

- **WA-56.** Construct a new 8-inch gravity sewer in Wide Hollow Road/101st Avenue/Estes Road/Hennessy Road from Midvale Road to 96th Avenue. The construction trigger for this improvement is the development in the Wide Hollow area.

Improvement WA-16 and WA-17 will divert flows from the 21-inch line in 67th Avenue at Borley Way. With the construction of the Wide Hollow Trunk, the Sierra Estates Lift Station can be decommissioned and the flows routed into the newly constructed sewer line.

67th Avenue Sub-Trunk

- **WA-18.** Construct a new 8-inch gravity sewer in Scenic Drive from 84th Avenue Extension to 80th Avenue. The construction trigger for this improvement is new development or septic conversion.

- **WA-19.** Construct a new 8-inch gravity sewer in 80th Avenue from Vista Parkway to Englewood Avenue. The construction trigger for this improvement is new development or septic conversion.

Washington Avenue Trunk

- **WA-20.** Construct a parallel 24-inch gravity sewer in Washington Avenue from approximately 50 ft west of 40th Avenue to approximately 530 ft east of 40th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.

- **WA-21.** Construct a parallel 24-inch gravity sewer in Washington Avenue from approximately 530 ft east of 40th Avenue to approximately 690 ft west of 36th Avenue. The construction trigger for this improvement is estimated at 1,800 EDUs.
- **WA-22.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 690 ft west of 36th Avenue to approximately 155 ft east of 36th Avenue. The construction trigger for this improvement is estimated at 1,800 EDUs.
- **WA-23.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 155 ft east of 36th Avenue to approximately 75 ft west of 31st Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-24.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 75 ft west of 31st Avenue to approximately 205 ft west of 28th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-25.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 205 ft west of 28th Avenue to approximately 175 ft east of 28th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-26.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 175 ft east of 28th Avenue to approximately 280 ft west of 27th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-27.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 280 ft west of 27th Avenue to 27th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-28.** Construct a parallel 30-inch gravity sewer in Washington Avenue from 27th Avenue to approximately 210 ft west of 24th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-29.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 210 ft west of 24th Avenue to 24th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-30.** Construct a parallel 30-inch gravity sewer in Washington Avenue from 24th Avenue to approximately 200 ft west of 24th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.
- **WA-31.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 200 ft west of 24th Avenue to approximately 780 ft west of 16th Avenue. The construction trigger for this improvement is estimated at 9,000 EDUs.

- **WA-32.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 780 ft west of 16th Avenue to approximately 675 ft west of 16th Avenue. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-33.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 675 ft west of 16th Avenue to approximately 400 ft west of 16th Avenue. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-34.** Construct a parallel 30-inch gravity sewer in Washington Avenue from approximately 400 ft west of 16th Avenue to 16th Avenue. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-35.** Construct a parallel 30-inch gravity sewer in 16th Avenue from Washington Avenue to Spokane Street. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-36.** Construct a parallel 30-inch gravity sewer in Spokane Street from 16th Avenue to 15th Avenue. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-37.** Construct a parallel 30-inch gravity sewer in Spokane Street from 15th Avenue to Pleasant Avenue. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-38.** Construct a parallel 30-inch gravity sewer in Spokane Street from Pleasant Avenue to 7th Street. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-39.** Construct a parallel 30-inch gravity sewer in 7th Avenue from Spokane Street to Pierce Street. The construction trigger for this improvement is estimated at 10,000 EDUs.
- **WA-40.** Construct a parallel 36-inch gravity sewer in Pierce Street from 7th Avenue to approximately 160 ft west of 6th Avenue. The construction trigger for this improvement is estimated at 10,000 EDUs.
- **WA-41.** Construct a parallel 36-inch gravity sewer in Pierce Street from approximately 160 ft west of 6th Avenue to 2nd Avenue. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-42.** Construct a parallel 36-inch gravity sewer in 2nd Avenue from Pierce Street to approximately 345 ft north of Pierce Street. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-43.** Construct a parallel 36-inch gravity sewer in 2nd Avenue from approximately 345 ft north of Pierce Street to King Street. The construction trigger for this improvement is estimated at 2,300 EDUs.

- **WA-44.** Construct a parallel 36-inch gravity sewer in King Street from 2nd Avenue to Voelker Avenue. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-45.** Construct a parallel 36-inch gravity sewer in Voelker Avenue from King Street to approximately 210 ft north of Baldie Way. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-46.** Construct a parallel 36-inch gravity sewer in Voelker Avenue from approximately 210 ft north of Baldie Way to Mead Avenue. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-47.** Construct a parallel 36-inch gravity sewer in Mead Avenue from Voelker Avenue to approximately 375 ft east of Presson Lane. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-48.** Construct a parallel 36-inch gravity sewer in Mead Avenue from approximately 375 ft east of Presson Lane to approximately 715 ft east of Presson Lane. The construction trigger for this improvement is estimated at 2,300 EDUs.
- **WA-49.** Construct a parallel 36-inch gravity sewer in City Right of Way from Mead Avenue to approximately 220 ft north of Mead Avenue. The construction trigger for this improvement is estimated at 10,000 EDUs.
- **WA-50.** Construct a parallel 36-inch gravity sewer in City right-of-way from approximately 220 ft north of Mead Avenue to Tennant Lane. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-51.** Construct a parallel 36-inch gravity sewer in Tennant Lane from approximately 760 ft west of 1st Street to 1st Street. The construction trigger for this improvement is estimated at 3,600 EDUs.
- **WA-52.** Construct a parallel 36-inch gravity sewer in Tennant Lane from 1st Street to Fair Avenue. The construction trigger for this improvement is estimated at 10,000 EDUs.
- **WA-53.** Construct a parallel 36-inch gravity sewer in Fair Avenue from Tennant Lane to Viola Avenue. The construction trigger for this improvement is estimated at 10,000 EDUs.
- **WA-54.** Construct a parallel 36-inch gravity sewer in Viola Avenue from Fair Avenue to 12th Avenue. The construction trigger for this improvement is estimated at 10,000 EDUs.

The West Valley Area is expected to include the largest amount of anticipated growth within the Yakima Urban Growth Area. Wastewater flows from these new developments will be conveyed eastward through the Washington Avenue Trunk to the Yakima Regional WWTP. Since the existing trunk system cannot accommodate flows from the West Valley UGA, a new parallel relief is recommended for this trunk. The proposed Washington Relief Trunk has the advantage of

being constructed in phases, and offers the flexibility to either parallel the existing Washington Trunk or to slightly divert from the existing alignment if construction constraints are discovered during the pre-design phase.

The Washington Relief Trunk phasing includes improvements WA-20 through WA-54 and WA-17, which is a part of the Wide Hollow Trunk. The following is the suggested construction phasing, and is based on the construction triggers.

- **Phase 1 –** Improvement WA-21 and WA-22. This 1,050 ft stretch of sewer improvement is recommended at 1,800 EDUs.
- **Phase 2 –** Improvements WA-41 through WA-48. This 1.06 mile stretch of sewer improvements is recommended at 2,300 EDUs.
- **Phase 3 –** Improvements WA-32 through WA-38, WA-50, and WA-51. This 1.27 mile stretch of sewer improvements is recommended at 3,600 EDUs.
- **Phase 4 –** Improvements WA-17, WA-20, and WA-23 through WA-32. This 2.79 mile stretch of sewer improvements is recommended at 9,000 EDUs. Also the 18-inch sewer line in Zier Road extension from 64th Avenue to 40th Avenue becomes deficient at 9,000 EDUs, therefore improvement WA-17 is recommended to divert flow from this sewer line.
- **Phase 5 –** Improvements WA-39, WA-40, WA-49, and WA-52 through WA-54. This 0.76 mile stretch of sewer improvements is recommended at 10,000 EDUs.

The phasing of the Washington Relief Trunk is graphically shown on **Figure 7.5** and the improvement details for each phase are listed in **Table 7.2**. It should be noted that several pipe segments were also grouped based on upstream or downstream construction needs.

Freemont Way Trunk

- **WA-57.** Construct a new 12-inch gravity main in Fremont Way Extension from 76th Avenue to 86th Avenue. The construction trigger for this improvement is the development in the West Valley Area.

7.2.3 2nd Avenue Basin Improvements

The hydraulic analysis of the modeled 2nd Avenue Basin indicates several improvements are needed to increase the capacity of the existing system and to provide service to future developments. These improvements are listed in **Table 7.1** and discussed in this section, grouped into the following trunk systems: Cowiche Canyon Road Trunk and 2nd Avenue Trunk.

Cowiche Canyon Road Trunk

- **2A-1.** Construct a new 12-inch gravity sewer in Cowiche Canyon Road from 78th Avenue to Prospect Way. The construction trigger for this improvement is the development or septic conversion in the Cowiche Canyon area.
- **2A-2.** Construct a new 12-inch gravity sewer in Vertner Road from 80th Avenue to 66th Avenue. The construction trigger for this improvement is the development or septic conversion in the Cowiche Canyon area.
- **2A-3.** Construct a new 12-inch gravity sewer in Prospect Way from 66th Avenue to Cowiche Canyon Road. The construction trigger for this improvement is the development or septic conversion in the Cowiche Canyon area.
- **2A-4.** Construct a new 12-inch gravity sewer in Cowiche Canyon Road from Prospect Way to approximately 1,225 ft west of Powerhouse Road. The construction trigger for this improvement is the development or septic conversion in the Cowiche Canyon area.
- **2A-5.** Construct a new 12-inch gravity sewer in Powerhouse Road from Cowiche Canyon Road to City Reservoir Road. The construction trigger for this improvement is the development or septic conversion in the Cowiche Canyon area.

2nd Avenue Trunk

- **2A-7.** Replace existing 15-inch gravity sewer with 18-inch in Jerome Avenue, Custer Avenue, Cherry Avenue from 18th Avenue to 6th Avenue. The construction trigger for this improvement is the development or septic conversion in the Cowiche Canyon area.

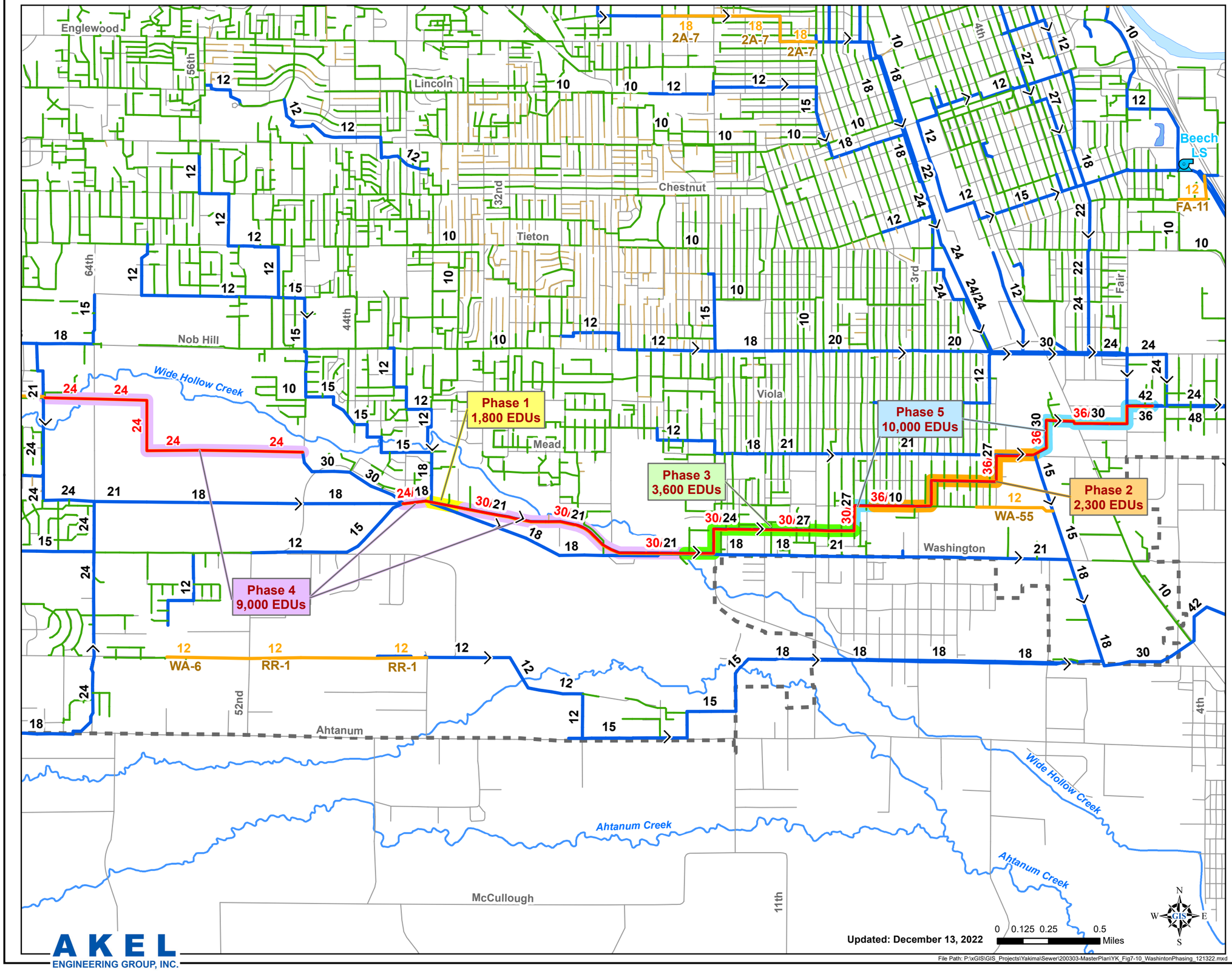
With the construction of the improvements in the Cowiche Canyon area, the flow to the Stonehedge Lift Station can be diverted to the new gravity lines and the lift station can be decommissioned.

7.2.4 Beech Street Basin and Trunk System

The hydraulic analysis of the modeled Beech Street Basin indicates several improvements are needed to increase the capacity of the existing system and to provide service to future developments. These improvements are listed in **Table 7.1** and discussed in this section, grouped into the following trunk systems: North Fair Avenue Trunk, Beech Street Trunk, and River Road Trunk.

North Fair Avenue Trunk

- **FA-1.** Construct a new 8-inch gravity sewer in 4th Street from 4th Street (Tamarack Lift Station) to Erickson Lane. The construction trigger for this improvement is the development in the Boise Mill Cascade area.



Legend

Future System Improvements

- Washington Trunk Improvements
- Other CIP Projects

Pipe Phasing & EDUs

- Phase 1 - 1,800 EDUs
- Phase 2 - 2,300 EDUs
- Phase 3 - 3,600 EDUs
- Phase 4 - 9,000 EDUs
- Phase 5 - 10,000 EDUs

Existing System

- Lift Station

Pipes by Diameter

- 6" or Smaller
- 8" to 10"
- 12" or Larger
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 7.5
Washington Relief Trunk Phasing

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

Table 7.2 Recommended Phasing and Triggers for the Washington Relief Trunk

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	Existing Pipe Diameter (in)	Relief Trunk Size (in)	Length (ft)	EDUs required before relief is needed	Construction Phases and Triggers				
								Phase 1 at 1,800 EDUs (ft)	Phase 2 at 2,300 EDUs (ft)	Phase 3 at 3,600 EDUs (ft)	Phase 4 at 9,000 EDUs (ft)	Phase 5 at 10,000 EDUs (ft)
Improvement to relive 18-inch Gravity Main along Zier Rd Ext between 64th and 40th Avenue												
WA-17	Gravity Main	Through field between Nob Hill Blvd an	From 67th Ave to 48th Ave	-	24	8,000	Construct with 9,000 EDUs				8,000	
Washington Avenue Relief Trunk												
WA-20	Gravity Main	Washington Avenue	From approx. 50 ft w/o 40th Ave to approx. 530 ft e/o 40th Ave	18	24	600	Construct with 9,000 EDUs				600	
WA-21	Gravity Main	Washington Avenue	From approx. 530 ft e/o 40th Ave to approx. 690 ft w/o 36th Ave	18	24	150	Construct with 1,800 EDUs	150				
WA-22	Gravity Main	Washington Avenue	From approx. 690 ft w/o 36th Ave to approx. 155 ft e/o 36th Ave	21	30	900	Construct with 1,800 EDUs	900				
WA-23	Gravity Main	Washington Avenue	From approx. 155 ft e/o 36th Ave to approx. 75 ft w/o 31st Ave	21	30	1,350	Construct with 9,000 EDUs				1,350	
WA-24	Gravity Main	Washington Avenue	From approx. 75 ft w/o 31st Ave to approx. 205 ft w/o 28th Ave	21	30	450	Construct with 9,000 EDUs				450	
WA-25	Gravity Main	Washington Avenue	From approx. 205 ft w/o 28th Ave to approx. 175 ft e/o 28th Ave	21	30	400	Construct with 9,000 EDUs				400	
WA-26	Gravity Main	Washington Avenue	From approx. 175 ft e/o 28th Ave to approx. 280 ft w/o 27th Ave	21	30	100	Construct with 9,000 EDUs				100	
WA-27	Gravity Main	Washington Avenue	From approx. 280 ft w/o 27th Ave to 27th Ave	21	30	300	Construct with 9,000 EDUs				300	
WA-28	Gravity Main	Washington Avenue	From 27th Ave to approx. 210 ft w/o 24th Ave	21	30	1,300	Construct with 9,000 EDUs				1,300	
WA-29	Gravity Main	Washington Avenue	From approx. 210 ft w/o 24th Ave to 24th Ave	21	30	250	Construct with 9,000 EDUs				250	
WA-30	Gravity Main	Washington Avenue	From 24th Ave to approx. 200 ft w/o 24th Ave	21	30	250	Construct with 9,000 EDUs				250	
WA-31	Gravity Main	Washington Avenue	From approx. 200 ft w/o 24th Ave to approx. 780 ft w/o 16th Ave	21	30	1,750	Construct with 9,000 EDUs				1,750	
WA-32	Gravity Main	Washington Avenue	From approx. 780 ft w/o 16th Ave to approx. 675 ft w/o 16th Ave	21	30	100	Construct with 3,600 EDUs			100		
WA-33	Gravity Main	Washington Avenue	From approx. 675 ft w/o 16th Ave to approx. 400 ft w/o 16th Ave	21	30	300	Construct with 3,600 EDUs			300		
WA-34	Gravity Main	Washington Avenue	From approx. 400 ft w/o 16th Ave to 16th Ave	24	30	350	Construct with 3,600 EDUs			350		
WA-35	Gravity Main	16th Avenue	From Washington Ave to Spokane St	24	30	650	Construct with 3,600 EDUs			650		
WA-36	Gravity Main	Spokane Street	From 16th Ave to 15th Ave	24	30	400	Construct with 3,600 EDUs			400		
WA-37	Gravity Main	Spokane Street	From 15th Ave to Pleasant Ave	24	30	1,650	Construct with 3,600 EDUs			1,650		
WA-38	Gravity Main	Spokane Street	From Pleasant Ave to 7th St	27	30	1,700	Construct with 3,600 EDUs			1,700		
WA-39	Gravity Main	7th Avenue	From Spokane St to Pierce St	27	30	650	Construct with 10,000 EDUs					650
WA-40	Gravity Main	Pierce Street	From 7th Ave to approx. 160 ft w/o 6th Ave	27	36	500	Construct with 10,000 EDUs					500
WA-41	Gravity Main	Pierce Street	From approx. 160 ft w/o 6th Ave to 2nd Ave	27	36	1,500	Construct with 2,300 EDUs		1,500			
WA-42	Gravity Main	2nd Avenue	From Pierce St to approx. 345 ft n/o Pierce St	27	36	300	Construct with 2,300 EDUs		300			
WA-43	Gravity Main	2nd Avenue	From approx. 345 ft n/o Pierce St to King St	27	36	350	Construct with 2,300 EDUs		350			
WA-44	Gravity Main	King Street	From 2nd Ave to Voelker Ave	27	36	1,750	Construct with 2,300 EDUs		1,750			
WA-45	Gravity Main	Voelker Ave	From King St to approx. 210 ft n/o Baldie Wy	27	36	350	Construct with 2,300 EDUs		350			
WA-46	Gravity Main	Voelker Ave	From approx. 210 ft n/o Baldie Wy to Mead Ave	27	36	350	Construct with 2,300 EDUs		350			
WA-47	Gravity Main	Mead Avenue	From Voelker Ave to approx. 375 ft e/o Presson Ln	27	36	650	Construct with 2,300 EDUs		650			
WA-48	Gravity Main	Mead Avenue	From approx. 375 ft e/o Presson Ln to approx. 715 ft e/o Presson Ln	27	36	350	Construct with 2,300 EDUs		350			
WA-49	Gravity Main	City Right of Way	From Mead Ave to approx. 220 ft n/o Mead Ave	30	36	400	Construct with 10,000 EDUs					400
WA-50	Gravity Main	City Right of Way	From approx. 220 ft n/o Mead Ave to Tennant Ln	30	36	750	Construct with 3,600 EDUs			750		
WA-51	Gravity Main	Tennant Lane	From approx. 760 ft w/o 1st St to 1st St	30	36	800	Construct with 3,600 EDUs			800		
WA-52	Gravity Main	Tennant Lane	From 1st St to Fair Ave	30	36	1,350	Construct with 10,000 EDUs					1,350
WA-53	Gravity Main	Fair Ave	From Tennant Ln to Viola Ave	30	36	450	Construct with 10,000 EDUs					450
WA-54	Gravity Main	Viola Avenue	From Fair Ave to 12th Ave	36	36	650	Construct with 10,000 EDUs					650
							Total Length	1,050	5,600	6,700	14,750	4,000

AKEL ENGINEERING GROUP, INC.

12/13/2022

Notes

- **FA-2.** Construct a new 8-inch gravity sewer in Erickson Lane from 4th Street Avenue to I-82. The construction trigger for this improvement is the development in the Boise Mill Cascade area.

- **FA-3.** Construct a new 8-inch gravity sewer in I-82 eastbound Ramp right-of-way from approximately 170 ft north of Q Street to Erickson Lane. The construction trigger for this improvement is the development in the Boise Mill Cascade area.

- **FA-4.** Construct a new 12-inch gravity sewer in I-82 eastbound Ramp right-of-way from Erickson Lane to D Street. The construction trigger for this improvement is the development in the Boise Mill Cascade area.

- **FA-5.** Construct a new 12-inch gravity sewer in I-82 eastbound Ramp right-of-way from D Street to Lincoln Avenue. The construction trigger for this improvement is the development in the Boise Mill Cascade area.

- **FA-6.** Construct a new 12-inch gravity sewer in I-82 eastbound Ramp right-of-way from Lincoln Avenue to approx. 75 ft east of Lincoln Avenue. The construction trigger for this improvement is the development in the Boise Mill Cascade area.

- **FA-7.** Construct a new 8-inch gravity sewer in Future Bravo Co. Boulevard from 8th Street to BNSF Railroad. The construction trigger for this improvement is the development in the Bravo Co. Boulevard area.

- **FA-8.** Construct a new 8-inch gravity sewer in Future Bravo Co. Boulevard from BNSF Railroad to E Street. The construction trigger for this improvement is the development in the Bravo Co. Boulevard area.

- **FA-9.** Construct a new 8-inch gravity sewer in Future Bravo Co. Boulevard from E Street to D Street. The construction trigger for this improvement is the development in the Bravo Co. Boulevard area.

- **FA-10.** Construct a new 8-inch gravity sewer in D Street from Future Bravo Co. Boulevard to 950 ft east of 10th Street. The construction trigger for this improvement is the development in the Bravo Co. Boulevard area.

Beech Street Trunk

- **FA-11.** Construct a new 12-inch gravity sewer in 15th Street from Race Street Lift Station to Beech Street (Reverse Grade). The construction trigger for this improvement is the decommissioning of Race Street Lift Station.

River Road Trunk

- **2A-6.** Construct a new 27-inch gravity sewer in Clover Lane from Ackley Road to River Road. The construction trigger for this improvement is the development of the Gleed Census-Designated-Place Sewer Extension Project. This is a preliminary capacity improvement, as flow information becomes available for the project the final design of sanitary sewer pipeline shall comply with the rules, regulations, and specifications outlined in the City Standards and in this WWCSMP.

The following additional notes are relevant to the improvements associated with the Beech Street Basin and Trunk System:

- When improvements FA-1 through FA-6 are constructed, the flows from Tamarack Lift Station can be routed into the new gravity sewers and the lift station can be de-commissioned.
- When improvement FA-11 is constructed, the flows from Race Street Lift Station can be routed into the new gravity sewers and the lift station can be de-commisioned.

7.2.5 Rudkin Road Basin and Trunk System

The hydraulic analysis of the modeled Rudkin Road Basin indicates several improvements are needed to increase the capacity of the existing system and to provide service to future developments. These improvements are listed in **Table 7.1** and discussed in this section, grouped into the following trunk systems: Longfibre Road Trunk and Rudkin Road Trunk.

Longfirbre Road Trunk

- **WA-55.** Replace the existing 8-inch gravity sewer with 12-inch in Pierce Street from approximately 175 feet west of Ledwich Avenue to approximately 85 feet east of Longfibre Road. The construction trigger for this improvement is estimated at 117 EDUs.

Rudkin Road Trunk

- **WA-6.** Construct a new 12-inch gravity sewer in Occidental Road Extension from 59th Avenue to 52nd Avenue. The construction trigger for this improvement is new development or septic conversion.
- **WA-7.** Construct a new 12-inch gravity sewer in Occidental Road Extension from 52nd Avenue to approximately 235 ft west of 47th Avenue. The construction trigger for this improvement is new development or septic conversion.
- **RR-1.** Construct a new 12-inch gravity sewer in Sorenson Road from approximately 235 ft west of 47th Avenue to 38 Avenue. The construction trigger for this improvement is the development in the Sozo Development area or septic conversion of southern lots.

- **RR-2.** Replace the existing 30-inch gravity sewer with 42-inch in Rainier Place and Rudkin Road from South 18th Street to Rudkin Road Lift Station. The construction trigger for this improvement is estimated at 4,065 EDUs.

- **LS-2 (Rudkin Road Lift Station).** Replace two existing 1,200 gpm pumps at the Rudkin Road lift station with two new 1,850 gpm pump to increase the lift station's firm capacity by 1,300 gpm. The construction trigger for this improvement is estimated at 4,065 EDUs.

7.2.6 Terrace Heights Improvements

The community of Terrace Heights is planning to construct an Industrial Waste Lift Station that would convey IW flow to the YRWWTP. Per City staff request, this master plan accounts for the construction of the force main project to connect the proposed lift station to the City's treatment facility. The Terrace Heights capacity improvement is listed in **Table 7.1**

- **TH-1.** Construct a new 12-inch gravity sewer in WSDOT WA-24 from Riverside Road to the YRWWTP. The construction trigger for this improvement is the construction of the Terrace Heights Industrial Waste Lift Station.

Figure 7.6 shows the wastewater collection system performance under buildout peak dry weather flows (irrigation season) and includes the proposed improvements described in this section.

According to the hydraulic model results, few existing pipelines will exhibit d/D ratios greater than 0.75. Thus, most of the collection system pipelines will be less than 75% full.

Similarly, **Figure 7.7** shows the wastewater collection system performance under buildout peak wet weather flows and includes the proposed improvements described in this section. During PWWFs, few pipe segments experience acceptable surcharging conditions, including the Zier Road segment from 64th Avenue to 40th Avenue, and Nob Hill Boulevard segment from 24th Avenue to 10th Avenue. These segments meet the City's performance and design criteria with a minimum freeboard of more than three feet.

7.3 INDUSTRIAL WASTE TRUNK CAPACITY EVALUATION

The industrial waste trunk currently serves four users and has capacity to accommodate new users. The remaining capacity available in each critical segment of the trunk are documented on **Figure 7.8** and briefly described as follows:

- **Segment 1 – 12-inch gravity main along J Street and 23rd Avenue west of 16th Avenue:** This segment currently receives industrial wastewater from Seneca Food Corporation with a peak hour flow of approximately 173 gpm. This segment has a remaining capacity of approximately 650 gpm.

Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Pipe d/D
- d/D > 0.9
- d/D 0.75 - 0.9
- d/D 0.50 - 0.75

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Updated: December 21, 2022

0 0.25 0.5 1 Mile

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-6_FutPDWF_122122.mxd

Figure 7.6
Proposed System at Ultimate Flows for PDWF-I

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Pipe d/D
- d/D > 0.9
- d/D 0.75 - 0.9
- d/D 0.50- 0.75

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Updated: December 21, 2022

0 0.25 0.5 1 Mile

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-7_FutPWWF_122122.mxd

Figure 7.7
Proposed System at Ultimate Flows for PWWF

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

Segment 1
12" on J St and 23rd Ave
Remaining Capacity: 650 gpm

Segment 2
12" on J St
Remaining Capacity: 785 gpm

Segment 3
18" on I St, Quincy St, 3rd Ave, and Cherry Ave
Remaining Capacity: 1,065 gpm

Segment 4
18" on 2nd Ave
Remaining Capacity: 2,175 gpm

Segment 5
Existing 24" on 2nd Ave, Nob Hill Blvd, 13th St, and Viola Ave
Remaining Capacity: 3,750 gpm

Seneca
Jewel
Del Monte
Noel Canning
YRWWTP

River Rd
Fruitvale Blvd
Englewood Ave
W Lincoln Ave
Summitview Ave
W Chestnut Ave
Chestnut
Tieton
W Nob Hill Blvd
W Viola Ave
Mead
E I St
E H St
E F St
E D St
E Yakima Ave
E Walnut St
E Maple St
W Spruce St
E Beech St
Pacific Ave
E Viola Ave
E Mead Ave
N 16th Ave
N 6th Ave
4th
3rd
Fair
S 1st St
S 18th St
S 24th Ave
S 20th Ave
S 12th Ave
Cornell Ave
S 2nd Ave
Ledwich Ave
Yakima River
Marsh
Terrace Heights

Legend

Existing Industrial Users by Average Flow

- 0 - 50,000 gpd
- 100,000 - 150,000 gpd
- 200,000 - 300,000 gpd

Existing System

- WWTP
- Pipes

Industrial Pipelines

- Gravity Pipes
- Double Barrel Force Mains
- Segment 1
- Segment 2
- Segment 3
- Segment 4
- Segment 5
- Streams
- Lakes

PRELIMINARY

Updated: January 17, 2023

0 0.125 0.25 0.5 Miles

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-8_IWTrunk_RemainingCap_011723.mxd

Figure 7.8
IW Trunk Remaining Capacity
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

- **Segment 2 – 12-inch gravity main along J Street, east of 16th Avenue :** This segment receives industrial wastewater from Segment 1 with a peak hour flow of approximately 173 gpm. This segment has a remaining capacity of approximately 785 gpm.

- **Segment 3 – 18-inch gravity main along I Street, Quincy Street, 3rd Avenue, and Cherry Avenue:** This segment includes the existing double barrel force main (**Figure 7.8**) and receives industrial wastewater from Segment 2 and Jewel Apple Ltd. This segment currently exhibits a peak hour flow of approximately 525 gpm and has a remaining capacity of approximately 1,065 gpm.

- **Segment 4 – 18-inch gravity main along 2nd Avenue:** This segment receives industrial wastewater from Segment 3 and Del Monte Foods fruit processing plant. This segment currently exhibits a peak hour flow of approximately 933 gpm. This segment has a remaining capacity of approximately 2,175 gpm.

- **Segment 5 – 24-inch gravity main along 2nd Avenue, Nob Hill Boulevard, 13th Street, and Viola Avenue:** This segment receives industrial wastewater from Segment 4 and Noel Canning and Bottling Company. This segment currently exhibits a peak hour flow of approximately 966 gpm. This segment has a remaining capacity of approximately 3,750 gpm

7.4 LIFT STATION CAPACITY EVALUATION

This master plan included evaluating the capacity adequacy of the four modeled lift stations: Rudkin Road, Race Street, Sierra Estates, and Beech Street. **Table 7.3** lists the existing lift stations, their firm capacity, and the peak wet weather flows. The existing and future capacity evaluation results for each lift station are also summarized on this table and briefly documented in the following subsections.

7.4.1 Rudkin Road Lift Station

Hydraulic analysis indicates that the highest flow experienced at this lift station during existing and future peak wet weather conditions are 3,491 gallons per minute (gpm) and 6,331 gpm, respectively. Given the firm pumping capacity of 5,100 gpm, this lift station is deficient by approximately 1,231 gpm for the ultimate buildout scenario. This master plan recommends replacing existing 1,200 gpm pumps with two new 1,850 gpm pumps to provide a firm pumping capacity of 6,400 gpm.

7.4.2 Race Street Lift Station

Hydraulic analysis indicates that the highest flow experienced at this lift station during existing peak wet weather conditions is 323 gpm. The modeled flow is less than the firm capacity of 375 gpm, resulting in a surplus of approximately 52 gpm.

Table 7.3 Lift Station Capacity Analysis

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Pump Station	Location	Firm Capacity (Excludes Standby) (gpm)	Total Capacity (Includes Standby) (gpm)	Existing Peak Wet Weather Flows (gpm)	(mgd)	Surplus/ Deficiency (gpm)	Future Peak Wet Weather Flows (gpm)	(mgd)	Surplus/ Deficiency (gpm)	Recommended Improvements
Lift Stations along modeled system										
Race Street	15th Street and Race	375	750	323	0.47	52	To be Abandoned		-	**To be Abandoned**
Beech	1753 E Beech St	4,800	7,200	3,148	4.53	1,652	3,130	4.51	**1,670**	**-**
Sierra Estates	96th and Tieton	150	300	90	0.13	60	To be Abandoned		-	**To be Abandoned**
Rudkin Road	Rudkin Road	5,100	7,800	3,491	5.03	1,609	6,331	9.12	**-1,231**	Replace existing 1,200 gpm pumps with two new **1,850 gpm** pumps **Updated firm capacity = 6,400 gpm**

AKEL ENGINEERING GROUP, INC.

12/13/2022

Given the planned improvements along the Beech Street Trunk (Section 7.2.4), this lift station will be decommissioned in the near future.

7.4.3 Sierra Estates Lift Station

Hydraulic analysis indicates that the highest flow experienced at this lift station during existing peak wet weather conditions is 90 gpm. The modeled flow is less than the firm capacity of 150 gpm, resulting in a surplus of approximately 60 gpm.

Given the planned improvements along the Wide Hollow Trunk (Section 7.2.6), this lift station will be decommissioned in the near future.

7.4.4 Beech Street Lift Station

Hydraulic analysis indicates that the highest flow experienced at this lift station during existing and future peak wet weather conditions are 3,148 gpm and 3,130 gpm, respectively. Given the firm pumping capacity of 4,800 gpm, this lift station will have a surplus capacity of approximately 1,670 gpm for the ultimate buildout scenario. As such, this lift station does not require capacity improvements.

7.5 INFILTRATION AND INFLOW

The infiltration and inflows in the City were well documented in the 2010 Infiltration and Inflow report, prepared by Wastewater Division staff (**Appendix C**). The report thoroughly documents the amount of infiltration and inflows experienced during the irrigation season at the YRWWTP, in gallons per day per capita as extracted from billing data. The 2020 infiltration and inflows in the City were estimated by reviewing the annual YRWWTP flows for non-irrigation and irrigation season dry weather flows and maintained the distribution documented in the 2010 I&I report.

The 2020 infiltration and inflow analysis is summarized in **Table 7.4**, and intended to help the City track irrigation inflows from tributary basins served by the wastewater collection system. This table lists the 2020 non-irrigation season average dry weather flow, 2020 irrigation season maximum day flow, and the corresponding estimated inflow.

Table 7.4 indicates that out of a total City-wide Infiltration and Inflow of 2.76 mgd (down from 4.92 mgd in 2010), the Beech Street Basin (formally the Fair Ave Basin) accounted for approximately 1.29 MGD, or 47 percent. Similarly, the Rudkin Road Basin accounted for approximately 0.63 mgd, or 23 percent. These basins represent approximately 70 percent of the total Infiltration and Inflow and should be targeted for condition assessments

Table 7.4 2020 Irrigation Inflow Distribution by Basin

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Basin	Number of Accounts	Percent of Total (%)	Dry Weather Flows (MGD)	Irrigation Season Flows (MGD)	Irrigation Inflow (MGD)	Percent of Total (%)
2nd Avenue	6,174	21%	1.86	2.14	0.28	10%
Beech Street	2,625	9%	1.24	2.53	1.29	47%
Fair Avenue	667	2%	0.16	0.24	0.08	3%
Nob Hill Boulevard	4,919	17%	0.60	0.85	0.26	9%
Rudkin Road	1,558	5%	1.50	2.13	0.63	23%
Washington	13,339	46%	2.08	2.31	0.23	8%
Industrial Waste Trunk	4	0%	0.31	0.31	0.00	0%
Other[1]	n/a	n/a	0.72	0.72	0.00	0%
Total	**29,286**	100%	8.47	11.24	**2.76**	100%

AKEL ENGINEERING GROUP, INC.

12/13/2022

Note:

1. Accounts not serviced by the City's wastewater collection system include areas within the community of Terrace heights and the City of Moxee.

CHAPTER 8 – CONDITION AND RISK ASSESSMENT

This chapter documents the condition and risk analysis for the City of Yakima's wastewater collection system. The following sections include a discussion of the data utilized to establish risk and criticality, criteria development, results of the risk analysis, and recommended renewal and replacement actions.

8.1 OVERVIEW

The purpose of this evaluation is to identify pipelines in the wastewater collection system with the largest risk and highest criticality based on their likelihood of failure (LOF) and consequence of failure (COF) scores. This risk analysis will be used to provide renewal and replacement actions so the system can maintain levels of service desired by the City and expected by the customers. This evaluation will aid City staff in justifying capital improvement budgets and assist the City in changing from a reactive repair strategy to a proactive renewal and replacement strategy by identifying high risk and high criticality pipelines.

This chapter documents the methodology used to identify risk and recommended pipeline renewal and replacement recommendations.

8.2 AVAILABLE DATA

As part of the data collection phase, the City of Yakima provided detailed system maps, asset data inventory, CCTV review, and pipeline maintenance records. The availability and quality of data are discussed below and documented in **Table 8.1**.

- **System Maps**: These maps included pipeline connections and alignments based on Yakima's existing wastewater collection system GIS, which was most recently updated in September 2021.

- **Asset Data Inventory**: This inventory included pipeline age, material, and capacity. Pipeline age and material was available for approximately 90 percent and 97 percent of pipelines, respectively. Pipeline capacities were available for pipelines included in the hydraulic model.

- **CCTV Data**: The City of Yakima has comprehensive CCTV data for the existing wastewater collection system. However, due to limitations on the ability to extract and transfer CCTV records, only 8-percent of the system CCTV data was available for use in this analysis. CCTV information was utilized in a Microsoft Access Database, and pipeline defects were linked with the GIS database based on the asset identification number from the Pipeline Assessment and Certification Program (PACP).

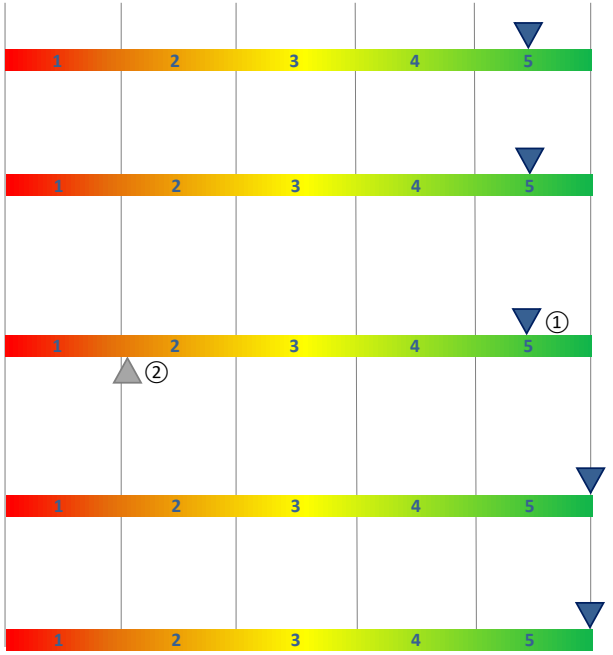
Table 8.1 Condition Assessment Data Availability and Quality

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

	Focus	Group	Availability	Quality Needs Improvement — Excellent
1	Asset Information	Up-to-Date System Maps	The system maps were updated based on the GIS current as of September 2021.	
2	Asset Information	Asset Data Inventory (Age, Material, Capacity)	Age: Available for 90% of pipes Material: Available for 97% of pipes Capacity: Available for pipelines included in the hydraulic model	
3	Asset Knowledge	Closed Circuit Television of Gravity Mains	① The availability of city-wide CCTV data. ② The ability to export and transfer CCTV data. Approximately 38.7 miles of pipelines have PACP-Structural historical records, and 40.9 miles of pipelines have PACP-O&M historical records available for this analysis. Some PACP errors.	
4	Geographic Information	Geographic Data Inventory	Channels/Rivers: Information available	
5	Municipal Information	Municipal Data Inventory	Roads: Up-to-date road maps available Medical/Childcare Facilities: Facility locations available	



8/10/2022

According to City staff, the City of Yakima has comprehensive CCTV data for the existing wastewater collection system. However, due to limitations on the ability to extract and transfer CCTV records, about 92-percent of pipes have no historical CCTV data used in this analysis.

- **Geographic Data Inventory**: These data included geographical information on local channels, creeks, streams, and rivers.
- **Municipal Data Inventory**: This inventory included an inventory of all local roads, as well as critical facilities such as medical and childcare facilities.

8.3 RISK ASSESSMENT METHODOLOGY

Risk assessment and analysis are at the heart of asset management planning and are among the primary tools for identifying and prioritizing renewal and replacement projects with the highest urgency. The results of this process guide optimized decisions on financial planning and are used for choosing where the limited available public funds are most wisely spent.

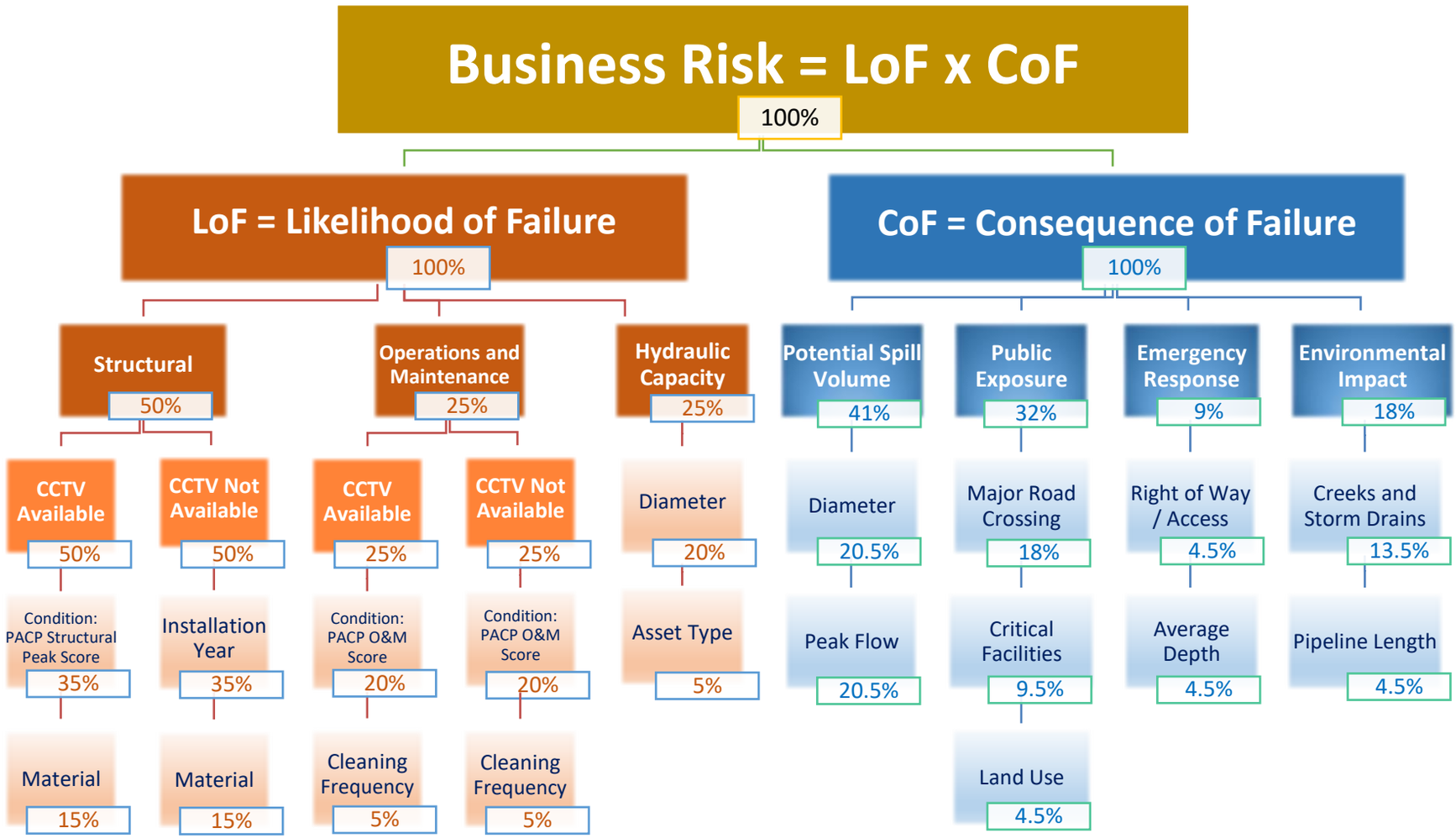
The risk analysis incorporated information about the wastewater collection system extracted from the hydraulic model as well as user-defined risk assessment criteria to perform a risk analysis for each asset included in the analysis. The results of this analysis can be used to prioritize capital projects throughout the City, focusing on the areas of highest risk first and developing an improvement plan for the recommendations.

Risk analysis consists of assessing the probability (or likelihood) of an asset failing and, more importantly, linking it to a consequence if such failure were to occur. This analysis allows the agency to identify existing and future risks that potentially impact the level of customer service and the associated costs. Thus, the risk, also known as the business risk exposure (BRE), is calculated by multiplying the probability or likelihood of failure (LOF) by the consequence of failure (COF), as show on **Figure 8.1**.

Risk (BRE) = Likelihood of Failure (LOF) x Consequence of Failure (COF)

The probability (or likelihood) of failure analysis allows a prediction of failure timing for a particular asset. Did the asset fail to meet the level of service? Has capacity become inadequate? How is the structural condition? Is the lifecycle cost efficient? A numerical LOF score is assigned to each asset based on this assessment.

The consequence of failure analysis assesses the impact of such failure on the residential or commercial environment, and the resulting anticipated economic loss.



LEGEND

- Business Risk
- LoF
- CoF

PRELIMINARY

July 06, 2022

AKEL ENGINEERING GROUP, INC.

Figure 8.1

Risk Assessment Diagram

Wastewater Collection System Master Plan
City of Yakima

Criterion Type: The various criteria can be categorized differently based on the information evaluated. The various criteria included in this risk assessment are briefly summarized as follows:

- Proximity to specific locations or infrastructure elements (critical facilities such as schools or hospitals, active service connections, critical pumping facilities, railroads, major roads, or freeways)
- Hydraulic Model Results (asset flows)
- Maintenance Records (year of installation, historical leak repair information, and problematic materials)
- Asset Material and Age

Criterion Score: Each criterion assigns a score, typically between one and five, to an asset based on a scale specific to each criterion. A score of one indicates that a given criterion will minimally contribute to the total consequence or likelihood of failure for a specific asset, while a score of five indicates a criterion will maximally contribute to the asset's total score.

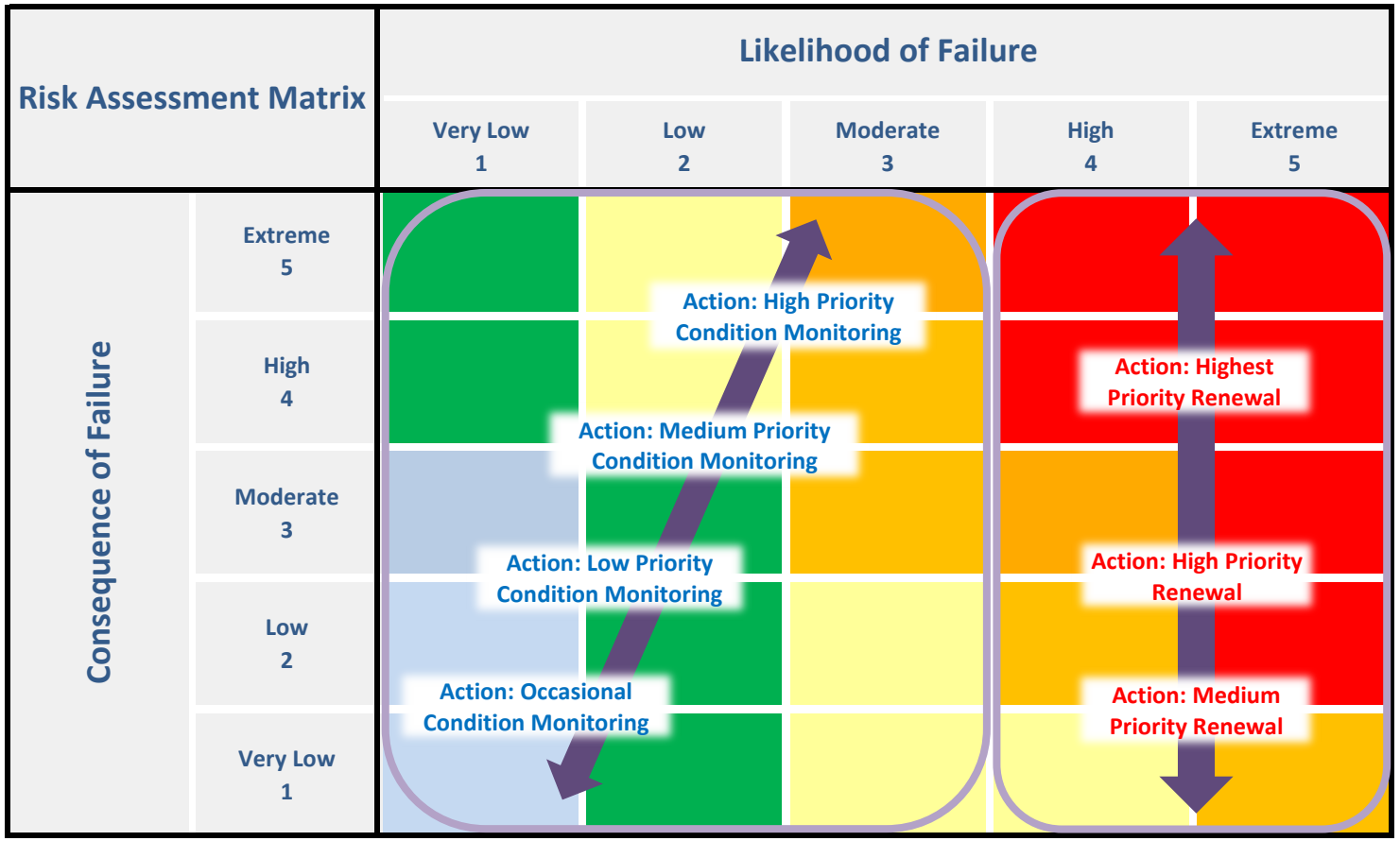
Criterion Weight: Each criterion includes a weight that determines how much contribution it makes to the total COF or LOF scores. A higher weight means the score for an asset from a particular criterion will contribute more to the total COF or LOF score than a criterion with a lower weight.

The asset criteria types, scores, and weights for both COF and LOF calculations were established in coordination with City staff before being incorporated into the risk assessment analysis.

A total of five categories were used to assign numerical scores to each COF and LOF category. The five rating categories include Extreme, High, Moderate, Low, and Very Low, as documented in **Table 8.2.** High scores are associated with the Extreme and High rating categories and represent at-risk assets that require immediate attention. Low scores are associated with the Very Low and Low rating categories and may represent new or low-risk assets.

Table 8.2 Rating and Scores

Risk Rating	Score
Extreme	5
High	4
Moderate	3
Low	2
Very Low	1



LEGEND

PRELIMINARY

Risk Color Coding

Extreme	*High*	*Moderate*	*Low*	*Very Low*

Renewal Actions Levels

Highest Priority	*High Priority*	*Medium Priority*

Condition Monitoring Levels

High Priority	*Medium Priority*	*Low Priority*	*Occasional*

July 6, 2022

Figure 8.2

Risk Assessment Scoring and Action Plan

Wastewater Collection System Master Plan

City of Yakima

The Risk Assessment Scoring and Action Plan matrix on **Figure 8.2** illustrates how pipelines are classified in the Extreme rating category (red) or High rating category (orange), by combining their LOF and COF scores. The red and orange zone on **Figure 8.2** indicate assets that require immediate attention for renewal or replacement. The yellow zone highlights assets requiring more aggressive monitoring. The green and blue zones require simple monitoring.

8.4 RISK ASSESSMENT CRITERIA

This section documents the risk assessment criteria for the sewer pipelines in the City's wastewater collection system. The criteria for evaluating the risk of distribution mains are divided into two categories: Consequence of Failure (COF) and Likelihood of Failure (LOF).

Consequence of Failure: The COF criteria are intended to qualitatively identify the consequences of the failure of pipelines within the system and are used in the COF score calculation. The measure or proxy, scale, and weights vary for each criterion. These criteria, scores, and weights were reviewed and approved by City staff before incorporation into the risk assessment.

Likelihood of Failure: The LOF criteria are intended to qualitatively identify the likelihood of failure of distribution mains within the system and are used in the LOF score calculation. The type, score values, and weights vary for each criterion. These criteria, scores, and weights were reviewed and approved by City staff before incorporation into the risk assessment.

8.4.1 Consequence of Failure Criteria

The specific score values and weights for pipeline consequences of failure are documented below and summarized in **Table 8.3.**

- **Diameter (20.5%):** This criterion assesses the consequence of failure of a pipeline based on the diameter. Scores range from a value of 1 for pipelines less than 8-inches in diameter to a value of 5 for pipelines greater than or equal to 21-inches in diameter.
- **Peak Flow (20.5%):** This criterion assesses the consequence of failure of pipelines based on the flow conveyed in the pipes under peak wet weather flow conditions. Scores range from a value of 1 for non-critical pipelines with flows less than or equal to 2.5 gpm to a value of 5 for pipelines with flows greater than or equal to 2,500 gpm.
- **Major Road Crossing (18%):** This criterion assesses the consequence of failure of pipelines along major roads. Scores range from a value of 1 for pipelines not along major roads to a value of 5 for pipelines along Highways or Railroads.
- **Critical Facilities (9.5%):** This criterion assesses the consequence of failure of pipelines in close proximity to critical facilities, which were assumed to include schools, childcare facilities, and medical facilities. Scores vary from a value of 1 for pipelines not in proximity

Table 8.3 Consequence of Failure Criteria

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

							Likelihood of Failure	Very Low	Low	Moderate	High	Extreme
							Rating	1	2	3	4	5
1 COF No.	2 Failure Type	3 Consequence Categories	4 Description	5 Weighting	7 Category Weighting	8 Measure or Proxy	9 Consequence Scale					
1	Potential Spill Volume	Diameter	Larger diameter pipelines typically carry higher flows, and failures can lead to larger spill quantities.	20.5%	41%	Pipeline Diameter	< 8"	8" - 10"	12" - 15"	18" - 21"	≥ 21"	
2		Peak Flow	Failures in high flow pipelines result in larger spills and a higher likelihood of contamination of adjacent infrastructure.	20.5%		Maximum Pipeline Flow	≤ 2.5 gpm	2.5 - 100 gpm	100 - 1,500 gpm	1,500 - 2,500 gpm	> 2,500 gpm	
3	Public Exposure	Major Road Crossing	Failures in arterial streets are costly and have adverse impacts to public opinion.	18.0%	32%	Traffic Disruption (Road Crossing)	Other Mains			Pipelines in Arterial Roads	Pipelines in Highway Roads or Railroads	
4		Critical Facilities	Failures adjacent to schools and medical facilities may require greater levels of clean up, and more critical response.	9.5%		Proximity to critical customers	Other Mains				Within 150 feet of: Schools, Child Care Facilities, Medical Facilities, Skilled Nursing Facilities	
5		Land Use	Pipelines in developed land can lead to reduced access in addition to health and safety risks.	4.5%		Land Use Type	Undeveloped Area				Developed Area	
6	Emergency Response	Right-of-Way / Access	Pipelines located outside the right-of-way are more difficult to access and as a result, are more costly to repair.	4.5%	9%	Pipeline Location	Other Mains				All or Portion of the Pipeline Located Outside of ROW	
7		Average Depth	Pipelines located further under ground level are more difficult to access and as a result, are more costly to repair.	4.5%		Pipeline Depth	≤ 10'	10-14'	14-18'	18-24'	> 24'	
8	Environmental Impact	Creeks and Storm Drains	Pipelines within 200 feet of a body of water pose environmental hazards and potentially costly mitigation measures.	13.5%	18%	Proximity to channels or other bodies of water	Other Mains			Located within 250 ft of a storm drain	Located within 250 ft of water	
9		Pipeline Length	Failures in longer pipelines can result in spills over a larger area and require greater levels of cleanup.	4.5%		Pipeline Length	≤ 250'	250' - 500'	500' - 750'	750' - 1,000'	> 1,000'	

to a critical facility to a value of 5 for pipelines within 150 feet of a critical facility.

- **Land Use (4.5%):** This criterion assesses the consequence of failure of pipelines based on land use. Scores range from a value of 1 for pipelines not in proximity to developed area to a value of 5 for pipelines constructed within urbanized areas.

- **Right-of-Way Access (4.5%):** This criterion assesses the consequence of failure of pipelines based on accessibility. Scores vary from a value of 1 for pipelines located within the right of way (ROW) to a value of 5 for pipelines located outside the ROW.

- **Average Depth (4.5%):** This criterion assesses the consequence of failure of pipelines based on the average depth from ground surface to the invert of the pipelines. Scores range from a value of 1 for pipelines with depth less than or equal to 10 feet to a value of 5 for pipelines with depth greater than 24 feet.

- **Creeks and Storm Drains (13.5%):** This criterion assesses the consequence of failure of pipelines based on proximity to water bodies. Scores range from a value of 1 for pipelines not in proximity to water bodies to a value of 4 to 5 for pipelines within 250 feet of storm drainage facilities and creeks, respectively.

- **Pipeline Length (4.5%):** This criterion assesses the consequence of failure of pipelines based on length. Scores range from a value of 1 for pipelines less than or equal to 250 feet in length to a value of 5 for pipelines more than 1,000 feet in length.

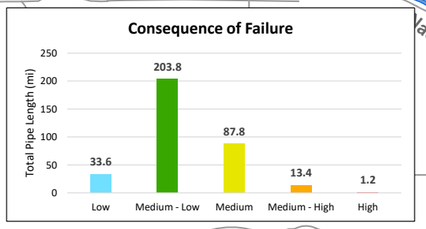
Based on the consequence of failure criteria, each pipeline was assigned a score. The breakdown of the pipeline COF is documented graphically on **Figure 8.3** and summarized below:

- Very Low: 33.6 miles (9.9%)
- Low: 203.8 miles (60.0%)
- Moderate: 87.8 miles (25.8%)
- High: 13.4 miles (3.9%)
- Extreme: 1.2 miles (0.4%)

8.4.2 Likelihood of Failure Criteria

The specific score values and weights for pipeline likelihood of failure are documented below and summarized in **Table 8.4.**

- **CCTV – PACP Structural Peak Score (35%):** This criterion assesses the likelihood of failure of pipelines based on the structural score extracted from the available CCTV data. Scores range from a value of 1 for pipelines with a peak structural score of 1 to a value of 5 for pipelines with a peak structural score of 5.



Dahl
Naches
Naches River
Lookout Point
Yakima River
Buds
Rest Haven
Cowiche Canyon
Fruitvale
Scenic
Englewood
Lincoln
Terrace Heights
Marsh
Summitview
80th
56th
4th
Chestnut
32nd
Tieton
64th
3rd
Fair
96th
Nob Hill
44th
Wide Hollow Creek
Viola
Mead
YRWWTP
1st
Dazet
Washington
52nd
Ahtanum
Bachelor Creek
Ahtanum Creek
Main
McCullough
11th
12
82
24

Updated: January 26, 2023

0 0.25 0.5 1 Mile

N
W GIS E
S

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\220316-IAPIYK_Fig8-26_COF_012623.mxd

AKEL
ENGINEERING GROUP, INC.

Legend

Existing System

- WWTP
- Lift Stations

Consequence of Failure

- Very Low (33.6 Miles, 9.9%)
- Low (203.8 Miles, 60%)
- Moderate (87.8 Miles, 25.8%)
- High (13.4 Miles, 3.9%)
- Extreme (1.2 Miles, 0.4%)
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 8.3
Consequence of Failure
Wastewater Collection System
Master Plan
City of Yakima

Table 8.4 Likelihood of Failure Criteria

Wastewater Collection System Master Plan

City of Yakima

PRELIMINARY

Likelihood of Failure	Very Low	Low	Moderate	High	Extreme
Rating	1	2	3	4	5

1	2	3	4	5	7	8	9	10	11	12	13	14
LOF No.	Failure Type	Likelihood Categories	Description	Weighting With CCTV Data	Weighting Without CCTV Data	Category Weighting	Measure or Proxy	Likelihood Scale				
1	Structural Failure	Condition: PACP Structural Peak Score	Pipelines with higher peak structural scores have more significant structural defects, and are therefore more likely to fail.	35%	-	50%	Peak Structural Defect Score	1	2	3	4	5
2		Installation Year	Pipeline Age can contribute to increased chance of failure.	-	35%		Installation Year	≤ 20 Years	20-40 Years	40-60 Years	60-80 Years	≥ 80 Years
3		Material	Useful life and durability varies across different materials and can lead to elevated risk for certain materials.	15%	15%		Pipeline Material	PVC, CIPP	PE	Truss Pipe, SP, RCP, Unknown	VCP, CIP	AC, CP, NRCP
4	Maintenance Failure	Condition: PACP O&M Peak Score	Pipelines with higher peak scores have more significant defects, and therefore are more likely to fail.	20%	20%	25%	Peak O&M Defect Score	1	2	3 or No CCTV Data	4	5
5		Cleaning Frequency	Pipelines with more frequent cleaning frequency are assumed to accumulate sediment and debris more quickly, which can lead to failure.	5%	5%		Cleaning Frequency	> 48 months	24 - 48 months	9 - 24 months or Unknown	3 - 9 months	< 3 months
6	Hydraulic Capacity Failure	Diameter	Smaller diameter pipelines are more likely to experience overflow or stoppage and are therefore more likely to fail.	20%	20%	25%	Pipeline Diameter	≥ 21"	16" - 20"	12" - 15"	8" - 10"	< 8"
7		Asset Type	Force main pipelines typically carry higher flows, and failures can lead to larger spill quantities.	5%	5%		Pipeline Hydraulic Condition	Gravity Mains				Force Mains

AKEL ENGINEERING GROUP, INC.

8/14/2022

- **Installation Year (35%):** This criterion assesses the likelihood of failure of pipelines based on the installation year. Scores range from a value of 1 for pipelines less than or equal to 20 years old to a value of 5 for pipelines constructed more than 80 years ago. This criterion was used to estimate the Structural CCTV results for pipelines without CCTV inspection (92 percent of the system).

- **Material (15%):** This criterion assesses the likelihood of failure of pipelines based on pipeline material. Scores range from a value of 1 for pipelines constructed of Polyvinyl Chloride (PVC) or Cured-in-place Pipe (CIPP) to a score of 5 for pipelines constructed of either Asbestos-Cement (AC), Concrete Pipe (CP), or Non-Reinforced Concrete Pipe (NRCP).

- **CCTV Results – PACP Operational and Maintenance Peak Score (20%):** This criterion assesses the likelihood of failure of pipelines based on the operational and maintenance score extracted from the available CCTV data. Scores range from a value of 1 for pipelines with a peak operational and maintenance score of 1 to a value of 5 for pipelines with a peak operational and maintenance score of 5. Pipelines without CCTV data were given a moderate score of 3.

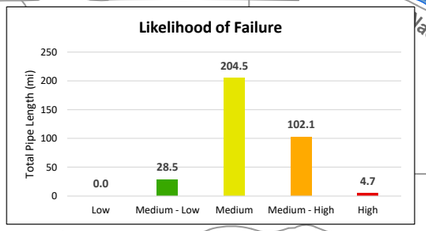
- **Cleaning Frequency (5%):** This criterion assesses the likelihood of failure of pipelines based on how frequent the pipelines must be cleaned. Scores range from a value of 1 for pipelines that rarely require cleaning to a value of 5 for pipelines often need to be cleaned.

- **Diameter (20%):** This criterion assesses the likelihood of failure of pipelines based on the diameter. Scores range from a value of 1 for pipelines larger than 21-inches in diameter to a value of 5 for pipelines less than 8-inches in diameter.

- **Asset Type (5%):** This criterion assesses the likelihood of failure of pipelines based on asset type. Scores vary from a value of 1 for gravity mains to a score of 5 for force mains.

Based on the likelihood of failure criteria, each pipeline was assigned a score. The breakdown of the pipeline LOF is documented graphically on **Figure 8.4** and summarized below:

- Very Low: 0.0 miles (0.0%)
- Low: 28.5 miles (8.4%)
- Moderate: 204.5 miles (60.2%)
- High: 102.1 miles (30.1%)
- Extreme: 4.7 miles (1.4%)



Legend

Existing System

- WWTP
- Lift Stations

Likelihood of Failure

- Very Low (0.0 Miles, 0.0%)
- Low (28.5 Miles, 8.4%)
- Moderate (204.5 Miles, 60.2%)
- High (102.1 Miles, 30.1%)
- Extreme (4.7 Miles, 1.4%)
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 8.4
Likelihood of Failure
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.

8.4.3 Pipeline Condition Assessment

Sewer mains were assessed to provide a general understanding of the existing system's condition and to determine improvements to mitigate condition deficiencies. The condition assessment involves a review of CCTV information recorded of the sewer lines from 2012 to 2015. The review of the CCTV was completed in accordance with National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) scoring. This included determining structural, operational and maintenance, construction, and miscellaneous defects.

Based on a review of the existing condition information, the gravity sewer mains were generally found to be in good condition. Defects within the system generally consist of defective end lining, fine roots at joints, multiple cracks, and water line sagging. The condition assessment focused on documenting major defects (PACP Rating > 3), and determining an appropriate rehabilitation method, as major structural defects can lead to costly pipeline failures. Other defects (PACP Rating 1-3) were used in the process of evaluating criticality for individual pipe segments..

8.5 RISK ASSESSMENT RESULTS

The risk assessment was performed to assess the risk of failure of wastewater collection pipelines within the existing system. Using the consequence (COF) and likelihood of failure (LOF) criteria discussed in the previous sections, a consequence of failure score and likelihood of failure score was determined for each pipeline. Figures documenting the COF and LOF scores received for each individual criterion can be found in **Appendix D**. The risk score is a combination of the consequence of failure and likelihood of failure scores.

Based on the breakdown of the COF and LOF scores, risk category thresholds were determined to classify the pipelines as Very Low, Low, Moderate, High, and Extreme risk. These risk thresholds are briefly described as follows:

- **Very Low: 0.0 miles** of pipelines are categorized as Very Low Risk.
- **Low:** Approximately **22.1 miles** of pipelines are categorized as Low Risk, which represented 6.5-percent of all pipelines included in the risk analysis.
- **Moderate:** Approximately **162.8 miles** of pipelines are categorized as Moderate Risk, which represented 47.9-percent of all pipelines included in the risk analysis.
- **High:** Approximately **150.8** of pipelines are categorized as High Risk, which represented 44.4-percent of all pipelines included in the risk analysis.
- **Extreme:** Approximately **4.1 miles** of pipelines are categorized as Extreme Risk, which represented 1.2-percent of all pipelines included in the risk analysis.

The results of the pipeline risk assessment are summarized on **Figure 8.5**, with results shown graphically on **Figure 8.6** and **Figure 8.7**. **Table 8.5** summarized the total pipeline length by overall risk score and ranking. The high- and extreme-risk pipelines represent the most critical assets in the system. Failure of these assets results in the largest impact to customer level of service. Overall, approximately 45.6-percent of the assessed pipelines were determined to have high or extreme risk of failure.

8.6 RENEWAL AND REPLACEMENT RECOMMENDATIONS

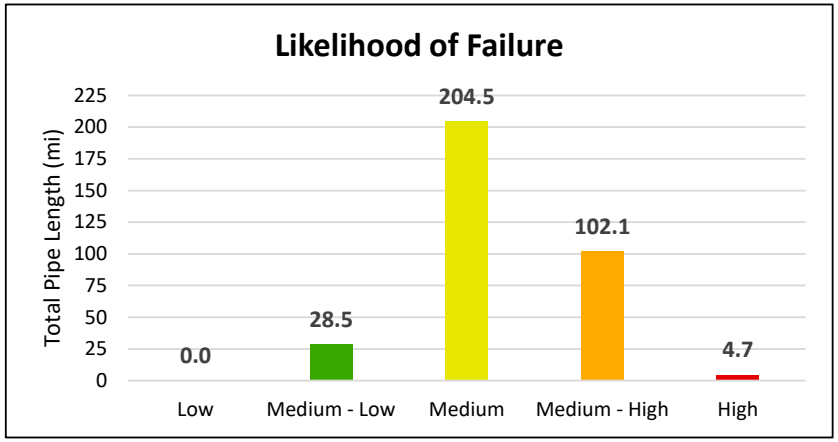
As part of the condition and risk assessment a capital project decision matrix (**Figure 8.8**) was developed, which was used to determine the renewal and replacement method to be implemented based on the pipeline condition.

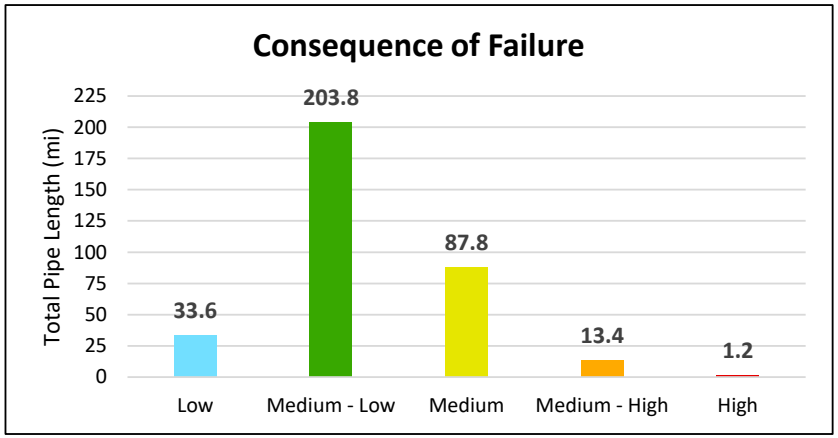
It should be noted that this master plan recommended rehabilitation actions for the gravity pipelines that have accessible CCTV records only (approximately 8-percent of system). As CCTV record become available for the remaining collection system, the City should plan to update the City-Wide Risk Assessment to expand upon the renewal and replacement recommendations presented in this master plan.

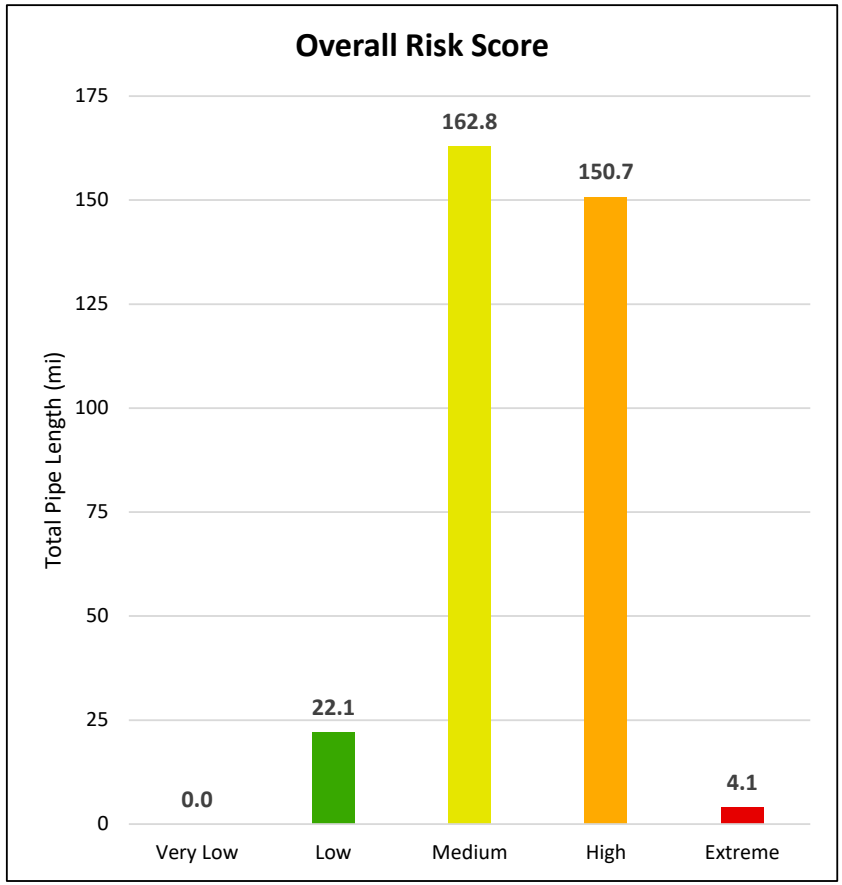
Each pipeline improvement has a unique improvement ID that includes abbreviations corresponding to the specific sewer collection basins as well as the repair or rehabilitation method associated with each improvement. The abbreviations incorporated in the improvement IDs are briefly summarized as follows:

Renewal Method: The improvement IDs include abbreviations indicating the renewal method being implemented, which includes:

- **Replacement (RP):** This includes replacing an existing pipeline by trenching along the existing pipeline alignment.
- **Point Repair with Full Lining (PRFL):** This includes conducting point repairs on a defective existing pipeline and replacing the full lining.
- **Point Repair with Partial Lining (PR):** This includes conducting point repairs on a defective existing pipeline and replacing the partial lining around the repaired defect area.
- **Gravity Main Condition Assessment (CC):** This includes performing new and periodic CCTV inspections for gravity mains. This is intended to determine if the failure rate is progressing.
- **Periodic Maintenance (M):** This includes periodic maintenance activities such as root removal or pipeline cleaning.







LEGEND

Risk Ranking, by Pipe

- Extreme
- High
- Moderate
- Low
- Very Low

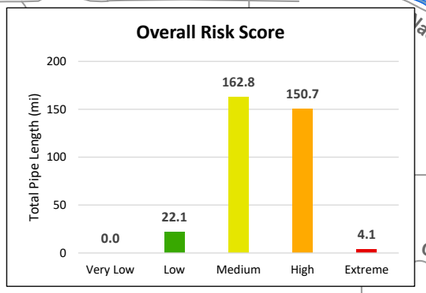
PRELIMINARY

Jan 26, 2023

AKEL ENGINEERING GROUP, INC.

Figure 8.5
Risk Assessment

Wastewater Collection System Master Plan
City of Yakima



Legend

Existing System

- WWTP
- Lift Stations

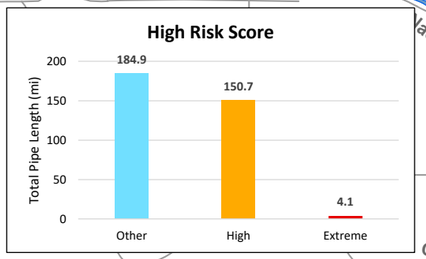
Overall Risk

- Low (22.1 Miles, 6.5%)
- Moderate (162.8 Miles, 47.9%)
- High (150.7 Miles, 44.4%)
- Extreme (4.1 Miles, 1.2%)
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 8.6
Overall Risk Score
Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Dahl
Naches
Naches River
Lookout Point
Yakima River
Buds
Rest Haven
Cowiche Canyon
Fruitvale
Scenic
Englewood
Lincoln
Terrace Heights
Marsh
Summitview
Chestnut
Tieton
Nob Hill
Wide Hollow Creek
Viola
Mead
YRWWTP
Washington
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
Main
Fair
4th
56th
80th
64th
44th
32nd
3rd
1st
52nd
11th
96th
12
82
24

Updated: January 30, 2023

0 0.25 0.5 1 Mile

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\220316-IAP\YK_Fig8-22_HighRisk_013023.mxd

AKEL
ENGINEERING GROUP, INC.

Legend

Existing System

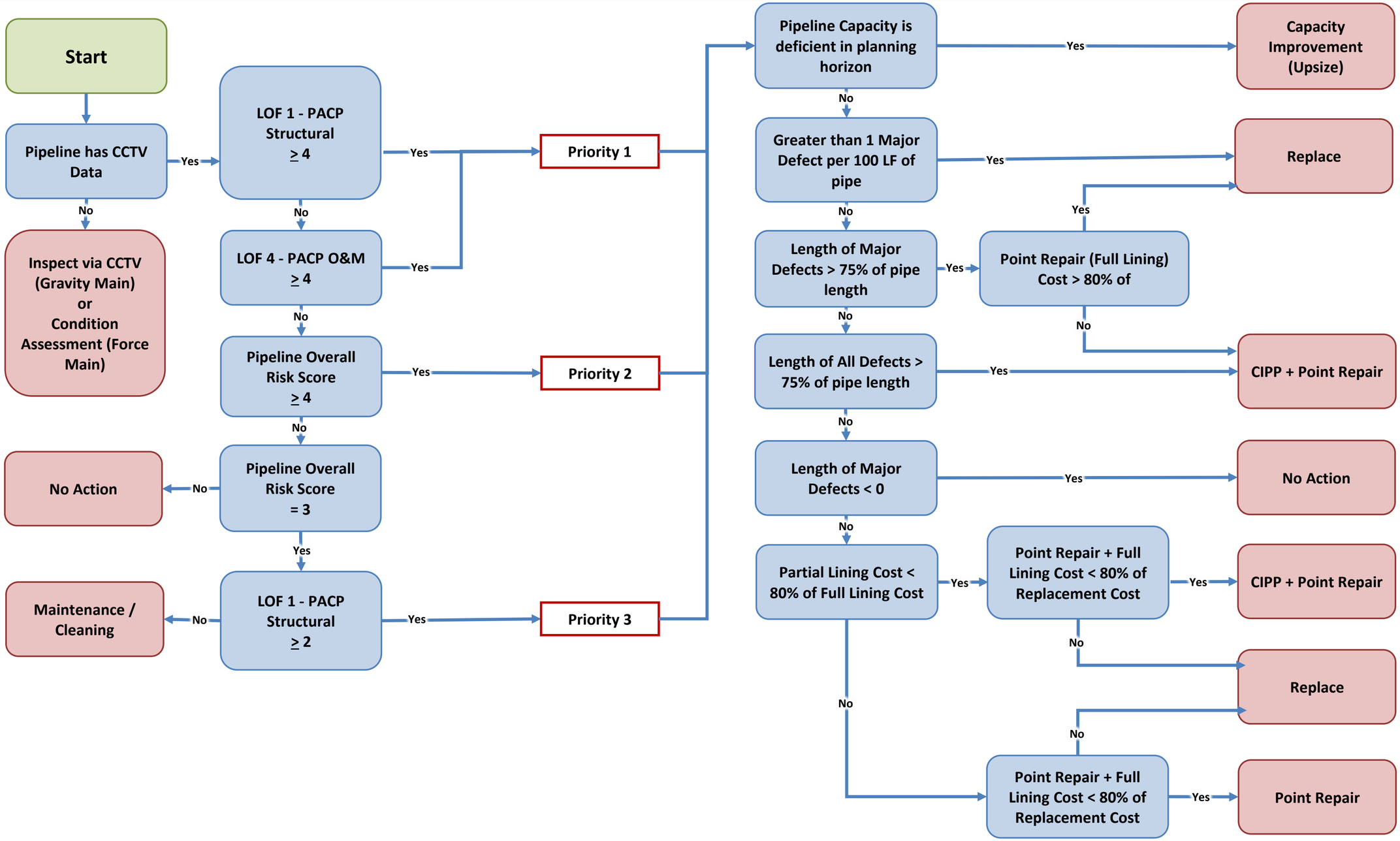
- WWTP
- Lift Stations

High Risk

- Very Low - Moderate (184.9 Miles, 54.4%)
- High (150.7 Miles, 44.4%)
- Extreme (4.1 Miles, 1.2%)
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 8.7
High Risk Score
Wastewater Collection System
Master Plan
City of Yakima



LEGEND

- Decision Point
- Renewal Choice
- Renewal Priority

PRELIMINARY

Aug 24, 2022

Figure 8.8
Decision Matrix

Wastewater Collection System Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.

Table 8.5 Total Pipe Length, by Risk Score

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Pipe Diameter	Total Pipe Length, by Risk Score					
	Very Low	Low	Medium	High	Extreme	Total
(in)	(mi)	(mi)	(mi)	(mi)	(mi)	(mi)
2	-	0.04	0.06	-	-	0.10
3	-	-	-	0.39	-	0.39
5	-	-	1.02	0.41	0.09	1.52
6	-	-	9.79	11.72	2.76	24.26
8	-	0.91	128.30	89.80	0.81	219.82
10	-	0.25	9.30	12.41	0.09	22.06
12	-	5.45	4.86	9.53	0.06	19.89
14	-	0.27	-	0.22	-	0.49
15	-	3.61	1.74	6.02	0.05	11.43
16	-	0.13	-	0.89	-	1.02
18	-	3.43	1.79	7.54	0.10	12.86
20	-	-	0.32	0.54	-	0.86
21	-	0.79	0.38	2.77	-	3.94
22	-	0.34	0.32	0.40	-	1.06
24	-	2.24	2.11	3.62	-	7.97
27	-	2.44	1.23	2.47	-	6.14
30	-	1.59	0.53	1.19	-	3.30
36	-	0.47	0.60	0.22	0.12	1.41
42	-	0.15	0.25	0.09	-	0.49
48	-	0.00	0.23	0.51	-	0.74
Total	**0.00**	**22.11**	**162.83**	**150.75**	**4.08**	**339.76**
	0.0%	**6.5%**	**47.9%**	**44.4%**	**1.2%**	**100%**

AKEL ENGINEERING GROUP, INC.

8/25/2022

- **Improvement Number:** Each ID includes a unique number with each improvement group for improvement sequencing.

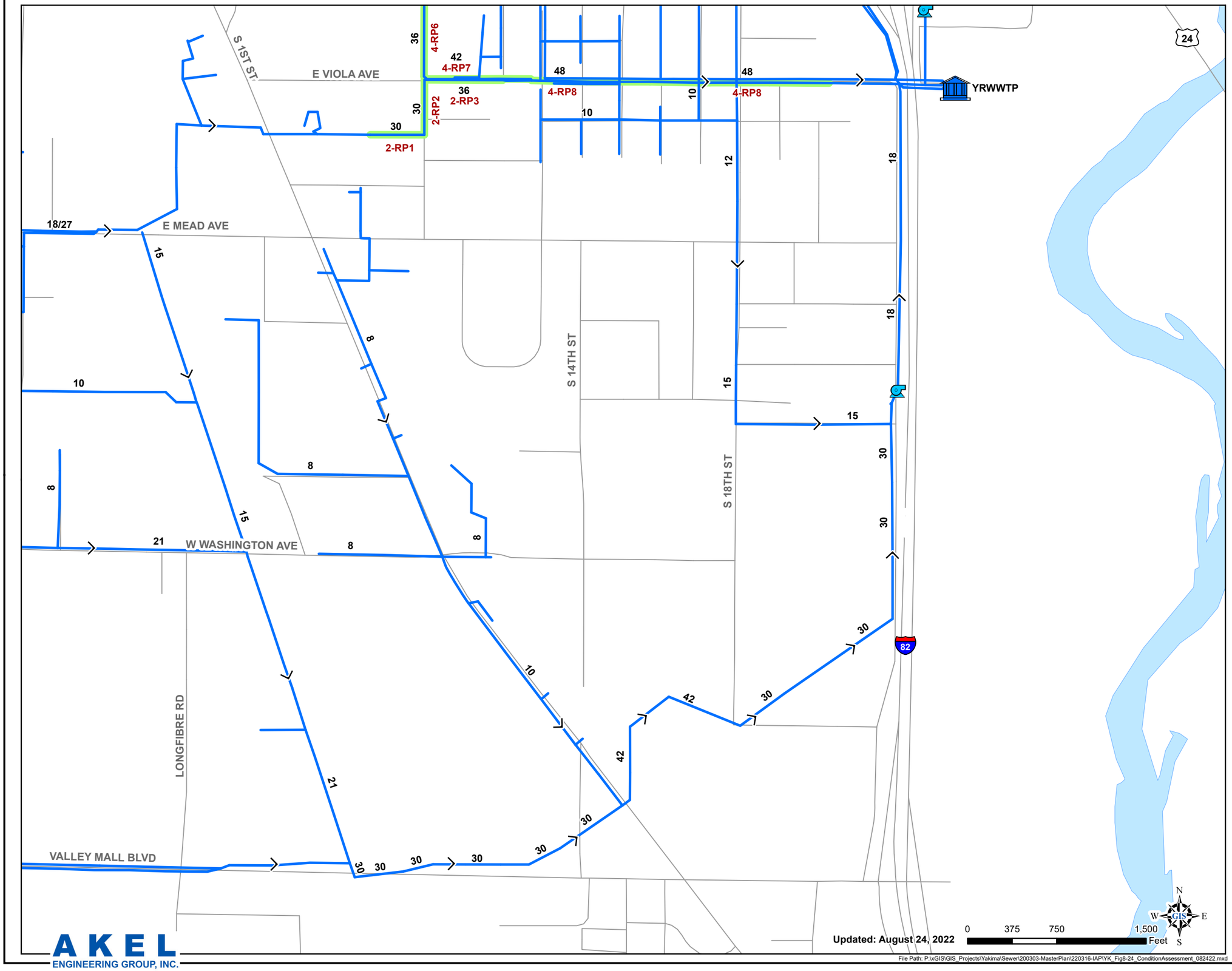
In addition to Improvement Groupings and Renewal Methods, pipelines were assigned a priority ranking based on the results of the Risk Assessment. The assigned priorities are briefly summarized as follows:

- **Priority 1**: This includes pipelines with either a PACP Structural Peak score or a PACP Operational and Maintenance Peak score value greater than or equal to 4.
- **Priority 2**: This includes pipelines with an overall risk score value greater than or equal to 4.
- **Priority 3**: This includes pipelines with an overall risk score value equal to 3 and PACP Structural Peak score value greater than or equal to 2.

8.6.1 Pipeline Renewal Improvements

The pipeline renewal improvements identified as part of the condition assessment are shown on **Figure 8.9** and **Figure 8.10.** and listed as follows:

- **2-RP1:** Replace 30-inch gravity main along Tennant Lane from 452 feet west of Fair Avenue to Fair Avenue.
- **2-RP2:** Replace 30-inch gravity main along Fair Avenue from Tennant Lane to Viola Avenue.
- **2-RP3:** Replace 36-inch gravity main along Viola Avenue from Fair Avenue to 78 feet west of 13th Street.
- **4-RP1:** Replace 27-inch gravity main along 6th Street from G Street to Chestnut Avenue.
- **4-RP2:** Replace 27-inch gravity main along Chestnut Avenue from 6th Street to 7th Street.
- **4-RP3:** Replace 27-inch gravity main along 7th Street from Chestnut Avenue to Beech Street.
- **4-RP5:** Replace 30-inch gravity main along Ranchrite Road from Railroad to 237 feet east of 1st Street.
- **4-RP6:** Replace 36-inch gravity main along Nob Hill Boulevard from 6th Street to Fair Avenue.
- **4-RP7:** Replace 36-inch gravity main along Fair Avenue from Nob Hill Boulevard to Viola Avenue.



Updated: August 24, 2022

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\220316-IAP\YK_Fig8-24_ConditionAssessment_082422.mxd

Legend

Existing System

- WWTP
- Lift Stations

Improvement Needed

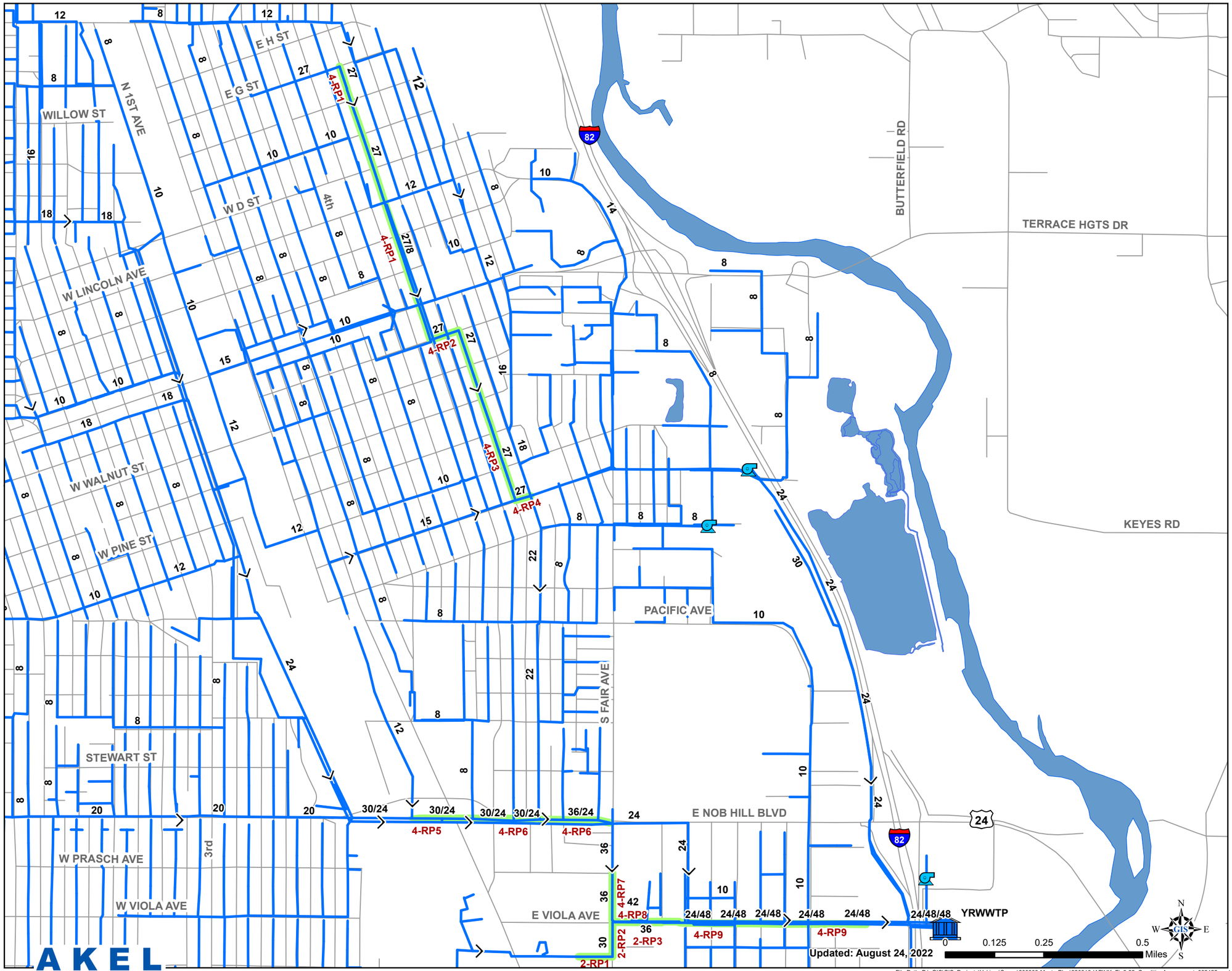
- Pipes
- Replace
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 8.9
Condition Assessment

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

Existing System

- WWTP
- Lift Stations

Improvement Needed

- Pipes
- Replace
- Streets
- Streams
- Lakes

PRELIMINARY

Figure 8.10
Condition Assessment
Wastewater Collection System
Master Plan
City of Yakima

Updated: August 24, 2022

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\220316-IAP\YK_Fig8-25_ConditionAssessment_082422.mxd

AKEL
ENGINEERING GROUP, INC.

- **4-RP8:** Replace 42-inch gravity main along Viola Avenue from Fair Avenue to 85 feet west of 13th Street.
- **4-RP9:** Replace 48-inch gravity main along Viola Avenue from 85 feet west of 13th Street to Rudkin Road.

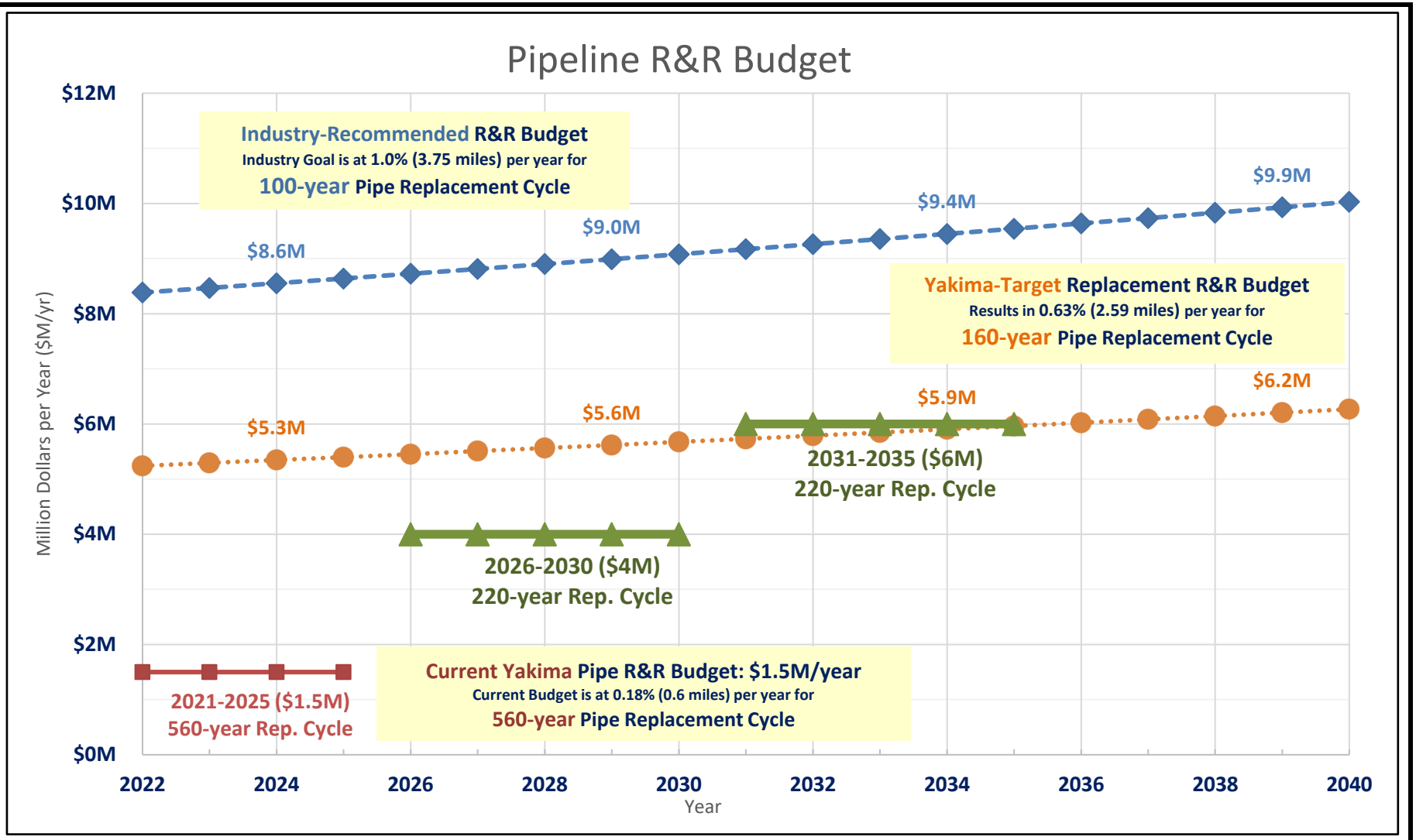
8.7 SUGGESTED PIPELINE REPLACEMENT BUDGET

The industry recommended goal of pipeline annual R&R budgets is at 1 percent of system pipeline length for a 100-year pipeline replacement cycle. However, based on the City's public works budget and limitations, the pipeline replacement cycle is approximately at 560-years, which is 0.18 percent of system pipelines per year.

The suggested pipeline replacement budgets are shown on **Figure 8.11** and include the estimated costs for replacing pipelines through the year 2040.

- **Industry Recommended R&R Budget:** The Industry-Recommended R&R Budget costs start from a base rate of $8.4 million per year, with a pipeline replacement rate of 1.0-percent of system length per year, and the future costs in 2040 are expected to be approximately $10.0 million per year.
- **Yakima-Target R&R Budget:** A Yakima-Target R&R Budget has been prepared following comments from City staff indicating that existing PVC sewer mains have historically provided a life expectancy of 160 years. The Yakima-target R&R Budget costs start from a base rate of $5.1 million per year, with a pipeline replacement rate of 0.63-percent of system length per year, and the future costs in 2040 are expected to be approximately $6.3 million per year. This target approach provides the most cost-effective use of the existing sewer mains capacity and condition.

It should be noted that the cost estimates are based on 2023 dollars.



LEGEND

- Industry Recommended Pipe R&R Budget
- City of Yakima Current R&R Budget (FY21-25)
- Recommended R&R Budget
- City Preference R&R Budget (160 Year Cycle)

AKEL ENGINEERING GROUP, INC.

Assumptions:

1. System Growth is assumed to be 1%, requires verification based on historical construction.
2. All costs in 2023 dollars.
3. Weighted average pipeline unit cost = $296/foot.
4. 30% contingency added for estimated construction cost.
5. 30% contingency added for capital improvement cost
6. Current budget reflects Fund 476 from 2021 Adopted Budget.
7. Yakima Target R&R Budget reflects comments received from City staff indicating that existing PVC sewer mains have historically provided a life expectancy of 160 years. This target approach provides the most cost-effective use of the existing sewer mains capacity and condition.

January 31, 2023

Figure 8.11
Pipeline Renewal & Replacement Budget
Wastewater Collection System Master Plan
City of Yakima

CHAPTER 9 – CAPITAL IMPROVEMENT PROGRAM

This chapter provides a summary of the recommended Capital Improvement Program (CIP) for the City of Yakima's wastewater collection system. The program is based on the evaluation of the City's wastewater collection system and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the City in planning and constructing the collection system improvements through the ultimate buildout scenario. This chapter also presents the cost criteria and methodologies for developing the capacity improvement costs.

9.1 COST ESTIMATE ACCURACY

Cost estimates presented in the capacity improvement costs were prepared for general master planning purposes and, where relevant, for further project evaluation. Final costs of a project will depend on several factors including the final project scope, costs of labor and material, and market conditions during construction.

AACE International (Association for the Advancement of Cost Engineering, International) has defined three classifications. These classifications are presented in order of increasing accuracy: Order of Magnitude, Budget, and Definitive.

- **Order of Magnitude Estimate.** This classification is also known as an "original estimate", "study estimate", or "preliminary estimate", and is generally intended for master plans and studies.

  This estimate is not supported with detailed engineering data about the specific project, and its accuracy is dependent on historical data and cost indices. It is generally expected that this estimate would be accurate within -30 percent to +50 percent.

- **Budget Estimate.** This classification is also known as an "official estimate" and generally intended for pre-design studies. This estimate is prepared to include flow sheets and equipment layouts and details. It is generally expected that this estimate would be accurate within -15 percent to +30 percent.

- **Definitive Estimate.** This classification is also known as a "final estimate" and is prepared during the time of contract bidding. The data includes complete plot plans and elevations, and equipment data sheets, and complete specifications. It is generally expected that this estimate would be accurate within -5 percent to +15 percent.

Costs developed in this study should be considered "Order of Magnitude" and have an expected accuracy range of **-30 percent** and **+50 percent**.

9.2 COST ESTIMATE METHODOLOGY

Cost estimates presented in this chapter are opinions of probable construction and other relevant costs developed from several sources including cost curves, AEG experience on other master planning projects, and input from City staff on the development of public and private cost sharing. Where appropriate, costs were escalated to reflect the more current ENR (formerly Engineering News-Record) Construction Cost Index (CCI). Dating from the early 20th Century, ENR CCI is a cost estimating tool updated weekly, used by engineers to gage the current cost for new construction.

This section documents the unit costs used in developing the opinion of probable construction costs, the Construction Cost Index, the land acquisition costs, and markups to account for construction contingency and other project related costs.

9.2.1 Unit Costs

The unit cost estimates used in developing the CIP are summarized in **Table 9.1**. The unit costs are intended for developing the Order of Magnitude estimates, and do not account for site specific conditions, changes in labor or material costs during the time of construction, final project scope, implementation schedule, detailed utility and topography surveys, investigation of alternative routings for pipes, and other various factors. The CIP included in this report accounts for construction and project-related contingencies as described in this chapter.

9.2.2 Construction Cost Index

Costs estimated in this study are adjusted utilizing the ENR CCI, which is widely used in the engineering and construction industries.

The costs of this master plan were benchmarked using a 20-city national average ENR CCI of 13,175, reflecting a date of January 2023.

9.2.3 Construction Contingency Allowance

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore construction contingencies were used. The estimated construction costs in this master plan include a **30-percent** contingency allowance to account for unforeseen events and unknown field conditions.

9.2.4 Project Related Costs

The capital improvement costs also account for project-related costs , comprising of engineering design, project administration (developer and City staff), construction management and inspection, and legal costs. The project related costs in this master plan were estimated by applying an additional **30-percent** to the estimated construction costs.

Table 9.1 Unit Costs

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Pipelines	
Pipe Size (in)	**Unit Cost New/Parallel/Replacement** ($/ Linear Feet)
Gravity Mains[2]	
8	$264
10	$286
12	$293
15	$308
18	$331
21	$360
24	$374
27	$432
30	$508
36	$631
42	$936
48	$1,070
Force Mains[3]	
12	$253

Lift Stations[3]
Estimated Lift Station Project Cost = 1,645,860*$Q^{0.60}$ (where Q is in mgd)

AKEL ENGINEERING GROUP, INC.

1/30/2023

Notes :

1. AEG prepared the construction cost estimates for the master plan using January 2023 20-Cities ENR CCI of 13,175. When the City moves projects forward for implementation, it should update the costs to the current 20-Cities ENR CCI plus an allowance for escalation during design and bidding and to the construction mid-point.
2. Gravity Main costs are based on costs extracted from the City of Yakima 2013 WWCSMP, and are revised to reflect the current January 2023 ENR CCI of 13,175.
3. Unit Costs based on Akel Engineering Group experience on similar projects and escalated using ENR CCI of 13,175 for January 2023.

9.3 CAPITAL IMPROVEMENT PROGRAM

This section documents the capital improvement program, including estimated costs and recommended construction phasing.

9.3.1 Capital Improvement Costs

The CIP costs for the projects identified in this master plan for mitigating existing deficiencies and for servicing anticipated future growth throughout the City are summarized in **Table 9.2**. The CIP lists the type of improvement, location, cost, construction triggers, suggested phasing, and cost sharing.

Each improvement was assigned a unique code identifier associated with the improvement type and is summarized graphically on **Figure 9.1** and **Detail A** through **Detail D** in **Appendix B**.

9.3.2 Recommended Improvement Groupings

The recommended pipeline improvements are grouped by collection basin and listed in **Table 9.2**. Each improvement includes a general description of the street alignment and limits as well as existing pipe diameter and length.

The CIP generally includes the following three types of improvements:

- **Replacement Pipeline, Capacity Deficiency Triggered by Future Development:** An existing pipeline is recommended for replacement where additional flow due to future development will create a capacity deficiency. This type of improvement is listed as *Replace* in **Table 9.2**.
- **New Pipeline, Triggered by Future Development:** The new pipeline is proposed where none exists to serve future growth expansion. This type of improvement is listed as *New* in **Table 9.2**.
- **Parallel Pipeline, Triggered by Future Development:** A new parallel pipeline is proposed to be constructed next to an existing gravity main where additional flow due to future development will create a capacity deficiency. This type of improvement is listed as *Parallel* in **Table 9.2.**

The opinion of probable construction costs, for the projects included in this master plan, are based on the pipe unit costs summarized in **Table 9.1.** It is assumed that any replacement pipes will be in the same alignment and the same slope as the existing pipe. However, this study recommends an investigation of the alignment during the pre-design stage of each project.

Detail A

Detail B

Detail C

Detail D

Galloway
Lookout Point
Southern
Dahl
Naches River
Naches
Yakima River
Buds
Rest Haven
Naches Heights
Cowiche Canyon
Scenic
Englewood
Summitview
Fruitvale
Lincoln
Chestnut
Tieton
Marsh
Terrace Heights
Keyes
Nob Hill
Wide Hollow Creek
Mead
Viola
Washington
YRWWTP
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
Main
1st
2nd
3rd
4th
11th
32nd
44th
52nd
56th
64th
80th
96th

Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 9.1
Capital Improvement Program
Wastewater Collection System
Master Plan
City of Yakima

Updated: December 21, 2022

0 0.25 0.5 1 Mile

N W GIS E S

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-3_CapImp_122122.mxd

Table 9.2 Capital Improvement Program

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	Existing Pipe Diameter	Pipeline Improvements				Infrastructure Costs			Construction Triggers	Funding Source	Capacity Allocation			
					New/Parallel /Replace	Diameter	Length	Unit Costs	Baseline Constr. Costs	Estimated Constr. Costs	Capital Improv. Costs			% Benefit		Cost Sharing	
														Existing	Future	Existing	Future
				(in)		(in)	(ft)	($/Unit)	($)	($)	($)	(EDUs)					
Washington Avenue Basin Improvements																	
64th Avenue/Ahtanum Trunk																	
WA-1	Gravity Main	Gilbert Road	From Hackett Rd to approx. 1,335 ft w/o Hackett Rd	-	New	12	1,350	293	395,000	514,000	668,000	Construct with Development in Wiley area	Other	0%	100%	0	668,000
WA-2	Gravity Main	Gilbert Road	From approx. 1,335 ft w/o Hackett Rd to Wiley Rd	-	New	15	1,350	308	416,000	541,000	703,000	Construct with Development in Wiley area	Other	0%	100%	0	703,000
WA-3	Gravity Main	Wiley Road	From Gilbert Rd to Ahtanum Rd	-	New	15	1,650	308	508,000	660,000	858,000	Construct with Development in Wiley area	Other	0%	100%	0	858,000
WA-4	Gravity Main	Ahtanum Road	From Wiley Rd to approx. 1,300 ft w/o 90th Ave	-	New	15	4,150	308	1,277,000	1,660,000	2,158,000	Construct with Development in Wiley area	Other	0%	100%	0	2,158,000
WA-5	Gravity Main	Ahtanum Road	From approx. 1,300 ft w/o 90th Ave to approx. 225 ft e/o 90th Ave	-	New	15	1,500	308	462,000	601,000	781,000	Construct with Development in Wiley area	Other	0%	100%	0	781,000
							Subtotal - 64th Avenue/Ahtanum Trunk		**3,058,000**	**3,976,000**	**5,168,000**					**0**	**5,168,000**
Wide Hollow Trunk																	
WA-8	Gravity Main	Summitview Road	From 1550ft se/o 112th Ave to 102nd Ave	-	New	8	2,050	264	540,000	702,000	913,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	913,000
WA-9	Gravity Main	Summitview Road	From 102nd Ave to Pear Ave	-	New	12	1,450	293	424,000	551,000	716,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	716,000
WA-10	Gravity Main	Pear Avenue	From Summitview Ave to Orchard Ave	-	New	12	1,300	293	380,000	494,000	642,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	642,000
WA-11	Gravity Main	Orchard Avenue	From approx. 1,275 ft w/o Hennessy Rd to Hennessy Rd	-	New	10	1,300	286	371,000	482,000	627,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	627,000
WA-12	Gravity Main	Orchard Avenue	From Hennessy Rd to Pear Ave	-	New	12	1,300	293	380,000	494,000	642,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	642,000
WA-13	Gravity Main	Pear Avenue	From Orchard Ave to Tieton Dr	-	New	15	1,350	308	416,000	541,000	703,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	703,000
WA-14	Gravity Main	Tieton Drive	From Pear Ave to approx. 490 ft w/o 96th Ave	-	New	15	800	308	246,000	320,000	416,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	416,000
WA-15	Gravity Main	96th Avenue	From 1350ft s/o Wide Hollow Rd to Wide Hollow Rd	-	New	10	1,350	286	386,000	502,000	653,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	653,000
WA-16	Gravity Main	Wide Hollow Rd/Viola Ave/Borley Wy	From 96th Ave to 67th Ave	-	New	24	9,250	374	3,460,000	4,498,000	5,847,000	Construct with Wide Hollow Sewer Extension Project	City	0%	100%	0	5,847,000
WA-17	Gravity Main	Through field between Nob Hill Blvd and Washington Ave	From 67th Ave to 48th Ave	-	New	24	8,000	374	2,992,000	3,890,000	5,057,000	Construct with Wide Hollow Sewer Extension Project or with 9000 EDUs tributary to Washington Ave and 40th Ave	City	0%	100%	0	5,057,000
LS-1	Lift Station	Summitview Road	102nd Ave	-	New		3 @ 75 gpm		837,000	1,088,000	1,414,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	1,414,000
WA-56	Gravity Main	Wide Hollow Rd/1-th Ave/Estes Rd/Hennessy Rd	From Midvale Rd to 96th Ave	-	New	8	5,300	264	1,397,000	1,816,000	2,361,000	Construct with Development in Wide Hollow area	Other	0%	100%	0	2,361,000
							Subtotal - Wide Hollow Trunk		**11,829,000**	**15,378,000**	**19,991,000**					**0**	**19,991,000**
67th Avenue Sub-Trunk																	
WA-18	Gravity Main	Scenic Drive	From 84th Ave Ext to 80th Ave	-	New	8	1,300	264	343,000	446,000	580,000	Construct with new development / septic conversion	Other	0%	100%	0	580,000
WA-19	Gravity Main	80th Avenue	From Vista Parkway to Englewood Ave	-	New	8	900	264	237,000	308,000	400,000	Construct with new development / septic conversion	Other	0%	100%	0	400,000
							Subtotal - 67th Avenue Sub-Trunk		**580,000**	**754,000**	**980,000**					**0**	**980,000**
Washington Avenue Trunk																	
WA-20	Gravity Main	Washington Avenue	From approx. 50 ft w/o 40th Ave to approx. 530 ft e/o 40th Ave	18	Parallel	24	600	374	224,000	291,000	378,000	Construct with 9,000 EDUs	City	0%	100%	0	378,000
WA-21	Gravity Main	Washington Avenue	From approx. 530 ft e/o 40th Ave to approx. 690 ft w/o 36th Ave	18	Parallel	24	150	374	56,000	73,000	95,000	Construct with 1,800 EDUs	City	0%	100%	0	95,000
WA-22	Gravity Main	Washington Avenue	From approx. 690 ft w/o 36th Ave to approx. 155 ft e/o 36th Ave	21	Parallel	30	900	508	457,000	594,000	772,000	Construct with 1,800 EDUs	City	0%	100%	0	772,000
WA-23	Gravity Main	Washington Avenue	From approx. 155 ft e/o 36th Ave to approx. 75 ft w/o 31st Ave	21	Parallel	30	1,350	508	686,000	892,000	1,160,000	Construct with 9,000 EDUs	City	0%	100%	0	1,160,000
WA-24	Gravity Main	Washington Avenue	From approx. 75 ft w/o 31st Ave to approx. 205 ft w/o 28th Ave	21	Parallel	30	450	508	229,000	298,000	387,000	Construct with 9,000 EDUs	City	0%	100%	0	387,000
WA-25	Gravity Main	Washington Avenue	From approx. 205 ft w/o 28th Ave to approx. 175 ft e/o 28th Ave	21	Parallel	30	400	508	203,000	264,000	343,000	Construct with 9,000 EDUs	City	0%	100%	0	343,000
WA-26	Gravity Main	Washington Avenue	From approx. 175 ft e/o 28th Ave to approx. 280 ft w/o 27th Ave	21	Parallel	30	100	508	51,000	66,000	86,000	Construct with 9,000 EDUs	City	0%	100%	0	86,000
WA-27	Gravity Main	Washington Avenue	From approx. 280 ft w/o 27th Ave to 27th Ave	21	Parallel	30	300	508	152,000	198,000	257,000	Construct with 9,000 EDUs	City	0%	100%	0	257,000
WA-28	Gravity Main	Washington Avenue	From 27th Ave to approx. 210 ft w/o 24th Ave	21	Parallel	30	1,300	508	660,000	858,000	1,115,000	Construct with 9,000 EDUs	City	0%	100%	0	1,115,000
WA-29	Gravity Main	Washington Avenue	From approx. 210 ft w/o 24th Ave to 24th Ave	21	Parallel	30	250	508	127,000	165,000	215,000	Construct with 9,000 EDUs	City	0%	100%	0	215,000
WA-30	Gravity Main	Washington Avenue	From 24th Ave to approx. 200 ft w/o 24th Ave	21	Parallel	30	250	508	127,000	165,000	215,000	Construct with 9,000 EDUs	City	0%	100%	0	215,000
WA-31	Gravity Main	Washington Avenue	From approx. 200 ft w/o 24th Ave to approx. 780 ft w/o 16th Ave	21	Parallel	30	1,750	508	889,000	1,156,000	1,503,000	Construct with 9,000 EDUs	City	0%	100%	0	1,503,000

Table 9.2 Capital Improvement Program

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	Existing Pipe Diameter	Pipeline Improvements				Infrastructure Costs			Construction Triggers	Funding Source	Capacity Allocation			
					New/Parallel /Replace	Diameter	Length	Unit Costs	Baseline Constr. Costs	Estimated Constr. Costs	Capital Improv. Costs			% Benefit		Cost Sharing	
														Existing	Future	Existing	Future
				(in)		(in)	(ft)	($/Unit)	($)	($)	($)	(EDUs)					
WA-32	Gravity Main	Washington Avenue	From approx. 780 ft w/o 16th Ave to approx. 675 ft w/o 16th Ave	21	Parallel	30	100	508	51,000	66,000	86,000	Construct with 3,600 EDUs	City	0%	100%	0	86,000
WA-33	Gravity Main	Washington Avenue	From approx. 675 ft w/o 16th Ave to approx. 400 ft w/o 16th Ave	21	Parallel	30	300	508	152,000	198,000	257,000	Construct with 3,600 EDUs	City	0%	100%	0	257,000
WA-34	Gravity Main	Washington Avenue	From approx. 400 ft w/o 16th Ave to 16th Ave	24	Parallel	30	350	508	178,000	231,000	300,000	Construct with 3,600 EDUs	City	0%	100%	0	300,000
WA-35	Gravity Main	16th Avenue	From Washington Ave to Spokane St	24	Parallel	30	650	508	330,000	429,000	558,000	Construct with 3,600 EDUs	City	0%	100%	0	558,000
WA-36	Gravity Main	Spokane Street	From 16th Ave to 15th Ave	24	Parallel	30	400	508	203,000	264,000	343,000	Construct with 3,600 EDUs	City	0%	100%	0	343,000
WA-37	Gravity Main	Spokane Street	From 15th Ave to Pleasant Ave	24	Parallel	30	1,650	508	838,000	1,089,000	1,416,000	Construct with 3,600 EDUs	City	0%	100%	0	1,416,000
WA-38	Gravity Main	Spokane Street	From Pleasant Ave to 7th St	27	Parallel	30	1,700	508	864,000	1,123,000	1,460,000	Construct with 3,600 EDUs	City	0%	100%	0	1,460,000
WA-39	Gravity Main	7th Avenue	From Spokane St to Pierce St	27	Parallel	30	650	508	330,000	429,000	558,000	Construct with 10,000 EDUs	City	0%	100%	0	558,000
WA-40	Gravity Main	Pierce Street	From 7th Ave to approx. 160 ft w/o 6th Ave	27	Parallel	36	500	631	315,000	410,000	533,000	Construct with 10,000 EDUs	City	0%	100%	0.00	533,000.00
WA-41	Gravity Main	Pierce Street	From approx. 160 ft w/o 6th Ave to 2nd Ave	27	Parallel	36	1,500	631	946,000	1,230,000	1,599,000	Construct with 2,300 EDUs	City	0%	100%	0.00	1,599,000.00
WA-42	Gravity Main	2nd Avenue	From Pierce St to approx. 345 ft n/o Pierce St	27	Parallel	36	300	631	189,000	246,000	320,000	Construct with 2,300 EDUs	City	0%	100%	0.00	320,000.00
WA-43	Gravity Main	2nd Avenue	From approx. 345 ft n/o Pierce St to King St	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
WA-44	Gravity Main	King Street	From 2nd Ave to Voelker Ave	27	Parallel	36	1,750	631	1,104,000	1,435,000	1,866,000	Construct with 2,300 EDUs	City	0%	100%	0.00	1,866,000.00
WA-45	Gravity Main	Voelker Ave	From King St to approx. 210 ft n/o Baldie Wy	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
WA-46	Gravity Main	Voelker Ave	From approx. 210 ft n/o Baldie Wy to Mead Ave	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
WA-47	Gravity Main	Mead Avenue	From Voelker Ave to approx. 375 ft e/o Presson Ln	27	Parallel	36	650	631	410,000	533,000	693,000	Construct with 2,300 EDUs	City	0%	100%	0.00	693,000.00
WA-48	Gravity Main	Mead Avenue	From approx. 375 ft e/o Presson Ln to approx. 715 ft e/o Presson Ln	27	Parallel	36	350	631	221,000	287,000	373,000	Construct with 2,300 EDUs	City	0%	100%	0.00	373,000.00
WA-49	Gravity Main	City Right of Way	From Mead Ave to approx. 220 ft n/o Mead Ave	30	Parallel	36	400	631	252,000	328,000	426,000	Construct with 10,000 EDUs	City	0%	100%	0.00	426,000.00
WA-50	Gravity Main	City Right of Way	From approx. 220 ft n/o Mead Ave to Tennant Ln	30	Parallel	36	750	631	473,000	615,000	800,000	Construct with 3,600 EDUs	City	0%	100%	0.00	800,000.00
WA-51	Gravity Main	Tennant Lane	From approx. 760 ft w/o 1st St to 1st St	30	Parallel	36	800	631	505,000	657,000	854,000	Construct with 3,600 EDUs	City	0%	100%	0.00	854,000.00
WA-52	Gravity Main	Tennant Lane	From 1st St to Fair Ave	30	Parallel	36	1,350	631	852,000	1,108,000	1,440,000	Construct with 10,000 EDUs	City	0%	100%	0.00	1,440,000.00
WA-53	Gravity Main	Fair Ave	From Tennant Ln to Viola Ave	30	Parallel	36	450	631	284,000	369,000	480,000	Construct with 10,000 EDUs	City	0%	100%	0.00	480,000.00
WA-54	Gravity Main	Viola Avenue	From Fair Ave to 12th Ave	36	Parallel	36	650	631	410,000	533,000	693,000	Construct with 10,000 EDUs	City	0%	100%	0.00	693,000.00
								Subtotal - Washington Avenue Trunk	**13,431,000**	**17,461,000**	**22,700,000**					**0**	**22,700,000**
Fremont Way Trunk																	
WA-57	Gravity Main	Fremont Way Extension	From 76th Ave to 86th Ave	-	New	12	2,915	293	853,000	1,109,000	1,442,000	Construct with Development in West Valley area	City	0%	100%	0	1,442,000
								Subtotal - Fremont Way Trunk	**853,000**	**1,109,000**	**1,442,000**					**0**	**1,442,000**
2nd Avenue Basin Improvements																	
Cowiche Canyon Road Trunk																	
2A-1	Gravity Main	Cowiche Canyon Road	From 78th Ave to Prospect Wy	-	New	12	4,800	293	1,405,000	1,827,000	2,375,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	23,750	2,351,250
2A-2	Gravity Main	Vertner Road	From 80th Ave to 66th Ave	-	New	12	4,600	293	1,346,000	1,750,000	2,275,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	22,750	2,252,250
2A-3	Gravity Main	Prospect Way	From 66th Ave to Cowiche Canyon Rd	-	New	12	2,650	293	775,000	1,008,000	1,310,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	13,100	1,296,900
2A-4	Gravity Main	Cowiche Canyon Road	From Prospect Wy to approx. 1,225 ft sw/o Powerhouse Rd	-	New	12	3,800	293	1,112,000	1,446,000	1,880,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	18,800	1,861,200
2A-5	Gravity Main	Powerhouse Road	From Cowiche Canyon Rd to City Reservoir Rd	-	New	12	1,075	293	315,000	410,000	533,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	5,330	527,670
								Subtotal - Cowiche Canyon Road Trunk	**4,953,000**	**6,441,000**	**8,373,000**					**83,730**	**8,289,270**
2nd Avenue Trunk																	
2A-7	Gravity Main	Jerome Ave, Custer Ave, Cherry Ave	From 18th Ave to 6th Ave	15	Replace	18	3,950	331	1,309,000	1,702,000	2,213,000	Construct with development / septic conversion in Cowiche Canyon area	Other	1%	99%	22,130	2,190,870
								Subtotal - 2nd Avenue Trunk	**1,309,000**	**1,702,000**	**2,213,000**					**22,130**	**2,190,870**
Beech Street Basin Improvements																	

Table 9.2 Capital Improvement Program

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improvement No.	Type of Improvement	Street Alignment	Project Limits	Existing Pipe Diameter	Pipeline Improvements				Infrastructure Costs			Construction Triggers	Funding Source	Capacity Allocation			
					New/Parallel /Replace	Diameter	Length	Unit Costs	Baseline Constr. Costs	Estimated Constr. Costs	Capital Improv. Costs			% Benefit		Cost Sharing	
														Existing	Future	Existing	Future
				(in)		(in)	(ft)	($/Unit)	($)	($)	($)	(EDUs)					
North Fair Avenue Trunk																	
FA-1	Gravity Main	4th Street	From 4th St (Tamarack Lift Station) to Erickson Lane	-	New	8	1,200	264	316,000	411,000	534,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	32,040	501,960
FA-2	Gravity Main	Erickson Lane	From 4th Street Avenue to I-82	-	New	8	2,825	264	745,000	969,000	1,260,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	75,600	1,184,400
FA-3	Gravity Main	I-82 Ramp EB ROW	From approx. 170 ft n/o Q Street to Erickson Lane	-	New	8	2,175	264	573,000	745,000	969,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	58,140	910,860
FA-4	Gravity Main	I-82 Ramp EB ROW	From Erickson Lane to D Street	-	New	12	2,825	293	827,000	1,075,000	1,398,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	83,880	1,314,120
FA-5	Gravity Main	I-82 Ramp EB ROW	From D St to Lincoln Ave	-	New	12	475	293	139,000	181,000	235,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	14,100	220,900
FA-6	Gravity Main	I-82 Ramp EB ROW	From Lincoln Ave to approx. 75 ft se/o Lincoln Ave	-	New	12	125	293	37,000	48,000	62,000	Construct with Development in Boise Mill Cascade area	City	6%	94%	3,720	58,280
FA-7	Gravity Main	Future Bravo Co. Boulevard	From 8th Street to BNSF Railroad	-	New	8	1,075	264	283,000	368,000	478,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	478,000
FA-8	Gravity Main	Future Bravo Co. Boulevard	From BNSF Railroad to E Street	-	New	8	525	264	138,000	179,000	233,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	233,000
FA-9	Gravity Main	Future Bravo Co. Boulevard	From E St to D St	-	New	8	1,000	264	264,000	343,000	446,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	446,000
FA-10	Gravity Main	D Street	From Future Bravo Co. Boulevard to 950 ft e/o 10th Street	-	New	8	950	264	250,000	325,000	423,000	Construct with Development in Bravo Co. Boulevard area	City	0%	100%	0	423,000
								Subtotal - North Fair Avenue Trunk	**3,572,000**	**4,644,000**	**6,038,000**					**267,480**	**5,770,520**
Beech Street Trunk																	
FA-11	Gravity Main	15th Street	From Race St Lift Station to Beech St (Reverse Grade)	-	New	12	1,325	293	388,000	504,000	655,000	Construct for the de-commission of Race Street Lift Station	City	0%	100%	0	655,000
								Subtotal - Beech Street Trunk	**388,000**	**504,000**	**655,000**					**0**	**655,000**
River Road Trunk																	
2A-6	Gravity Main	Clover Lane	From Ackley Rd to River Rd	-	New	27	8,150	432	3,521,000	4,577,000	5,950,000	Construct with Gleed Census-Designated-Place Sewer Extension Project	Other	0%	100%	0	5,950,000
								Subtotal - River Road Trunk	**3,521,000**	**4,577,000**	**5,950,000**					**0**	**5,950,000**
Rudkin Road Basin Improvements																	
Longfibre Road Trunk																	
WA-55	Gravity Main	Pierce Street	From approx. 175 ft w/o Ledwich Ave to approx. 85 ft e/o Longfibre Rd	8	Replace	12	2,000	293	585,000	761,000	989,000	Construct with 117 EDUs	City	0%	100%	0	989,000
								Subtotal - Longfibre Road Trunk	**585,000**	**761,000**	**989,000**					**0**	**989,000**
Rudkin Road Trunk																	
WA-6	Gravity Main	Occidental Road Extension	From 59th Ave to 52nd Ave	-	New	12	2,150	293	629,000	818,000	1,063,000	Construct with development / septic conversion	Other	0%	100%	0	1,063,000
WA-7	Gravity Main	Occidental Road Extension	From 52nd Avenue to approx. 235 ft w/o 47th Ave	-	New	12	1,300	293	380,000	494,000	642,000	Construct with development / septic conversion	Other	0%	100%	0	642,000
RR-1	Gravity Main	Sorenson Road	From approx. 235 ft w/o 47th Ave to 38 Ave	-	New	12	3,250	293	951,000	1,236,000	1,607,000	Construct with Development in Sozo Development Area and or septic conversion of southern lots	Other	0%	100%	0	1,607,000
RR-2	Gravity Main	Rainier Place / Rudkin Road	From South 18th Street to Rudkin Road Lift Station	30	Replace	42	3,200	936	2,995,000	3,894,000	5,062,000	Construct with 4,065 EDUs	City	0%	100%	0	5,062,000
LS-2	Lift Station	Rudkin Road		-	Replace	Replace lower capacity pumps with 2 @ 1,850 gpm Increase firm capacity by 1,300 gpm			4,491,000	5,838,000	7,589,000	Construct with 4,065 EDUs	City	0%	100%	0	7,589,000
								Subtotal - Rudkin Road Trunk	**9,446,000**	**12,280,000**	**15,963,000**					**0**	**15,963,000**
Terrace Heights Improvements																	
Terrace Heights Industrial Waste Trunk																	
TH-1	Force Main	WSDOT WA-24 / YRWWTP	From Riverside Road to YRWWTP	-	New	12	2,800	293	819,000	1,065,000	1,385,000	Construct in tandem with construction of Terrace Heights Industrial Waste Lift Station	Other	0%	100%	0	1,385,000
								Subtotal - Terrace Heights Industrial Waste Trunk	**819,000**	**1,065,000**	**1,385,000**					**0**	**1,385,000**
								Gravity Main Improvement Costs	**48,197,000**	**62,661,000**	**81,459,000**					**373,340**	**81,085,660**
								Force Main Improvement Costs	**819,000**	**1,065,000**	**1,385,000**					**0**	**1,385,000**
								Lift Station Improvement Costs	**5,328,000**	**6,926,000**	**9,003,000**					**0**	**9,003,000**
								Total Improvement Costs	**54,344,000**	**70,652,000**	**91,847,000**					**373,340**	**91,473,660**

AKEL ENGINEERING GROUP, INC.

Notes:

1. Unit Costs are based on the January 2023 20-City ENR CCI of 13,175.
2. Baseline construction costs plus 30-percent to account for unforseen events and unknown conditions.
3. Esimated construction costs plus 30-percent to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs.

9.3.3 Construction Triggers

The capacity improvements are identified and categorized based on their urgency to mitigate existing deficiencies and to serve future growth. The construction triggers for each improvement are described as follows:

- **Improvements to Mitigate Existing System Deficiencies:** These are considered near-term improvements and are intended to mitigate existing capacity deficiencies. This master plan recommends these improvements be scheduled for construction as soon as possible and as fiscal budgets permit.
- **Improvements to Mitigate Future System Deficiencies:** These are intermediate-term and long-term improvements intended to service future developments within the UGA. This master plan included construction triggers, expressed in equivalent dwelling units (EDUs). This trigger is based on remaining capacity in the existing facility planned for future improvement. The remaining capacity is converted to EDUs assuming 190 gpd/EDU. These triggers identify the equivalent number of residential single-family units that can be served by the existing collection system prior to requiring upsizing or parallel relief. Other triggers are associated with specific developments or projects that may alter the routing of sewer flows within the collection system.
- **As Development Occurs:** New infrastructure required to serve future growth to be constructed on an as-needed basis as development occurs.

9.3.4 Recommended Cost Allocation Analysis

Capacity allocation analysis is needed to identify improvement funding sources, and to establish a nexus between development impact fees and improvements needed to service growth. The capacity allocation analysis, for the proposed improvements, was based on the average dry weather flows from existing customers compared to average dry weather flows from the buildout scenarios flows. In compliance with the provisions of Assembly Bill AB 1600, the analysis differentiates between the project needs of servicing existing users and for those required to service anticipated future developments.

Table 9.2 lists each improvement and separates the cost by responsibility between existing and future users. The cost responsibility is based on model parameters for existing and future land use and may change depending on the nature of development.

9.3.5 Recommended Condition and Risk Assessment Improvements

The projects recommended in the Condition and Risk Assessment are intended to replace or refurbish the existing assets that are close to or have exceeded their useful life. The results of this analysis will assist the City in managing and maintaining the existing sanitation infrastructure.

The recommended projects were designated as either condition assessment improvements or operations and maintenance recommendations depending on their specific renewal choice; their costs are summarized in **Table 9.3**. These recommendations were determined as a result of the risk assessment and are intended to mitigate or determine the condition of extreme and high-risk sewer infrastructure within the City's service area. In order to facilitate the prioritization of the projects included in the risk analysis, each project has been prioritized based on its risk score and condition.

It should be noted that the improvement project prioritization is intended to be used for planning purposes only. Specific on-site conditions, available funds, and other factors should be taken into consideration when preparing to schedule and construct the projects included in the condition and risk assessment.

Table 9.3 Condition Assessment Improvements, Cost Estimates

Wastewater Collection System Master Plan
City of Yakima

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Pipeline Renewal Choice	Priority[1]	Pipeline Improvements			Infrastructure Costs		
						Diameter (in)	Length (ft)	Unit Cost[2] ($)	Baseline Constr. Costs ($)	Estimated Constr. Costs[3] ($)	Capital Improv. Cost[4] ($)
Pipeline Improvements											
2-RP1	Gravity Main	E Tennant Ln	From approx. 452' w/o S Fair Ave to S Fair Ave	Replacement	2	30	460	508	234,000	305,000	397,000
2-RP2	Gravity Main	S Fair Ave	From E Tennant Ln to E Viola Ave	Replacement	2	30	470	508	239,000	311,000	405,000
2-RP3	Gravity Main	E Viola Ave	From S Fair Ave to approx. 78' w/o S 13th St	Replacement	3	36	910	631	574,000	747,000	972,000
4-RP1	Gravity Main	S 6th St	From E G St to E Chestnut Ave	Replacement	2	27	3,540	432	1,529,000	1,988,000	2,585,000
4-RP2	Gravity Main	E Chestnut Ave	From S 6th St to S 7th St	Replacement	2	27	400	432	173,000	225,000	293,000
4-RP3	Gravity Main	S 7th St	From E Chestnut Ave to E Beech St	Replacement	2	27	2,400	432	1,037,000	1,349,000	1,754,000
4-RP4	Gravity Main	ROW	From S 7th St to approx. 213' e/o S 7th St	Replacement	2	27	220	432	95,000	124,000	162,000
4-RP5	Gravity Main	E Ranchrite Rd	From railroad to approx. 237' e/o S 1st St	Replacement	2	30	820	508	417,000	543,000	706,000
4-RP6	Gravity Main	E Nob Hill Blvd	From S 6th St to S Fair Ave	Replacement	2	36	1,880	631	1,186,000	1,542,000	2,005,000
4-RP7	Gravity Main	S Fair Ave	From E Nob Hill Blvd to E Viola Ave	Replacement	2	36	1,330	631	839,000	1,091,000	1,419,000
4-RP8	Gravity Main	E Viola Ave	From S Fair Ave to approx. 85' w/o S 13th St	Replacement	2	42	890	936	833,000	1,083,000	1,408,000
4-RP9	Gravity Main	E Viola Ave	From approx. 85' w/o S 13th St to Rudkin Rd	Replacement	2	48	3,090	1,070	3,305,000	4,297,000	5,587,000
					Total - Condition Assessment Improvement Costs				**$10,461,000**	**$13,605,000**	**$17,693,000**

AKEL ENGINEERING GROUP, INC.

1/31/2023

Notes:

1. Project priority for condition assessment improvements was determined by the severity of pipeline defects and overall risk score of pipeline.
2. Unit Costs are based on the January 2023 20-City ENR CCI of 13,175.
3. Estimated Construction costs include 30 percent of baseline construction costs to account for unforeseen events and unknown field conditions.
4. Capital Improvement Costs also include an additional 30 percent of the estimated construction costs to account for engineering design, project administration, construction management and inspection, and legal costs.

APPENDIX B

CIP Detail Map

Detail A

Detail B

Detail C

Detail D

Galloway
Lookout Point
Southern
Dahl
Naches River
Naches
Yakima River
Buds
Rest Haven
Naches Heights
Cowiche Canyon
Scenic
Englewood
Fruitvale
Lincoln
Chestnut
Tieton
Summitview
Terrace Heights
Keyes
Marsh
Nob Hill
Wide Hollow Creek
Viola
Mead
Washington
YRWWTP
Dazet
Ahtanum
Bachelor Creek
Ahtanum Creek
McCullough
80th
64th
56th
44th
32nd
3rd
Fair
1st
4th
Main
52nd
11th
96th

Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing Modeled System
- WWTP
- Lift Stations

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 7.3
Capacity Improvements
Wastewater Collection System
Master Plan
City of Yakima

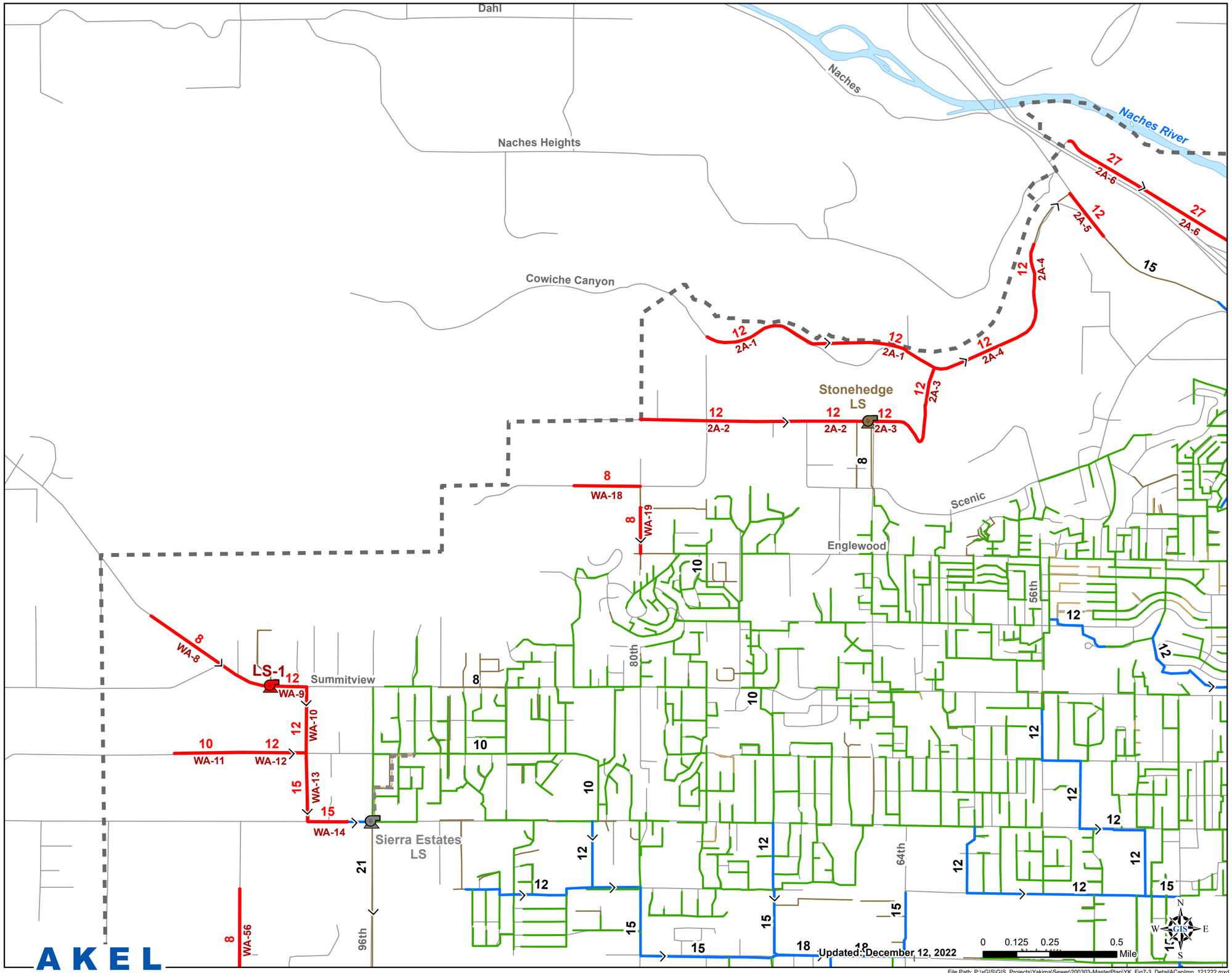
Updated: December 21, 2022

0 0.25 0.5 1 Mile

N W GIS E S

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Yakima\Sewer\200303-MasterPlan\YK_Fig7-3_CapImp_122122.mxd



Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing Modeled System
- Lift Station

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

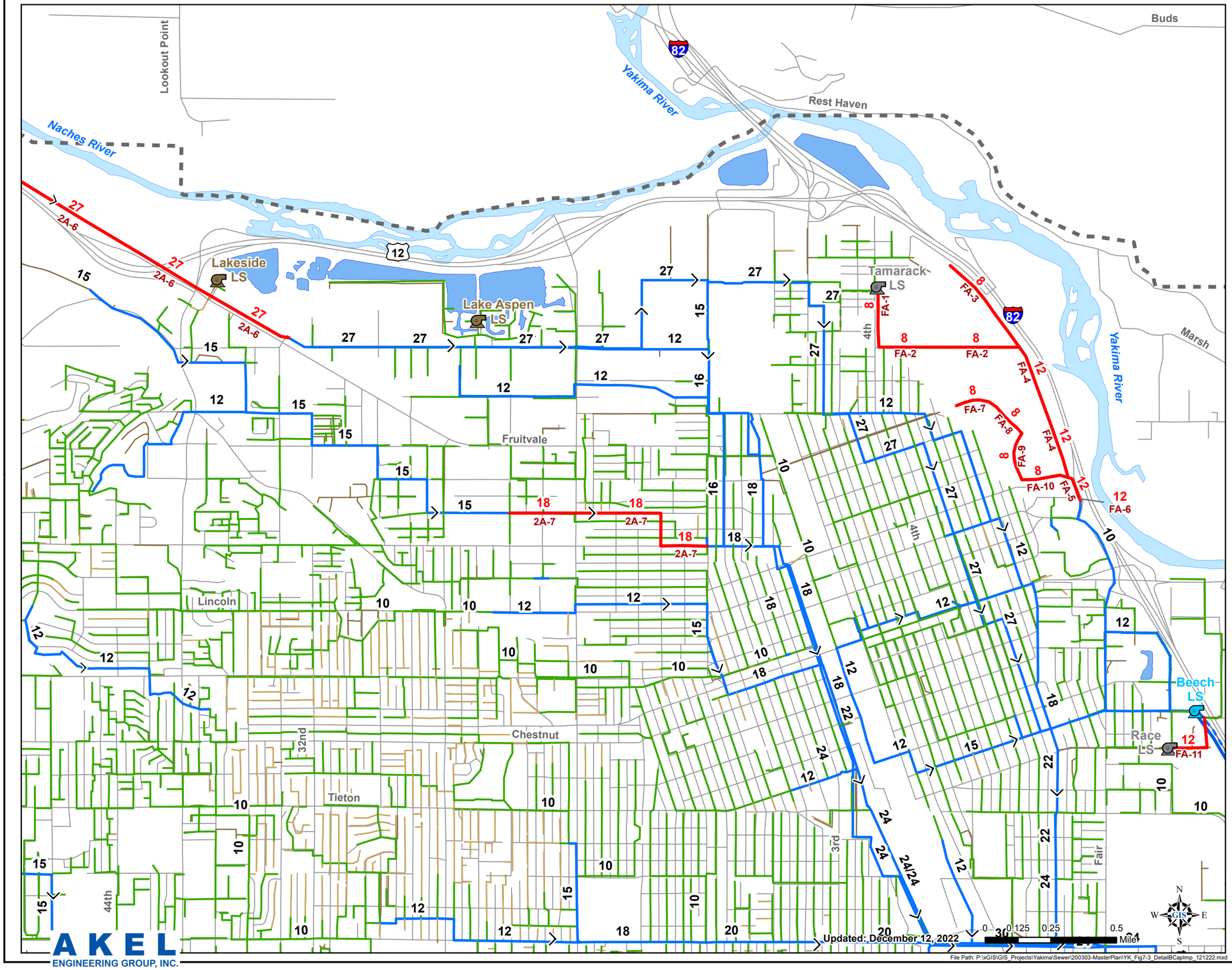
Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area

PRELIMINARY

Figure 7.3 - Detail A
Capacity Improvements

Wastewater Collection System
Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.



Legend

Future System Improvements
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing System
- Lift Station

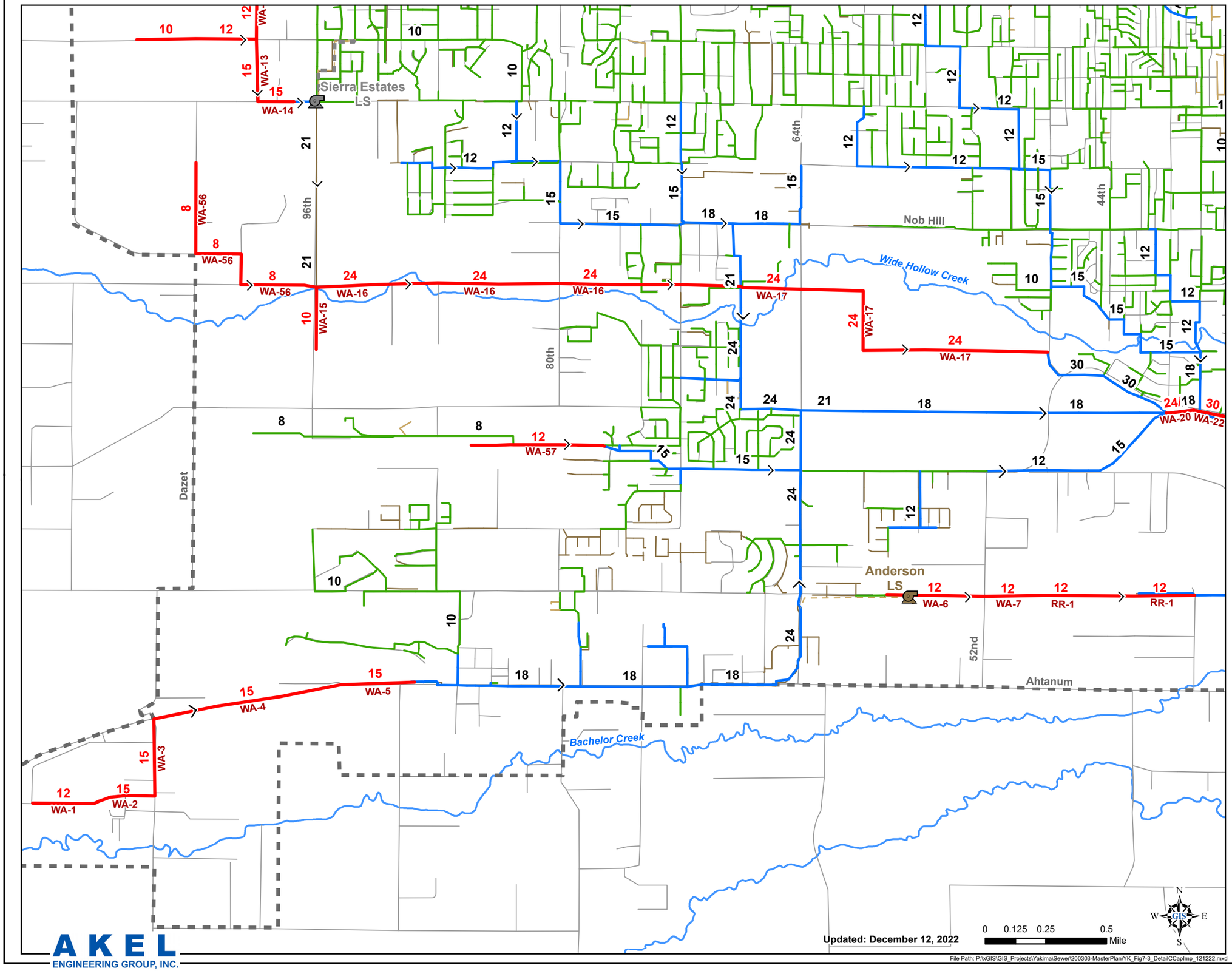
Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 7.3 - Detail B
Capacity Improvements
Wastewater Collection System
Master Plan
City of Yakima

AKEL ENGINEERING GROUP, INC.



Legend

Future System Improvements
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing System
- Lift Station

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

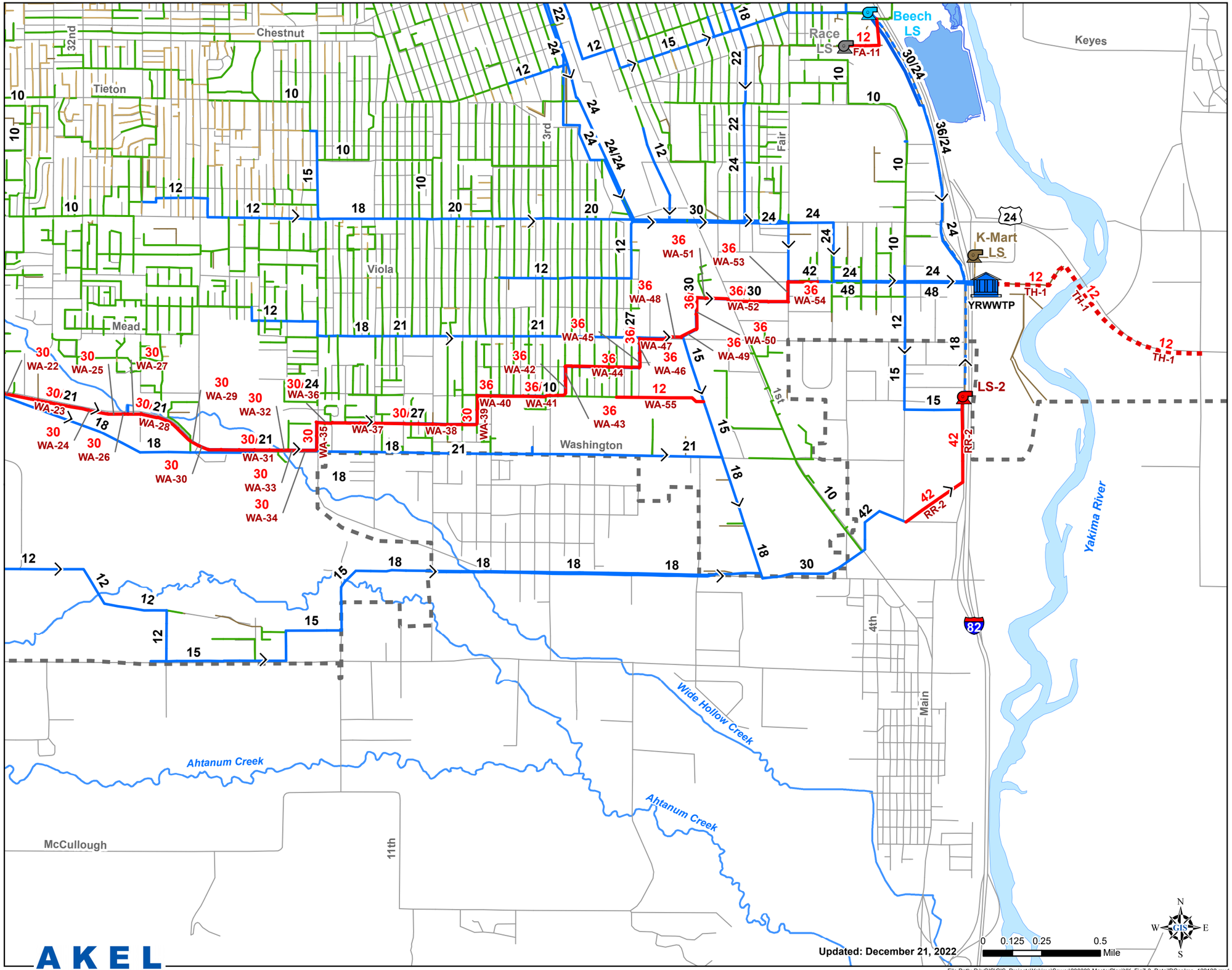
Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area

PRELIMINARY

Figure 7.3 - Detail C
Capacity Improvements

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.



Legend

Future System Improvements
- Lift Station
- Gravity Mains
- Force Mains

Abandoned System
- Lift Stations
- Force Main

Existing System
- WWTP
- Lift Station

Pipes by Diameter
- 6" or Less Gravity Main
- 6" or Less Force Main
- 8" - 10" Gravity Main
- 8" - 10" Force Main
- 12" or Larger Gravity Main
- 12" or Larger Force Main

Existing Non-Modeled System
- Lift Stations
- Pipes
- Streets
- Streams
- Urban Area
- Lakes

PRELIMINARY

Figure 7.3 - Detail D
Capacity Improvements

Wastewater Collection System
Master Plan
City of Yakima

AKEL
ENGINEERING GROUP, INC.