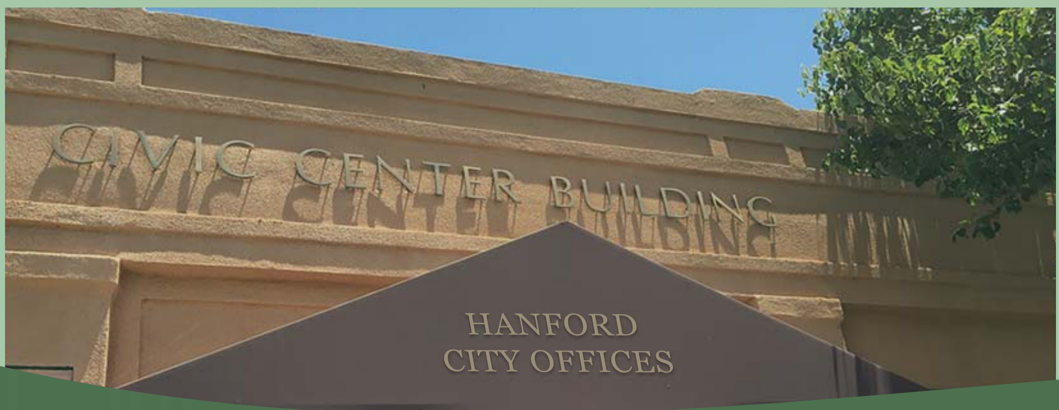
SEPTEMBER 2017

FINAL

City of Hanford

Sewer System Master Plan



AKEL
ENGINEERING GROUP, INC.

ADOPTION RESOLUTION

AKEL
ENGINEERING GROUP, INC.

RESOLUTION NO. 17-56-R

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF HANFORD ADOPTING THE HANFORD SEWER SYSTEM MASTER PLAN, DATED SEPTEMBER 2017

At a regular meeting of the City Council of the City of Hanford, duly called and held on November 7, 2017 at 7:00 P.M., it was moved by Council Member Sorensen, and seconded by Council Member Mendes, and duly carried that the following resolution be adopted:

WHEREAS, to ensure that sewer system facilities are properly planned and constructed, the City of Hanford contracted with the consulting firms of Quad Knopf, Inc. and Zumwalt-Hansen & Associates to develop a Sewer System Master Plan to facilitate future urban growth; and

WHEREAS, the firms of Quad Knopf, Inc., and Zumwalt-Hansen & Associates, subcontracted with the firm of Akel Engineering Group, Inc., to prepare the Sewer System Master Plan and related studies; and

WHEREAS, the Sewer System Master Plan Report is organized in eight sections (1) Introduction; (2) Planning Area Characteristics; (3) System Performance and Design; (4) Existing Sewer Collection Facilities; (5) Sewer Flows; (6) Hydraulic Model Development; (7) Evaluation and Proposed Improvements; (8) Capital Improvement Program; and

WHEREAS, the Land Use Element, and the Public Facilities Element of the 2035 Hanford General Plan adopted on April 24, 2017 by Resolution 17-21-R, provide specific statements supporting the development and implementation of a Sewer System Master Plan for planned urban growth; and

WHEREAS, THE City Council of the City of Hanford has determined that the proposed Sewer System Master Plan will incorporate and implement the new policies and concepts established in the adopted 2035 Hanford General Plan and is necessary for planned urban growth and development in the City consistent with the 2035 General plan.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Hanford has determined that as a result of the proposed Master Plan, no new effects could occur, or new mitigation measures would be required that have not been addressed within the scope of the certified Environmental

Impact Report (SCH No. 2015041024) prepared for the 2035 General Plan Update. The Environmental Impact Report prepared for the 2035 General Plan was certified by Resolution 17-20-R, adopted on April 24, 2017, which included a Statement of Overriding Considerations and a Mitigation and Monitoring Program, herein incorporated by reference. The Program Environmental Impact Report adequately analyzed and addressed the Sewer System Master Plan.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the City Council of the City of Hanford hereby adopts the Sewer System Master Plan dated September 2017.

PASSED, ADOPTED, and APPROVED this 7th day of November, 2017, by the following vote:

AYES: Sue Sorensen, Justin Mendes, Francisco Ramirez, Martin Devine, David Ayers

NOES: ————

ABSTAIN: ————

ABSENT: ————

DAVID G. AYERS,
MAYOR of the City of Hanford

ATTEST:

JENNIFER GOMEZ,
CITY CLERK

STATE OF CALIFORNIA)
COUNTY OF KINGS) ss
CITY OF HANFORD)

I, JENNIFER GOMEZ, City Clerk of the City of Hanford, do hereby certify the foregoing Resolution was duly passed and adopted by the City Council of the City of Hanford at a regular meeting thereof held on the 7th day of November, 2017.

Dated: November 8, 2017

JENNIFER GOMEZ,
CITY CLERK

CITY OF HANFORD

2017

SEWER SYSTEM MASTER PLAN

Final

September 2017

REGISTERED PROFESSIONAL ENGINEER
ANTOINE A. AKEL
C 041682
CIVIL
STATE OF CALIFORNIA
9/29/17

AKEL
ENGINEERING GROUP, INC.

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Smart Planning Our Water Resources

September 29, 2017

City of Hanford
319 Douty Street
Hanford CA, 93230

Attention: Lou Camara
Director of Public Works

Subject: 2017 Sewer System Master Plan – Final Report

Dear Lou:

We are pleased to submit the final report for the City of Hanford Sewer System Master Plan. This master plan is a standalone document, though it was prepared as part of the integrated infrastructure master plans for the water, sewer, and storm drainage master plans. The master plan documents the following:

- Existing collection system facilities, acceptable hydraulic performance criteria, and projected wastewater flows consistent with the Planned Area Boundary
- Development of the City's hydraulic sewer model.
- Capacity evaluation of the existing sewer system with improvements to mitigate existing deficiencies and to accommodate future growth.
- Capital improvement program (CIP) with an opinion of probable construction costs and suggestions for cost allocations to meet AB 1600.

We extend our thanks to you; John Doyel, Director of Public Utilities/ City Engineer; Darlene Mata, Community Development Director, and other City staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Principal

Enclosure: Report

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

Acknowledgements

City Council

David Ayers, Mayor

Sue Sorensen, Vice Mayor

Martin Devine

Francisco Ramirez

Justin Mendes

Management Personnel

Lou Camara, Director of Public Works

John Doyel, Director of Public Utilities / City Engineer

Mike Cosenza, Utilities Superintendent

Darlene Mata, Community Development Director

Other City Engineering, Planning, and Operations Staff

City of Hanford
Sewer System Master Plan

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TABLES

APPENDICES

EXECUTIVE SUMMARY

This executive summary presents a brief background of the City of Hanford's sewer system, the planning area characteristics, the planning and design criteria, the hydraulic model development and a capital improvement program.

The hydraulic model was used to evaluate the capacity adequacy of the existing sewer system and for recommending improvements to mitigate existing deficiencies and for servicing future growth. The prioritized capital improvement program accounts for growth throughout the Hanford Planning Area.

ES.1 STUDY OBJECTIVES

The City of Hanford recognizes the importance of planning, developing, and financing system facilities to provide sewer collection services to existing customers and for servicing anticipated growth within the Hanford Planning Area, the City initiated the preparation of the 2017 Sewer System Master Plan (SSMP).

City Council approved Akel Engineering Group Inc. to prepare this master plan in November of 2013. This 2017 SSMP is intended to serve as a tool for planning and phasing the construction of future sewer system infrastructure for the projected buildout of the City of Hanford. The 2017 SSMP evaluates the City's sewer system and recommends capacity improvements necessary to service the need of existing users and for servicing the future growth of the City.

The planning boundary and horizon for the master plan were developed in accordance with the City's recently adopted General Plan. 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 sewer system facilities.
- Document growth planning assumptions and known future developments.
- Update the sewer system performance criteria.
- Project future sewer flows.
- Update the hydraulic model using available data.
- Evaluate the adequacy of capacity for the sewer system facilities to meet existing and projected peak dry weather flows.
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.

- Perform a capacity allocation analysis for cost sharing purposes between existing users and future growth.
- Develop a 2017 Sewer 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:

- Water System Master Plan
- Sewer System Master Plan
- Storm Drainage System Master Plan

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

ES.3 STUDY AREA DESCRIPTION

The City is located in Kings County, approximately 30 miles southeast of the City of Fresno and 20 miles west of the City of Visalia (**Figure ES.1**). The City's closest neighbor, the City of Lemoore, is located 8 miles to the west. Highway 198 bisects the southern boundary of the City in the east-west direction, while Highway 43 is adjacent to the City's eastern boundary. In 2002, the City outlined the long-term Urban Growth Boundary (UGB), which was approved by City Council, and identified lands intended for future urbanization within the City service area.

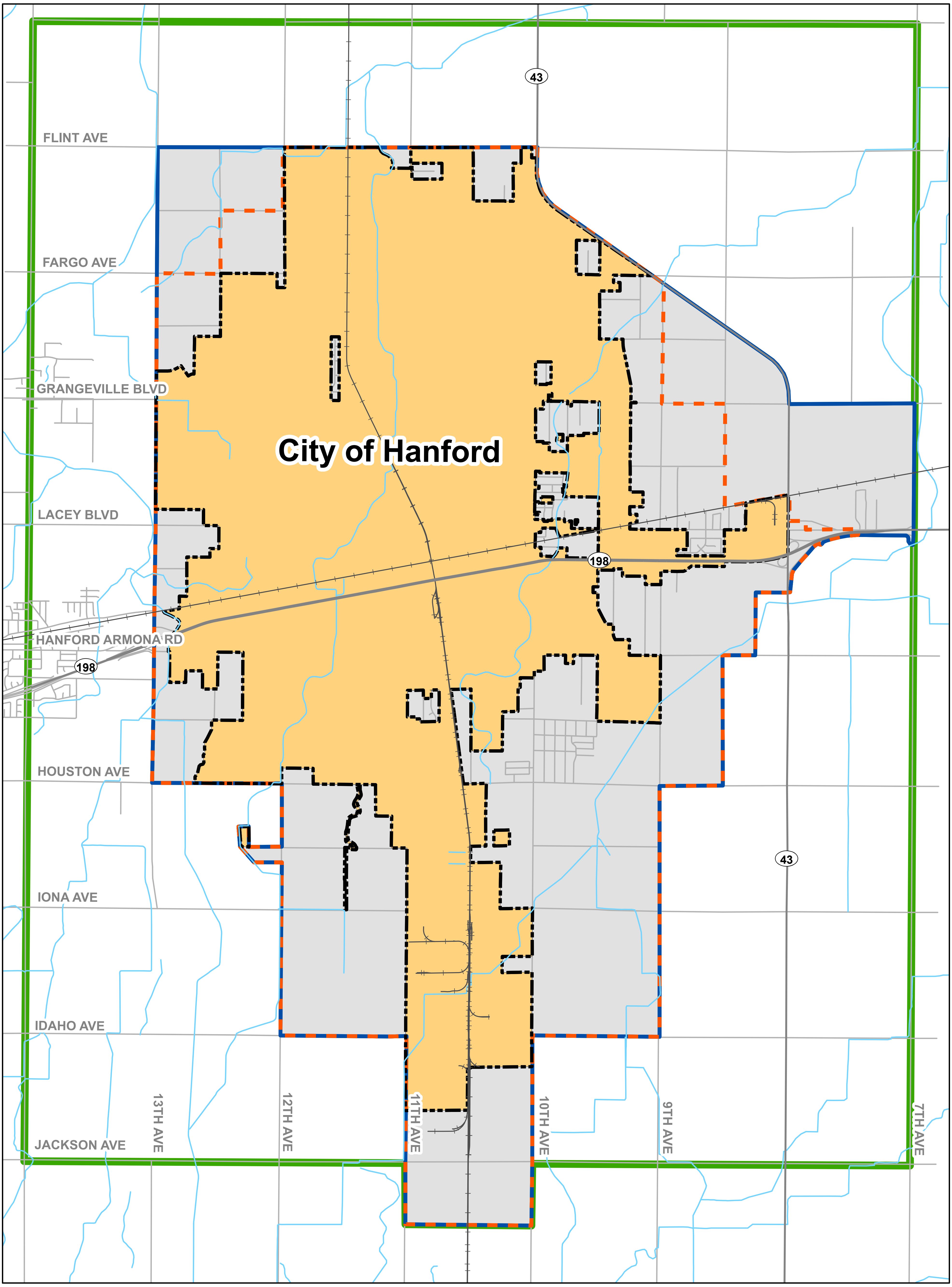
The City operates and maintains a sewer system that covers the majority of the area within the City Limits. The existing sewer collection system conveys flows to the City's Wastewater Treatment Plant (WWTP).

ES.4 SYSTEM PERFORMANCE AND DESIGN CRITERIA

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. Design criteria include capacity requirements for the sewer collection system facilities and flow calculation methodologies for future users.

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.



Legend

- Streets
- Waterways
- City Limits
- 2035 Growth Boundary
- Planned Area Boundary
- General Plan Study Area Boundary

Update: September 1, 2016

0 0.25 0.5 1 Mile

N W E S

AKEL ENGINEERING GROUP, INC.

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ES. 1
Planning Area
Sewer System Master Plan
City of Hanford

During peak dry weather flows (PDWF), the maximum allowable d/D ratio for proposed pipelines smaller than 18-inches is 0.5. For proposed pipelines 18-inches and larger, the maximum allowable d/D criteria is 0.75. The maximum allowable d/D for all existing pipes (all diameters) is 0.92. The criterion for existing pipe is relaxed in order to maximize the use of the existing pipes before costly pipes improvements are required.

The City's design standards pertaining to the d/D criteria are summarized in **Table ES.1**.

ES.5 EXISTING SEWER SYSTEM OVERVIEW

The City provides sewer collection services to approximately 56,000 residents, as well as commercial, industrial, and institutional establishments. The City owns, operates, and maintains the sewer collection system which consists of gravity and force mains, with pipes up to 48-inches in size ultimately conveying the flow to the City's WWTP.

The City's existing sewer system is shown in **Figure ES.2**, which displays the existing system by pipe sizes. This figure also labels the existing lift stations and the WWTP.

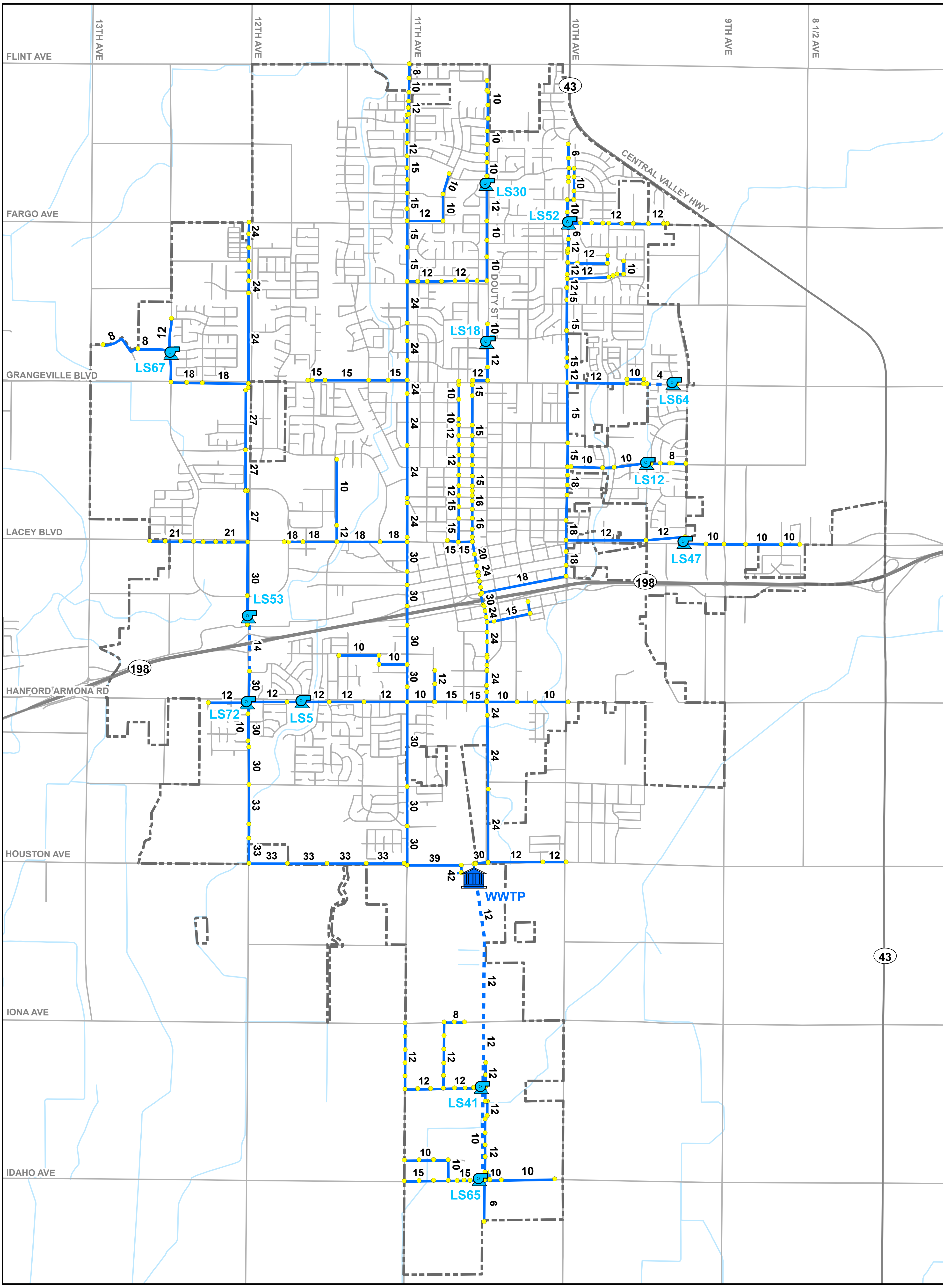
ES.6 SEWER FLOWS

The sewer flows collected and treated at the WWTP vary monthly, daily, and hourly. Flow data influent to Hanford's WWTP was obtained from City Operation Staff. The flow data covered the time period from year 2006 to year 2015. **Table ES.2** shows the flows experienced at the WWTP have decreased from 4.93 mgd in 2006 to 4.44 mgd in 2015. In addition to listing the 2006-2015 flows, and for comparison purposes, the table calculates the peaking factors applied to the corresponding average annual flows for each year.

The land use methodology was used to estimate the buildout flows and to be consistent with the City's General Plan. **Table ES.3** identifies the total acreages for existing residential and non-residential categories and the undeveloped lands designated for urbanization. The areas planned for development were multiplied by the corresponding unit sewer flow factor to estimate the sewer flows at buildout.

ES.7 HYDRAULIC MODEL DEVELOPMENT

The City's hydraulic model combines information on the physical characteristics of the sewer system (pipelines, lift stations, force mains) and operational characteristics (how they operate). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes, including backwater calculations for surcharged conditions. 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 model.



Legend

Existing System

- WWTP
- Lift Stations
- Manholes
- Gravity Mains
- Force Mains
- City Limits
- Streets
- Highways
- Waterways

Update: October 27, 2016

0 0.25 0.5 1 Mile

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AKEL ENGINEERING GROUP, INC.

ES. 2 Existing Modeled Sewer System

Sewer System Master Plan
City of Hanford

Table ES.1 Planning and Design Criteria
Sewer System Master Plan
City of Hanford

Pipeline Criteria		
Peak Dry Weather Flow Criteria		
Diameter (in)	**Maximum Allowable d/D**	
	Existing Trunks	**Proposed Trunks**
< 18	**0.92**	**0.50**
≥ 18	**0.92**	**0.75**

Peak Flow Estimation

$Q_{peak} = 1.80 \times Q_{avg}^{0.92}$ (cubic feet per second, cfs units)

$Q_{peak} = 1.74 \times Q_{avg}^{0.92}$ (million gallons per day, mgd units)

Unit Flow Factor Criteria

Land Use Classification	Unit Flow Factor (gpd/acre)
Residential	
Low Density Residential	790
Medium Density Residential	1,350
High Density Residential	2,450
Mixed Use	
Office Residential	1,650
Neighborhood Mixed Use	1,250
Corridor Mixed Use	900
Downtown Mixed Use	2,950
Non-Residential	
Neighborhood Commercial	640
Regional Commercial	790
Service Commercial	520
Highway Commercial	640
Office	1,030
Public Facilities	520
Light Industrial	590
Heavy Industrial	680
Educational Facilities	800

Table ES.2 Historical Flows at the Hanford Wastewater Treatment Plant

Sewer System Master Plan

City of Hanford

Year	Population	Per Capita Flows	Average Annual Flow (AAF) (mgd)	Percentage Change	Seasonal Average ADWF[1] (mgd)	Seasonal Average AWWF[2] (mgd)	Maximum Month MMDWF (mgd)	Maximum Month MMWWF (mgd)	Maximum Day MDDWF (mgd)	Maximum Day MDWWF (mgd)
Historical Flows										
2006	48,920	101	4.93	-	4.98	4.94	5.00	5.04	5.51	7.85
2007	50,534	98	4.97	0.9%	4.98	4.97	5.06	5.07	6.00	5.90
2008	51,922	99	5.16	3.7%	5.27	5.15	5.38	5.25	6.39	6.07
2009	52,970	93	4.92	-4.7%	4.87	4.98	4.93	5.16	5.72	7.60
2010	53,967	90	4.86	-1.1%	4.83	4.89	4.86	5.22	5.76	7.14
2011	54,146	87	4.73	-2.8%	4.79	4.70	4.90	4.83	5.75	7.25
2012	54,541	87	4.72	-0.2%	4.77	4.68	4.86	4.73	5.37	5.99
2013	54,513	87	4.73	0.3%	4.75	4.72	4.79	4.80	5.12	7.11
2014	54,727	86	4.69	-0.9%	4.73	4.70	4.82	4.81	5.11	5.27
2015	55,337	80	4.44	-5.3%	4.44	4.44	4.46	4.52	5.00	4.77
Historical Peaking Factors (Applied to ADWF)										
2006			0.99		1.00	0.99	1.01	1.01	1.11	1.58
2007			1.00		1.00	1.00	1.02	1.02	1.21	1.19
2008			1.01		1.00	0.98	1.02	1.00	1.21	1.15
2009			1.01		1.00	1.02	1.01	1.06	1.18	1.56
2010			0.99		1.00	1.01	1.01	1.08	1.19	1.48
2011			0.99		1.00	0.98	1.02	1.01	1.20	1.51
2012			1.00		1.00	0.98	1.02	0.99	1.13	1.25
2013			0.99		1.00	0.99	1.01	1.01	1.08	1.50
2014			1.00		1.00	0.99	1.02	1.02	1.08	1.11
2015			1.00		0.94	1.00	1.00	0.96	1.13	1.07

AKEL ENGINEERING GROUP, INC.

2/28/2017

Notes :

1. Dry weather montshs include months from May to September

2. Wet weather months include months from October to April

Table ES.3 Average Daily Sewer Flows

Sewer System Master Plan
City of Hanford

Land Use Classifications	Buildout Sewer Flows												
	Existing Development			Future Development to be Serviced within Planned Area Boundary									
	Within Service Area			Within Service Area				Planned Area Boundary				Total	
	Existing Development (net acre)	Sewer Unit Factor (gpd/net acre)	Average Daily Flow (gpd)	New Development (net acre)	Anticipated New Development (net acre)	Future Sewer Unit Factor (gpd/net acre)	Average Daily Flow (gpd)	Existing Development (net acre)	New Development (net acre)	Future Sewer Unit Factor (gpd/net acre)	Average Daily Flow (gpd)	Total Development within PAB (net acres)	Average Daily Flow (gpd)
Residential													
Low Density	2,837	790	2,241,112	1,026	462	790	810,586	539	1,401	790	1,533,071	5,804	4,584,768
Medium Density	498	1,350	672,112	225	101	1,350	303,765	35	312	1,350	468,650	1,070	1,444,527
High Density	84	2,450	207,025	73	33	2,450	179,563	0	64	2,450	156,587	222	543,175
Subtotal	3,419		3,120,249	1,324	596		1,293,914	574	1,777		2,158,307	7,095	6,572,470
Mixed Use													
Office Residential	89	1,650	146,438	25	25	1,650	41,382	0	0	1,650	0	114	187,820
Neighborhood Mixed Use	12	1,250	15,475	42	42	1,250	52,290	0	15	1,250	19,316	70	87,081
Corridor Mixed Use	250	900	225,397	225	225	900	202,676	10	3	900	11,970	489	440,042
Downtown Mixed Use	81	2,950	237,564	42	42	2,950	125,021	0	0	2,950	0	123	362,585
Subtotal	432		624,873	334	334		421,369	10	18		31,286	795	1,077,528
Non-Residential													
Neighborhood Commercial	27	640	17,344	26	26	640	16,676	8	12	640	12,717	73	46,737
Regional Commercial	216	790	170,839	160	160	790	126,046	18	169	790	148,329	564	445,214
Service Commercial	103	520	53,300	54	54	520	27,862	56	63	520	61,859	275	143,020
Highway Commercial	48	640	30,464	68	68	640	43,258	16	16	640	20,550	147	94,272
Office	88	1,030	90,856	30	30	1,030	31,302	0	0	1,030	0	119	122,158
Light Industrial	105	590	62,103	61	21	590	35,701	83	557	590	377,647	806	475,452
Heavy Industrial	376	680	255,456	568	199	680	385,995	211	2,607	680	1,915,866	3,761	2,557,317
Airport Protection	0	0	0	125	125	0	0	111	563	0	0	799	0
Educational Facilities	445	800	356,256	117	117	800	93,312	11	97	800	85,928	669	535,496
Public Facilities	438	520	227,812	56	56	520	29,115	3	13	520	8,294	510	265,221
Open Space with Irrigation	16	0	0	45	33	0	0	0	121	0	0	182	0
Open Space without Irrigation	346	0	0	65		0	0	41	54	0	0	507	0
Interest Area	0	1,650	0	0		1,650	0	49	552	1,650	992,261	601	992,261
Subtotal	2,208		1,264,430	1,372	888		789,266	607	4,825		3,623,450	9,012	5,677,147
Totals	6,059		**5,009,552**	3,031	1,818	0	2,504,548	1,192	6,621		5,813,044	16,903	13,327,145

AKEL

12/28/2016

The hydraulic modeling software used for evaluating the capacity adequacy of the City's sewer collection system, InfoSewer by Innovyze Inc., uses the simplified St Venant's equation, which is utilized to simulate backwater and surcharge conditions, in addition to simulating manifolded force mains. The software also incorporates the use of the Manning's 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.

ES.8 CAPACITY EVALUATION

The hydraulic model was used for evaluating the sewer system for capacity deficiencies during peak dry weather flows. The planning and design criteria were used as a basis to judge the adequacy of the capacity of for the existing sewer collection system. The design flows simulated in the hydraulic model for existing conditions, and at buildout include:

- Existing PDWF: **7.6** mgd
- Future PDWF at buildout: **18.8** mgd

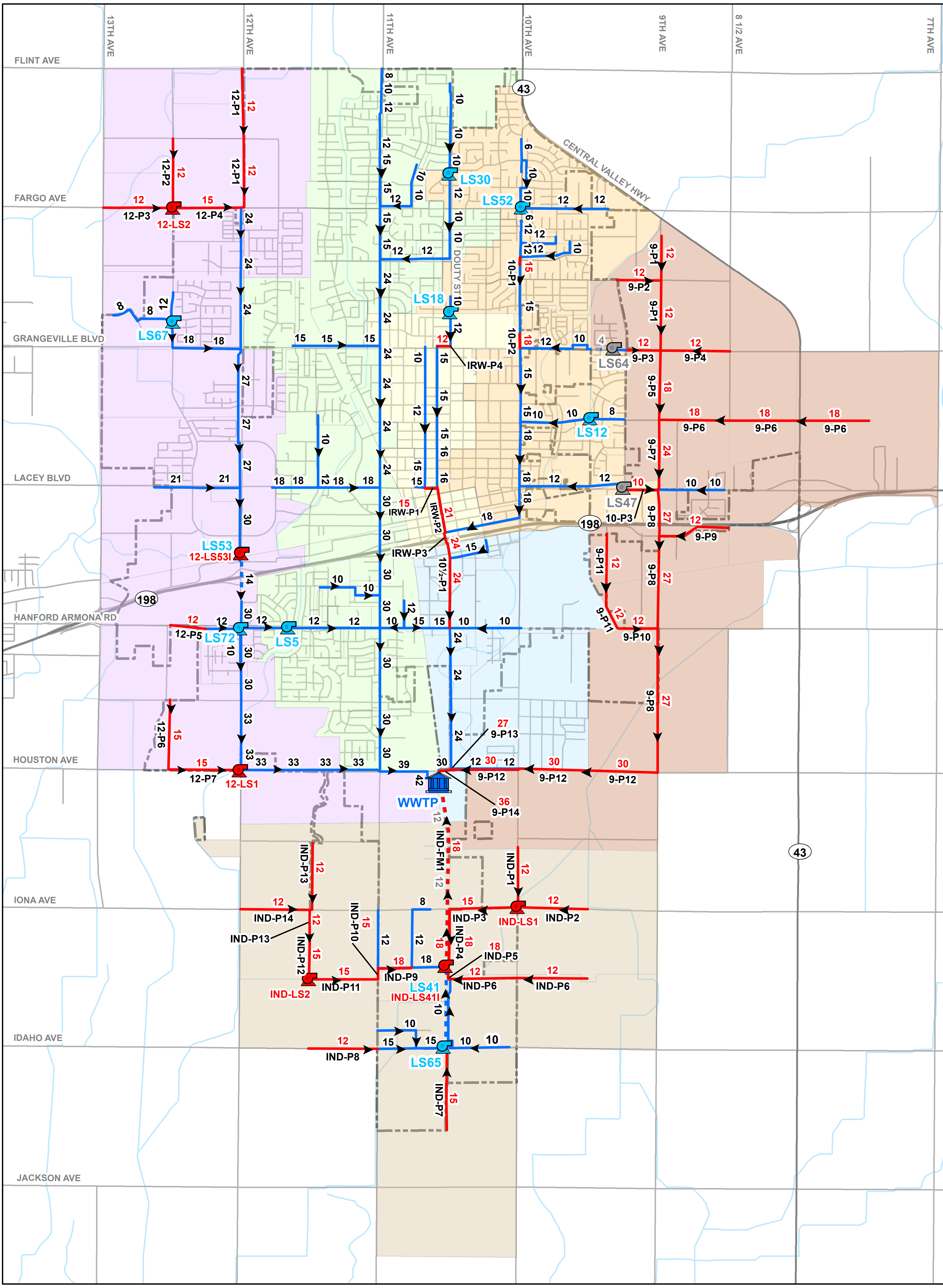
In general, the hydraulic model indicated that the sewer system exhibited acceptable performance to service the existing customers during peak dry weather flow conditions. Future flows were then added to the hydraulic model and the existing sewer collection system was expanded in order to serve these future users. The proposed improvements for the future system are shown with recommended pipe sizes on an overall exhibit (**Figure ES.3**).

ES.9 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement Program costs for the projects identified in this master plan for mitigating existing system deficiencies and for serving anticipated future growth throughout the City are summarized on **Table ES.4** and are graphically represented on **Figure ES.3**.

The estimated construction costs include the baseline costs plus **15 percent** contingency allowance to account for unforeseen events and unknown field conditions. Capital improvement costs include the estimated construction costs plus **15 percent** project-related costs (engineering design, project administration, construction management and inspection, and legal costs).

The costs in this sewer system master plan were benchmarked using a 20-City national average Engineering News Records (ENR) Construction Cost Index (CCI) of 10,532, reflecting a date of January 2017. In total, the CIP includes approximately 22 miles of pipeline improvements, and 6 lift station improvements, with a project cost totaling over 53 million dollars.



Legend

Proposed Improvements
- Lift Stations and Pumps
- Gravity Mains
- Force Mains

Future Basins
- 9th Ave Basin

- 10th Ave Basin
- 10 1/2 Ave Basin
- 11th Ave Basin
- 12th Ave Basin
- Irwin St Basin
- Industrial Area Basin

Abandoned
- Lift Stations
- Gravity Main
- Force Main

Existing System
- WWTP
- Lift Stations
- Gravity Mains
- Force Mains

- City Limits
- Streets
- Highways
- Waterways

Update: July 13, 2017

0 0.25 0.5 1 Mile

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AKEL ENGINEERING GROUP, INC.

ES. 3
Capital Improvement Program

Sewer System Master Plan
City of Hanford

Table ES.4 Capital Improvement Program

Sewer System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements: Existing Diameter	New/Parallel/Replace	Diameter	Length	Casings: Railroad	Casings: Highway	Casings: Canal/ Slough	Infrastructure Costs: Pipe Unit Cost	Pipe Cost [1,2]	Baseline Constr. Consts	Estimated Constr. Costs [3]	Capital Improv. Costs [4]	Suggested Cost Allocation: Existing Users	Suggested Cost Allocation: Future Users	Cost Sharing: Existing Users	Cost Sharing: Future Users
				(in)		(in)	(ft)				($/unit)	($)	($)	($)	($)	(%)	(%)	($)	($)
12th Avenue Trunk																			
Pipeline Capacity Improvements																			
12-P1	Gravity Main	12th Ave	From Flint Ave to Fargo Ave	-	New	12	5,400			1	228	1,370,042	1,370,042	1,575,548	1,811,880	0%	100%	0	1,811,880
12-P2	Gravity Main	Future 12 1/2 Ave	From approx 2,650 ft n/o Fargo Ave to Fargo Ave	-	New	12	2,675			1	228	749,730	749,730	862,190	991,518	0%	100%	0	991,518
12-P3	Gravity Main	Fargo Ave	From 13th Ave to future 12 1/2 Ave	-	New	12	2,675			1	228	749,730	749,730	862,190	991,518	0%	100%	0	991,518
12-P4	Gravity Main	Fargo Ave	From future 12 1/2 Ave to 12th Ave	-	New	15	2,575				239	616,660	616,660	709,160	815,533	0%	100%	0	815,533
12-P5	Gravity Main	Hanford Armona Rd	From ext. of future 12 1/2 Ave to 12th Ave		New	12	1,350				228	307,310	307,310	353,407	406,418	0%	100%	0	406,418
12-P6	Gravity Main	Future 12 1/2 Ave	From ext. of Hume Ave to Houston Ave	-	New	15	2,675				239	640,608	640,608	736,700	847,205	0%	100%	0	847,205
12-P7	Gravity Main	Houston Ave	From future 12 1/2 Ave to 12th Ave	-	New	15	2,750			2	239	975,369	975,369	1,121,675	1,289,926	0%	100%	0	1,289,926
Lift Station Improvements						Firm Capacity													
12-LS53I	Lift Station	12th Avenue	300 ft n/o of Glendale Ave		Replace	2 @ 1,200 gpm					-	1,207,973	1,207,973	1,389,169	1,597,545	35%	65%	558,274	1,039,270
12-LS1	Lift Station	Houston Ave	Intersection of Houston Ave and 12th Ave		New	1 @ 600 gpm					-	550,707	550,707	633,313	728,310	0%	100%	0	728,310
12-LS2	Lift Station	Fargo Ave	2,600 ft w/o 12th Ave		New	1 @ 400 gpm					-	477,677	477,677	549,329	631,728	0%	100%	0	631,728
												Subtotal - 12th Avenue Trunk	7,645,808	8,792,679	10,111,581			558,274	9,553,307
9th Avenue Trunk																			
Pipeline Capacity Improvements																			
9-P1	Gravity Main	9th Ave	From Fairview Pl to Grangeville Blvd	-	New	12	4,375				228	995,914	995,914	1,145,301	1,317,096	0%	100%	0	1,317,096
9-P2	Gravity Main	Leland Way	From 9 1/4 Ave to 9th Ave	-	New	12	1,700				228	386,984	386,984	445,031	511,786	0%	100%	0	511,786
9-P3 [5]	Gravity Main	Grangeville Blvd	From 9 1/4 Ave to 9th Ave	-	New	12	1,350				228	307,310	307,310	353,407	406,418	63%	37%	255,271	151,147
9-P4	Gravity Main	Grangeville Blvd	From 8 1/2 Ave to 9th Ave	-	New	12	2,650				228	603,239	603,239	693,725	797,784	0%	100%	0	797,784
9-P5	Gravity Main	9th Ave	From Grangeville Blvd to Florinda St	-	New	18	2,650				258	683,439	683,439	785,954	903,847	7%	93%	65,111	838,736
9-P6	Gravity Main	Florinda St	From approx 2,600 ft e/o HWY 43 to 9th Ave	-	New	18	8,000				258	2,063,211	2,063,211	2,372,692	2,728,596	0%	100%	0	2,728,596
9-P7	Gravity Main	9th Ave	From Florinda St to Lacey Blvd	-	New	24	2,700	1			291	996,352	996,352	1,145,804	1,317,675	2%	98%	32,046	1,285,629
9-P8	Gravity Main	9th Ave	From Lacey Blvd to Houston Ave	-	New	27	10,775	1	1		336	4,565,788	4,565,788	5,250,657	6,038,255	7%	93%	450,149	5,588,106
9-P9	Gravity Main	Third St	From ext. of David St to 9th Ave	-	New	12	2,750				228	626,003	626,003	719,903	827,889	0%	100%	0	827,889
9-P10	Gravity Main	Hanford Armona Rd	From approx 450 ft e/o 9 1/2 Ave to 9th Ave	-	New	12	1,500				228	341,456	341,456	392,675	451,576	0%	100%	0	451,576
9-P11	Gravity Main	9 1/2 Ave	From approx 300 ft s/o Third St to Hanford Armona Rd	-	New	12	3,750				228	853,640	853,640	981,686	1,128,939	0%	100%	0	1,128,939
9-P12	Gravity Main	Houston Ave	From 9th Ave to 10 1/2 Ave	-	New	30	7,875			1	395	3,346,232	3,346,232	3,848,167	4,425,392	7%	93%	311,967	4,113,424
9-P13	Gravity Main	10 1/2 Ave	From approx 50 ft n/o Houston Ave to Houston Ave	-	New	27	50				336	16,777	16,777	19,293	22,187	70%	30%	15,454	6,733
9-P14	Gravity Main	Houston Ave	From 10 1/2 Ave to approx 500 ft w/o 10 1/2 Ave	-	New	36	725	1			491	619,831	619,831	712,806	819,727	40%	60%	325,862	493,865
												Subtotal - 9th Avenue Trunk	16,406,175	18,867,102	21,697,167			1,455,860	20,241,307
10th Avenue Trunk																			
Pipeline Capacity Improvements																			
10-P1	Gravity Main	10th Ave	From approx 100 ft n/o Lakewood Dr to 200 ft s/o Lakewood Dr	12	Replace	15	300				239	71,844	71,844	82,621	95,014	65%	35%	61,759	33,255
10-P2	Gravity Main	10th Ave	From approx 150 ft s/o Cross Ave to Grangeville Blvd	12	Replace	18	575				258	148,293	148,293	170,537	196,118	73%	27%	143,166	52,952
Slope Deficiency Improvements																			
10-P3 [6]	Gravity Main	Lacey Blvd	From 9 1/4 Ave to 9th Ave	10	Replace	10	1,300				222	289,086	289,086	332,449	382,317	50%	50%	191,158	191,158
												Subtotal - 10th Avenue Trunk	509,224	585,607	673,448			396,083	277,365
10 1/2 Avenue																			
Slope Deficiency Improvements																			
10½-P1	Gravity Main	Irwin St	From Third St to Hanford Armona Rd	24	Replace	24	3,350				291	974,170	974,170	1,120,295	1,288,339	79%	21%	1,017,090	271,249
												Subtotal - 10 1/2 Avenue Trunk	974,170	1,120,295	1,288,339			1,017,090	271,249
Irwin St Trunk																			
Slope Deficiency Improvements																			

Table ES.4 Capital Improvement Program

Sewer System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements							Infrastructure Costs		Baseline Constr. Consts	Estimated Constr. Costs [3]	Capital Improv. Costs [4]	Suggested Cost Allocation		Cost Sharing	
				Existing Diameter (in)	New/Parallel/Replace	Diameter (in)	Length (ft)	Casings: Railroad	Casings: Highway	Casings: Canal/ Slough	Pipe Unit Cost ($/unit)	Pipe Cost [1,2] ($)	($)	($)	($)	Existing Users (%)	Future Users (%)	Existing Users ($)	Future Users ($)
IRW-P1	Gravity Main	Lacey Blvd	From Redington St to Irwin St	15	Replace	15	525				239	125,727	125,727	144,586	166,274	92%	8%	152,719	13,555
IRW-P2	Gravity Main	Irwin St	From Lacey Blvd to Fourth St	20, 24	Replace	21	1,850	1			280	729,700	729,700	839,155	965,028	79%	21%	766,182	198,847
IRW-P3	Gravity Main	Irwin St	From Fourth St to 3rd St	24, 30	Replace	24	500		1		291	778,998	778,998	895,848	1,030,225	79%	21%	818,544	211,681
IRW-P4	Gravity Main	Grangeville Blvd	From Douty St to Irwin St	12	Replace	12	525				228	119,510	119,510	137,436	158,051	96%	4%	151,099	6,952
											Subtotal - Irwin Street Trunk		1,753,935	2,017,025	2,319,579			1,888,544	431,036
Industrial Trunk																			
Pipeline Capacity Improvements																			
IND-P1	Gravity Main	10th Ave	From approx 2,300 ft n/o Iona Ave to Iona Ave	-	New	12	2,300				228	523,566	523,566	602,101	692,416	0%	100%	0	692,416
IND-P2	Gravity Main	Iona Ave	From future 9 1/2 Ave to ext. of 10th Ave	-	New	12	2,675			1	228	749,730	749,730	862,190	991,518	0%	100%	0	991,518
IND-P3	Gravity Main	Iona Ave	From 10th Avenue to 10 1/2 Ave	12	Replace	15	2,125				239	508,895	508,895	585,229	673,013	0%	100%	0	673,013
IND-P4	Gravity Main	ext. 10 1/2 Ave	From Iona Ave to Industry Ave	12	Replace	18	2,675				258	689,886	689,886	793,369	912,374	6%	94%	53,771	858,603
IND-P5	Gravity Main	ext. 10 1/2 Ave	From approx 600 ft s/o Industry Ave to Industry Ave	12	Replace	18	600				258	154,741	154,741	177,952	204,645	12%	88%	24,979	179,666
IND-P6	Gravity Main	Future ROW	From future 9 1/2 Ave to ext. of 10 1/2 Ave	-	New	12	5,225			1	228	1,330,205	1,330,205	1,529,736	1,759,197	0%	100%	0	1,759,197
IND-P7	Gravity Main	ext. 10 1/2 Ave	From 3,100 ft s/o Idaho Ave to Idaho Ave	6	Replace	15	3,250				239	778,309	778,309	895,056	1,029,314	32%	68%	329,018	700,296
IND-P8	Gravity Main	Idaho Ave	From approx 2,600 ft w/o 11th Avenue to 11th Avenue	-	New	12	2,650				228	603,239	603,239	693,725	797,784	32%	68%	252,053	545,730
IND-P9	Gravity Main	Industry Ave	From 11th Avenue to Crown Avenue	12	Replace	18	1,325				258	341,719	341,719	392,977	451,924	31%	69%	139,155	312,768
IND-P10	Gravity Main	11th Ave	From approx 420 ft s/o Industry Ave to Industry Ave	-	New	15	425				239	101,779	101,779	117,046	134,603	0%	100%	0	134,603
IND-P11	Gravity Main	Future ROW	From future 11 1/2 Ave to 11th Ave	-	New	15	2,600				239	622,647	622,647	716,045	823,451	0%	100%	0	823,451
IND-P12	Gravity Main	Future 11 1/2 Ave	From approx 1,350 ft s/o Iona Ave to approx 420 ft s/o Industry Ave	-	New	15	1,325				239	317,311	317,311	364,907	419,643	19%	81%	77,724	341,919
IND-P13	Gravity Main	Future 11 1/2 Ave	From approx 2,530 ft n/o Iona Ave to approx 1,350 ft s/o Iona Ave	-	New	12	3,975			1	228	1,045,659	1,045,659	1,202,507	1,382,884	0%	100%	0	1,382,884
IND-P14	Gravity Main	Iona Ave	From 12th Ave to future 11 1/2 Ave	-	New	12	2,650				228	603,239	603,239	693,725	797,784	0%	100%	0	797,784
IND-FM1	Force Main	ext. 10 1/2 Ave	From Industry Ave to Houston Ave	12	Replace	18	7,275				258	1,876,232	1,876,232	2,157,667	2,481,317	11%	89%	266,908	2,214,409
Lift Station Improvements						Firm Capacity													
IND-LS41I	Lift Station	Industry Ave	1,300 e/o Crown Ave		Replace	2 @ 1,500 gpm						1,552,759	1,552,759	1,785,673	2,053,524	11%	89%	220,891	1,832,632
IND-LS1	Lift Station	Iona Ave	Intersection of Iona Ave and 10th Ave		New	1 @ 500 gpm						512,425	512,425	589,289	677,682	0%	100%	0	677,682
IND-LS2	Lift Station	Future 11 1/2 Ave	2,650 ft s/o Iona Ave		New	1 @ 500 gpm						512,425	512,425	589,289	677,682	0%	100%	0	677,682
											Subtotal - Industrial Avenue Trunk		12,824,767	14,748,482	16,960,754			1,364,501	15,596,253
											Subtotal - Pipeline Capacity Improvements		35,300,112	40,595,129	**46,684,398**			**5,901,186**	**40,783,211**
											Subtotal - Lift Station Improvements		4,813,966	5,536,061	**6,366,470**			**779,165**	**5,587,305**
											Total Improvement Costs		40,114,078	46,131,190	**53,050,868**			**6,680,352**	**46,370,517**

AKEL ENGINEERING GROUP, INC.

Notes:

6/6/2017

1. Railroad and canal/slough casings assumed at a length of 200 feet. Highway casings assumed at a length of 600 feet.
2. Unit costs based on a January 2017 ENR CCI of 10,532.
3. Baseline construction costs plus 15% to account for unforeseen events and unknown conditions.
4. Estimated construction cost plus 15% to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs.
5. Improvement 9-P3 is meant to redirect flow from Lift Station 64 to the 9th Avenue Trunk.
6. Improvement 10-P2 is meant to redirect flow from Lift Station 47 to the 9th Avenue Trunk.

CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the City of Hanford's (City) sewer system (also known as a wastewater collection system), the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

1.1 BACKGROUND

The City of Hanford is located approximately 30 miles southeast of the city of Fresno and 20 miles west of the city of Visalia (**Figure 1.1**). The City provides sewer collection services to approximately 56,000 residents, as well as commercial, industrial, and institutional establishments. The City owns, operates, and maintains the sewer collection system, which consists of gravity mains and force mains, with up to 48-inch pipe sizes, ultimately conveying the flow to the Hanford Wastewater Treatment Plant (WWTP). The WWTP has a rated treatment capacity of 8.0 million gallons per day (mgd).

In 1990, the City developed a Sewer System Master Plan that identified capacity deficiencies in the existing sewer system and recommended improvements to alleviate existing deficiencies and serve future developments in the Planned Area Boundary. Recognizing the importance of planning, developing, and financing system facilities to provide reliable sewer service to existing customers and for servicing anticipated growth, the City initiated updating elements of the 1990 Sewer System Master Plan, to reflect current land use conditions.

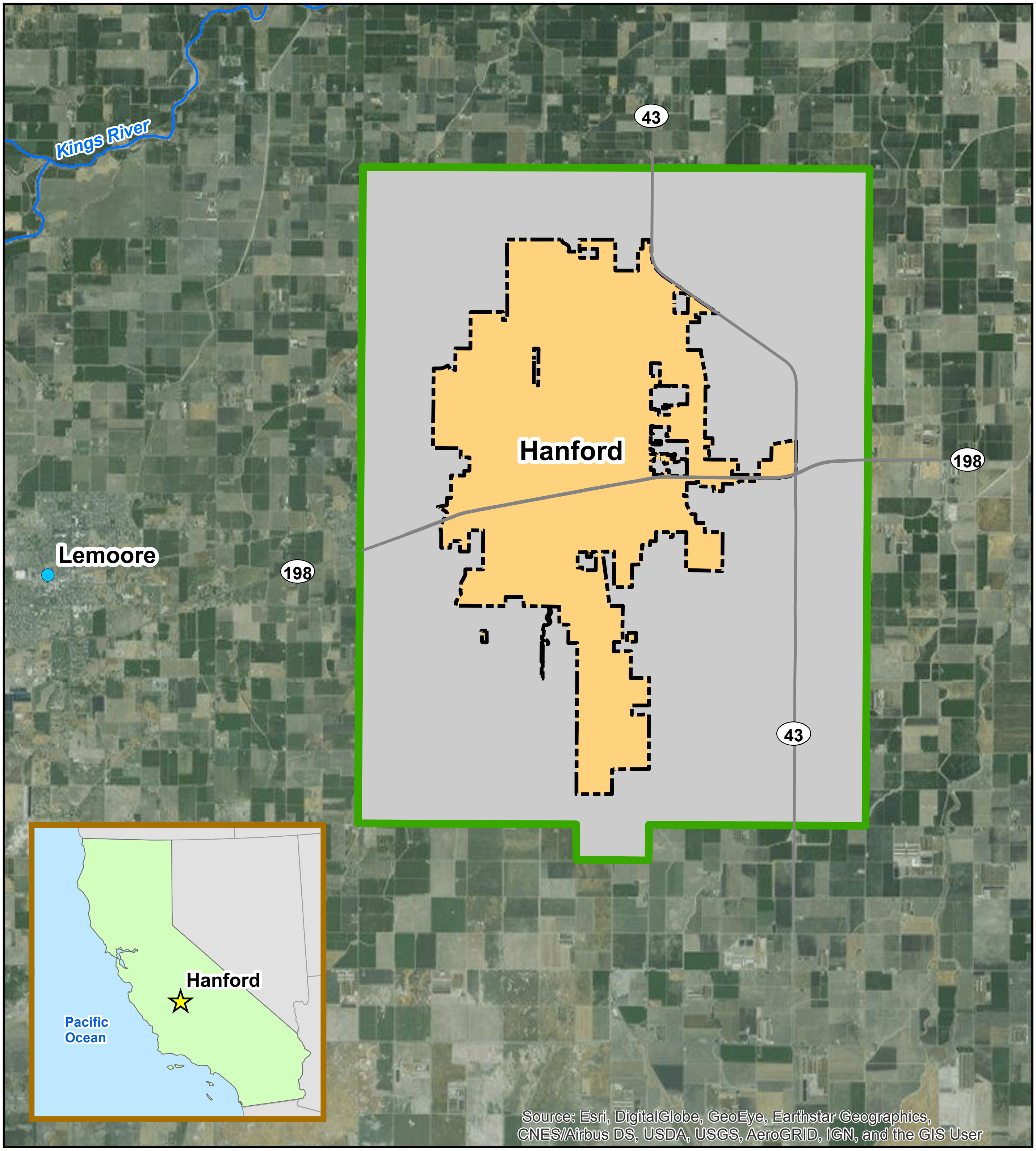
1.2 SCOPE OF WORK

City Council approved Akel Engineering Group Inc. to prepare this master plan in November of 2013. This 2017 Sewer System Master Plan (SSMP) is intended to serve as a tool for planning and phasing the construction of future sewer system facilities for the projected buildout of the City. The 2017 SSMP evaluates the City's sewer system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the City.

The Planned Area Boundary and horizon for the master plan is stipulated in the City's General Plan. Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

The City authorized Akel Engineering Group Inc. to complete the following tasks:

- Summarize the City's existing sewer system facilities.
- Document growth planning assumptions and known future developments.



Legend

- Cities
- City Limits Area
- General Plan Area
- Highways
- River

Update: January 18, 2016

0 0.5 1 2 Miles

N S E W

AKEL ENGINEERING GROUP, INC.

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Figure 1.1
Regional Location Map

Sewer System Master Plan
City of Hanford

- Summarize the sewer system performance criteria.
- Project future sewer flows.
- Update the hydraulic model using available data. Evaluate the adequacy of capacity for the sewer system facilities to meet existing and projected peak dry weather flows.
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.
- Perform a capacity allocation analysis for cost sharing purposes between existing users and future growth.
- Develop a 2017 Sewer System Master Plan Report.

1.3 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:

- Water System Master Plan
- Sewer System Master Plan
- Storm Drainage System Master Plan

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

1.4 PREVIOUS MASTER PLANS

The City's most recent sewer master plan was completed in 1990. This master plan included evaluation of servicing growth to the planning area, evaluated existing sewer flows and projected future flows and recommended phased improvements to the sewer system for a horizon year of 2010. Additionally, the 1990 master plan included the development of the hydraulic model that served as the basis for the evaluation. Improvements were recommended for servicing existing and future growth areas, and a corresponding Capital Improvement Program was developed to quantify the corresponding costs. Additionally, an Industrial Park Area Infrastructure Master Plan was developed in 1995 to account for the future industrial developments occurring in the southernmost part of the City.

1.5 RELEVANT REPORTS

The City has completed several special studies intended to evaluate localized growth. These reports were referenced and used during this capacity analysis. The following lists relevant reports that were used in the completion of this master plan, as well as a brief description of each document:

- **Sewer System Master Plan, June 1990 (1990 SSMP).** This report documents the planning and performance criteria, evaluates the sewer system, recommends improvements, and provides an estimate of costs.

- **Industrial Park Area Infrastructure Master Plan (1995 IPA Master Plan).** This report documents the infrastructure required to serve future industrial development within the study area. The study area included the area bounded to the north by Houston Avenue, to the south by Jackson Avenue, to the east by 10th Avenue and to the west by 12th Avenue.

- **City of Hanford General Plan Update, (2017 General Plan).** The City's 2017 General Plan provides future land use planning, and growth assumptions for the Planning Area. Additionally, this report establishes the planning horizon for improvements in this master plan.

1.6 REPORT ORGANIZATION

The Sewer System Master Plan report contains the following chapters:

Chapter 1 – Introduction. This chapter provides a brief background of the City of Hanford's (City) sewer system (also known as a sewer collection system), the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

Chapter 2 – Planning Area Characteristics. This chapter presents a discussion of the planning area characteristics for this master plan and includes a study area description, service area land use, and population for the City of Hanford.

Chapter 3 – System Performance and Design Criteria. This chapter presents the City's planning and design criteria, which were used in this master plan for evaluating the adequacy of capacity for the existing sewer system and for sizing improvements required to mitigate deficiencies and to accommodate future growth. The design criteria include: capacity requirements for the sewer facilities, flow calculation methodologies for future users, and flow peaking factors.

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

Chapter 5 – Sewer Flows. This chapter summarizes historical sewer flows experienced at the City's WWTP and defines flow terminologies relevant to this evaluation. This chapter discusses the wastewater flow distribution within the six collection basins, and identifies the design flows used in the hydraulic modeling effort and capacity evaluation. The design flows include the existing condition (existing customers) and the projected ultimate buildout scenario.

Chapter 6 – Hydraulic Model Development. This chapter describes the development of the City's sewer system hydraulic model. Hydraulic network analysis has become an effectively powerful tool in all aspects of sewer 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 sewer system capacity evaluation during peak dry weather flows and peak wet weather flows for the existing and buildout flows. The recommended sewer system improvements needed to mitigate capacity deficiencies are also discussed in this chapter

Chapter 8 – Capital Improvement Program. This chapter provides a summary of the recommended Capital Improvement Program (CIP) for the City's sewer system. The program is based on the evaluation of the City's sewer 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.

1.7 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, was accomplished with the strong commitment and very active input from dedicated team members including:

- Lou Camara, Director of Public Works
- John Doyel, Director of Public Utilities / City Engineer
- Darlene Mata, Community Development Director
- Mike Cosenza, Utilities Superintendent
- QK Inc, General Plan Consultant
- John Zumwalt, City of Hanford Consultant

This report was prepared in conjunction with the General Plan Update, and included coordination with QK and John Zumwalt, who were the General Plan consultants.

1.8 UNIT CONVERSIONS AND ABBREVIATIONS

Engineering units were used in reporting flow rates and volumes pertaining to the design and operation of various components of the sewer system. In some cases, different sets of units were used to describe the same parameter where it was necessary to report values in smaller or larger quantities. Values reported in one set of units can be converted to another set of units by applying a multiplication factor. A list of multiplication factors for units used in this report are shown on **Table 1.1**.

Various abbreviations and acronyms were also used in this report to represent relevant wastewater system terminologies and engineering units. A list of abbreviations and acronyms is included in **Table 1.2**.

1.9 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 calculated using the developed wastewater unit factors.
- Calculate and allocating future wastewater loads, based on the future developments land use.
- Extract ground elevations along the gravity and force mains from available contour maps.
- Generate maps and exhibits used in this master plan.

Table 1.1 Unit Conversions

Sewer System Master Plan

City of Hanford

Volume Unit Calculations		
To Convert From:	**To:**	**Multiply by:**
acre feet	gallons	325,857
acre feet	cubic feet	43,560
acre feet	million gallons	0.3259
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	646300
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

Table 1.2 Abbreviations and Acronyms

Sewer System Master Plan

City of Hanford

Abbreviation	Expansion	Abbreviation	Expansion
1990 SSMP	1990 Sewer System Master Plan	gpd	Gallons per Day
10Yr-24Hr	10-Year 24-Hour	gpm	Gallons per Minute
ADWF	Average Dry Weather Flow	HGL	Hydraulic Grade Line
AAF	Annual Average Flow	LF	Linear Feet
Akel	Akel Engineering Group, Inc.	MDDWF	Maximum Day Dry Weather Flow
AWWF	Average Wet Weather Flow	MDWWF	Maximum Day Wet Weather Flow
CCI	Construct Cost Index	mgd	Million Gallons per Day
CIP	Capital Improvement Program	MMDWF	Maximum Month Dry Weather Flow
City	City of Hanford	MMWWF	Maximum Month Wet Weather Flow
d/D	depth of flow to pipe diameter	PDWF	Peak Dry Weather Flow
ENR	Engineering News Record	ROW	Right of Way
fps	Feet per Second	WWTP	Wastewater Treatment Plant
GIS	Geographic Information Systems		

CHAPTER 2 - PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of the planning area characteristics for this master plan and includes a study area description, service area land use, and population for the City of Hanford.

2.1 STUDY AREA DESCRIPTION

The City is located in Kings County, approximately 30 miles southeast of the city of Fresno and 20 miles west of the city of Visalia (**Figure 2.1**). The City's closest neighbor, the city of Lemoore, is located 8 miles to the west. Highway 198 bisects the southern boundary of the City in the east-west direction, while Highway 43 is adjacent to the City's eastern boundary. In 2002, the City outlined the long-term Urban Growth Boundary (UGB), which was approved by City Council, and identified lands intended for future urbanization within the City service area.

The City operates and maintains a sewer system that services the majority of the area within the City Limits. Currently, the sewer flows are conveyed to the City WWTP.

2.2 PLANNING AREA BOUNDARIES

The City's 2017 General Plan update designates two boundaries for defining urban expansion:

- **Planned Area Boundary:** This boundary serves as the limits of the area to be planned for urban development.

- **2035 Growth Boundary:** This boundary serves as the limits of the area to be developed with urban uses during the 2015 to 2035 planning period.

It should be noted that for the purposes of this master plan, City Staff has requested improvements to be sized to account for the development of the Planned Area Boundary. Based on growth assumptions consistent with the 2017 General Plan Update, buildout of the Planned Area Boundary is not expected to be reached before the year 2050.

2.3 SEWER SERVICE AREAS AND LAND USE

The City's sewer system services residential and non-residential lands within the service area, as summarized on **Table 2.1**. This service area includes:

- 6,059 net acres of developed lands inside the City limits.
- 2,765 net acres of undeveloped lands inside the City limits.
- 265 net acres of underutilized lands inside the City limits that are expected to redevelop.

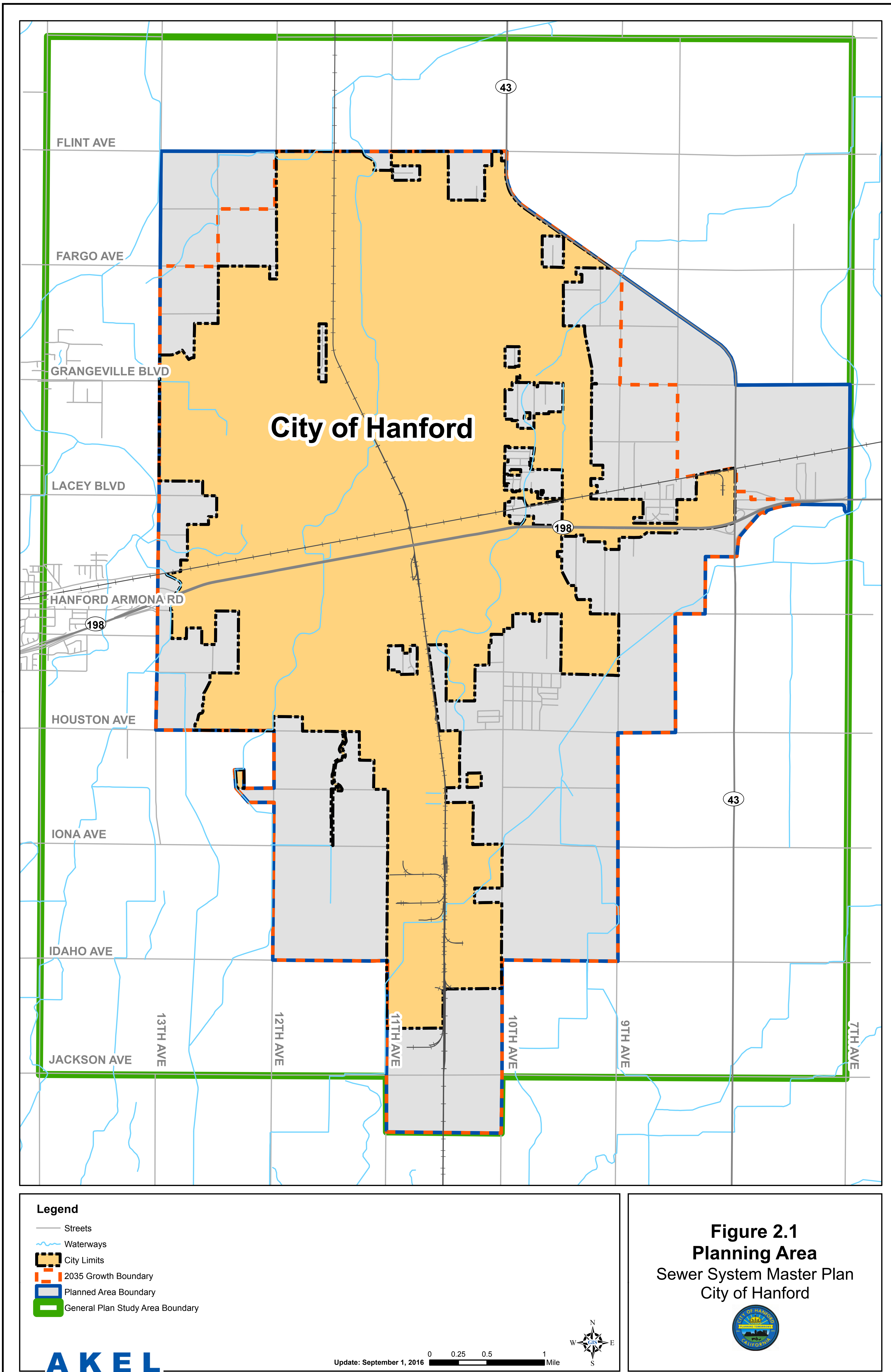

Figure 2.1
Planning Area
Sewer System Master Plan
City of Hanford

Table 2.1 Existing and Future Development
Sewer System Master Plan
City of Hanford

Land Use Classification	Existing Service Area				2035 Growth Boundary				Planned Area Boundary				Total in 2035 Growth Boundary	Total in Planned Area Boundary
	Developed (acres)	Undeveloped (acres)	Underutilized (acres)	*Subtotal* (acres)	Developed (acres)	Undeveloped (acres)	Underutilized (acres)	*Subtotal* (acres)	Developed (acres)	Undeveloped (acres)	Underutilized (acres)	*Subtotal* (acres)	(net acres)	(net acres)
Residential														
Low Density	2,837	991	35	3,863	476	790	82	1,348	63	529	0	592	5,211	5,804
Medium Density	498	220	5	723	35	215	21	271	0	72	4	76	994	1,070
High Density	84	65	8	158	0	38	0	38	0	26	0	26	196	222
Subtotal - Residential	3,419	1,276	48	4,744	511	1,043	103	1,657	63	627	4	694	6,401	7,095
Mixed Use														
Office Residential	89	20	5	114	0	0	0	0	0	0	0	0	114	114
Neighborhood Mixed Use	12	42	0	54	0	15	0	15	0	0	0	0	70	70
Corridor Mixed Use	250	139	86	476	10	3	0	13	0	0	0	0	489	489
Downtown Mixed Use	81	15	28	123	0	0	0	0	0	0	0	0	123	123
Subtotal - Mixed Use	432	216	119	767	10	18	0	29	0	0	0	0	795	795
Non-Residential														
Neighborhood Commercial	27	26	0	53	8	11	1	20	0	0	0	0	73	73
Regional Commercial	216	154	6	376	0	0	0	0	18	163	6	188	376	564
Service Commercial	103	47	7	156	56	63	0	119	0	0	0	0	275	275
Highway Commercial	48	68	0	115	16	4	12	32	0	0	0	0	147	147
Office	88	30	1	119	0	0	0	0	0	0	0	0	119	119
Light Industrial	105	20	40	166	83	520	36	640	0	0	0	0	806	806
Heavy Industrial	376	535	33	943	211	2,380	227	2,817	0	0	0	0	3,761	3,761
Airport Protection	0	125	0	125	111	501	63	674	0	0	0	0	799	799
Educational Facilities	445	110	7	562	11	17	0	28	0	80	0	80	590	669
Public Facliities	438	56	0	494	3	13	0	16	0	0	0	0	510	510
Open Space	362	105	4	471	41	159	0	200	0	17	0	17	671	688
Open Space with Irrigation	16	41	4		0	105	0		0	17	0			
Open Space without Irrigation	346	65	0		41	54	0		0	0	0			
Interest Area	0	0	0	0	0	0	0	0	49	509	43	601	0	601
Subtotal - Non-Residential	2,208	1,274	98	3,580	539	3,668	340	4,547	68	769	49	886	8,127	9,012
Total														
	6,059	2,765	265	9,090	1,060	4,729	443	6,233	131	1,396	53	1,580	**15,323**	**16,903**

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The existing land use statistics were based on the land use information developed for the recently adopted General Plan (**Appendix A**). The land use is shown graphically on **Figure 2.2**. The land use information provided included developed and undeveloped areas, which were classified into the following subtypes:

- Net Area. Net areas are typically fully developed, and exclude street and other associated right of ways.
- Gross Area. Gross areas are typically large undeveloped parcels, which may be subdivided in future developments. Part of these areas will include street and other right of ways.

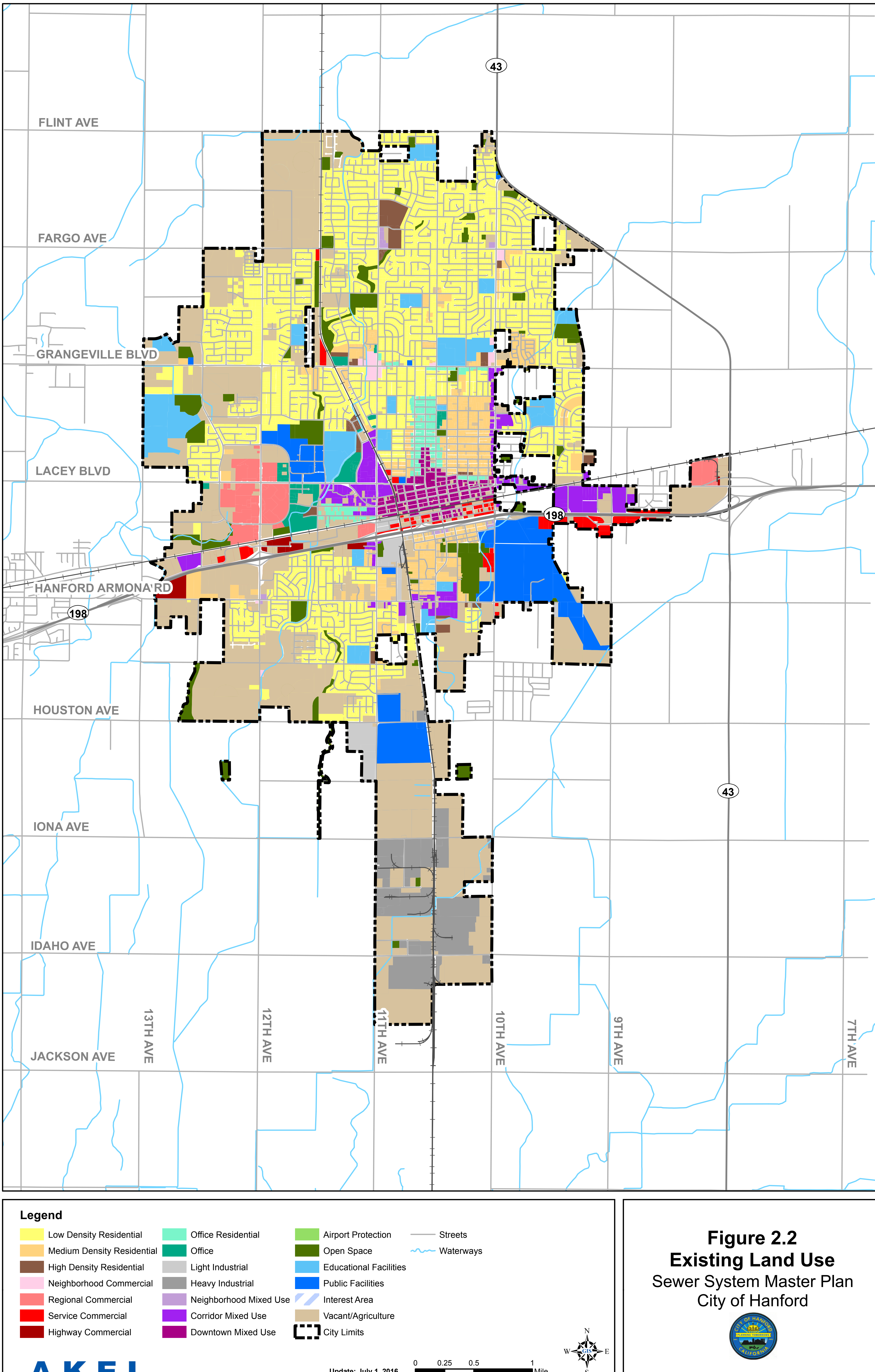
For the purpose of this master plan, net areas were used in the quantification of wastewater flows, as they represent the total acreage that contributes flows to the sewer collection system. In order to convert the areas that were identified as gross areas to net areas, the following reduction factors were applied:

- Single Family Residential land use types: 1 gross acre = 0.80 net acre
- Multi-Family Residential / Mixed Use land use types: 1 gross acre = 0.85 net acre
- Commercial / Industrial land use types: 1 gross acre = 0.90 net acre

The City's general plan anticipates approximately 16,900 net acres of residential and non-residential development at ultimate buildout of the Planned Area Boundary. The land use designations utilized in this master plan are consistent with the Land Use Element of the City's General Plan, as shown on **Figure 2.3**.

2.4 HISTORICAL AND FUTURE GROWTH

The City's historical and projected population data are presented in **Table 2.2**. The historical information was extracted from the previous master plan and California Department of Finance documents. The City's 2017 General Plan Update anticipates future growth of approximately 2.1 percent per year, which is slightly greater than historical trends approximately 2.0 percent per year. The 2017 General Plan Update is planning for a 2035 population of 90,000. **Table 2.2** documents the historical population from 2010 to 2015 and the projected population by year to the buildout master plan horizon of 2050. This horizon reflects the buildout of the Planned Area Boundary.



Update: July 1, 2016

Figure 2.2
Existing Land Use
Sewer System Master Plan
City of Hanford

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Hanford\2016\Sewer\Final\HC\HF_Fig2-2_ExistLandUse_070116.mxd

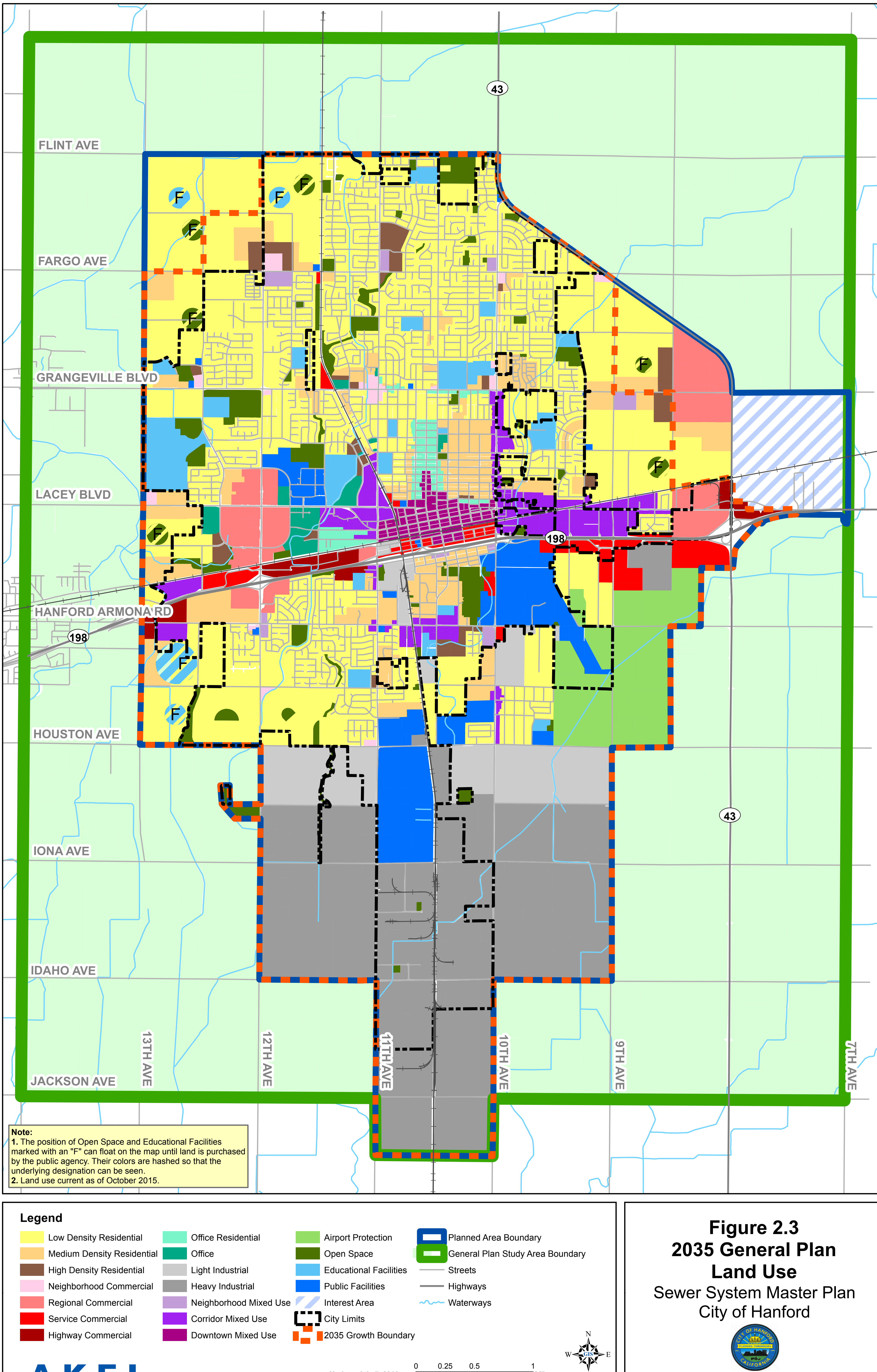


Figure 2.3
2035 General Plan Land Use
Sewer System Master Plan
City of Hanford

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Table 2.2 Historical and Projected Population

Sewer System Master Plan

City of Hanford

Year	Population	Annual Growth(%)
Historical		
2010	53,967	-
2011	54,146	0.3%
2012	54,541	0.7%
2013	54,513	-0.1%
2014	54,727	0.4%
2015	55,337	1.1%
Projected		
2016	57,070	3.1%
2017	58,803	3.0%
2018	60,536	2.9%
2019	62,270	2.9%
2020	64,003	2.8%
2021	65,736	2.7%
2022	67,469	2.6%
2023	69,202	2.6%
2024	70,935	2.5%
2025	72,669	2.4%
2026	74,402	2.4%
2027	76,135	2.3%
2028	77,868	2.3%
2029	79,601	2.2%
2030	81,334	2.2%
2031	83,067	2.1%
2032	84,801	2.1%
2033	86,534	2.0%
2034	88,267	2.0%
2035	**90,000**	2.0%
2036	91,890	2.1%
2037	93,820	2.1%
2038	95,790	2.1%
2039	97,801	2.1%
2040	99,855	2.1%
2041	101,952	2.1%
2042	104,093	2.1%
2043	106,279	2.1%
2044	108,511	2.1%
2045	110,790	2.1%
2046	113,116	2.1%
2047	115,492	2.1%
2048	117,917	2.1%
2049	120,393	2.1%
2050	**122,922**	2.1%

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10/26/2016

Note :

1. 2035 population based on 2016 General Plan buildout population of 90,000.

CHAPTER 3 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the City's performance and design criteria, which were used in this master plan for evaluating the adequacy of capacity for the existing sewer system and for sizing improvements required to mitigate deficiencies and to accommodate future growth. The design criteria include: capacity requirements for the sewer facilities, flow calculation methodologies for future users, and flow peaking factors.

3.1 HYDRAULIC CAPACITY CRITERIA

In addition to applying the City design standards for evaluating hydraulic capacities; this master plan included hydraulic modeling. The 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 sewer system, InfoSewer by Innovyze Inc., utilizes the Muskingum-Cunge technique for analyzing unsteady open channel flow. Pressurized pipe in the hydraulic model is assumed to flow full for the entirety of the pipe, so as to utilize the energy equation.

Manning's Equation for Pipe Capacity

The Continuity equation and the Manning 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: $Q = V A$

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

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

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 City's design standards pertaining to the d/D criteria are summarized in **Table 3.1**. During peak dry weather flows (PDWF), the maximum allowable d/D ratio for proposed pipes smaller than 18 inches is 0.5, and for all proposed pipes larger than 18 inches, 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 pipes improvements are required.

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, velocity of half-full flows approaches the velocity of nearly full flows.

Changes in Pipe Size

When a smaller gravity sewer pipe joins a larger pipe, the invert of the larger pipe is generally 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.

Table 3.1 Planning and Design Criteria
Sewer System Master Plan
City of Hanford

Pipeline Criteria		
Peak Dry Weather Flow Criteria		
Diameter	**Maximum Allowable d/D**	
(in)	**Existing Trunks**	**Proposed Trunks**
< 18	**0.92**	**0.50**
≥ 18	**0.92**	**0.75**

Peak Flow Estimation

$Q_{peak} = 1.80 \times Q_{avg}^{0.92}$ (cubic feet per second, cfs units)

$Q_{peak} = 1.74 \times Q_{avg}^{0.92}$ (million gallons per day, mgd units)

Unit Flow Factor Criteria	
Land Use Classification	**Unit Flow Factor**
	(gpd/acre)
Residential	
Low Density Residential	790
Medium Density Residential	1,350
High Density Residential	2,450
Mixed Use	
Office Residential	1,650
Neighborhood Mixed Use	1,250
Corridor Mixed Use	900
Downtown Mixed Use	2,950
Non-Residential	
Neighborhood Commercial	640
Regional Commercial	790
Service Commercial	520
Highway Commercial	640
Office	1,030
Public Facilities	520
Light Industrial	590
Heavy Industrial	680
Educational Facilities	800

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.

The minimum recommended velocity in force mains is at 2 feet per second. 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. C-Factors were based on the previous hydraulic model.

The capacities of pump stations are evaluated and designed to meet the peak wet weather flows 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

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

3.2.1 Unit Flow Factors Methodology

Sewer unit factors are developed by using water consumption records and applying a return to sewer ratio for each land use to estimate sewer flow coefficients. There are several methods for developing the unit factors. This analysis relied on the use of the City’s 2013 water consumption billing records, which lists the monthly water consumption per customer account throughout the City, to estimate the unit factors within the service area.

3.2.2 Average Daily Sewer Unit Flow Factors

A return to sewer ratio was applied to each unadjusted water demand factor for individual land uses, and sewer flows were balanced to wastewater treatment plant flows. Generally, non-residential land uses return the majority of the water demand to the sewer system. These unit factors were estimated at 80-90 percent return to sewer ratio. The same concept can be applied to multi-family residential lots, which were estimated at a 70-75 percent return to sewer ratio. Single family residential lots often have the lowest return to sewer ratio. This is largely due to water lost for landscape irrigation. Single family lots were estimated between 35 and 65 percent return to sewer ratio. Lastly, unit factors were adjusted to 100 percent occupancy, and rounded.

This analysis generally indicates that existing residential land uses have higher flow generation factors than that of non-residential land uses. The existing unit factor analysis is shown on **Table 3.2**.

It should be noted that additional water conservation is expected for residential land uses with the completion and implementation of water metering. Water conservation was taken into account for residential land uses and the future water demand unit factors were decreased accordingly in the water system master plan. Anticipated increases in land use densities, as identified in the General Plan, are assumed to be offset by future water conservation efforts.

While the impact of water conservation may have some impact on residential flow generation, it is not expected to reduce flows significantly, as most of the conservation is expected to be realized in landscape irrigation. Therefore, minimal adjustments were made to future residential unit factors. Existing non-residential factors were slightly lower than normal and were adjusted for future scenarios to apply a level of conservancy when projecting future sewer flows. **Table 3.3** shows the 2013 sewer flow factors as well as the ones used for estimating flows from future developments within the Planned Area Boundary.

3.2.3 Peaking Equations

The sewer system is evaluated based on its ability to convey peak sewer flows. Peaking factors represent the increase in sewer 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.

Typical values for peaking factors of 2.0 are generally used to estimate peak flows at treatment facilities where flow fluctuations are attenuated during the time of travel in the sewer, 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 City's 1990 SSMP included a peaking factor curve for dry weather flows, which is summarized below:

- $Q_{peak} = 1.80 \times Q_{avg}^{0.92}$ (cubic feet per second, cfs units)
- $Q_{peak} = 1.74 \times Q_{avg}^{0.92}$ (million gallons per day, mgd units)

This master plan used the same peaking factor equations as included in the 1990 SSMP, which are also summarized on **Table 3.1**.

Table 3.2 Sewer Flow Unit Factor Analysis

Sewer System Master Plan
City of Hanford

Land Use Classification	Existing Development within Service Area	2013 Average Daily Water Demand Unit Factors										2013 Average Daily Wastewater Flow Unit Factors						
		2013 Consumption			2013 Production		2013 Production at 100% Occupancy			2013 Water Unit Factor		Return to Sewer Ratio	2013 Wastewater Flows		2013 Wastewater Flows at 100% Occupancy		2013 Recommended Wastewater Unit Factor	
		Annual Consumption	Unadjusted Water Unit Factors	Balance to 2013 Consumption	Unaccounted-For-Water Rate[5]	Production (w/o Vacancy Rate)	Vacancy Rate[1]	Projected Production at 100% Occupancy		Recommended Factor	Balance Using Recommended Unit Factor		Unadjusted Wastewater Unit Factor	Balance to Existing Condidions	Projected Flows at 100% Occupancy		Recommended Wastewater Unit Factor	Balance Using Recommended Unit Factor
	(net acres)	(gpd)	(gpd/net acres)	(gpd)	(%)	(gpd)	(%)	(gpd/net acres)	(gpd)	(gpd/net acres)	(gpd)		(gpd/net acres)	(gpd)	(gpd/net acres)	(gpd)		
Residential																		
Low Density	2,837	6,314,534	2,226	6,314,534	2.1%	6,451,640	8.6%	2,325	7,058,687	2,325	7,058,687	0.35	722	2,264,067	790	2,477,098	790	2,477,098
Medium Density	498	734,868	1,476	734,868	2.1%	750,824	8.6%	2,750	821,471	2,750	821,471	0.50	1,234	245,724	1,350	268,845	1,350	268,845
High Density	84	287,248	3,399	287,248	2.1%	293,485	8.6%	3,800	321,100	3,800	321,100	0.65	2,239	189,221	2,450	207,025	2,450	207,025
Subtotal Residential	3,419	7,336,650		7,336,650		7,495,949			8,201,258		8,201,258			2,699,012		2,952,968		2,952,968
Mixed use																		
Office Residential	89	175,813	1,981	175,813	2.1%	179,630	8.0%	2,200	195,250	2,200	195,250	0.75	1,518	134,723	1,650	146,438	1,650	146,438
Neighborhood Mixed Use	12	19,787	1,598	19,787	2.1%	20,217	8.0%	1,775	21,975	1,775	21,975	0.70	1,150	14,237	1,250	15,475	1,250	15,475
Corridor Mixed Use	250	293,162	1,171	293,162	2.1%	299,527	8.0%	1,300	325,573	1,300	325,573	0.70	828	207,365	900	225,397	900	225,397
Downtown Mixed Use	81	304,555	3,782	304,555	2.1%	311,168	8.0%	4,200	338,226	4,200	338,226	0.70	2,714	218,558	2,950	237,564	2,950	237,564
Subtotal Mixed Use	432	793,317	1,836	793,317		810,542			881,024		881,024			574,883		624,873		624,873
Non-Residential																		
Neighborhood Commercial	27	19,522	720	19,522	2.1%	19,946	8.0%	800	21,680	800	21,680	0.90	644	17,452	700	18,970	700	18,970
Regional Commercial	216	194,724	900	194,724	2.1%	198,952	8.0%	1,000	216,252	1,000	216,252	0.90	828	179,057	900	194,627	900	194,627
Service Commercial	103	59,992	585	59,992	2.1%	61,295	8.0%	650	66,625	650	66,625	0.90	552	56,580	600	61,500	600	61,500
Highway Commercial	48	34,289	720	34,289	2.1%	35,034	8.0%	800	38,080	800	38,080	0.90	644	30,654	700	33,320	700	33,320
Office	88	103,257	1,171	103,257	2.1%	105,499	8.0%	1,300	114,673	1,300	114,673	0.80	966	85,211	1,050	92,621	1,050	92,621
Light Industrial	105	71,086	675	71,086	2.1%	72,629	8.0%	750	78,945	750	78,945	0.90	644	67,787	700	73,682	700	73,682
Heavy Industrial	376	287,531	765	287,531	2.1%	293,774	8.0%	850	319,320	850	319,320	0.90	690	259,212	750	281,753	750	281,753
Airport Protection	0	0	0	0	2.1%	0	0.0%	0	0	0	0	0.00	0	0	0	0	0	0
Educational Facilities	445	801,976	1,801	801,976	2.1%	819,389	8.0%	2,000	890,640	2,000	890,640	0.40	736	327,756	800	356,256	800	356,256
Public Facilities	438	256,416	585	256,416	2.1%	261,984	8.0%	650	284,765	650	284,765	0.80	460	201,526	500	219,050	500	219,050
Open Space	346	838,854	2,422	838,854	2.1%	857,068	0.0%	3,300	857,068	3,300	857,068	0.00	0	0	0	0	0	0
Interest Area	0	0	0	0	2.1%	0	0.0%	0	0	0	0	0.00	0	0	0	0	0	0
Subtotal Non-Residential	2,192	2,573,365		2,667,647		2,725,569			2,888,047		2,888,047			1,225,236		1,331,778		1,331,778
	6,044	10,703,332		10,797,614		**11,032,060**			11,970,329		**11,970,329**			4,499,131		4,909,618		**4,909,618**

2/18/2016

Notes:
1. Residential vacancy rate extracted from 2013 United States Census American Community Survey Data

Table 3.3 Unit Average Daily Sewer Flow Factors

Sewer System Master Plan

City of Hanford

Land Use Designation	Sewer Existing (gpd/net acre)	Sewer Future (gpd/net acre)
Residential		
Low Density Residential	790	790
Medium Density Residential	1,350	1,350
High Density Residential	2,450	2,450
Mixed Use		
Office Residential	1,650	1,650
Neighborhood Mixed Use	1,250	1,250
Corridor Mixed Use	900	900
Downtown Mixed Use	2,950	2,950
Non-Residential		
Neighborhood Commercial	700	640
Regional Commercial	900	790
Service Commercial	600	520
Highway Commercial	700	640
Office	1,050	1,030
Public Facilities	500	520
Light Industrial	700	590
Heavy Industrial	750	680
Educational Facilities	800	800
Non-Flow Generating		
Open Space	0	0
Airport Protection	0	0

CHAPTER 4 - EXISTING SEWER COLLECTION FACILITIES

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

4.1 SEWER COLLECTION SYSTEM OVERVIEW

The City is located approximately 30 miles southeast of the city of Fresno and 20 miles west of the city of Visalia (**Figure 1.1**). The City provides sewer collection services to approximately 56,000 residents, as well as commercial, industrial, and institutional establishments. The City owns, operates, and maintains the sewer collection system (**Figure 4.1**), which consists of gravity and force mains, with pipes up to 48-inches in size ultimately conveying the flow to the Hanford Wastewater Treatment Plant (WWTP).

The City's WWTP has a rated treatment capacity of 8.0 million gallons per day (mgd). A modeled pipe inventory, listing the total length by pipe diameter, is shown on **Table 4.1**. This table is based on information extracted from the drawings and the atlas map provided by City staff. The 10-inch and 12-inch diameter modeled pipes account for 43 percent of the total sewer pipe lengths.

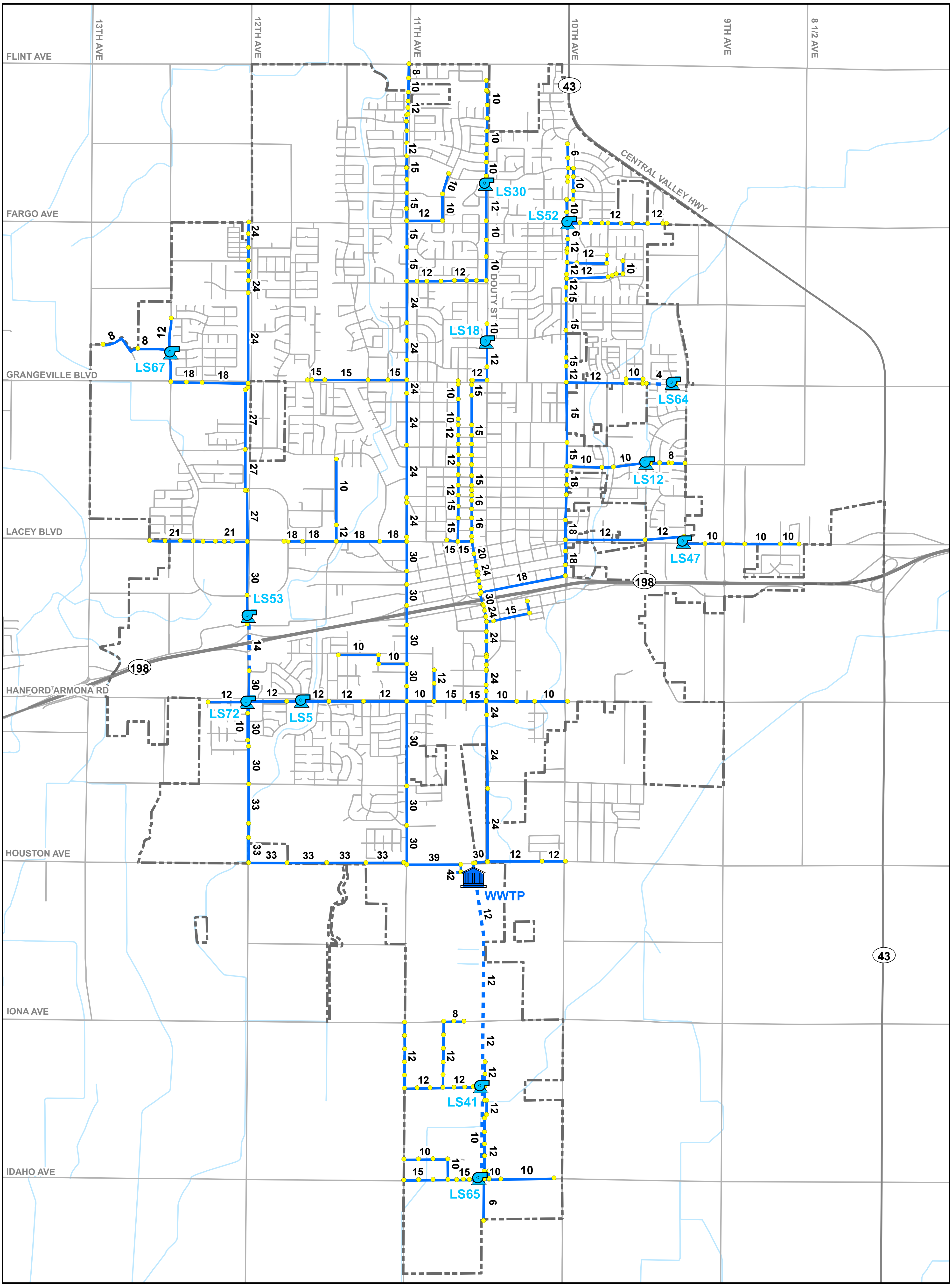
4.2 SEWER COLLECTION BASINS AND TRUNKS

Based on the City's topography, the sewer system is divided into six separate dendritic sewer collection basins, each defining the boundaries of a sewer collection trunk system. The following six major wastewater collection basins were created and shown on **Figure 4.2**: 10th Avenue, 10 ½ Avenue, 11th Avenue, 12th Avenue, Industrial Area, and Irwin Street. The sewer trunk system for each collection basin is shown on **Figure 4.3**, and a schematic diagram intended to simplify the connectivity between the basins and trunks is shown on **Figure 4.4**.

4.2.1 10th Avenue Collection Basin

The 10th Avenue Collection Basin encompasses 3,023 acres in the northeast portion of the City. This basin includes the areas generally north of Highway 198 between Douty Street and Highway 43. This basin collects flows along 10th Avenue, starting at Encore Drive, where a 10-inch trunk conveys flow south to Lift Station 52, at the Fargo Avenue. Flows are pumped through a 6-inch force main to a 12-inch trunk beginning at Birch Avenue, where flow continues south to Lakewood Drive, where it continues as a 15-inch south to Florinda Street.

At Florinda Street, the 15-inch trunk increases in size to an 18-inch trunk and continues along 10th Avenue to Fourth Street, where it turns west and continues on Fourth Street before joining the 30-inch trunk in Irwin Street.



Legend

Existing System

- WWTP
- Lift Stations
- Manholes
- Gravity Mains
- Force Mains
- City Limits
- Streets
- Highways
- Waterways

Figure 4.1
Existing Modeled Sewer System
Sewer System Master Plan
City of Hanford

0 0.25 0.5 1 Mile

Update: October 27, 2016

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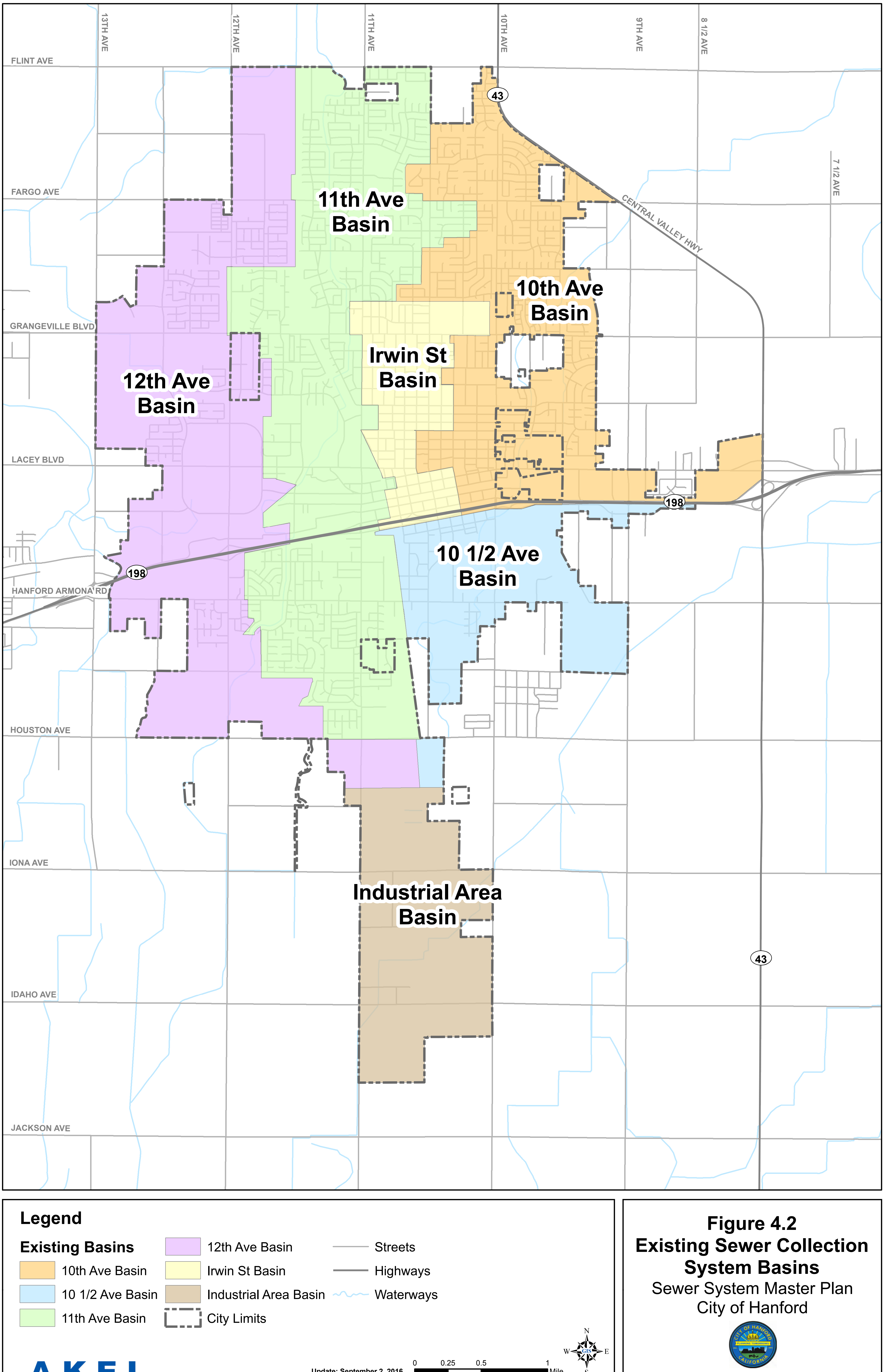
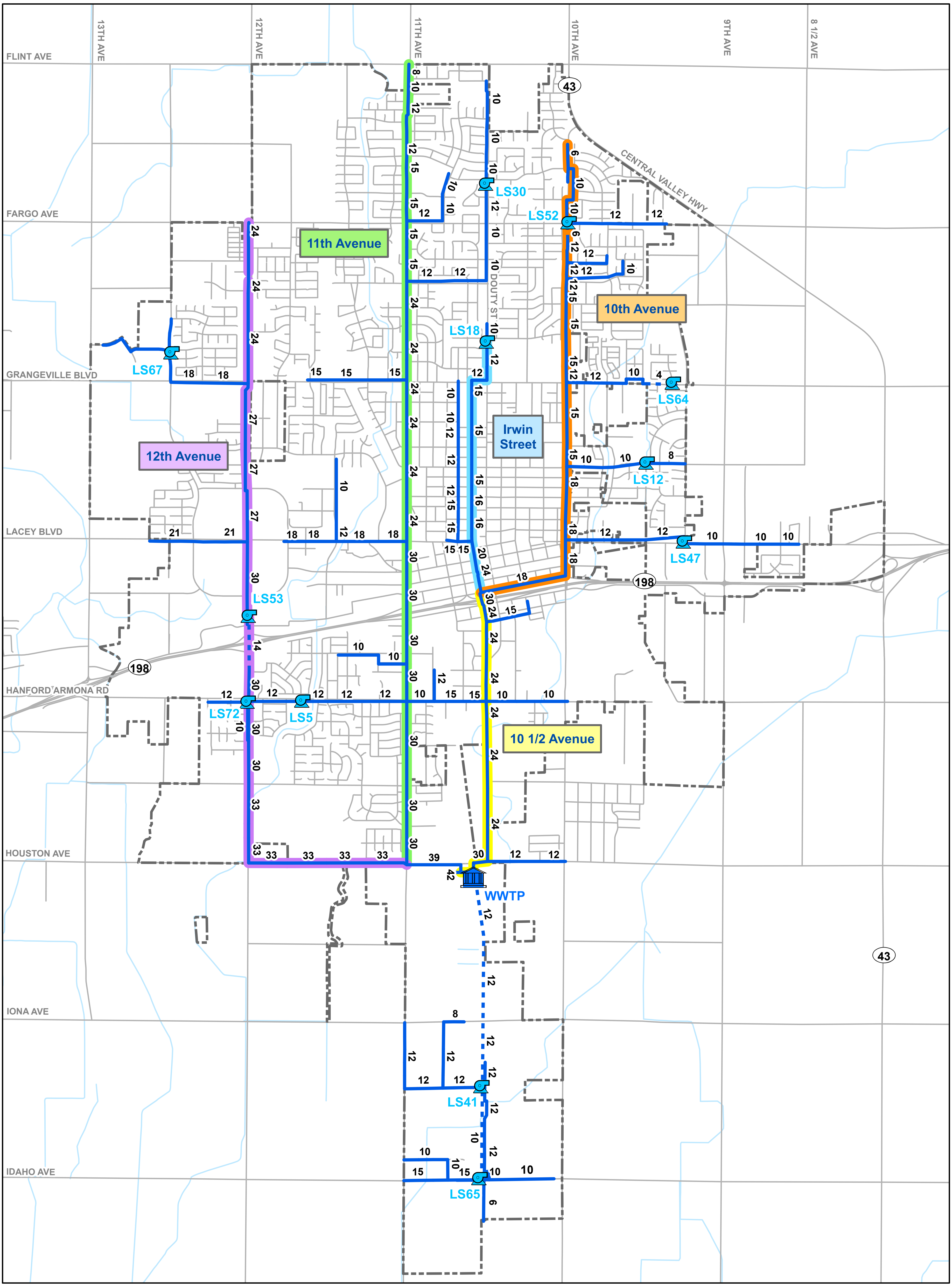


Figure 4.2
Existing Sewer Collection System Basins
Sewer System Master Plan
City of Hanford



Legend

Existing System

- WWTP
- Lift Stations
- Gravity Mains
- Force Mains

Sewer Collection Trunks

- 10th Avenue
- 10 1/2 Avenue
- 11th Avenue
- 12th Avenue
- Irwin Street

- City Limits
- Streets
- Highways
- Waterways

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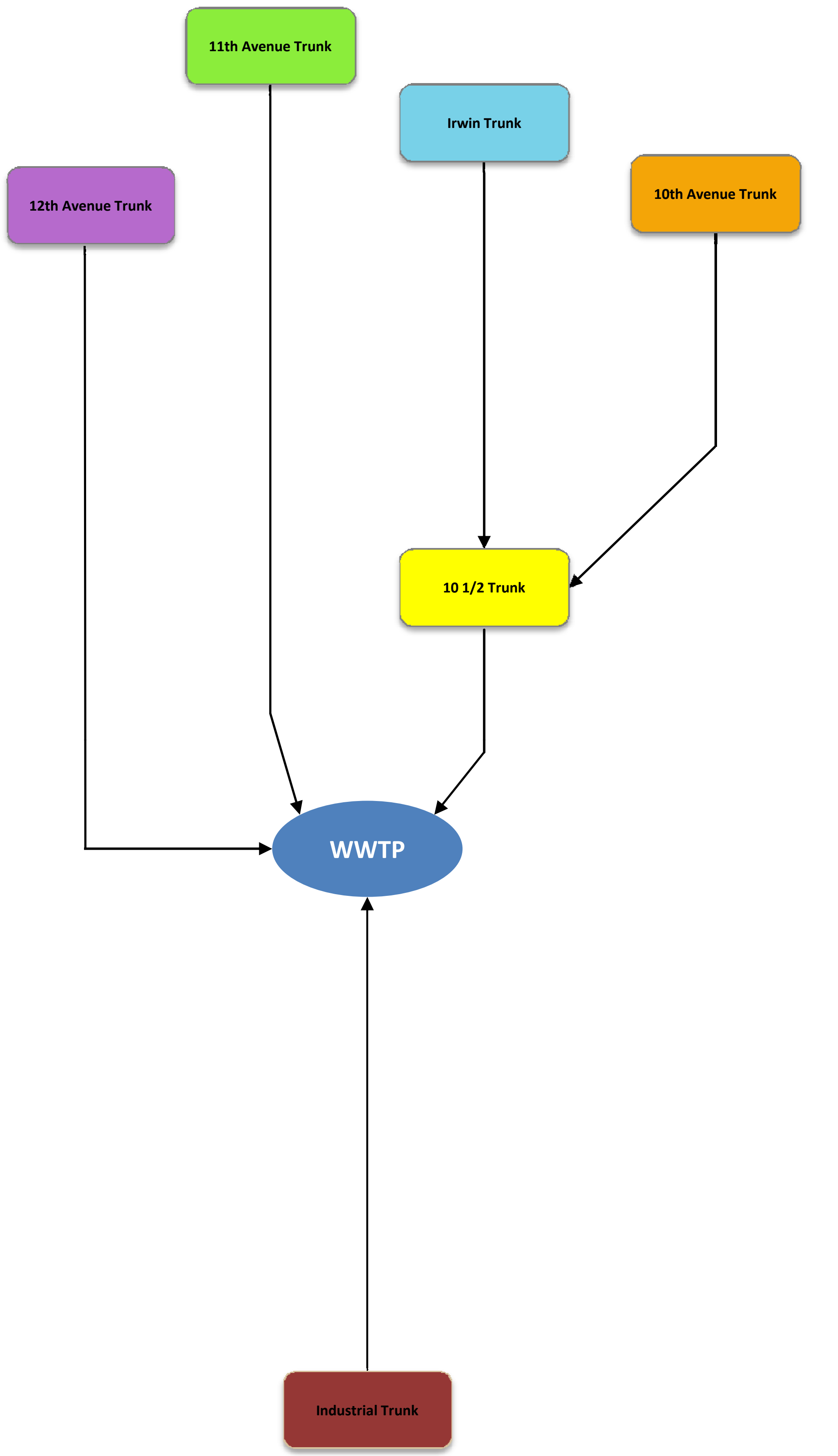
Update: June 13, 2017

0 0.25 0.5 1 Mile

File Path: P:\xGIS\GIS_Projects\Hanford\2016\Sewer\Final\HC\HF_Fig4-3_ExistModTrunkSys_061317.mxd

Figure 4.3
Existing Modeled Trunk System

Sewer System Master Plan
City of Hanford



LEGEND

10th Avenue Basin

10 1/2 Basin

11th Avenue Basin

12th Avenue Basin

Irwin Street Basin

Industrial Area Basin

June 8, 2016

Figure 4.4

Sewer Basin and Trunk Connectivity

Sewer System Master Plan

City of Hanford

AKEL ENGINEERING GROUP, INC.

Table 4.1 Modeled Existing Pipe Inventory

Sewer System Master Plan

City of Hanford

Size (in)	Length (ft)	Length (mi)
Force Mains		
4	841	0.16
6	543	0.10
10	3,119	0.59
12	7,476	1.42
14	1,800	0.34
Total	**13,779**	**2.61**
Gravity Mains		
6	2,999	0.57
8	5,157	0.98
10	34,179	6.47
12	51,840	9.82
14	160	0.03
15	25,335	4.80
16	1,544	0.29
18	14,148	2.68
20	820	0.16
21	3,262	0.62
24	23,647	4.48
27	5,389	1.02
30	18,450	3.49
33	7,928	1.50
36	424	0.08
39	1,806	0.34
42	743	0.14
48	359	0.07
Total	**198,190**	**37.5**

4.2.2 10 ½ Avenue Collection Basin

The 10 ½ Avenue Collection Basin encompasses 2,954 acres in the east-central part of the City. This basin collects flows generally east of 10 ½ Avenue, between Highway 198 and Houston Avenue. The main trunk begins at the intersection of 4th Street and Irwin Street, where a 30-inch trunk crossing Highway 198 conveys flow south to a 24-inch trunk at Third Street.

This pipe continues south along 10 ½ Avenue until reaching Houston Avenue where it connects a 30-inch trunk. This 30-inch trunk then conveys flow west along Houston Avenue and increasing in size to a 36-inch. The 36-inch trunk then increases to a 48-inch diameter trunk at the WWTP property prior to discharge at the headworks.

4.2.3 11th Avenue Collection Basin

The 11th Avenue Collection Basin encompasses 3,243 acres in central and north-central Hanford. This basin collects flow generally between 12th Avenue and 10th Avenue, starting at Flint Avenue and conveying flow south to Houston Avenue.

Starting at Flint Avenue, flow is collected along 11th Avenue in 8-inch, 10-inch, and 12-inch pipelines before entering a 15-inch at Pepper Drive. Flow continues south in a 15-inch pipeline before increasing in size to a 24-inch trunk at Cortner Street. Flow continues south along 11th Avenue before increasing in size to a 30-inch trunk at Lacey Boulevard, where it continues until joining a 39-inch trunk at Houston Avenue, where it continues to the WWTP.

4.2.4 12th Avenue Collection Basin

The 12th Avenue Collection Basin encompasses 4,218 acres in the western part of the City. This basin collects flows generally between 13th Avenue and 12th Avenue, starting at Fargo Avenue and continuing south until the City WWTP.

Starting at Fargo Avenue flow is collected along a 12th Avenue in a 24-inch trunk before increasing in size to a 27-inch trunk at Grangeville Boulevard. Flow continues in a 27-inch trunk south along 12th Avenue until increasing in size to a 30-inch trunk at Lacey Boulevard, where it continues to Lift Station 53 at Glendale Avenue. Flows are pumped through a 14-inch force main to Hayden Avenue, where it transitions to gravity flow in a 30-inch trunk and continues south to Hume Avenue. From Hume Avenue, flows continue south along 12th Avenue in a 33-inch trunk before turning west at Houston Avenue, where it continues to 11th Avenue. At 11th Avenue, the trunk diameter increases in size to a 39-inch, before continuing to the WWTP.

4.2.5 Irwin Collection Basin

The Irwin Collection Basin encompasses 670 acres in the central portion of the City. It is bound to the north by Terrace Drive and to the south by Third Street. The basin is generally bound to the east and west by 10th Avenue and 11th Avenue respectively.

Starting at Terrace Drive flow is collected in a 12-inch trunk before increasing in size to a 15-inch trunk at Grangeville Boulevard. Flow continues south along Irwin Street in a 16-inch trunk at Ivy Street, which continues south to Lacey Boulevard. At Lacey Boulevard, the trunk diameter increases to a 20-inch for a short distance, before once again increasing in size to a 24-inch trunk north of Sixth Street. Flows continue south and combine with the 10 ½ Avenue collection basin at Fourth Street.

4.2.6 Industrial Area Collection Basin

The Industrial Area Collection Basin encompasses 4,131 acres in the southern portion of the City. This basin is bound to the north by Houston Avenue and to the south by Jackson Avenue respectively. 12th Avenue and 9th Avenue serve as the western and eastern limits of this basin.

Flows are generally conveyed by gravity along Idaho Avenue in 8-inch, 10-inch, and 15-inch gravity trunks before being conveyed to Lift Station 65, where they are pumped through a 10-inch force main to Lift Station 41. Additional flows are collected along Industry Avenue and BNSF railway and conveyed by gravity in 10-inch, 12-inch, and 15-inch trunks to Lift Station 41. Flows from tributary to Lift Station 41 and pumped from Lift Station 65 are combined at Lift Station 41, where they are pumped through a 12-inch force main to the WWTP.

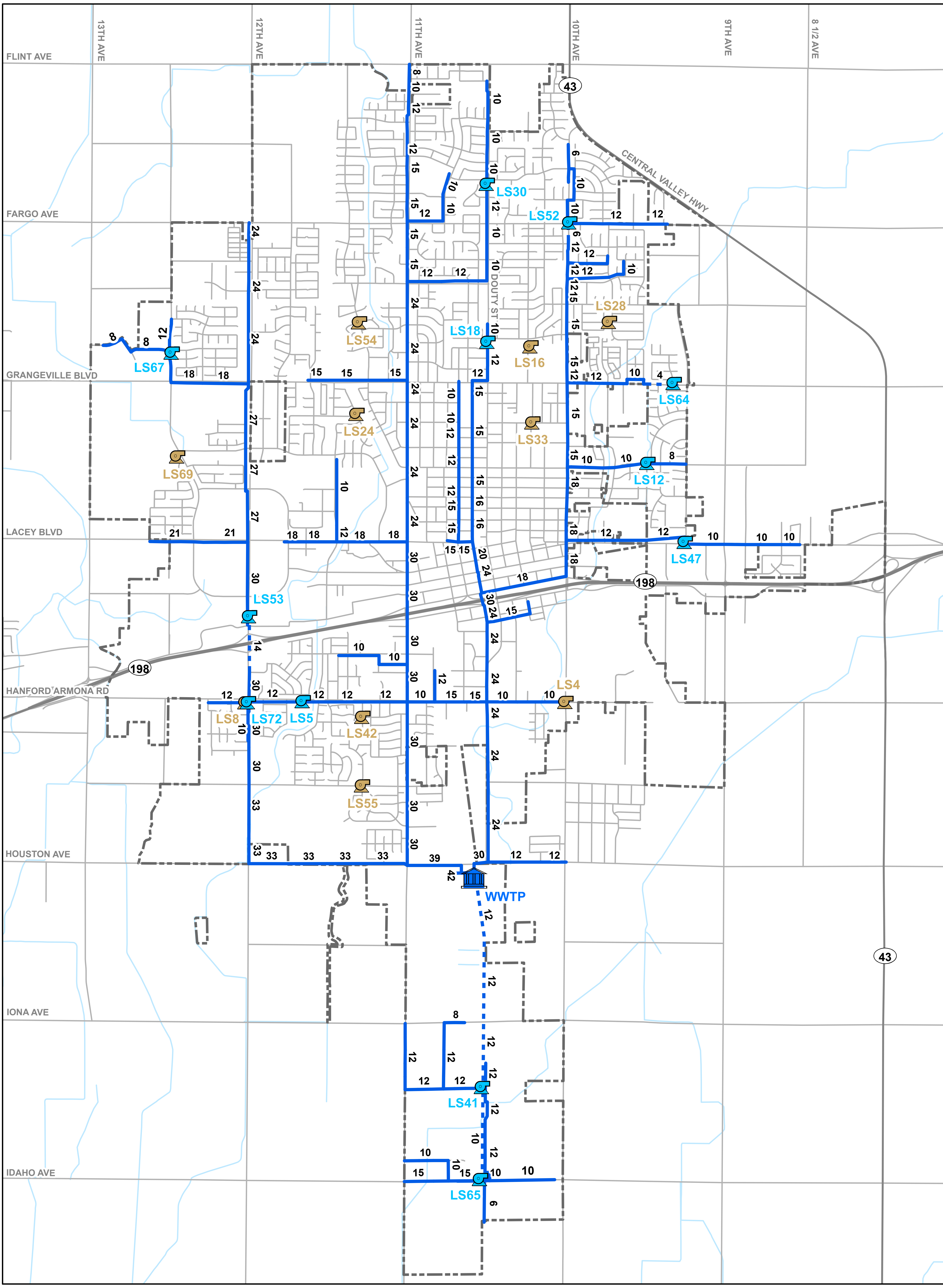
4.3 LIFT STATIONS

When routing flows by gravity is not possible due to adverse grades, lift stations are used to pump flows to a point where gravity conveyance is once again feasible. The City currently maintains 21 lift stations in the sewer collection system, as summarized on **Table 4.2** and shown on **Figure 4.5**.

Table 4.2 lists each lift station with relevant information obtained from the City's records including: location, year built, type, number of pumps, and horse power if data was provided. The lift stations are operated to turn "on" or "off" based on the levels in their wet wells.

The hydraulic model included 12 lift stations and an individual capacity evaluation was included along with the hydraulic modeling effort. The following lift stations were modeled:

- **Lift Station 5.** This lift station services the area along Hanford Armona Road between Bengston Avenue and 12th Avenue. The lift station is located near the intersection of Hanford Armona Road and Bengston Avenue and was built in 1960. The lift station has a firm capacity of 350 gpm and a total capacity of 700 gpm. The pump discharges into a 4-inch force main that conveys flow along Hanford Armona Road before discharging into a 12-inch gravity trunk west of Manor Avenue.



Legend

Existing System

- WWTP
- Modeled Lift Stations
- Non-Modeled Lift Stations
- Gravity Mains
- Force Mains
- City Limits
- Streets
- Highways
- Waterways

Figure 4.5
Existing Lift Stations

Sewer System Master Plan
City of Hanford

AKEL ENGINEERING GROUP, INC.

Update: October 26, 2016

0 0.25 0.5 1 Mile

File Path: P:\xGIS\GIS_Projects\Hanford\2016\Sewer\Final\HC\HF_Fig4-5_ExistLiftStations_102616.mxd

Table 4.2 Lift Station Inventory

Sewer System Master Plan
City of Hanford

Pump Station No.	Date Installed	Location	Bypass	Pit Depth (ft)	Pump Make	Firm Capacity (gpm)	Total Capacity	Motor HP	Volts	Phase	Generator Connect	Portable Connect	SCADA	Comments
Modeled Lift Stations														
5	1960	Hanford Armona Rd. and Bengston Ave.	Yes	16.1	F.M. 4"	350	700	3	230	3	Yes	No	Yes	Dry well bypass too high
12	1961	Florinda St. and Lassen Dr.	No	19.3	F.M. 4"	350	700	3	230	3	Yes	No	Yes	Dry well
18	1953	Douty St. south of Terrace St.	Yes	16.5	F.M. 4"	415	830	3	230	3	No	No	Yes	Dry well
30	1962	Douty St. and Encore Dr.	No	19.9	F.M. 4"	350	700	3	230	3	Yes	No	Yes	Dry well
41 [1,2]	2017	Industry Ave. east of Crown St.			HOMA AMX 434	550	1100							Wet pit
47	1985	310 N. 9 1/4 Ave.	No	23.8	Hydromatic	375	750	3	230	3	Yes	Yes	Yes	Wet pit upgraded to 3 ph Nov. 2001
52	1990	Fargo Ave. and 10th Ave.	No	22.3	Paco	425	850	10	230	3	Yes	No	Yes	Wet pit
53 [1,2]	2017	East side of 12th Ave. between Hwy 198 and Mall Dr.				1000	1500	20						Wet pit
64	2000	Grangeville Blvd. and Brookhollow Dr.	No	16.5	Myers sub	110	250		230	3	No	No	No	Wet pit - #1-110 grinder & #2-140 gpm
65	2002	10510 Idaho Ave.	No	25.0	Flygt sub	2170	3250	30	480	3	Yes	Yes	No	Wet pit - 1085 gpm
67	2004	1875 Centennial and W. Berkshire Ln.	No	27.6	Flygt sub	350	700	7.5	480	3	No	Yes	No	Wet pit - Impellers upgraded from "C" to "N" 11/2010 due to SHAPE Inc. error
72	2008	1716 Hanford Armona Rd.	No	26.0	Flygt sub	1000	2000	10	230	3	No	Yes	Yes	Wet pit
Non-Modeled Lift Stations														
4	1955	710 E. Hanford Armona Rd. & northeast corner of 10th Ave.	No	14.5	F.M. 350	350	350	1.5	230	3	Yes	No	Yes	Wet pit
8 [3]	1962	Hanford Armona Rd. and 12th Ave.	No	17.3	F.M. 4"	350		3						
16	1959	Kensington Way	Yes	15.5	F.M. 4"	350	350	3	230	3	No	No	Yes	Dry well
24	1961	Williams St. and Malone St.	Yes	15.2	F.M. 4"	350	700	3	230	3	No	No	Yes	Dry well
28	1962	903 E. Moffat @ 125' west of Neil Way	Yes	16.0	F.M. 4"	350	700	3	230	3	No	No	Yes	Dry well
33	1964	Malone St. and Green St.	Yes	16.8	F.M. 4"	220	220	3	230	3	No	No	Yes	Dry well
42	1981	Anacapa Ave. and Tempe Dr.	No	16.0	Myers	200	400	3	230	Single	Yes	No	Yes	Wet pit (sump pump). Rehabbed Dec. 2001
54	1994	Rodgers Rd. and Raymond Dr.	Yes	15.3	Myers	40	110	2&3	230	Single	No	No	No	Wet pit - #1-70 gpm & #2-40 gpm
55	1994	Hume Ave. and Echo Ln.	No	23.3	Myers	40	230	2&5	480	3	Yes	Yes	No	Wet pit - #1-40 grinder & #2-190 gpm
69	2004	Centennial at Greenfield	No	21.8	HOMA AMX334	210	420	2.9	230	3	No	Yes	No	Wet pit - Upgrade pumps 3/2014 from 3/4 hp dewater. New pumps equipped with AMX cutter.

Notes:

1. Unless noted otherwise, lift station information extracted from "Sanitary Sewer Facilities Record", City of Hanford Utility Division, received 04/22/2014.
2. Information provided by City Staff on February 08, 2017.
3. Lift station 8 was abandoned and removed
4. Firm Capacity of the lift station equivalent to the total capacity of the lift station with the largest pump out of service.

- **Lift Station 12.** This lift station services the area along Florinda Street, between Lassen Drive and 9 ¼ Avenue. The lift station is located on the intersection of Lassen Drive and Florinda Street and was built in 1961. The lift station has a firm capacity of 350 gpm and a total capacity of 700 gpm. The pump discharges into a 10-inch force main that conveys flow west along Florinda Street before discharging into a 10-inch gravity trunk east of Sequoia Circle.

- **Lift Station 18.** This lift station services the area along Douty Street between Encore Drive and Terrace Drive. The lift station is located on Douty Street, south of Terrace Avenue. and was built in 1953. The lift station has a firm capacity of 415 gpm and a total capacity of 830 gpm. The pump discharges into a 12-inch force main that conveys flow south along Douty Street before discharging into a 12-inch gravity trunk north of Lorita Way.

- **Lift Station 30.** This lift station services the area that is north of Encore Drive, bounded to the east by 10th Avenue and bounded to the west by Aspen Street and is located on the intersection of Douty Street and Encore Drive and was built in 1962. The lift station has a firm capacity of 350 gpm and a total capacity of 700 gpm. The pump discharges into a 12-inch force main that conveys flow south along Douty Street before discharging into a 10-inch gravity trunk at Fargo Avenue.

- **Lift Station 41.** This lift station services the area along Industry Ave between 11th Avenue and the BNSF railway as well as east of the BNSF railway between Iona Avenue and Idaho Avenue. The lift station is located on Industry Avenue east of Crown Street and was originally built in 1977. In early 2017, Lift Station 41 was upgraded and now has a firm capacity of 550 gpm and a total capacity of 1,100 gpm. The pump discharges into a 12-inch force main that conveys flow north before discharging at the City WWTP.

- **Lift Station 47.** This lift station services the area along Lacey Boulevard between 9 ¼ Avenue and Sierra Drive. The lift station is located at the intersection of 9 ¼ Avenue and Lacey Boulevard and was built in 1985. The lift station has a firm capacity of 375 gpm and a total capacity of 750 gpm. The pump discharges into a 12-inch force main that conveys flow north along 9 ¼ Avenue before discharging into a 12-inch gravity trunk north of Lacey Boulevard. It should be noted that Lift Station 47 is planned to be abandoned in the future and the existing flows will be conveyed into 9th Avenue through a 10-inch gravity main.

- **Lift Station 52.** This lift station services the area that is north of Fargo Avenue and east of 10th Avenue. The lift station is located on the intersection of Fargo Avenue and 10th Avenue and was built in 1990. The lift station has a firm capacity of 425 gpm and a total capacity of 850 gpm. The pump discharges into a 6-inch force main that conveys flow south along 10th Avenue before discharging into a 12-inch gravity trunk at Birch Avenue

- **Lift Station 53.** This lift station services the area along 12th Avenue north of Glendale Avenue. The lift station is located north of the intersection of 12th Avenue and Glendale

Avenue. Lift Station 53 was upgraded in early 2017 and now has a firm capacity of 1,000 gpm and a total capacity of 1,500 gpm. The pump discharges into a 14-inch force main that conveys flow south along 12th Avenue before discharging into a 30-inch gravity trunk at Hayden Avenue.

- **Lift Station 64.** This lift station services the Freedom Park area that is east of Brookhollow Drive, and north of Grangeville Boulevard. The lift station is located on the intersection of Brookhollow Drive and Grangeville Boulevard and was built in 2000. The lift station has a firm capacity of 110 gpm and a total capacity of 250 gpm. The pump discharges into a 4-inch force main that heads west along Grangeville Boulevard. It should be noted that Lift Station 64 is planned to be abandoned at buildout of the master plan.
- **Lift Station 65.** This lift station services the area along Idaho Avenue between 11th Avenue and the BNSF railway. The lift station is located at 10510 Idaho Avenue and was built in 2002. The lift station has a firm capacity of 2,170 gpm and a total capacity of 3,250 gpm. The pump discharges into a 10-inch force main that conveys flow north along the BNSF railway before discharging into Lift Station 41.
- **Lift Station 67.** This lift station services one of the western area of the city, between 13th Avenue to Centennial Drive. The lift station is located at the intersection of Berkshire Lane and Centennial Drive. The lift has a firm capacity of 350 gpm and a total capacity of 700 gpm. The flows collected at this lift station are discharged into a 6-inch force main that convey flows towards a 12-inch gravity main along Centennial Drive. The flows are then conveyed east through an 18-inch gravity main along Grangeville Boulevard, ultimately discharging into a 27-inch gravity main along 12th Avenue.
- **Lift Station 72.** This lift station services the area east of 12th Avenue between Springcrest Street and Hanford Armona Road. The lift station is located near the intersection of 12th Avenue and Hanford Armona Road and was built in 2008. The lift station has a firm capacity of 1,000 gpm and a total capacity of 2,000 gpm. The pump discharges into a 12-inch force main that conveys flow along 12th Avenue before discharging into a 30-inch gravity trunk in 12th Avenue.

4.4 HANFORD WASTEWATER TREATMENT PLANT

The Hanford WWTP is an 8.0 million gallons per day (mgd) secondary treatment facility. The facility is located on Houston Avenue with a street address of 10555 Houston Avenue. The plant was first built in 1901 and has gone under four plant expansion upgrades, the most recent being in 2004, with the intention to provide the plants current capacity and technology. The plant currently operates at an average flow of 4.7 mgd.

CHAPTER 5 – SEWER FLOWS

This chapter summarizes historical wastewater flows experienced at the City WWTP and defines flow terminologies relevant to this evaluation. This chapter discusses the wastewater flow distribution within the six collection basins, and identifies the design flows used in the hydraulic modeling effort and capacity evaluation. The design flows include the existing condition (existing customers) and the projected ultimate buildout scenario.

5.1 FLOWS AT THE HANFORD WWTP

The wastewater flows collected and treated at the City WWTP vary monthly, daily, and hourly. While the dry weather flows are influenced by customer uses, the wet weather flows are influenced by the severity and length of storm events. **Figure 5.1** shows the monthly flows versus rainfall at the WWTP for 2013.

Flow data influent to the City WWTP was obtained from City operation staff. The flow data covered a period from 2006 to 2015. From this data monthly, daily, and peak daily flows, were determined as summarized on **Table 5.1**.

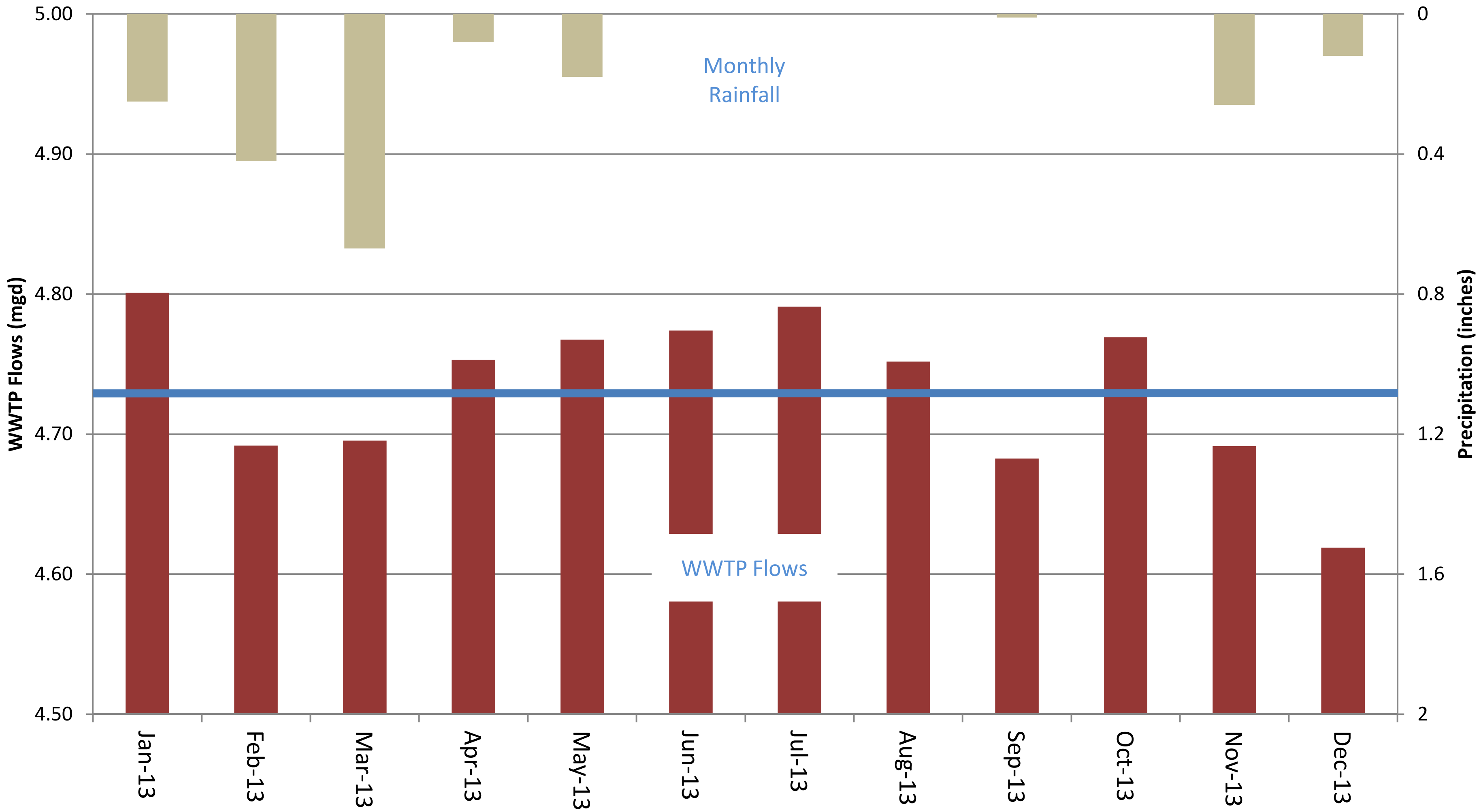
The following definitions are intended to document relevant terminologies shown on **Table 5.1**:

- **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) and average wet weather flow (AWWF).

- **Average Dry Weather Flow (ADWF).** The average dry weather flow occurs on a daily basis during the dry weather season, defined as the months of May to September, with no evident reaction to rainfall. The ADWF also includes the Base Wastewater Flow (BWF). The base wastewater flow is the average flow that is generated by residential, commercial, and industrial users. The flow pattern from these users varies depending on land use types.

- **Average Wet Weather Flow (AWWF).** This average wet weather flow occurs on a daily basis during the wet weather season, defined as the months of October to April. In addition to the flow components in the ADWF, the AWWF includes infiltration and inflow from storm rainfall events.

- **Maximum Month Dry Weather Flow (MMDWF).** This maximum month flow occurs during the dry weather season.



LEGEND

WWTP Inflow

Rainfall

Average Inflow

June 7, 2016

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Figure 5.1

2013 Hanford WWTP Flows

Sewer System Master Plan

City of Hanford

Table 5.1 Historical Flows at the Hanford Wastewater Treatment Plant

Sewer System Master Plan
City of Hanford

Year	Population	Per Capita Flows	Average Annual Flow (AAF) (mgd)	Percentage Change	Seasonal Average ADWF[1] (mgd)	Seasonal Average AWWF[2] (mgd)	Maximum Month MMDWF (mgd)	Maximum Month MMWWF (mgd)	Maximum Day MDDWF (mgd)	Maximum Day MDWWF (mgd)
Historical Flows										
2006	48,920	101	4.93	-	4.98	4.94	5.00	5.04	5.51	7.85
2007	50,534	98	4.97	0.9%	4.98	4.97	5.06	5.07	6.00	5.90
2008	51,922	99	5.16	3.7%	5.27	5.15	5.38	5.25	6.39	6.07
2009	52,970	93	4.92	-4.7%	4.87	4.98	4.93	5.16	5.72	7.60
2010	53,967	90	4.86	-1.1%	4.83	4.89	4.86	5.22	5.76	7.14
2011	54,146	87	4.73	-2.8%	4.79	4.70	4.90	4.83	5.75	7.25
2012	54,541	87	4.72	-0.2%	4.77	4.68	4.86	4.73	5.37	5.99
2013	54,513	87	4.73	0.3%	4.75	4.72	4.79	4.80	5.12	7.11
2014	54,727	86	4.69	-0.9%	4.73	4.70	4.82	4.81	5.11	5.27
2015	55,337	80	4.44	-5.3%	4.44	4.44	4.46	4.52	5.00	4.77
Historical Peaking Factors (Applied to ADWF)										
2006			0.99		1.00	0.99	1.01	1.01	1.11	1.58
2007			1.00		1.00	1.00	1.02	1.02	1.21	1.19
2008			1.01		1.00	0.98	1.02	1.00	1.21	1.15
2009			1.01		1.00	1.02	1.01	1.06	1.18	1.56
2010			0.99		1.00	1.01	1.01	1.08	1.19	1.48
2011			0.99		1.00	0.98	1.02	1.01	1.20	1.51
2012			1.00		1.00	0.98	1.02	0.99	1.13	1.25
2013			0.99		1.00	0.99	1.01	1.01	1.08	1.50
2014			1.00		1.00	0.99	1.02	1.02	1.08	1.11
2015			1.00		0.94	1.00	1.00	0.96	1.13	1.07

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2/28/2017

Notes :

1. Dry weather montshs include months from May to September

2. Wet weather months include months from October to April

- **Maximum Month Wet Weather Flow (MMWWF).** This maximum month flow occurs during the wet weather season.

- **Maximum Day Dry Weather Flow (MDDWF).** This is the highest measured daily flow that occurs during a dry weather season.

- **Maximum Day Wet Weather Flow (MDWWF).** This is the highest measured daily flow that occurs during a wet weather season.

- **Peak Dry Weather Flow (PDWF).** This is the highest measured hourly flow that occurs during a dry weather season.

Table 5.1 shows the average annual flows experienced at the City WWTP have decreased from 4.93 mgd in 2006 (AAF) to 4.44 mgd in 2015, which represents a decrease of approximately 10%. **Table 5.1** also indicates that in 2015 the City's AAF is generally close to the MMDWF and the MMWWF. This indicates that there is little groundwater intrusion evident in the sewer system.

In addition to listing the 2006-2015 flows, and for comparison purposes, the table calculates the peaking factors applied to the corresponding average dry weather flows for each year. During wet weather flows, the maximum daily volume (MDWWF) experienced at the City WWTP was 1.58 times higher than the ADWF.

5.2 EXISTING SEWER FLOWS BY COLLECTION BASIN

The existing wastewater flows represented in this master plan were based on the City's existing land use and water billing consumption records. The number of acres and corresponding wastewater flows, for each sewer collection basin, are summarized on **Table 5.2**. These basins correspond to sewer trunk systems as previously discussed a previous chapter.

- **10th Avenue Basin.** This basin includes 17 percent of the total acres and 24 percent of the existing dry weather flows.

- **10 ½ Avenue Basin.** This basin includes 16 percent of the total acres and 4 percent of the existing dry weather flows.

- **11th Avenue Basin.** This basin includes 18 percent of the total acres and 42 percent of the existing dry weather flows.

- **12th Avenue Basin.** This basin includes 23 percent of the total acres and 15 percent of the existing dry weather flows.

- **Irwin Street Basin.** This basin includes 4 percent of the total acres and 11 percent of the existing dry weather flows.

Table 5.2 2013 Wastewater Flows by Basin

Sewer System Master Plan

City of Hanford

Basin	Area		Average Dry Weather Flows	
	Acres	Percent of Total (%)	Flows (gpm)	Percent of Total (%)
10th Avenue	3,023	17%	780	24%
10 1/2 Avenue	2,954	16%	118	4%
11th Avenue	3,243	18%	1,388	42%
12th Avenue	4,218	23%	507	15%
Irwin Street	670	4%	358	11%
Industrial Area	4,131	23%	149	5%
Total	**18,239**	100%	**3,301**	100%

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10/26/2016

- **Industrial Area Basin.** This basin includes 23 percent of the total acres and 5 percent of the existing dry weather flows.

5.3 BUILDOUT WASTEWATER FLOWS

The land use methodology was used to estimate the buildout flows from the City's Planning Area and to be consistent with the General Plan. **Table 5.3** documents the total acreages for residential and non-residential land use, and the undeveloped lands designated for urbanization. The undeveloped lands were multiplied by the corresponding unit flow factor to estimate the wastewater flows. The 2013 flows were increased to 5.0 mgd to account for 100% occupancy, and the ultimate buildout flows were calculated at 13.3 mgd.

The average dry weather flows for historical and future projected years are listed in **Table 5.4** and are based on the buildout of the Planned Area Boundary as discussed in a previous chapter. At buildout of the Planned Area Boundary, the projected average dry flow is expected at 13.3 mgd.

5.4 SEWER COLLECTION SYSTEM DESIGN FLOWS

The design flows most relevant in this capacity analysis of the sewer system were the peak dry weather flows (PDWF). The PDWF is used for evaluating the capacity adequacy of the sewer system under dry weather flow conditions, and to meet the criteria set forth in the previous chapter and in the City standards.

The design flows used in evaluating the capacity adequacy of the sewer collection system are as follows:

Existing

- Average Dry Weather Flow: **5.0** mgd
- Peak Dry Weather Flow: **7.6** mgd

Buildout

- Average Dry Weather Flow: **13.3** mgd
- Peak Dry Weather Flow: **18.8** mgd

Table 5.3 Average Daily Sewer Flows

Sewer System Master Plan
City of Hanford

Land Use Classifications	Buildout Sewer Flows												
	Existing Development			Future Development to be Serviced within Planned Area Boundary									
	Within Service Area			Within Service Area				Planned Area Boundary				Total	
	Existing Development (net acre)	Sewer Unit Factor (gpd/net acre)	Average Daily Flow (gpd)	New Development (net acre)	Anticipated New Development (net acre)	Future Sewer Unit Factor (gpd/net acre)	Average Daily Flow (gpd)	Existing Development (net acre)	New Development (net acre)	Future Sewer Unit Factor (gpd/net acre)	Average Daily Flow (gpd)	Total Development within PAB (net acres)	Average Daily Flow (gpd)
Residential													
Low Density	2,837	790	2,241,112	1,026	462	790	810,586	539	1,401	790	1,533,071	5,804	4,584,768
Medium Density	498	1,350	672,112	225	101	1,350	303,765	35	312	1,350	468,650	1,070	1,444,527
High Density	84	2,450	207,025	73	33	2,450	179,563	0	64	2,450	156,587	222	543,175
Subtotal	3,419		3,120,249	1,324	596		1,293,914	574	1,777		2,158,307	7,095	6,572,470
Mixed Use													
Office Residential	89	1,650	146,438	25	25	1,650	41,382	0	0	1,650	0	114	187,820
Neighborhood Mixed Use	12	1,250	15,475	42	42	1,250	52,290	0	15	1,250	19,316	70	87,081
Corridor Mixed Use	250	900	225,397	225	225	900	202,676	10	3	900	11,970	489	440,042
Downtown Mixed Use	81	2,950	237,564	42	42	2,950	125,021	0	0	2,950	0	123	362,585
Subtotal	432		624,873	334	334		421,369	10	18		31,286	795	1,077,528
Non-Residential													
Neighborhood Commercial	27	640	17,344	26	26	640	16,676	8	12	640	12,717	73	46,737
Regional Commercial	216	790	170,839	160	160	790	126,046	18	169	790	148,329	564	445,214
Service Commercial	103	520	53,300	54	54	520	27,862	56	63	520	61,859	275	143,020
Highway Commercial	48	640	30,464	68	68	640	43,258	16	16	640	20,550	147	94,272
Office	88	1,030	90,856	30	30	1,030	31,302	0	0	1,030	0	119	122,158
Light Industrial	105	590	62,103	61	21	590	35,701	83	557	590	377,647	806	475,452
Heavy Industrial	376	680	255,456	568	199	680	385,995	211	2,607	680	1,915,866	3,761	2,557,317
Airport Protection	0	0	0	125	125	0	0	111	563	0	0	799	0
Educational Facilities	445	800	356,256	117	117	800	93,312	11	97	800	85,928	669	535,496
Public Facilities	438	520	227,812	56	56	520	29,115	3	13	520	8,294	510	265,221
Open Space with Irrigation	16	0	0	45	33	0	0	0	121	0	0	182	0
Open Space without Irrigation	346	0	0	65		0	0	41	54	0	0	507	0
Interest Area	0	1,650	0	0		1,650	0	49	552	1,650	992,261	601	992,261
Subtotal	2,208		1,264,430	1,372	888		789,266	607	4,825		3,623,450	9,012	5,677,147
Totals	6,059		**5,009,552**	3,031	1,818	0	2,504,548	1,192	6,621		5,813,044	16,903	13,327,145

Table 5.4 Projected Per Capita Sewer Flow

Sewer System Master Plan
City of Hanford

Year	Population	Annual Growth (%)	Average Dry Weather Flows (mgd)	Average Dry Weather Flows (gpm)
Historical				
2010	53,967	-	4.83	3,353
2011	54,146	0.3%	4.79	3,330
2012	54,541	0.7%	4.77	3,314
2013	54,513	-0.1%	4.75	3,301
2014	54,727	0.4%	4.73	3,288
2015	55,337	1.1%	4.44	3,082
Projected				
2016	57,070	3.1%	4.67	3,240
2017	58,803	3.0%	4.89	3,398
2018	60,536	2.9%	5.12	3,557
2019	62,270	2.9%	5.35	3,715
2020	64,003	2.8%	5.58	3,873
2021	65,736	2.7%	5.81	4,032
2022	67,469	2.6%	6.03	4,190
2023	69,202	2.6%	6.26	4,348
2024	70,935	2.5%	6.49	4,506
2025	72,669	2.4%	6.72	4,665
2026	74,402	2.4%	6.95	4,823
2027	76,135	2.3%	7.17	4,981
2028	77,868	2.3%	7.40	5,140
2029	79,601	2.2%	7.63	5,298
2030	81,334	2.2%	7.86	5,456
2031	83,067	2.1%	8.09	5,615
2032	84,801	2.1%	8.31	5,773
2033	86,534	2.0%	8.54	5,931
2034	88,267	2.0%	8.77	6,090
2035	90,000	2.0%	9.00	6,248
2036	91,890	2.1%	9.25	6,420
2037	93,820	2.1%	9.50	6,597
2038	95,790	2.1%	9.76	6,777
2039	97,801	2.1%	10.02	6,960
2040	99,855	2.1%	10.29	7,148
2041	101,952	2.1%	10.57	7,340
2042	104,093	2.1%	10.85	7,535
2043	106,279	2.1%	11.14	7,735
2044	108,511	2.1%	11.43	7,939
2045	110,790	2.1%	11.73	8,147
2046	113,116	2.1%	12.04	8,359
2047	115,492	2.1%	12.35	8,576
2048	117,917	2.1%	12.67	8,798
2049	120,393	2.1%	12.99	9,024
2050	122,922	2.1%	13.33	9,255

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10/27/2016

CHAPTER 6 - HYDRAULIC MODEL DEVELOPMENT

This chapter describes the development of the City's sewer system hydraulic model. Hydraulic network analysis has become an effectively powerful tool in all aspects of sewer 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 SOFTWARE SELECTION

The City's hydraulic model combines information on the physical characteristics of the sewer system (pipelines, lift stations) and operational characteristics (how they operate). 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 network analysis software products released by different manufacturers that can equally perform the hydraulic analysis satisfactorily. The selection of a particular software depends on user preferences, the sewer system's unique requirements, and the costs for purchasing and maintaining the software.

The hydraulic modeling software used for evaluating the capacity adequacy of the City's sewer system, InfoSewer by Innovyze Inc., utilizes the simplified St. Venant's equation, which is utilized to simulate backwater and surcharge conditions. The software also incorporates the use of the Manning's Equation in other calculations including upstream pipe flow conditions.

6.2 HYDRAULIC 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 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.

Developing the hydraulic model included review of the previous sewer system hydraulic model, digitizing and quality control, developing pipe and manhole databases, and sewer loading allocation.

6.2.1 Existing Model Update

As part of the 1990 SSMP a hydraulic model of the City's trunk sewer system was developed for analysis and evaluation. This hydraulic model, developed using a computer program developed by Boyle Engineering Corporation called "BSWAN", was maintained and periodically updated by City staff following the completion of the 1990 SSMP. Information extracted from this model was used to develop the City's hydraulic model based in InfoSewer.

Following a review of the existing modeled sewer system, the City identified key areas to be incorporated into the updated hydraulic based on system updates and recent construction. These areas are summarized as follows:

- Florinda Street, between 9 ¼ Avenue and Lift Station 12 – Recently constructed 8-inch gravity sewer pipeline.
- 12th Avenue between Mall Drive and Houston Avenue – Recently constructed 30-inch and 33-inch gravity pipelines. Recently constructed 12-inch and 14-inch force mains.
- Houston Avenue between 12th Avenue and the City WWTP – Recently constructed 33-inch, 36-inch, and 42-inch gravity pipelines.
- 12th Avenue between Fargo Avenue and Muscat Place – Recently constructed 24-inch gravity pipeline.
- 11th Avenue between Flint Avenue and Fargo Avenue – Recently constructed gravity pipelines with diameters between 8-inch and 15-inch.
- Douty Street between Pioneer Way and Windsor Drive – recently constructed 10-inch gravity pipeline.
- 10th Avenue between Mission Drive and Greenwood Avenue – Recently constructed 10-inch gravity pipeline between Encore Drive and Lift Station 52. Recently constructed 12-inch gravity pipeline between Lift Station 52 force main north of Greenwood Road and Greenwood Road.
- Fargo Avenue between Meadow View Road and Lift Station 52 – Recently 12-inch constructed gravity pipeline.
- Grangeville Boulevard at Brookhollow Drive – Recently constructed 12-inch pipe stub intended to be put into service to convey flows toward 9 ¼ Avenue following decommissioning of Lift Station 64.
- Lacey Boulevard between Magna Carta Avenue and 12th Avenue – Recently constructed 21-inch gravity pipeline.

6.2.2 Skeletonization

The City's hydraulic model is considered a skeletonized hydraulic model; a skeletonized model does not include pipes not essential to the hydraulic analysis of the system. A skeletonized model is useful in creating a system that accurately reflects the hydraulics of the pipes within the system. In addition, skeletonizing the model will reduce complexities of large models, which will also reduce the time of analysis while maintaining accuracy, but will also comply with the limitations imposed by the computer program.

The modeled pipes generally included pipes 10-inches in diameter and larger, in addition to some critical 6-inch and 8-inch gravity sewer pipes. **Table 4.1** lists the total length of modeled sewer system pipes at 37.5 miles. The modeled sewer system is shown on **Figure 4.1**.

6.2.3 Digitizing and Quality Control

For key areas throughout the system City staff conducted manhole field surveys that recorded the rim elevations, pipe invert elevations, as well as the physical manhole location. This data was incorporated into the updated hydraulic model.

During the development of the new hydraulic model, the project team consisting of City staff and Akel Engineering staff implemented a thorough quality control program to resolve discrepancies. The quality control program included the following:

- The previous hydraulic model, developed in BSWAN, and used in the 1990 master plan
- Supplemental field surveys
- As-Builts or construction drawings

6.2.4 Load Allocation

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

Allocating loads to manholes within the hydraulic model required multiple steps, incorporating the efficiency and capabilities of GIS and the hydraulic modeling software. For existing loads, using GIS, each customer account was geocoded to its approximate service location. A return-to-sewer ratio was then applied to each customer account water consumption, consistent with the account land use type, to determine the customer account sewer flow. The loads calculated were allocated to the nearest manhole that serves the corresponding parcel using the capabilities the hydraulic model has for allocating loads.

Future sewer loads from each anticipated future development, as presented in a previous chapter, were also allocated to the model for the purpose of sizing the required future facilities. The loads from the Planned Area Boundary were allocated based on proposed land use and the land use acreages. As many of the areas were very large in size, loads were allocated evenly to the demand nodes within each area. Infill areas, redevelopment areas, and vacant lands were also included in the future load allocation.

CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

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

7.1 EAST SIDE CAPACITY STUDY

As part of the 2017 SSMP, the City initiated a capacity study of the sewer trunk lines that collect flows from the eastern portion of the City. This area is generally comprised of the 10th Avenue and Irwin Street trunks. The purpose of this capacity study was to determine the impact of future growth in the eastern portion of the City and confirm the pipe size requirements of the 9th Avenue sewer trunk.

A survey was conducted of the existing Irwin Street trunk between Lacey Boulevard and Hanford Armona Road, which revealed portions of the existing Irwin Street trunk have settled since their original construction. Due to the settlement of the existing pipelines, the hydraulic capacity of this trunk is significantly limited and is expected to experience surcharging under existing peak flow conditions.

This capacity study found the 10th Avenue and Irwin Street trunks are unable to receive the full buildout of the existing trunk tributary area. As such, and with imminent development planned in the eastern portion of the City, the trigger for the construction of the 9th Avenue sewer trunk is accelerated.

7.2 SEWER PIPELINE CAPACITY EVALUATION

The following sections summarize the evaluation of the existing sewer system pipelines under existing and buildout conditions. A summary of pipeline capacity improvements required to mitigate existing deficiencies and service future growth is also provided.

7.2.1 Existing Pipeline Capacity Evaluation

The system performance and design criteria summarized, on **Table 3.1**, was used as a basis to estimate the capacity adequacy of the existing sewer system pipelines. The peak design flow simulated in the hydraulic model for existing conditions was 7.6 mgd.

For existing pipes, the maximum d/D ratio is allowed to extend to the theoretical maximum capacity of the pipe, or a d/D of 0.92 (full pipe capacity). This prevents accelerating costly improvements to pipelines that may not need replacement. In general, the hydraulic model indicated that the sewer system exhibited acceptable performance to service the existing customers during peak dry weather flows (**Figure 7.1**).

7.2.2 Buildout Pipeline Capacity Evaluation

The design flow simulated in the hydraulic model for the buildout of the General Plan was equal to 18.8 mgd. During the peak dry weather simulations, the maximum allowable pipe d/D criteria for new pipes (0.5 for 12-inch or smaller and 0.75 for larger than 12-inches) was used. For existing pipes, the criteria were relaxed to allow a maximum d/D ratio of 0.92 (full pipe capacity) to prevent unnecessary pipe replacements.

The hydraulic model indicated several areas where sewer collection system infrastructure improvements are necessary in order to accommodate future flows at the buildout of the General Plan. Other additional sewers are required as expansion improvements, intended to connect future growth to the existing collection system.

7.2.3 Pipeline Improvements Required to Serve Future Growth

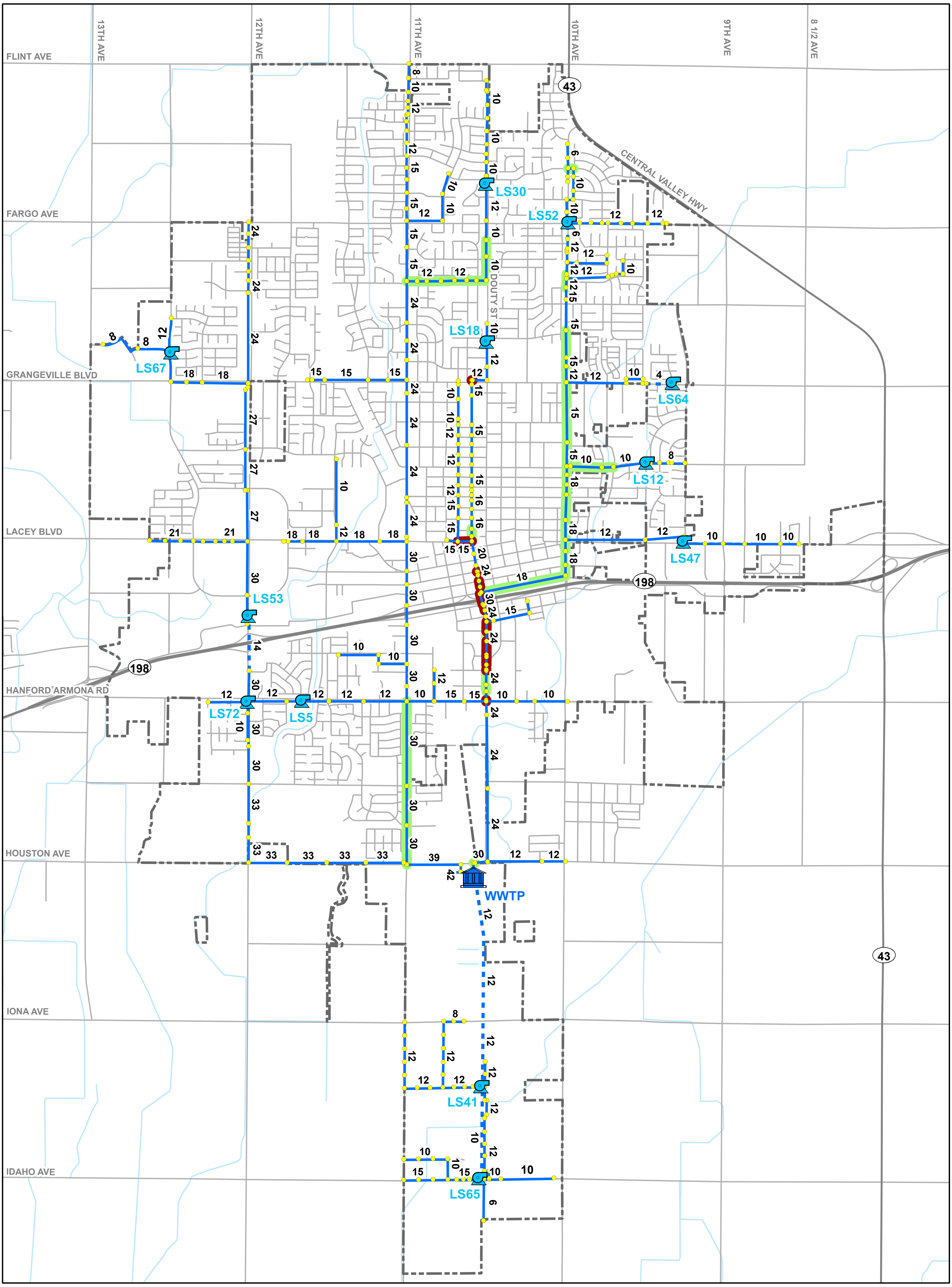
The proposed capacity improvements for the sewer system are listed on **Table 7.1**. This table lists the master plan assigned improvement number (e.g., IND-P1), along with other relevant information including alignment description, pipe size, pipe length, and a suggested phasing. The improvement numbering includes an identifier that associates the improvement with a trunk system, and the sequential numbering of the improvements in that basin.

The proposed improvements are shown with pipe sizes on an overall exhibit on **Figure 7.2**. Additionally, some of the improvements resulted in the abandonment of lift stations and realignment of the gravity systems. As such, the sewer flow basin boundaries are amended for the buildout conditions, and are documented on **Figure 7.3**. The buildout improvements are summarized by sewer trunk below.

7.2.3.1 12th Avenue Trunk

This section documents pipeline improvements within the 12th Avenue Trunk sewer service area.

- Improvement 12-P1: Construct a new 12-inch gravity sewer in 12th Avenue from Flint Avenue to Fargo Avenue.
- Improvement 12-P2: Construct a new 12-inch gravity sewer in Future 12 ½ Avenue from approximately 2,650 feet north of Fargo Avenue to Fargo Avenue.
- Improvement 12-P3: Construct a new 12-inch gravity sewer in Fargo Avenue from 13th Avenue to future 12 ½ Avenue to 12th Avenue.
- Improvement 12-P4: Construct a new 15-inch gravity sewer in Fargo Avenue from future 12 ½ Avenue to 12th Avenue.



Legend

Pipes d/D
- > 0.90
- 0.75 - 0.90
- 0.50 - 0.75

Existing System
- WWTP
- Lift Stations
- Manholes
- Gravity Mains
- Force Mains
- City Limits
- Streets
- Highways
- Waterways

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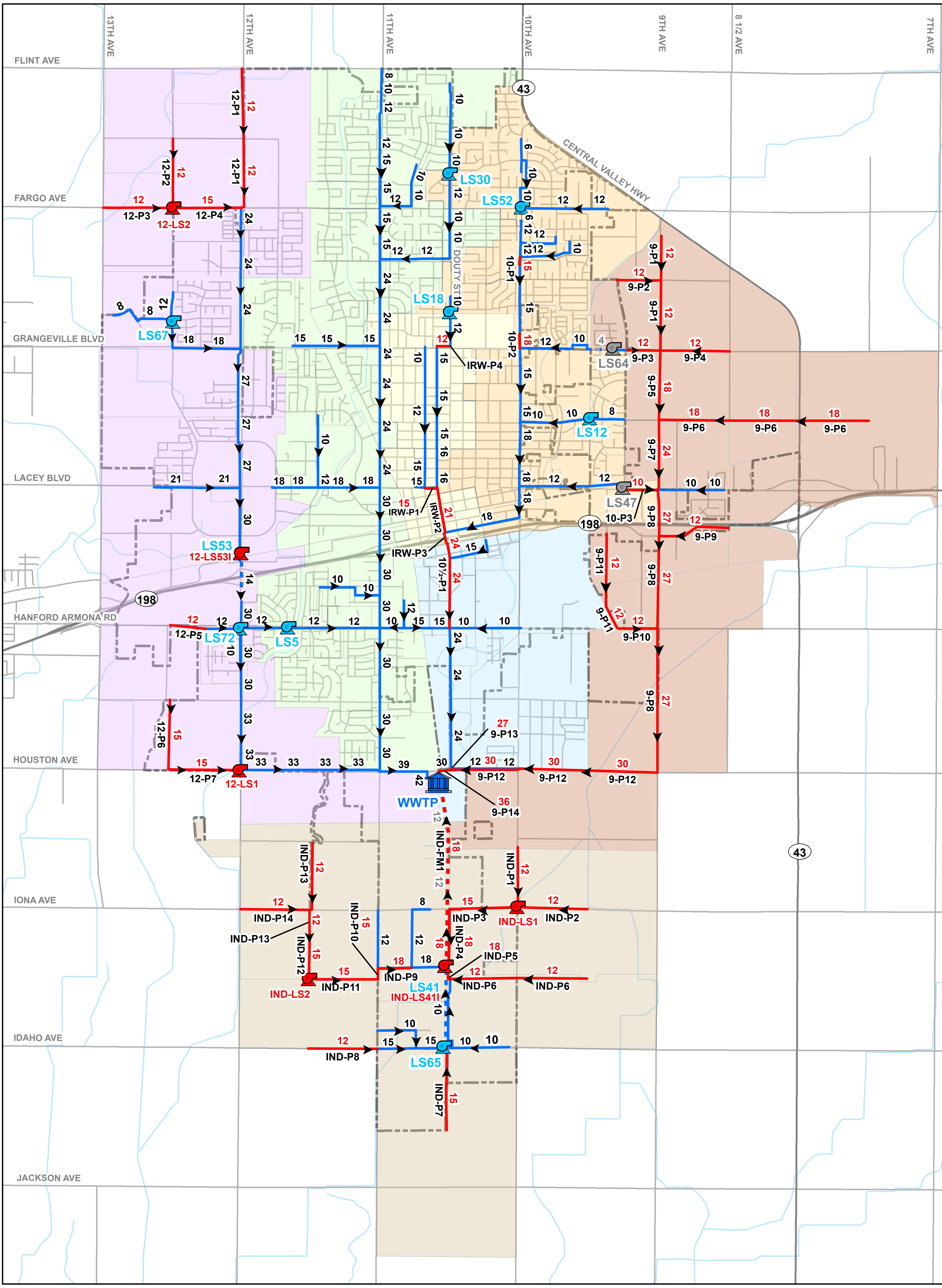
Update: October 27, 2016

0 0.25 0.5 1 Mile

File Path: P:\xGIS\GIS_Projects\Hanford\2016\Sewer\Final\HC\HF_Fig7-1_ExistSewerEval-dD_102716.mxd

Figure 7.1
Existing System Analysis for PDWF
Sewer System Master Plan
City of Hanford



Legend

Proposed Improvements
- Lift Stations and Pumps
- Gravity Mains
- Force Mains

Future Basins
- 9th Ave Basin

- 10th Ave Basin
- 10 1/2 Ave Basin
- 11th Ave Basin
- 12th Ave Basin
- Irwin St Basin
- Industrial Area Basin

Abandoned
- Lift Stations
- Gravity Main
- Force Main

Existing System
- WWTP
- Lift Stations
- Gravity Mains
- Force Mains

- City Limits
- Streets
- Highways
- Waterways

Update: July 13, 2017

0 0.25 0.5 1 Mile

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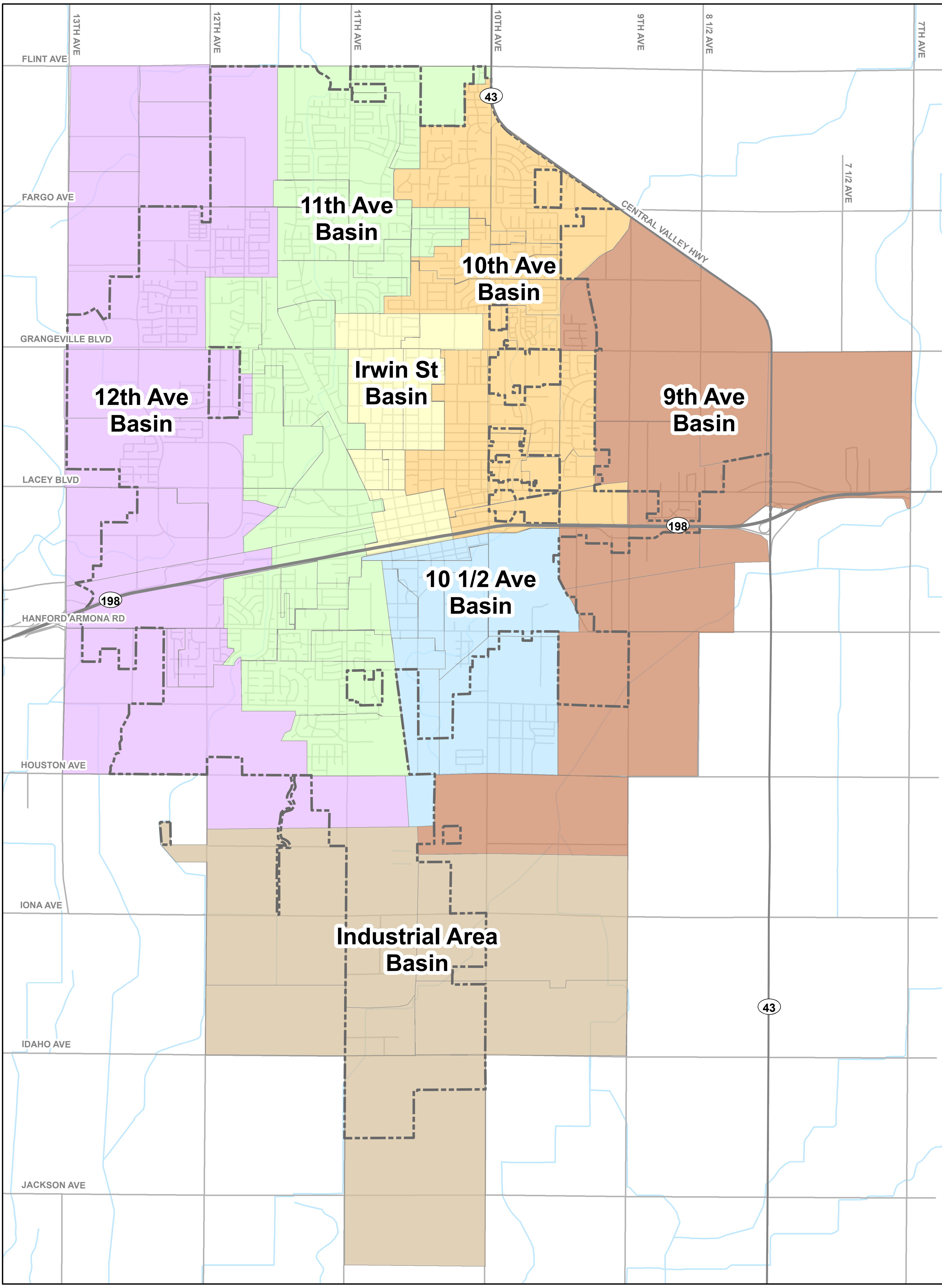
File Path: P:\xGIS\GIS_Projects\Hanford\2016\Sewer\Final\HC\HF_Fig7-2_ScheduleCIP_062717.mxd

Figure 7.2
Schedule of Improvements

Sewer System Master Plan
City of Hanford



Legend

Future Basins

- 9th Ave Basin
- 10th Ave Basin
- 10 1/2 Ave Basin
- 11th Ave Basin
- 12th Ave Basin
- Irwin St Basin
- Industrial Area Basin
- City Limits
- Streets
- Highways
- Waterways

0 0.25 0.5 1 Mile

N W E S

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Update: January 18, 2017

File Path: P:\xGIS\GIS_Projects\Hanford\2016\Sewer\Final\HC\HF_Fig7-3_FutSewerBasins_011817.mxd

Figure 7.3
Future Sewer Collection System Basins
Sewer System Master Plan
City of Hanford

Table 7.1 Schedule of Improvements

Sewer System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Existing Diameter (in)	New/Parallel/Replace	Pipeline Improvements: Diameter (in)	Length (ft)	Casings: Railroad	Highway	Canal/ Slough
12th Avenue Trunk										
Pipeline Capacity Improvements										
12-P1	Gravity Main	12th Ave	From Flint Ave to Fargo Ave	-	New	12	5,400			1
12-P2	Gravity Main	Future 12 1/2 Ave	From approx 2,650 ft n/o Fargo Ave to Fargo Ave	-	New	12	2,675			1
12-P3	Gravity Main	Fargo Ave	From 13th Ave to future 12 1/2 Ave	-	New	12	2,675			1
12-P4	Gravity Main	Fargo Ave	From future 12 1/2 Ave to 12th Ave	-	New	15	2,575			
12-P5	Gravity Main	Hanford Armona Rd	From ext. of future 12 1/2 Ave to 12th Ave		New	12	1,350			
12-P6	Gravity Main	Future 12 1/2 Ave	From ext. of Hume Ave to Houston Ave	-	New	15	2,675			
12-P7	Gravity Main	Houston Ave	From future 12 1/2 Ave to 12th Ave	-	New	15	2,750			2
Lift Station Improvements						Firm Capacity				
12-LS53I	Lift Station	12th Avenue	300 ft n/o of Glendale Ave		Replace	2 @ 1,200 gpm				
12-LS1	Lift Station	Houston Ave	Intersection of Houston Ave and 12th Ave		New	1 @ 600 gpm				
12-LS2	Lift Station	Fargo Ave	2,600 ft w/o 12th Ave		New	1 @ 400 gpm				
9th Avenue Trunk										
Pipeline Capacity Improvements										
9-P1	Gravity Main	9th Ave	From Fairview Pl to Grangeville Blvd	-	New	12	4,375			
9-P2	Gravity Main	Leland Way	From 9 1/4 Ave to 9th Ave	-	New	12	1,700			
9-P3	Gravity Main	Grangeville Blvd	From 9 1/4 Ave to 9th Ave	-	New	12	1,350			
9-P4	Gravity Main	Grangeville Blvd	From 8 1/2 Ave to 9th Ave	-	New	12	2,650			
9-P5	Gravity Main	9th Ave	From Grangeville Blvd to Florinda St	-	New	18	2,650			
9-P6	Gravity Main	Florinda St	From approx 2,600 ft e/o HWY 43 to 9th Ave	-	New	18	8,000			
9-P7	Gravity Main	9th Ave	From Florinda St to Lacey Blvd	-	New	24	2,700	1		
9-P8	Gravity Main	9th Ave	From Lacey Blvd to Houston Ave	-	New	27	10,775	1	1	
9-P9	Gravity Main	Third St	From ext. of David St to 9th Ave	-	New	12	2,750			
9-P10	Gravity Main	Hanford Armona Rd	From approx 450 ft e/o 9 1/2 Ave to 9th Ave	-	New	12	1,500			
9-P11	Gravity Main	9 1/2 Ave	From approx 300 ft s/o Third St to Hanford Armona Rd	-	New	12	3,750			
9-P12	Gravity Main	Houston Ave	From 9th Ave to 10 1/2 Ave		New	30	7,875			1
9-P13	Gravity Main	10 1/2 Ave	From approx 50 ft n/o Houston Ave to Houston Ave	-	New	27	50			
9-P14	Gravity Main	Houston Ave	From 10 1/2 Ave to approx 500 ft w/o 10 1/2 Ave	-	New	36	725	1		
10th Avenue Trunk										
Pipeline Capacity Improvements										
10-P1	Gravity Main	10th Ave	From approx 100 ft n/o Lakewood Dr to 200 ft s/o Lakewood Dr	12	Replace	15	300			
10-P2	Gravity Main	10th Ave	From approx 150 ft s/o Cross Ave to Grangeville Blvd	12	Replace	18	575			
10-P3	Gravity Main	Lacey Blvd	From 9 1/4 Ave to 9th Ave	10	Replace	10	1,300			
10 1/2 Avenue										
Pipeline Capacity Improvements										
10½-P1	Gravity Main	Irwin St	From Third St to Hanford Armona Rd	24	Replace	24	3,350			
Irwin St Trunk										
Pipeline Capacity Improvements										
IRW-P1	Gravity Main	Lacey Blvd	From Redington St to Irwin St	15	Replace	15	525			
IRW-P2	Gravity Main	Irwin St	From Lacey Blvd to Fourth St	20, 24	Replace	21	1,850	1		
IRW-P3	Gravity Main	Irwin St	From Fourth St to 3rd St	24, 30	Replace	24	500		1	
IRW-P4	Gravity Main	Grangeville Blvd	From Douty St to Irwin St	12	Replace	12	525			
Industrial Trunk										
Pipeline Capacity Improvements										
IND-P1	Gravity Main	10th Ave	From approx 2,300 ft n/o Iona Ave to Iona Ave	-	New	12	2,300			
IND-P2	Gravity Main	Iona Ave	From future 9 1/2 Ave to ext. of 10th Ave	-	New	12	2,675			1

Table 7.1 Schedule of Improvements

Sewer System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements: Existing Diameter (in)	New/Parallel/Replace	Diameter (in)	Length (ft)	Casings: Railroad	Highway	Canal/ Slough
IND-P3	Gravity Main	Iona Ave	From 10th Avenue to 10 1/2 Ave	12	Replace	15	2,125			
IND-P4	Gravity Main	Ext. 10 1/2 Ave	From Iona Ave to Industry Ave	12	Replace	18	2,675			
IND-P5	Gravity Main	ext. 10 1/2 Ave	From approx 600 ft s/o Industry Ave to Industry Ave	12	Replace	18	600			
IND-P6	Gravity Main	Future ROW	From future 9 1/2 Ave to ext. of 10 1/2 Ave	-	New	12	5,225			1
IND-P7	Gravity Main	Ext. 10 1/2 Ave	From 3,100 ft s/o Idaho Ave to Idaho Ave	6	Replace	15	3,250			
IND-P8	Gravity Main	Idaho Ave	From approx 2,600 ft w/o 11th Avenue to 11th Avenue	-	New	12	2,650			
IND-P9	Gravity Main	Industry Ave	From 11th Avenue to Crown Avenue	12	Replace	18	1,325			
IND-P10	Gravity Main	11th Ave	From approx 420 ft s/o Industry Ave to Industry Ave	-	New	15	425			
IND-P11	Gravity Main	Future ROW	From future 11 1/2 Ave to 11th Ave	-	New	15	2,600			
IND-P12	Gravity Main	Future 11 1/2 Ave	From approx 1,350 ft s/o Iona Ave to approx 420 ft s/o Industry Ave	-	New	15	1,325			
IND-P13	Gravity Main	Future 11 1/2 Ave	From approx 2,530 ft n/o Iona Ave to approx 1,350 ft s/o Iona Ave	-	New	12	3,975			1
IND-P14	Gravity Main	Iona Ave	From 12th Ave to future 11 1/2 Ave	-	New	12	2,650			
IND-FM1	Force Main	Ext. 10 1/2 Ave	From Industry Ave to Houston Ave	12	Replace	18	7,275			
Lift Station Improvements						Firm Capacity				
IND-LS41I	Lift Station	Industry Ave	1,300 e/o Crown Ave		Replace	2 @ 1,500 gpm				
IND-LS1	Lift Station	Iona Ave	Intersection of Iona Ave and 10th Ave		New	1 @ 500 gpm				
IND-LS2	Lift Station	Future 11 1/2 Ave	2,650 ft s/o Iona Ave		New	1 @ 500 gpm				

- Improvement 12-P5: Construct a new 12-inch gravity sewer in Hanford Armona Road from exterior of future 12 ½ Avenue to 12th Avenue.

- Improvement 12-P6: Construct a new 15-inch gravity sewer in Future 12 ½ Avenue to from exterior of Hume Avenue to Houston Avenue.

- Improvement 12-P7: Construct a new 15-inch gravity sewer in Houston Avenue from future 12 ½ Avenue to 12th Avenue.9th Avenue Trunk

7.2.3.2 9th Avenue Trunk

This section documents pipeline improvements within the 9th Avenue Trunk sewer service area.

- Improvement 9-P1: Construct a new 12-inch gravity sewer in 9th Avenue from Fairview Place to Grangeville Boulevard.

- Improvement 9-P2: Construct a new 12-inch gravity sewer in Leland Way from 9 ¼ Avenue to 9th Avenue.

- Improvement 9-P3: Construct a new 12-inch gravity sewer in Grangeville Boulevard from 9 ¼ Avenue to 9th Avenue. This improvement is meant to redirect flow from LS 64 to the 9th Avenue Trunk.

- Improvement 9-P4: Construct a new 12-inch gravity sewer in Grangeville Boulevard from 8 ½ Avenue to 9th Avenue.

- Improvement 9-P5: Construct a new 18-inch gravity sewer in 9th Avenue from Grangeville Boulevard to Florinda Street.

- Improvement 9-P6: Construct a new 18-inch gravity sewer in Florinda Street from approximately 2,600 feet east of Highway 43 to 9th Avenue.

- Improvement 9-P7: Construct a new 24-inch gravity sewer in 9th Avenue from Florinda Street to Lacey Boulevard.

- Improvement 9-P8: Construct a new 27-inch gravity sewer in 9th Avenue from Lacey Boulevard to Houston Avenue.

- Improvement 9-P9: Construct a new 12-inch gravity sewer in Third Street from extension of David Street to 9th Avenue.

- Improvement 9-P10: Construct a new 12-inch gravity sewer in Hanford Armona Road from approximately 450 feet east of 9 ½ Avenue to 9th Avenue

- Improvement 9-P11: Construct a new 12-inch gravity sewer in 9 ½ Avenue from approximately 300 feet south of Third Street to Hanford Armona Road.

- Improvement 9-P12: Construct a new 30-inch gravity sewer in Houston Avenue from 9th Avenue to 10 ½ Avenue.

- Improvement 9-P13: Construct a new 27-inch gravity sewer in 10 ½ Avenue from approximately 50 feet north of Houston Avenue to Houston Avenue.

- Improvement 9-P14: Construct a new 36-inch gravity sewer in Houston Avenue from 10 ½ Ave to approximately 500 feet west of 10 ½ Avenue.

7.2.3.3 10th Avenue Trunk

This section documents pipeline improvements within the 10th Avenue Trunk sewer service area.

- Improvement 10-P1: Replace the existing 12-inch gravity sewer with a new 15-inch gravity sewer in 10th Avenue from approximately 100 feet north of Lakewood Drive to 200 feet south of Lakewood Drive.

- Improvement 10-P2: Replace the existing 12-inch gravity sewer with a new 18-inch gravity sewer in 10th Avenue from approximately 150 feet south Crass Avenue to Grangeville Boulevard.

- Improvement 10-P3: Replace the existing 10-inch gravity sewer with a new 10-inch gravity sewer in Lacey Boulevard from 9 ¼ Avenue to 9th Avenue. This improvement is meant to redirect flow from LS47 to the 9th Avenue trunk.

7.2.3.4 10 ½ Avenue Trunk

This section documents pipeline improvements within the 10 ½ Avenue Trunk sewer service area.

Improvement 10 ½ -P1: Replace the existing 24-inch gravity sewer with a new 24-inch gravity sewer in Irwin Street from Third Street to Hanford Armona Road. This improvement is intended to mitigate existing pipe deficiencies and comply with minimum slope design criteria.

7.2.3.5 Irwin Street Trunk

This section documents pipeline improvements within the Irwin Street Trunk sewer service area.

- Improvement IRW-P1: Replace the existing 15-inch gravity sewer with a new 15-inch gravity sewer in Lacey Boulevard from Redington Street to Irwin Street. This improvement is meant to mitigate existing pipe deficiencies and comply with minimum slope design criteria.

- Improvement IRW-P2: Replace the existing 20-inch and 24-inch gravity sewer mains with a new 21-inch gravity sewer main in Irwin Street from Lacey Boulevard to Fourth Street. This improvement is meant to mitigate existing pipe deficiencies and comply with minimum slope design criteria.

- Improvement IRW-P3: Replace the existing 24-inch and 30-inch gravity sewer mains with a new 24-inch gravity sewer in Irwin Street from Fourth Street to Third Street. This improvement is meant to mitigate existing pipe deficiencies and comply with minimum slope design criteria.

- Improvement IRW-P4: Replace the existing 12-inch gravity sewer with a new 12-inch gravity sewer in Grangeville Boulevard from Douty Street to Irwin Street. This improvement is meant to mitigate existing pipe deficiencies and comply with minimum slope design criteria.

7.2.3.6 Industrial Trunk

This section documents pipeline improvements within the Industrial Trunk sewer service area.

- Improvement IND-P1: Construct a new 12-inch gravity sewer in 10th Avenue from approximately 2,300 feet north of Iona Avenue to Iona Avenue.

- Improvement IND-P2: Construct a new 12-inch gravity sewer in Iona Ave from future 9 ½ Avenue to exterior of 10th Avenue.

- Improvement IND-P3: Replace the existing 12-inch gravity sewer with a new 15-inch gravity sewer in Iona Avenue from 10th Avenue to 10 ½ Avenue.

- Improvement IND-P4: Replace the existing 12-inch gravity sewer with a new 18-inch gravity sewer in exterior 10 ½ Avenue from Iona Avenue to Industry Avenue.

- Improvement IND-P5: Replace the existing 12-inch gravity sewer with a new 18-inch gravity sewer in exterior 10 ½ Avenue from approximately 600 feet south of Industry Avenue to Industry Avenue.

- Improvement IND-P6: Construct a new 12-inch gravity sewer in future Right-of-Way from future 9 ½ Avenue to exterior of 10 ½ Avenue.

- Improvement IND-P7: Replace the existing 6-inch gravity sewer with a new 15-inch gravity sewer in exterior of 10 ½ Ave from 3,100 feet south of Idaho Avenue to Idaho Avenue.

- Improvement IND-P8: Construction a new 12-inch gravity sewer in Idaho Avenue from approximately 2,600 feet west of 11th Avenue to 11th Avenue.

- Improvement IND-P9: Replace the existing 12-inch gravity sewer with a new 18-inch gravity sewer in Industry Avenue from 11th Avenue to Crown Avenue.

- Improvement IND-P10: Construct a new 15-inch gravity sewer in 11th Avenue from approximately 420 feet south of Industry Avenue to Industry Avenue.

- Improvement IND-P11: Construct a new 15-inch gravity sewer in future Right-of-Way from 11 ½ Avenue to 11th Avenue.
- Improvement IND-P12: Construct a new 15-inch gravity sewer in future 11 ½ Avenue from approximately 1,350 feet south of Iona Avenue to approximately 420 feet south of Industry Avenue.
- Improvement IND-P13: Construct a new 12-inch gravity sewer in future 11 ½ Avenue from approximately 2,530 feet north of Iona Avenue to approximately 1,350 feet south of Iona Avenue.
- Improvement IND-P14: Construct a new 12-inch gravity sewer in Iona Avenue from 12th Avenue to future 11 ½ Avenue.

7.3 LIFT STATION AND FORCE MAIN CAPACITY EVALUATION

The City currently operates 21 lift stations that convey collected sewer flows to the WWTP. The modeled lift stations and corresponding force mains were evaluated under existing and buildout conditions to determine the capacity adequacy and identify necessary improvements.

7.3.1 Lift Station Evaluation

For the development of the hydraulic model, 12 of the 21 lift stations were modeled for the sewer system hydraulic analysis. An inventory of the lift stations operated by the city is shown in **Table 4.2**. A lift station evaluation was completed for existing and buildout condition and is documented **Table 7.2** and summarized below.

- **Lift Station 5:** The maximum modeled lift station inflow is 0.08 mgd under existing PDWF condition and 0.11 mgd under PDWF condition at buildout. This lift station experiences an increase in flow.
- **Lift Station 12:** The maximum modeled lift station inflow is 0.18 mgd under existing PDWF condition and 0.19 mgd under PDWF condition at buildout This lift station experiences a very slight increase in flow.
- **Lift Station 18:** The maximum modeled lift station inflow is 0.07 mgd under existing PDWF condition and 0.08 mgd under PDWF condition at buildout.
- **Lift Station 30:** The maximum modeled lift station inflow is 0.17 mgd under existing PDWF condition and 0.26 mgd under PDWF condition at buildout.
- **Lift Station 41:** The maximum modeled lift station inflow is 0.46 mgd under existing PDWF condition and 4.30 mgd under PDWF condition at buildout. Under buildout PDWF conditions this lift station experiences a firm capacity deficiency of approximately

Table 7.2 Lift Station Evaluation
Sewer System Master Plan
City of Hanford

Lift Station ID	Total Capacity		Firm Capacity		Existing Capacity Evaluation		Future Capacity Evaluation		Recommended Improvement
					Peak Inflow	Surplus/ Deficiency	Peak Inflow	Surplus/ Deficiency	
	(gpm)	(mgd)	(gpm)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	
5	700	1.01	350	0.50	0.08	0.43	0.11	0.39	
12	700	1.01	350	0.50	0.18	0.32	0.19	0.31	
18	830	1.20	415	0.60	0.07	0.53	0.08	0.52	
30	700	1.01	350	0.50	0.17	0.34	0.26	0.25	
41 [1]	1,100	1.58	550	0.79	0.46	0.33	4.30	-3.51	Replace existing pumps with 3 @ 1,500 gpm (2 Duty + 1 Standby)
47 [2]	750	1.08	375	0.54	0.13	0.41	-	-	
52	850	1.22	425	0.61	0.36	0.25	0.57	0.04	
53 [1]	1,500	2.16	1,000	1.44	1.19	0.25	3.41	-1.97	Replace existing pumps with 3 @ 1,200 gpm (2 Duty + 1 Standby)
64 [2]	250	0.36	110	0.16	0.08	0.08	-	-	
65	3,250	4.68	2,170	3.12	0.02	3.10	1.14	1.98	
67	700	1.01	350	0.50	0.01	0.49	0.19	0.31	
72	2,000	2.88	1,000	1.44	0.11	1.33	0.16	1.28	

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2/28/2017

Notes :

1. Firm Capacity based on information provided by City Staff on 02/24/2017.
2. Lift Station 47 and 64 to be abandoned.

3.5 mgd. To mitigate this deficiency, it is recommended to replace the pumps at the lift station with three pumps at 1,500 gpm capacity with a firm lift station capacity of 3,000 gpm.

- **Lift Station 47:** The maximum modeled lift station inflow is 0.13 mgd under existing PDWF condition. This lift station is planned to be abandoned upon the construction of the 9th Avenue trunk. The flow tributary to the lift station will be rerouted to the 9th Avenue trunk.

- **Lift Station 52:** The maximum modeled lift station inflow is 0.36 mgd under existing PDWF condition and 0.57 mgd under PDWF condition at buildout.

- **Lift Station 53:** The maximum modeled lift station inflow is 1.19 mgd under existing PDWF condition and 3.41 mgd under PDWF condition at buildout. Under buildout PDWF conditions this lift station experiences a firm capacity deficiency of approximately 1.97 mgd. It is recommended to upgrade the lift station with three pumps at 1,200 gpm capacities with a firm lift station capacity of 2,400 gpm.

- **Lift Station 64:** The maximum modeled lift station inflow is 0.08 mgd under existing PDWF condition. This lift station is planned to be abandoned upon the construction of the 9th Avenue trunk. The flow tributary to the lift station will be rerouted to the 9th Avenue trunk.

- **Lift Station 65:** The maximum modeled lift station inflow is 0.02 mgd under existing PDWF condition and 1.14 mgd under PDWF condition at buildout.

- **Lift Station 67:** The maximum modeled lift station inflow is 0.01mgd under existing PDWF condition and 0.19 mgd under PDWF condition at buildout.

- **Lift Station 72:** The maximum modeled lift station inflow is 0.11 mgd under existing PDWF condition and 0.16 mgd under PDWF condition at buildout.

7.3.2 Lift Station Capacity Improvements

As summarized on **Table 7.2**, Lift Station 41 and Lift Station 53 are undersized to convey the peak inflows due to the buildout of the General Plan. The improvements to mitigate these capacity deficiencies are describe as follows:

- Improvement IND-LS41I: This improvement upgrades the existing Lift Station 41 with a firm capacity of 3,000 gpm and total capacity of 4,500 gpm.

- Improvement 12-LS53I: This improvement upgrades the existing Lift Station 53 with a firm capacity of 2,400 gpm and total capacity of 3,600 gpm.

The buildout of the General Plan will require the construction of new lift stations to convey collected sewer flows from areas of new growth to the existing sewer system. These planned lift stations are shown graphically on **Figure 7.2** and summarized as follows:

- Improvement 12-LS1: Construct a new lift station location at intersection of Houston Avenue and 12th Avenue with a firm capacity of 600 gpm and total capacity of 1,200 gpm.

- Improvement 12-LS2: Construct a new lift station located 2,600 feet west of 12th Avenue on Fargo Avenue with a firm capacity of 400 gpm and total capacity of 800 gpm.

- Improvement IND-LS1: Construct a new lift station located on Iona Avenue at the intersection of Iona Avenue and 10th Avenue with a firm capacity of 500 gpm and total capacity of 1,000 gpm.

- Improvement IND-LS2: Construct a new lift station located 2,650 south of Iona Avenue on Future 11 ½ Avenue with a firm capacity of 500 gpm and total capacity of 1,000 gpm.

7.3.3 Force Main Evaluation

Force mains are intended to convey sewer flows under pressure from a lift station to a point where gravity conveyance is once again feasible. Force mains may be short in length, and simply “lift” sewer flows to an elevated position, or convey sewer flows over a greater length when gravity flow is not feasible. An evaluation of the modeled force mains is documented on **Table 7.3**. The force mains were evaluated for existing and buildout peak dry weather flow condition.

The analysis results indicate that the modeled force mains are generally adequate for conveying the existing and buildout sewer flows. The existing 12-inch force main downstream of Lift Station 41 will require upsizing to an 18-inch to accommodate the buildout flows of the industrial area (Improvement IND-FM1). It should be noted that the analysis indicates that the force main associated with Lift Station 5 is deficient under the peak velocity criteria. However, as this force main is a small diameter and short in length, improvement of this pipeline may be deferred to the end of its useful life, or if it is possible to consolidate with another project at the lift station.

Table 7.3 Force Main Evaluation

Sewer System Master Plan
City of Hanford

Lift Station ID	Force Main Diameter (in)	Force Main Length (ft)	Peak Flow Existing (mgd)	Peak Flow Future (mgd)	Peak Velocity Existing (ft/s)	Peak Velocity Future (ft/s)	Recommended Improvement
5	4	17	0.08	0.11	**8.9**	**8.9**	
12	10	30	0.18	0.19	1.4	1.4	
18	12	6	0.07	0.08	1.0	1.0	
30	12	45	0.17	0.26	1.0	1.0	
41	12	6,989	0.43	3.95	2.3	**8.5**	Replace with 18"
47 [1]	12	202	0.13	0.20	1.1	1.1	
52	6	504	0.36	0.57	4.8	4.8	
53	14	1,800	1.19	3.41	1.0	5.0	
64[1]	4	824	0.08	-	6.4	-	
65	10	3,050	0.02	1.14	4.4	4.4	
67	6	39	0.00	0.19	0.0	4.0	
72	12	29	0.11	0.16	2.8	2.8	

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Notes :

1. Lift Station 47 and 64 to be abandoned.

CHAPTER 8 - CAPITAL IMPROVEMENT PROGRAM

This chapter provides a summary of the recommended Capital Improvement Program (CIP) for the City's sewer system. The program is based on the evaluation of the City's sewer 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.

8.1 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.

The Association for the Advancement of Cost Engineering (AACE International), formerly known as the American Association of Cost Engineers, 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 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**.

8.2 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, Akel 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 Engineering News Records (ENR) Construction Cost Index (CCI).

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.

8.2.1 Unit Costs

The unit cost estimates used in developing the Capital Improvement Program are summarized on **Table 8.1**. The unit costs are intended for developing the Order of Magnitude estimate, and do not account for site specific conditions, 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. These factors are assumed included in the contingencies applied to the final capital improvement cost.

The unit costs include:

- **Pipeline Unit Costs.** Unit costs were escalated from the 1990 SSMP and compared to bid tabulations provided by City Staff to determine accurate representation of construction costs within the City.

- **Pump Station Costs.** These costs are based on a lift station project equation as shown on **Table 8.1**.

8.2.2 Construction Cost Index

Costs estimated in this study are adjusted utilizing the Engineering News Record (ENR) Construction Cost Index (CCI), which is widely used in the engineering and construction industries. The costs in this Sewer System Master Plan were benchmarked using a 20-City national average ENR CCI of 10,532, reflecting a date of January 2017.

8.2.3 Land Acquisition

Construction of pipelines is assumed to generally be within existing or future street right-of-way's. As such, land acquisition for easements are not included in the pipeline cost. Land acquisition for lift stations is included in the equation used for unit cost.

Table 8.1 Unit Costs

Sewer System Master Plan
City of Hanford

Pipeline Diameter (in)	Unit Cost ($/lineal foot)
Gravity Pipes	
10	$222
12	$228
15	$239
18	$258
21	$280
24	$291
27	$336
30	$395
36	$491
Pipeline Casings	
$22 per inch diameter per linear foot	
Lift Stations	
Estimated Lift Station Project Cost = 8,764*Q^2 + 244,811*Q + 331,618 , where Q is in mgd	

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Note:

1. January 2017 ENR CCI of 10532 used to estimate unit costs.

8.2.4 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 **15 percent** contingency allowance to account for unforeseen events and unknown field conditions.

8.2.5 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 **15 percent** to the estimated construction costs.

8.3 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement costs for the previously identified projects are summarized on **Table 8.2**. The Capital Improvement Program lists the type of improvement, location, cost, construction trigger, and cost sharing.

Each improvement was assigned a unique coded identifier associated with the improvement type, which corresponds to the summary figure (**Figure 8.1**) that shows the location and identifiers of each improvement. The suggested capital improvements costs include the contingencies described in the previous section.

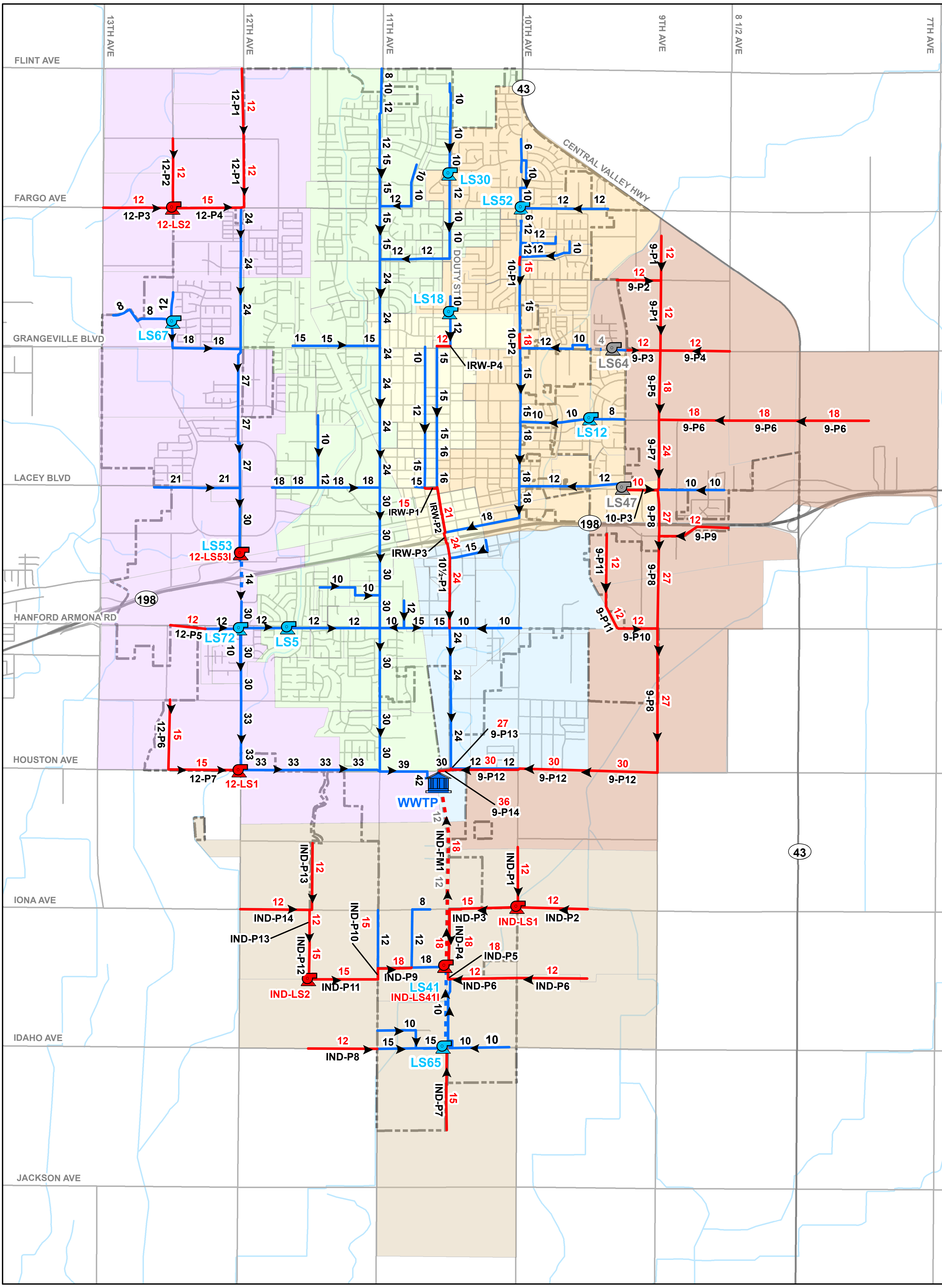
8.3.1 Pipelines

The recommended pipeline improvements are grouped by collection basin and listed on **Table 8.2**. Each improvement includes a general description of the street alignment and limits as well as existing pipe diameter and length.

The following three pipeline improvements categories were identified:

- **New Pipeline.** The new pipeline is proposed where none exists.
- **Replacement Pipeline.** This improvement is intended as a replacement to an existing pipeline and along the same alignment. The existing pipeline should be abandoned when the replacement pipeline has been constructed.
- **Parallel Pipeline.** This improvement is intended as a parallel to an existing pipeline. The existing pipeline should remain in service, even when this new improvement is constructed.

The opinion of probable construction costs, for the projects included in this master plan, are based on the pipe unit costs summarized on **Table 8.1**. It is assumed that any replacement pipes will be in the same alignment and at the same slope as the existing pipe, except in the cases where the



Legend

Proposed Improvements
- Lift Stations and Pumps
- Gravity Mains
- Force Mains

Future Basins
- 9th Ave Basin

- 10th Ave Basin
- 10 1/2 Ave Basin
- 11th Ave Basin
- 12th Ave Basin
- Irwin St Basin
- Industrial Area Basin

Abandoned
- Lift Stations
- Gravity Main
- Force Main

Existing System
- WWTP
- Lift Stations
- Gravity Mains
- Force Mains

- City Limits
- Streets
- Highways
- Waterways

Update: July 13, 2017

0 0.25 0.5 1 Mile

N W E S

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Figure 8.1
Capital Improvement Program
Sewer System Master Plan
City of Hanford

Table 8.2 Capital Improvement Program

Sewer System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements: Existing Diameter (in)	New/Parallel/Replace	Diameter (in)	Length (ft)	Casings: Railroad	Casings: Highway	Casings: Canal/ Slough	Infrastructure Costs: Pipe Unit Cost ($/unit)	Pipe Cost [1,2] ($)	Baseline Constr. Consts ($)	Estimated Constr. Costs [3] ($)	Capital Improv. Costs [4] ($)	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Cost Sharing: Existing Users ($)	Cost Sharing: Future Users ($)
12th Avenue Trunk																			
Pipeline Capacity Improvements																			
12-P1	Gravity Main	12th Ave	From Flint Ave to Fargo Ave	-	New	12	5,400			1	228	1,370,042	1,370,042	1,575,548	1,811,880	0%	100%	0	1,811,880
12-P2	Gravity Main	Future 12 1/2 Ave	From approx 2,650 ft n/o Fargo Ave to Fargo Ave	-	New	12	2,675			1	228	749,730	749,730	862,190	991,518	0%	100%	0	991,518
12-P3	Gravity Main	Fargo Ave	From 13th Ave to future 12 1/2 Ave	-	New	12	2,675			1	228	749,730	749,730	862,190	991,518	0%	100%	0	991,518
12-P4	Gravity Main	Fargo Ave	From future 12 1/2 Ave to 12th Ave	-	New	15	2,575				239	616,660	616,660	709,160	815,533	0%	100%	0	815,533
12-P5	Gravity Main	Hanford Armona Rd	From ext. of future 12 1/2 Ave to 12th Ave		New	12	1,350				228	307,310	307,310	353,407	406,418	0%	100%	0	406,418
12-P6	Gravity Main	Future 12 1/2 Ave	From ext. of Hume Ave to Houston Ave	-	New	15	2,675				239	640,608	640,608	736,700	847,205	0%	100%	0	847,205
12-P7	Gravity Main	Houston Ave	From future 12 1/2 Ave to 12th Ave	-	New	15	2,750			2	239	975,369	975,369	1,121,675	1,289,926	0%	100%	0	1,289,926
Lift Station Improvements						Firm Capacity													
12-LS53I	Lift Station	12th Avenue	300 ft n/o of Glendale Ave		Replace	2 @ 1,200 gpm					-	1,207,973	1,207,973	1,389,169	1,597,545	35%	65%	558,274	1,039,270
12-LS1	Lift Station	Houston Ave	Intersection of Houston Ave and 12th Ave		New	1 @ 600 gpm					-	550,707	550,707	633,313	728,310	0%	100%	0	728,310
12-LS2	Lift Station	Fargo Ave	2,600 ft w/o 12th Ave		New	1 @ 400 gpm					-	477,677	477,677	549,329	631,728	0%	100%	0	631,728
												Subtotal - 12th Avenue Trunk	7,645,808	8,792,679	10,111,581			558,274	9,553,307
9th Avenue Trunk																			
Pipeline Capacity Improvements																			
9-P1	Gravity Main	9th Ave	From Fairview Pl to Grangeville Blvd	-	New	12	4,375				228	995,914	995,914	1,145,301	1,317,096	0%	100%	0	1,317,096
9-P2	Gravity Main	Leland Way	From 9 1/4 Ave to 9th Ave	-	New	12	1,700				228	386,984	386,984	445,031	511,786	0%	100%	0	511,786
9-P3 [5]	Gravity Main	Grangeville Blvd	From 9 1/4 Ave to 9th Ave	-	New	12	1,350				228	307,310	307,310	353,407	406,418	63%	37%	255,271	151,147
9-P4	Gravity Main	Grangeville Blvd	From 8 1/2 Ave to 9th Ave	-	New	12	2,650				228	603,239	603,239	693,725	797,784	0%	100%	0	797,784
9-P5	Gravity Main	9th Ave	From Grangeville Blvd to Florinda St	-	New	18	2,650				258	683,439	683,439	785,954	903,847	7%	93%	65,111	838,736
9-P6	Gravity Main	Florinda St	From approx 2,600 ft e/o HWY 43 to 9th Ave	-	New	18	8,000				258	2,063,211	2,063,211	2,372,692	2,728,596	0%	100%	0	2,728,596
9-P7	Gravity Main	9th Ave	From Florinda St to Lacey Blvd	-	New	24	2,700	1			291	996,352	996,352	1,145,804	1,317,675	2%	98%	32,046	1,285,629
9-P8	Gravity Main	9th Ave	From Lacey Blvd to Houston Ave	-	New	27	10,775	1	1		336	4,565,788	4,565,788	5,250,657	6,038,255	7%	93%	450,149	5,588,106
9-P9	Gravity Main	Third St	From ext. of David St to 9th Ave	-	New	12	2,750				228	626,003	626,003	719,903	827,889	0%	100%	0	827,889
9-P10	Gravity Main	Hanford Armona Rd	From approx 450 ft e/o 9 1/2 Ave to 9th Ave	-	New	12	1,500				228	341,456	341,456	392,675	451,576	0%	100%	0	451,576
9-P11	Gravity Main	9 1/2 Ave	From approx 300 ft s/o Third St to Hanford Armona Rd	-	New	12	3,750				228	853,640	853,640	981,686	1,128,939	0%	100%	0	1,128,939
9-P12	Gravity Main	Houston Ave	From 9th Ave to 10 1/2 Ave		New	30	7,875			1	395	3,346,232	3,346,232	3,848,167	4,425,392	7%	93%	311,967	4,113,424
9-P13	Gravity Main	10 1/2 Ave	From approx 50 ft n/o Houston Ave to Houston Ave	-	New	27	50				336	16,777	16,777	19,293	22,187	70%	30%	15,454	6,733
9-P14	Gravity Main	Houston Ave	From 10 1/2 Ave to approx 500 ft w/o 10 1/2 Ave	-	New	36	725	1			491	619,831	619,831	712,806	819,727	40%	60%	325,862	493,865
												Subtotal - 9th Avenue Trunk	16,406,175	18,867,102	21,697,167			1,455,860	20,241,307
10th Avenue Trunk																			
Pipeline Capacity Improvements																			
10-P1	Gravity Main	10th Ave	From approx 100 ft n/o Lakewood Dr to 200 ft s/o Lakewood Dr	12	Replace	15	300				239	71,844	71,844	82,621	95,014	65%	35%	61,759	33,255
10-P2	Gravity Main	10th Ave	From approx 150 ft s/o Cross Ave to Grangeville Blvd	12	Replace	18	575				258	148,293	148,293	170,537	196,118	73%	27%	143,166	52,952
Slope Deficiency Improvements																			
10-P3 [6]	Gravity Main	Lacey Blvd	From 9 1/4 Ave to 9th Ave	10	Replace	10	1,300				222	289,086	289,086	332,449	382,317	50%	50%	191,158	191,158
												Subtotal - 10th Avenue Trunk	509,224	585,607	673,448			396,083	277,365
10 1/2 Avenue																			
Slope Deficiency Improvements																			
10½-P1	Gravity Main	Irwin St	From Third St to Hanford Armona Rd	24	Replace	24	3,350				291	974,170	974,170	1,120,295	1,288,339	79%	21%	1,017,090	271,249
												Subtotal - 10 1/2 Avenue Trunk	974,170	1,120,295	1,288,339			1,017,090	271,249
Irwin St Trunk																			
Slope Deficiency Improvements																			

Table 8.2 Capital Improvement Program

Sewer System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements: Existing Diameter (in)	Pipeline Improvements: New/Parallel/Replace	Pipeline Improvements: Diameter (in)	Pipeline Improvements: Length (ft)	Casings: Railroad	Casings: Highway	Casings: Canal/ Slough	Infrastructure Costs: Pipe Unit Cost ($/unit)	Infrastructure Costs: Pipe Cost [1,2] ($)	Baseline Constr. Consts ($)	Estimated Constr. Costs [3] ($)	Capital Improv. Costs [4] ($)	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Cost Sharing: Existing Users ($)	Cost Sharing: Future Users ($)
IRW-P1	Gravity Main	Lacey Blvd	From Redington St to Irwin St	15	Replace	15	525				239	125,727	125,727	144,586	166,274	92%	8%	152,719	13,555
IRW-P2	Gravity Main	Irwin St	From Lacey Blvd to Fourth St	20, 24	Replace	21	1,850	1			280	729,700	729,700	839,155	965,028	79%	21%	766,182	198,847
IRW-P3	Gravity Main	Irwin St	From Fourth St to 3rd St	24, 30	Replace	24	500		1		291	778,998	778,998	895,848	1,030,225	79%	21%	818,544	211,681
IRW-P4	Gravity Main	Grangeville Blvd	From Douty St to Irwin St	12	Replace	12	525				228	119,510	119,510	137,436	158,051	96%	4%	151,099	6,952
												Subtotal - Irwin Street Trunk	1,753,935	2,017,025	2,319,579			1,888,544	431,036
Industrial Trunk																			
Pipeline Capacity Improvements																			
IND-P1	Gravity Main	10th Ave	From approx 2,300 ft n/o Iona Ave to Iona Ave	-	New	12	2,300				228	523,566	523,566	602,101	692,416	0%	100%	0	692,416
IND-P2	Gravity Main	Iona Ave	From future 9 1/2 Ave to ext. of 10th Ave	-	New	12	2,675			1	228	749,730	749,730	862,190	991,518	0%	100%	0	991,518
IND-P3	Gravity Main	Iona Ave	From 10th Avenue to 10 1/2 Ave	12	Replace	15	2,125				239	508,895	508,895	585,229	673,013	0%	100%	0	673,013
IND-P4	Gravity Main	ext. 10 1/2 Ave	From Iona Ave to Industry Ave	12	Replace	18	2,675				258	689,886	689,886	793,369	912,374	6%	94%	53,771	858,603
IND-P5	Gravity Main	ext. 10 1/2 Ave	From approx 600 ft s/o Industry Ave to Industry Ave	12	Replace	18	600				258	154,741	154,741	177,952	204,645	12%	88%	24,979	179,666
IND-P6	Gravity Main	Future ROW	From future 9 1/2 Ave to ext. of 10 1/2 Ave	-	New	12	5,225			1	228	1,330,205	1,330,205	1,529,736	1,759,197	0%	100%	0	1,759,197
IND-P7	Gravity Main	ext. 10 1/2 Ave	From 3,100 ft s/o Idaho Ave to Idaho Ave	6	Replace	15	3,250				239	778,309	778,309	895,056	1,029,314	32%	68%	329,018	700,296
IND-P8	Gravity Main	Idaho Ave	From approx 2,600 ft w/o 11th Avenue to 11th Avenue	-	New	12	2,650				228	603,239	603,239	693,725	797,784	32%	68%	252,053	545,730
IND-P9	Gravity Main	Industry Ave	From 11th Avenue to Crown Avenue	12	Replace	18	1,325				258	341,719	341,719	392,977	451,924	31%	69%	139,155	312,768
IND-P10	Gravity Main	11th Ave	From approx 420 ft s/o Industry Ave to Industry Ave	-	New	15	425				239	101,779	101,779	117,046	134,603	0%	100%	0	134,603
IND-P11	Gravity Main	Future ROW	From future 11 1/2 Ave to 11th Ave	-	New	15	2,600				239	622,647	622,647	716,045	823,451	0%	100%	0	823,451
IND-P12	Gravity Main	Future 11 1/2 Ave	From approx 1,350 ft s/o Iona Ave to approx 420 ft s/o Industry Ave	-	New	15	1,325				239	317,311	317,311	364,907	419,643	19%	81%	77,724	341,919
IND-P13	Gravity Main	Future 11 1/2 Ave	From approx 2,530 ft n/o Iona Ave to approx 1,350 ft s/o Iona Ave	-	New	12	3,975			1	228	1,045,659	1,045,659	1,202,507	1,382,884	0%	100%	0	1,382,884
IND-P14	Gravity Main	Iona Ave	From 12th Ave to future 11 1/2 Ave	-	New	12	2,650				228	603,239	603,239	693,725	797,784	0%	100%	0	797,784
IND-FM1	Force Main	ext. 10 1/2 Ave	From Industry Ave to Houston Ave	12	Replace	18	7,275				258	1,876,232	1,876,232	2,157,667	2,481,317	11%	89%	266,908	2,214,409
Lift Station Improvements						Firm Capacity													
IND-LS41I	Lift Station	Industry Ave	1,300 e/o Crown Ave		Replace	2 @ 1,500 gpm						1,552,759	1,552,759	1,785,673	2,053,524	11%	89%	220,891	1,832,632
IND-LS1	Lift Station	Iona Ave	Intersection of Iona Ave and 10th Ave		New	1 @ 500 gpm						512,425	512,425	589,289	677,682	0%	100%	0	677,682
IND-LS2	Lift Station	Future 11 1/2 Ave	2,650 ft s/o Iona Ave		New	1 @ 500 gpm						512,425	512,425	589,289	677,682	0%	100%	0	677,682
												Subtotal - Industrial Avenue Trunk	12,824,767	14,748,482	16,960,754			1,364,501	15,596,253
												Subtotal - Pipeline Capacity Improvements	35,300,112	40,595,129	**46,684,398**			**5,901,186**	**40,783,211**
												Subtotal - Lift Station Improvements	4,813,966	5,536,061	**6,366,470**			**779,165**	**5,587,305**
												Total Improvement Costs	40,114,078	46,131,190	**53,050,868**			**6,680,352**	**46,370,517**

AKEL ENGINEERING GROUP, INC.

Notes:

6/6/2017

1. Railroad and canal/slough casings assumed at a length of 200 feet. Highway casings assumed at a length of 600 feet.
2. Unit costs based on a January 2017 ENR CCI of 10,532.
3. Baseline construction costs plus 15% to account for unforeseen events and unknown conditions.
4. Estimated construction cost plus 15% to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs.
5. Improvement 9-P3 is meant to redirect flow from Lift Station 64 to the 9th Avenue Trunk.
6. Improvement 10-P2 is meant to redirect flow from Lift Station 47 to the 9th Avenue Trunk.

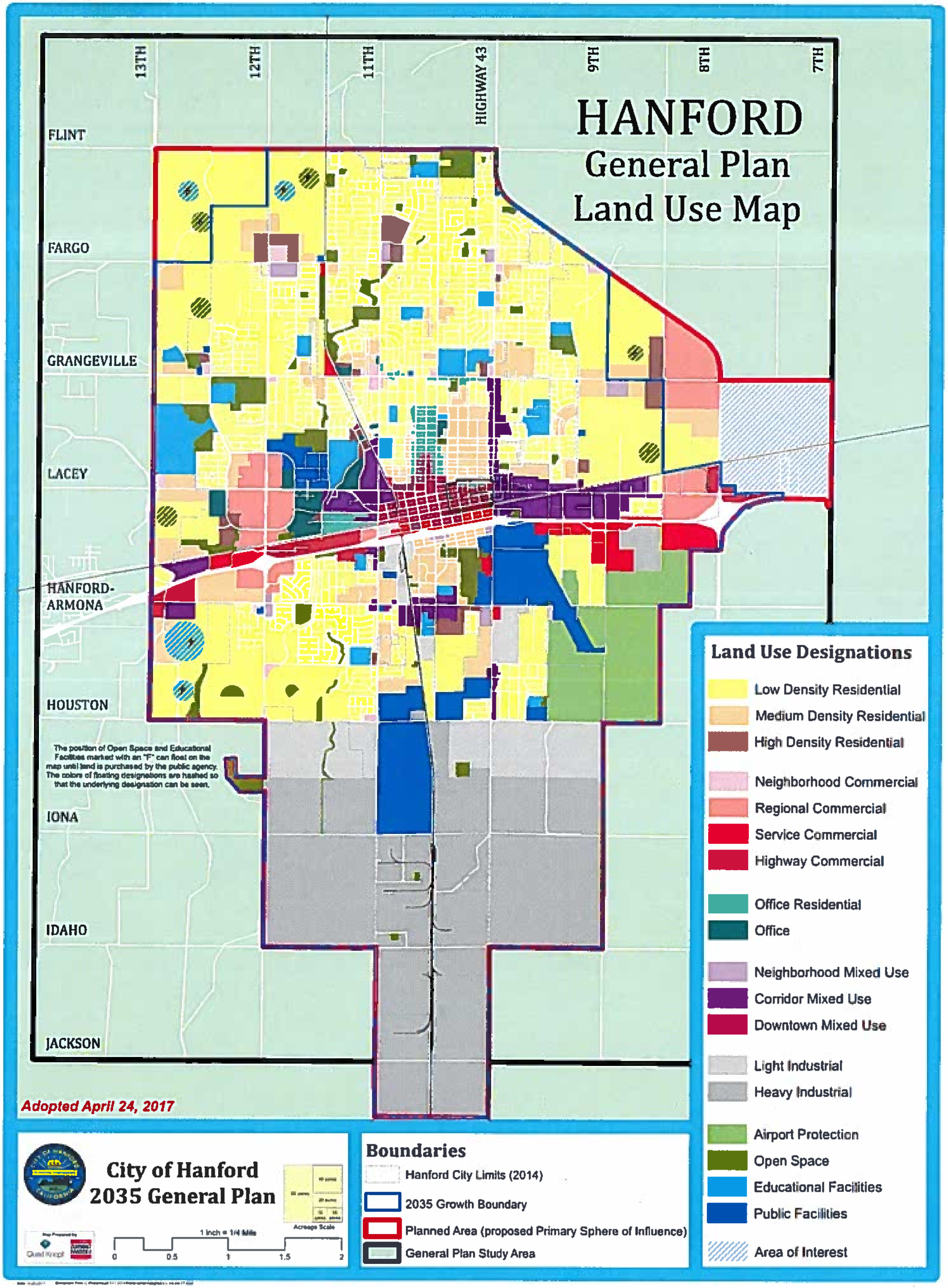
improvement is meant to mitigate existing pipe deficiencies and comply with minimum slope design criteria. However, this study recommends an investigation of the alignment during the pre-design stage of each project.

8.3.2 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. 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 8.2** 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.

APPENDIX A

General Plan Land Use Map



HANFORD
General Plan
Land Use Map
13TH
12TH
11TH
HIGHWAY 43
9TH
8TH
7TH
FLINT
FARGO
GRANGEVILLE
LACEY
HANFORD-
ARMONA
HOUSTON
IONA
IDAHO
JACKSON
The position of Open Space and Educational Facilities marked with an "F" can float on the map until land is purchased by the public agency. The colors of floating designations are hashed so that the underlying designation can be seen.
Adopted April 24, 2017
Land Use Designations
Low Density Residential
Medium Density Residential
High Density Residential
Neighborhood Commercial
Regional Commercial
Service Commercial
Highway Commercial
Office Residential
Office
Neighborhood Mixed Use
Corridor Mixed Use
Downtown Mixed Use
Light Industrial
Heavy Industrial
Airport Protection
Open Space
Educational Facilities
Public Facilities
Area of Interest
City of Hanford
2035 General Plan
1 inch = 1/4 Mile
0
0.5
1
1.5
2
Acreage Scale
Boundaries
Hanford City Limits (2014)
2035 Growth Boundary
Planned Area (proposed Primary Sphere of Influence)
General Plan Study Area