CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

VOLUME ONE

NOVEMBER 2007

NOLTE

BEYOND ENGINEERING

CITY OF RIVERBANK

2007 SEWER COLLECTION SYSTEM MASTER PLAN

Volume One

November 2007

Submitted to:

City of Riverbank
Department of Public Works
6707 Third Street
Riverbank, CA 95367

Prepared by:

Nolte Associates, Inc.
1215 West Center Street, Suite 201
Manteca, CA 95337
(209) 239-9080 ▪ (209) 239-4166 (Fax)

CONTENTS

Volume One

LIST OF TABLES

LIST OF FIGURES

Page

LIST OF PLATES

Volume Two

Appendices:

LIST OF ABBREVIATIONS

The following abbreviations are used in this report:

ac	Acres
ADWF	Average Dry Weather Flow
CIP	Capital Improvement Program
d/D	Ratio of depth of flow within pipe to pipe diameter
du/ac	Dwelling Units/Acre
ft	Feet/Foot
ft/sec	Feet per Second
GIS	Geographical Information System
gpd	Gallons per Day
gpd/ac	Gallons per Day per Acre
gpm	Gallons per Minute
hp	Horsepower
I/I	Infiltration and Inflow
mgd	Million Gallons per Day
MID	Modesto Irrigation District
OD	Outside Diameter
PDWF	Peak Dry Weather Flow
PF	Peaking Factor (diurnal)
PWWF	Peak Wet Weather Flow
SCADA	Supervisory Control and Data Acquisition
SF	Square Feet/Foot
SR	State Route
SSMP	Sanitary Sewer Management Plan
TM	Technical Memorandum
WGF	Wastewater Generation Factor
WWTP	Wastewater Treatment Plant

1 Introduction

In support of a new General Plan, a sewer collection system master plan is required. This 2007 Master Plan (2007 Master Plan) will serve as a basis for sewer collection infrastructure and as an aide to assessing the impact of new and future development. These tools will allow the City to plan, coordinate, and phase required system upgrades as new developments come on-line. In addition, the 2007 Master Plan will serve as a significant database for subsequent incorporation into a Sanitary Sewer Management Plan (SSMP). Background information, intended master planning tasks, and a brief discussion of the SSMP requirements are presented in this chapter.

1.1 Background and Purpose

In 2007, the City of Riverbank (City) will adopt the General Plan Policy Document (General Plan) [1] which identifies areas to be developed within the City to the year 2025. The General Plan extends the areas to be served by the City sewer collection system beyond areas identified in the previous 2001 Sewer System Master Plan (2001 Master Plan) [2].

As of March 2007, the City population is approximately 22,000 people. The area within the City encompasses approximately 2,400 acres (ac). The expansion of areas to be served by the municipal sewer system will increase anticipated wastewater flows and may require upsizing of trunk sewers. Additionally, investigating the condition and capacity of the existing sewer collection system would be useful for master planning and capital improvement program (CIP) development purposes. Considering these factors, a new master plan is warranted.

The primary objective of this 2007 Master Plan is to ensure that the City sewer collection system can adequately meet the development goals adopted in the General Plan. In particular, the 2007 Master Plan will address the following:

1. Projected wastewater flows for various land uses from the General Plan.

2. Design of trunk sewers to accommodate expanded service areas.

3. Upgrades to the existing collection system.

4. Phased CIP that provides appropriate infrastructure to support growth while remedying existing system deficiencies.

1.2 Scope of Master Plan

The following tasks were completed as part of the 2007 Master Plan:

1. Updated existing collection system information and prepared a sewer system map.
2. Revised wastewater generation factors (WGFs) for residential service based on historical data.
3. Cataloged existing collection system deficiencies based on interviews with City staff and a review of historical records.
4. Monitored flow in the existing collection system and confirmed WGFs.
5. Determined a peaking factor (PF) based on flow monitoring data.
6. Identified an appropriate infiltration/inflow (I/I) rate based on flow monitoring data.
7. Projected future wastewater flows using General Plan land use information, WGFs, PF, and I/I information.
8. Modeled the existing collection system to identify available capacity and existing collection system deficiencies.
9. Recommended piping improvements within the collection system to correct operational deficiencies.
10. Developed a CIP which identified specific wastewater-related infrastructure to support the new General Plan.

Each of these tasks is summarized in the following chapters.

1.3 Sanitary Sewer Management Plan

On May 2, 2006, the State Water Resources Control Board (SWRCB) adopted Order No. 2006-003, Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (Order). The goal of the Order is to reduce the occurrence of sanitary sewer overflows (SSOs) by requiring agencies to properly operate, maintain, and manage their wastewater collection system. The Order requires all agencies that own or operate sanitary sewer collection systems greater than one mile in length to enroll in an electronic reporting program for SSOs and develop and implement a Sanitary Sewer Management Plan (SSMP). The largest component for complying with the Order is the SSMP. The SSMP consists of eleven sections as follows:

Section Designation	Title
I	Goals
II	Organization
III	Legal Authority
IV	Operations and Maintenance Program
V	Design and Performance Provisions
VI	Overflow Emergency Response Plan
VII	System Evaluation and Capacity Assurance Plan
IX	Monitoring, Measurement, and Plan Modifications
X	SSMP Program Audits
XI	Communication Program

As noted earlier, the 2007 Master Plan represents a significant database that can be folded into the required SSMP. To comply with the Order, the City has also initiated the following:

1. Applied for coverage under the Order
2. Enrolled in SSO online database and completed collection system questionnaire

In addition, a summary of required tasks and a suggested time line for completion are provided in Table 1-1.

TABLE 1-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
IMPLEMENTATION TASKS FOR SSMP

Task	Suggested Completion Date
Prepare development plan and schedule (DPS) for completing SSMP	November 1, 2007[a]
Certify development plan and schedule for completing SSMP	November 1, 2007[a]
Complete Sections I and II of SSMP	November 1, 2007[a]
Complete and implement Sections III, IV, VI, and VII	January 2009
Complete and Implement Sections V, VIII, IX, X, and XI	June 2009
Certify final SSMP	June 2009

[a] Required Completion Date

2 Summary of Previous Sewer Master Plan

The 2007 Master Plan was developed based partly on information provided in previous sewer master plans. The 2001 Master Plan is summarized in this chapter.

2.1 2001 Sewer System Master Plan

The 2001 Master Plan addressed the wastewater collection and treatment needs to serve approximately 30,000 people, plus a seasonal cannery discharge at then-current approved levels. The service area evaluated by the 2001 Master Plan is presented in Figure 2-1. The key facilities that were proposed in the 2001 Master Plan included the First Street and Condray Avenue trunk lines, Crawford Road Pump Station, South Roselle/Claribel sewer main, and Roselle/Railroad force main.

2.2 Summary of Proposed Improvements

The 2001 Master Plan established a program to replace and/or upgrade eight sewer lift stations over a ten-year period. The upgrades included replacing pumps and controls, adding portable generator connection points with manual transfer switches, connecting each station to the Supervisory Control and Data Acquisition (SCADA) system, and replacing float-type controllers.

The following improvements were also recommended in the 2001 Master Plan (see Figure 2-2):

1. Replacement of the 15-inch to 18-inch main with a 30-inch to 36-inch line in Condray Avenue between the City corporation yard and Sierra Street.

2. Construction of the Crawford Road Pump Station.

3. Construction of an 18-inch sewer line in Crawford Road.

4. Construction of the Roselle Avenue force main.

5. Replacement of the 10-inch sewer main from Jackson and Stanislaus Street to Topeka and State Route (SR) 108 with a 15-inch to 18-inch line.

6. Construction of a 12-inch main from Claus Road and Sierra Street to Santa Fe and Snedigar Avenue.

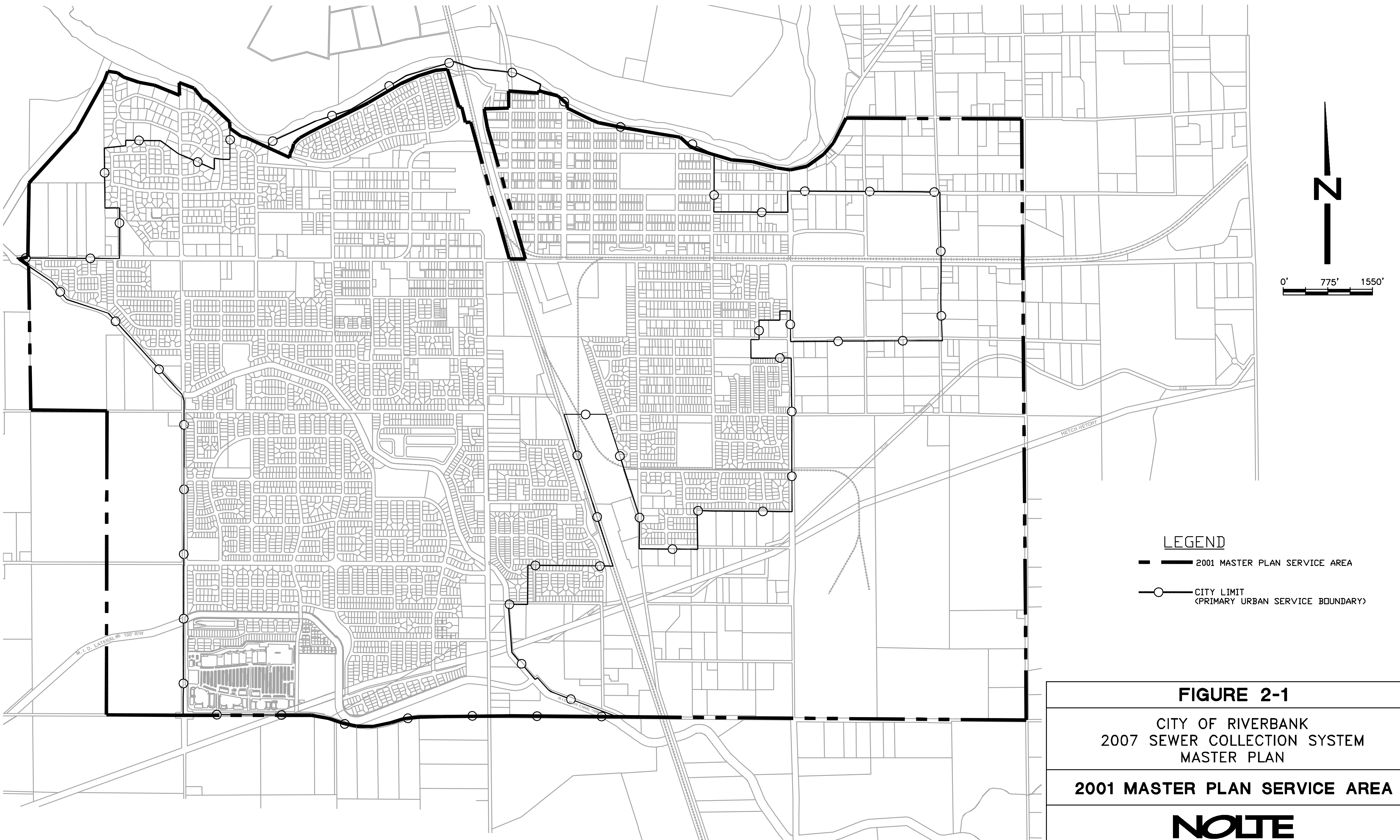


FIGURE 2-1

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

2001 MASTER PLAN SERVICE AREA

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 2-1.dwg SM 11/13/2007

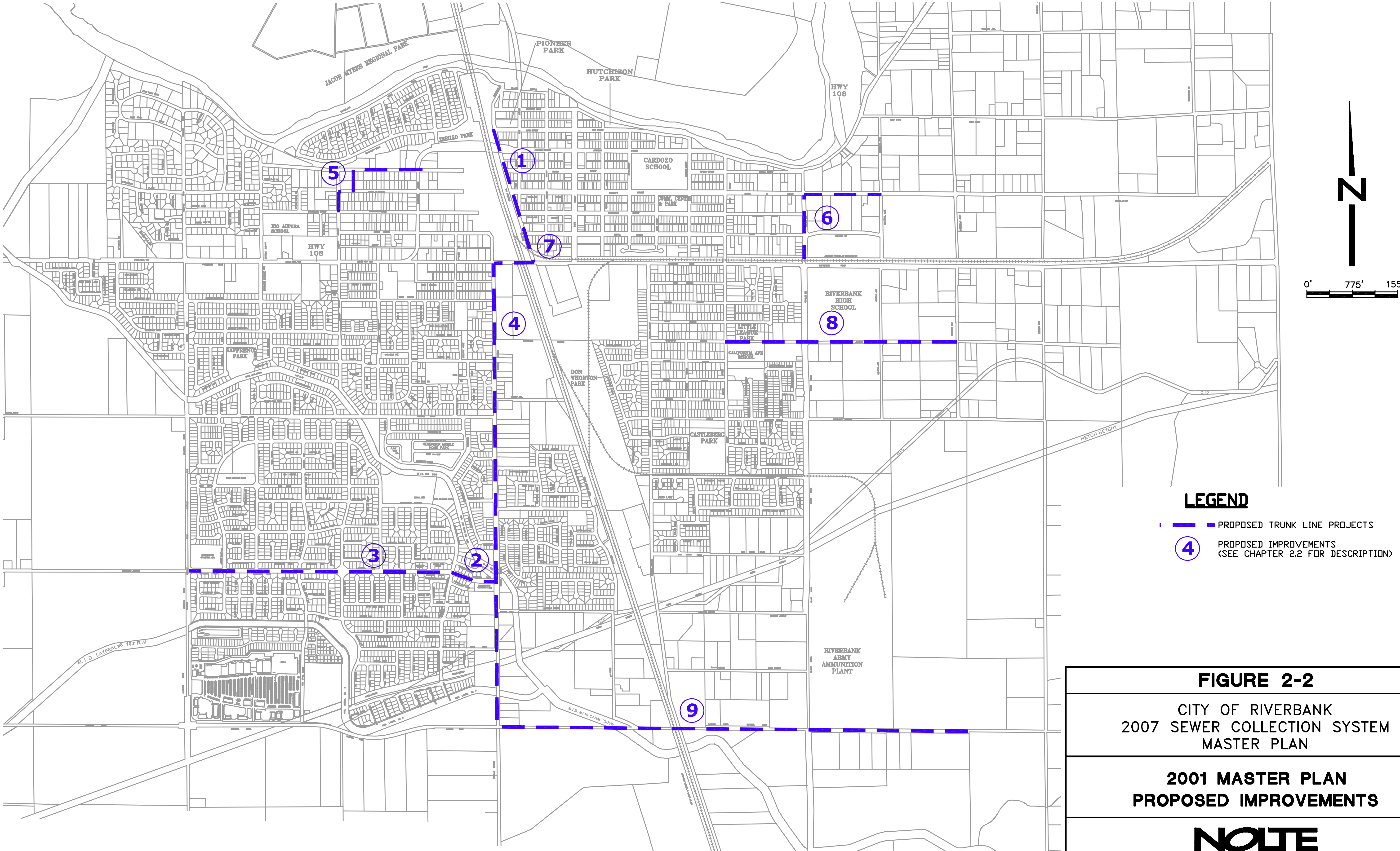


FIGURE 2-2

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

2001 MASTER PLAN PROPOSED IMPROVEMENTS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 2-2.dwg SM 11/13/2007

7. Replacement of the 12-inch main in First Street between Patterson Street and Sierra Street with an 18-inch to 21-inch line.

8. Construction of an 18-inch main in California Avenue between Eighth Street and Snedigar Avenue.

9. Construction of the South Roselle and Claribel sewer main.

10. Connection of each pump station to the City SCADA system.

2.3 Completed Projects from 2001 Master Plan

A new lift station (Crawford Road Pump Station) was constructed as recommended in the 2001 Master Plan. The service area of the pump station includes the Crossroads residential area and other areas south and east of the Modesto Irrigation District (MID) Main Canal. An 18-inch trunk line was also installed within Crawford Road to feed the Crawford Road Pump Station. As identified in the 2001 Master Plan, the 15-inch and 18-inch lines in Condray Avenue have been replaced with a 30-inch line to Sierra Street. The 10-inch sewer main from Jackson and Stanislaus Streets to Topeka Street and SR 108 has also been replaced with an 18-inch sewer line. Completed master plan projects are illustrated in Figure 2-3.

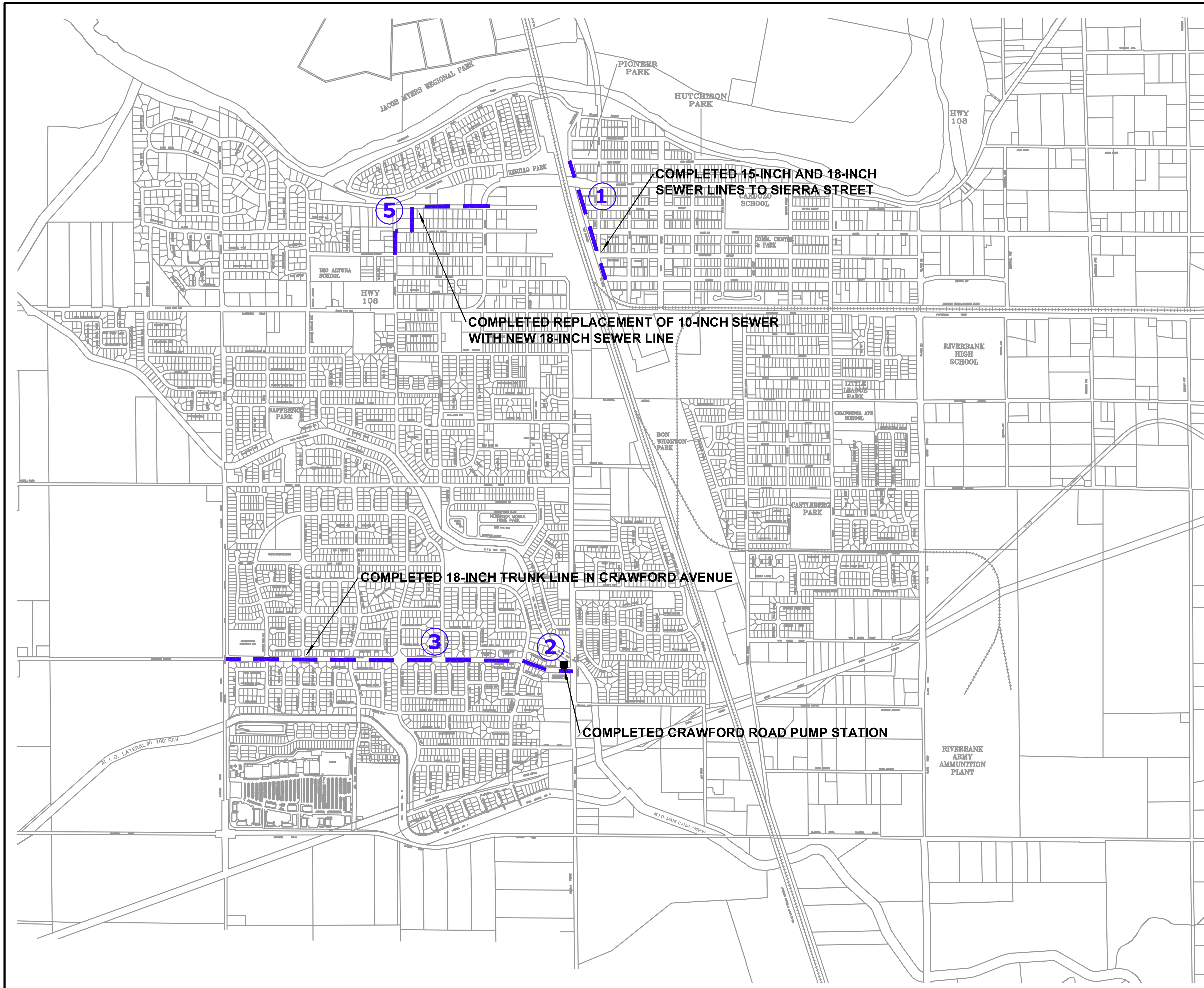


FIGURE 2-3

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

COMPLETED 2001 MASTER PLAN PROPOSED IMPROVEMENTS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 2-3.dwg SM 11/13/2007

3 Existing Conditions

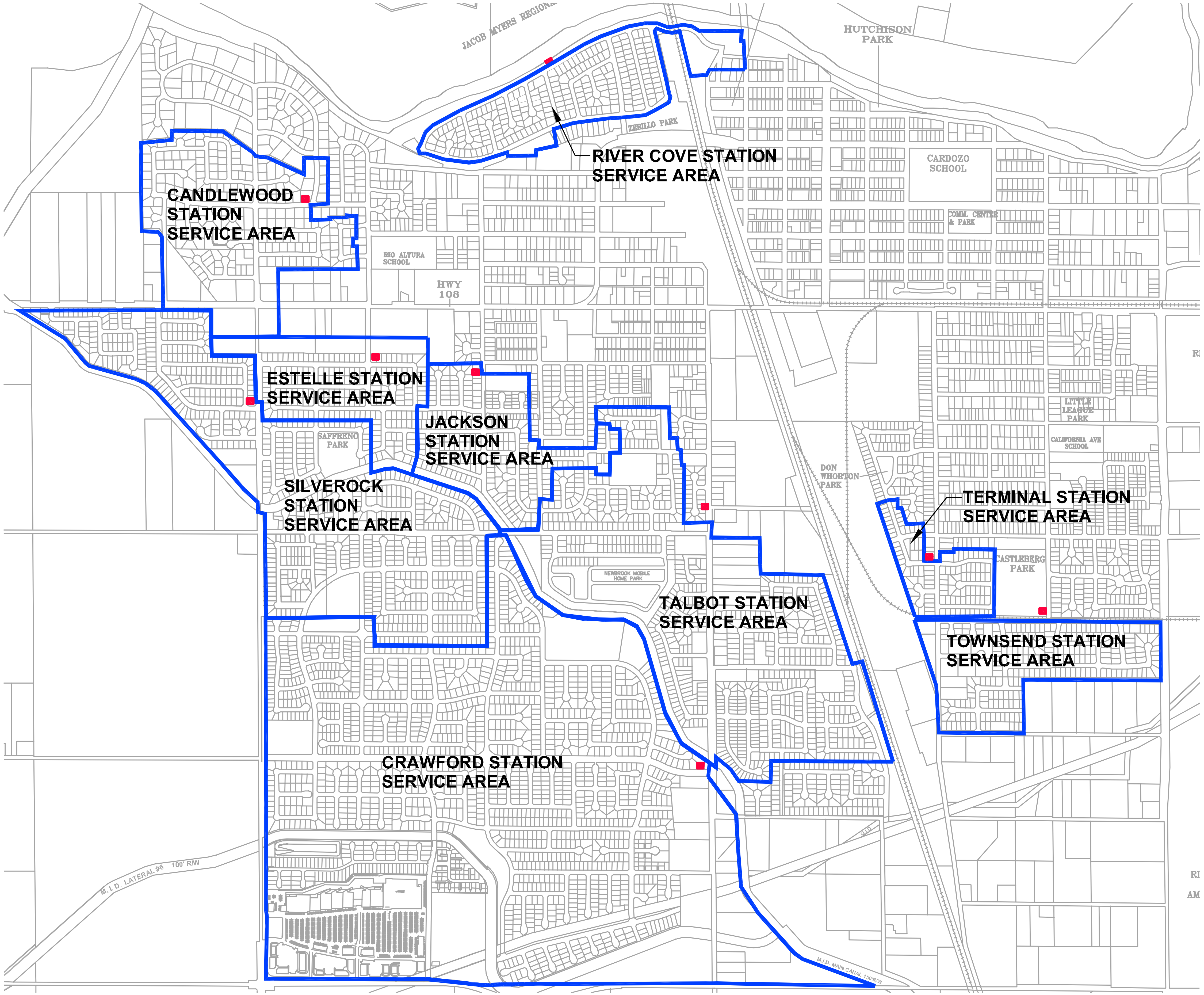
As an initial step in developing the 2007 Master Plan, information regarding the existing collection system was compiled. The wastewater collection system map was updated with manhole rim and invert elevations for lines 10-inches and larger. This chapter reviews the characteristics of the existing collection system and describes problematic areas.

3.1 Characteristics of the Existing Sewer System

The City sewer system consists of 6-inch to 36-inch diameter collection piping, nine lift/pump stations, and a wastewater treatment plant (WWTP) located on the north side of the Stanislaus River in San Joaquin County. Table 3-1 presents a list of the wastewater pump stations. The collection system serves the existing City, approximately bound by the Stanislaus River, Hetch Hetchy right-of-way, Oakdale Road, and Claus Road. All wastewater is conveyed from the collection system to the WWTP through a 27-inch outside diameter (OD) gravity line located on a trestle over the Stanislaus River. A map of the existing sewer collection system depicting gravity sewers and existing wastewater pump stations is provided as Plate 3-A. Existing pump station service areas are illustrated in Figure 3-1.

TABLE 3-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF WASTEWATER PUMP STATIONS

Station	Location	Number of Pumps	Capacity, (gpm) each	Horsepower, (hp) each
Candlewood	Candlewood at Arrowwood	2	500	10
Estelle	Colony Manor at Estelle	2	850	4.7
Jackson	Jackson at Ward	2	700	5
Talbot	Roselle at Talbot	2	619	4.7
		1	1,180.9	12
		1	840	10
Terminal	Terminal at Virginia	2	250	2
Townsend	Townsend at Eighth	2	250	2.7
River Cove	River Cove Drive	2	481	15
Crawford	Crawford at Roselle	2	1,544	28
		1	3,171	33.5
Silverock	Silverock at Oakdale	2	500	8.5



N

SCALE: 1"=1200'

0 600' 1200'

LEGEND

PUMP STATION SERVICE AREA BOUNDARY

PUMP STATION

FIGURE 3-1

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

EXISTING PUMP STATION SERVICE AREAS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 3-1.dwg SM 11/13/07

There are 6,162 existing sewer connections in the City as of December 2006. A summary of the historical increase in sewer connections is presented in Table 3-2.

TABLE 3-2
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SEWER CONNECTION INFORMATION FOR 2003-2006

Year	Residential	Commercial	Industrial	Government	Other	Total
2003	3,729	124	4	11	10	3,878
2004	5,347	147	4	11	10	5,519
2005	5,742	151	4	11	11	5,919
2006	5,947	186	5	11	13	6,162

As part of evaluating the existing sewer system, SFE Global monitored five locations in the City sewer collection system for a period of approximately 9½ weeks (February 16, 2007 to April 25, 2007). A summary of the results of the flow monitoring was documented in the TM *Flow Monitoring Field Data Report Conducted by SFE Global NW* (June 2007) [3].

3.2 Problematic Areas

Existing storm water inflow areas were identified based on feedback from City staff and results from flow monitoring data. City staff identified Terminal Avenue as an area known to have cross-connections between the sanitary sewer and storm drain systems. During heavy rains, the sewer system becomes overloaded and flooding is known to occur. Data from the SFE flow monitoring study supports these occurrences [3]. Areas of suspected storm water inflow are illustrated in Figure 3-2.

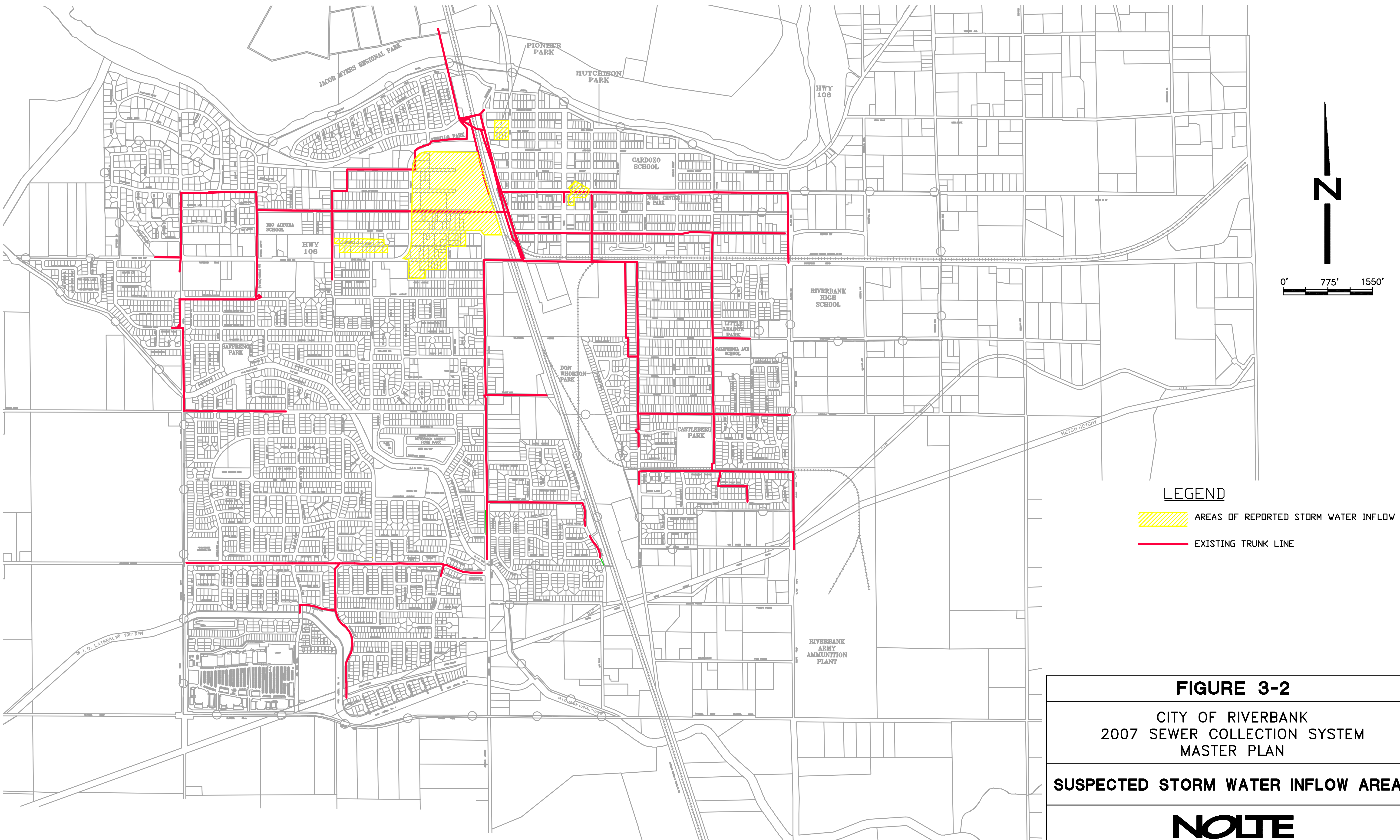


FIGURE 3-2

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

SUSPECTED STORM WATER INFLOW AREAS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 3-2.dwg SM 11/13/2007

4 Background Information - Design Criteria

Design criteria for the 2007 Master Plan is based on the technical memorandum (TM) *Summary of Proposed Design Criteria* (April 2007) [4]. The TM includes a discussion of the study area boundaries, land use, wastewater generation factors, and hydraulic parameters. Each is discussed in this chapter.

4.1 Study Area

The study area for the 2007 Master Plan is based on the secondary urban service boundary, which is the total planning area presented in the General Plan Land Use Diagram (Plate 4-A). For master planning purposes, the 2007 Master Plan study area extends beyond the current City limits and primary urban service boundary. The limits of the study area are shown in Figure 4-1.

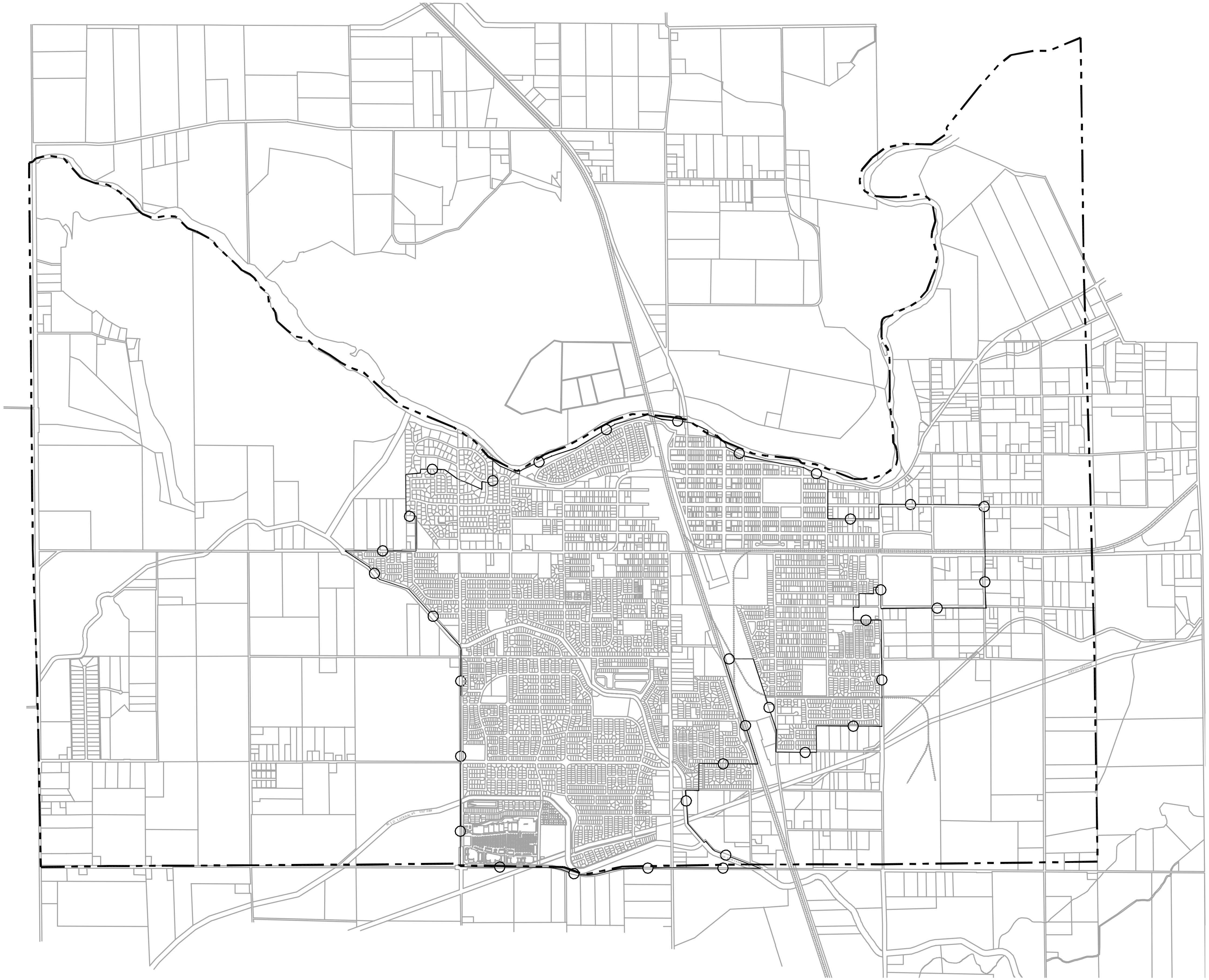
4.2 Land Use Assumptions

Information from the General Plan Land Use Map was used to project wastewater flows. Areas of infill within the existing City limits were also considered.

Existing and future land uses within City limits are divided into seven categories:

1. Medium Density Residential (MDR)
2. Low Density Residential (LDR)
3. Commercial (C)
4. Industrial (I)
5. School (SC)
6. Park (P)
7. Open Space (OS)

Assumptions for percentage of roadways and dwelling units per acre (du/ac) for each land use category for the residential areas are presented in Table 4-1.



N

0' 1300' 2600'

LEGEND

GENERAL PLAN STUDY AREA (SECONDARY URBAN SERVICE BOUNDARY)

CITY LIMIT (PRIMARY URBAN SERVICE BOUNDARY)

FIGURE 4-1

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

2007 MASTER PLAN STUDY AREA

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 4-1.dwg SM 11/13/2007

TABLE 4-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
ASSUMPTIONS FOR LAND USE AREAS WITHIN CITY LIMITS

Land Use	Roads (%)	Density (du/ac)
Medium Density Residential	30	5.5-6.5
Infill Development[a]	30	6.0
Low Density Residential (lot size ≤1 ac)	-	1.5-2.3
Low Density Residential (lot size >1 ac)[b]	-	-
Commercial	30	-
Industrial	30	-
School	-	-
Park	-	-
Open Space (Future Parks)	-	-

[a] All Infill areas within City limits are assumed to be Medium Density Residential.
[b] Demand factor unit is gallons per day per acre (gpd/ac).

As noted earlier, an updated General Plan will be approved by the City. The updated General Plan presents planned land usage for areas currently outside of the City limits. These land uses are divided into twelve categories:

1. Agricultural Resource Conservation Area (ARCA)
2. Buffer Greenway Open Space (BGOS)
3. Clustered Rural Residential (CRR)
4. High Density Residential (HDR)
5. Industrial-Business Park (IBP)
6. Infill Opportunity Area (IOA)
7. Low Density Residential (LDR)
8. Medium Density Residential (MDR)
9. Mixed Use Office Retail Residential (MUORR)
10. Multi Use Recreation (MUR)
11. Park (P)
12. School-Civic (SC)

Assumptions for percentage of roadways for each land use category, densities, and household sizes, were obtained from the General Plan consultants (EDAW). The assumptions for General Plan areas are presented in Table 4-2.

TABLE 4-2
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
GENERAL PLAN LAND USE ASSUMPTIONS

Land Use	Roads (%)	Density (du/ac)	Household Size[a]	FAR[b]	Non-Residential Development per Acre (SF)
Agricultural Resource Conservation Area	-	-	-	-	-
Buffer Greenway Open Space	-	-	-	-	-
Clustered Rural Residential	-	0.2	3.11	-	-
High Density Residential	30	18.0	2.18	-	-
Industrial-Business Park	30	-	-	0.25	-
Infill Opportunity Area:					
Downtown	-	0.9	2.18	0.51	997
West Riverbank	-	1.6	2.18	0.26	217
Low Density Residential	30	5.0	3.11	-	-
Medium Density Residential	30	10.0	3.00	-	-
Mixed Use Office Retail Residential[c,d]	30	18.0	2.18	0.25	-
Multi Use Recreation	-	-	-	-	-
Park	-	-	-	-	-
School-Civic	-	-	-	-	-

[a] Population/dwelling unit.
[b] Floor area ratio.
[c] 80% Non-Residential, 20% Residential
[d] MUORR5 and MUORR9 100% Non-Residential

4.3 Wastewater Generation Factors (WGFs)

Wastewater generation factors are used to estimate the amount of sewage that can be attributed to a specific land use. Recommended WGFs for both existing and future development land use areas for the City are summarized in Table 4-3. The methodology used for determining WGFs is discussed in Chapter Five.

TABLE 4-3
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
WASTEWATER GENERATION FACTORS FOR EXISTING AND FUTURE DEVELOPMENT AREAS

Land Use	Wastewater Generation Factor(gpd/ac)	
	Existing	Future
Agricultural Resource Conservation Area	-	0
Buffer Greenway Open Space (Open Space)	-	0
Clustered Rural Residential	-	100
High Density Residential	-	4,000
Industrial-Business Park (Industrial)	300	1,500
Low Density Residential	600	1,500
Medium Density Residential	1,500	2,500
Infill Opportunity Area:		
Downtown, Non-Residential	-	2,225
Downtown, Residential	-	2,225
West Riverbank, Non-Residential	-	1,850
West Riverbank, Residential	-	1,850
Mixed Use Office Retail Residential:		
Non-Residential (Commercial)	1,400	1,760
Residential	-	1,760
Multi Use Recreation	-	425
Park	1,400	400
School-Civic	200	425

The 2001 Master Plan incorporated the following assumptions:

1. Average Dry Weather Flow (ADWF) – 100 gallons per capita per day.

2. PF – 2.5 including I/I.

4.4 Peaking Factor

A flow monitoring study was conducted in 2007, and Figure 4-2 presents the PF curve developed from an analysis of the flow monitoring data collected (Volume Two, Appendix A). Because the flow range for the data is not broad enough to illustrate the inverse relationship between PF and

ADWF, a peaking factor of 1.6 will be used for flows of 1.5 mgd or larger based on historical data from similar communities. A PF of 2.0 is recommended for flows less than 1.5 mgd.

4.5 Inflow/Infiltration Allowance

An I/I allowance of 1,000 gpd/ac for the City was estimated from the results of the 2007 flow monitoring study (see Volume Two, Appendix A). The I/I allowance will be added to peak dry weather flows to simulate peak wet weather flows (PWWF).

4.6 Gravity Pipelines

Key design criteria for the sewer collection system are as follows:

1. New gravity wastewater lines should be 8-inches or larger in nominal diameter. Terminal runs that have no potential for further extension, such as cul-de-sacs, may be 6-inch diameter. Standards and requirements for sewer mains and laterals larger than 15-inches are determined by the City Engineer.

2. Sewers are sized to flow between 40 and 70 percent full (d/D between 0.4-0.7).

3. Minimum velocity of 2 feet per second (ft/sec) at PWWF should be attained. Maximum velocity should not exceed 10 ft/sec at design flow rate.

4. A Manning's "n" of 0.013 will be assumed for all new trunk sewers. A Manning's "n" of 0.015 will be assumed for all existing trunk sewers.

5. Maximum depth of cover for trunk sewers is 30 feet (ft). Minimum depth of cover for trunk sewers is 6 ft.

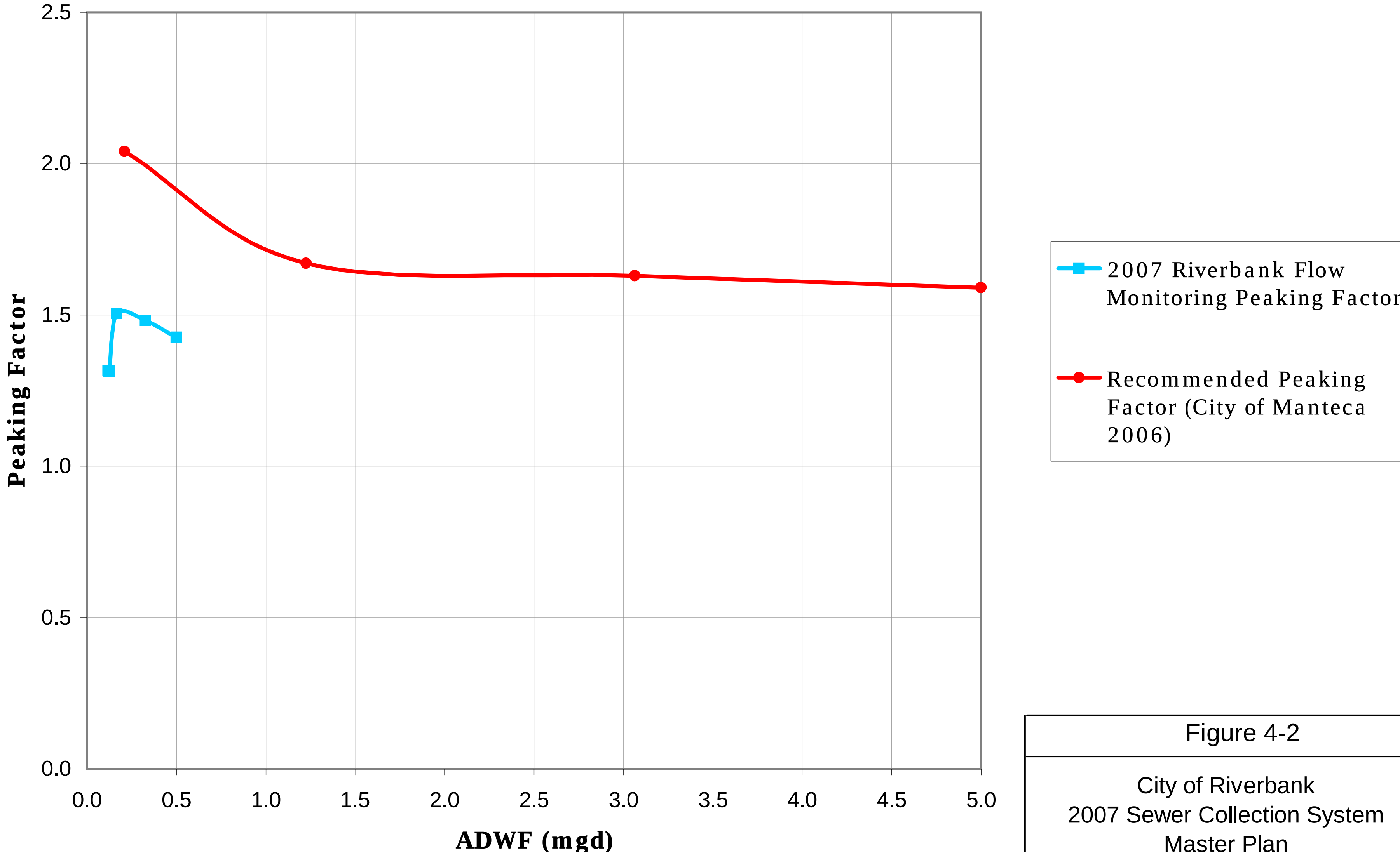


Figure 4-2

City of Riverbank
2007 Sewer Collection System
Master Plan

Peaking Factor Curve

4.7 Gravity Service Area Limits

Limits for gravity service areas were based on the following criteria:

1. Minimum depth of cover of 3 ft from existing or planned final grade.

2. Slope of 0.0035 ft/ft, which corresponds to the City standard for an 8-inch diameter sanitary sewer profile.

4.8 Force Main Criteria

Key design criteria for force mains are as follows:

1. Minimum velocity of 2 ft/sec should be maintained and a maximum velocity should be 7 ft/sec. A re-suspension velocity of at least 3.5 ft/sec must be achieved each pumping cycle.

2. Force mains should slope upward to the point of downstream connection to maximize pump efficiencies.

3. Low points are not allowed. High points should be mitigated by air relief valves.

4.9 Pump Station Criteria

Lift/pump stations should be designed for compatibility with current City equipment, systems, and operation/maintenance practices. Criteria for lift/pump stations include the following:

1. A minimum of two submersible-type pumps per station should be furnished – one duty, one back-up. Peak design capacity should be available with the largest pump out of service.

2. Design pumping rate should be the PWWF for the ultimate tributary area.

3. Pump station inventory should consider the need to convey low flows effectively as well as phasing considerations.

4. Either constant speed or variable frequency drive may be used for pump station drivers.

5. Electrical service infrastructure should be sized for ultimate requirements.

6. Emergency power should be provided on site.

7. Upstream sewer mains may not be considered part of available wet well storage volume.

5 Existing and Projected Sewer Flows

To analyze the impacts of the General Plan on future infrastructure, projections of sewer flows are necessary. This chapter presents: 1) existing flows within City limits, 2) future sewer flows within City limits considering infill and future development, and 3) projected flows for General Plan areas.

5.1 Description of Methodology

Variables required in determining sewer flow projections are presented in Table 5-1.

TABLE 5-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
VARIABLES REQUIRED FOR SEWER FLOW PROJECTIONS

Variable	Unit
Type of Land Use	--
WGF	gpd/du, gpd/ac
Density (lot sizes < 1 acre)	du/ac
Household Size	number of persons/du

Using the information from Table 5-1 and as described in the *Summary of Proposed Design Criteria* [4], the following step-by-step methodology was employed:

1. A summary of existing land use within the City was developed. The summary was divided into specific land use areas based on a review of historical information.

2. Existing land use was quantified through AutoCAD measurement of electronic files furnished by the City Engineer and checked against geographical information system (GIS) data supplied by the General Plan consultant.

3. Anticipated areas within the City boundary for future development (infill) were identified and quantified similar to steps 1 and 2 above.

4. For development beyond the current City boundary, a land use summary was obtained from the General Plan consultant.

5. A rationale for estimating WGF based on historical data was confirmed through supplemental analysis.

6. A WGF was selected and assigned based on the type of land use.

7. A land use area was then multiplied by the corresponding WGF to determine ADWF in units of gpd.

8. A PF was applied to the ADWF to obtain the peak dry weather flow (PDWF).

9. An I/I factor was applied to the PDWF to obtain the PWWF which was used for infrastructure analysis and sizing.

5.2 Land Use Areas within City Limits

Existing land use within the City limits is illustrated in Plate 5-A. A breakdown of land use by geographic area within the City limits is included in Table B-1 in Volume Two, Appendix B. A summary of existing land use development within the City limits is presented in Table 5-2.

TABLE 5-2
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
EXISTING LAND USE WITHIN CITY LIMITS

Type of Land Use	Area (ac)
Medium Density Residential	1,426.5
Low Density Residential	249.6
Commercial	211.5
Industrial	208.9
School	69.4
Park	39.0
Open Space	29.8
Total	**2,235**

Additional development within the City limits is anticipated in the future. Potential future development within existing land use areas are illustrated in Plate 5-B. Areas anticipated to contain future growth are summarized in Table 5-3.

TABLE 5-3
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
AREAS ASSUMED FOR FUTURE DEVELOPMENT WITHIN CITY LIMITS

Infill Designation[a]	Area (ac)	Infill Land Use
IN #1	3.0	MDR #1
IN #2	14.5	MDR #1
IN #3	2.1	MDR #2
IN #4	3.8	MDR #2
IN #5	2.4	MDR #3
IN #6	8.2	MDR #2
IN #7	2.4	MDR #2
IN #8	4.7	MDR #2
IN #9	4.7	MDR #2
IN #10	15.5	MDR #3
IN #11	2.0	MDR #6
IN #12	1.3	MDR #4
IN #13	3.2	MDR #4
IN #14	5.1	MDR #4
IN #16	1.9	MDR #4
IN #17	2.0	MDR #4
IN #18	1.6	MDR #4
IN #19	4.8	MDR #4
IN #20	5.4	MDR #4
-	14.3	MDR #5
-	21.7	MDR #7
-	6.3	MDR #8
-	6.3	C #4
-	1.1	C #5
-	35.0	I #2
-	10.8	SC #2
Total	**184**	

[a] See Plate 5-B

5.3 Additional Land Use Areas for General Plan

The updated General Plan presents planned land usage for areas currently outside of the City limits. A summary of additional land use envisioned under the General Plan is included as Table 5-4.

TABLE 5-4
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
ADDITIONAL LAND USE PLANNED FOR GENERAL PLAN AREAS

Type of Land Use	Area (ac)
Agricultural Resource Conservation Area	1,221
Buffer Greenway Open Space	400
Clustered Rural Residential	1,266
High Density Residential	73
Industrial-Business Park	263
Infill Opportunity Area – Downtown[a]	-
Infill Opportunity Area – West Riverbank[a]	-
Low Density Residential	1,232
Medium Density Residential	656
Mixed Use Office Retail Residential	158
Multi Use Recreation	139
Park	135
School-Civic	164
Total	**5,707**

[a] Infill Opportunity Areas are areas of new growth in addition to areas already within City limits. Acreages are included in Tables 5-2 and 5-3.

5.4 Projections of Existing Sewer Flows within City Limits

Existing WGF were based on an analysis of 2006 City billing data. The methodology used in calculating unit generation factors for existing residential units was based on an analysis of historical billings and WWTP influent flows. Influent flows to the WWTP were analyzed and summarized in the *2006 Annual Monitoring Report* for the City of Riverbank [5]. Influent flows are summarized in Table 5-5.

TABLE 5-5
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
2006 RIVERBANK WASTEWATER TREATMENT PLANT INFLUENT FLOWS

Month	Flow (mgd)
January	1.93
February	1.74
March	1.98
April	2.19
May	2.01
June	1.85
July	1.68
August	1.71
September	1.68
October	1.68
November	1.70
December	1.66
Average	**1.82**

The process for approximating residential wastewater flows within the existing City was based on 2006 City billing data. According to billing records, 90% of water used could be attributed to residential connections. This same ratio was then applied to determine the residential contribution to the WWTP influent (90% of average flow of 1.82 mgd). Based on the number of residential sewer connections and the total residential wastewater flow, the existing City can be characterized by an average wastewater generation rate of 275 gpd/du. Using density information along with the per unit generation factor, initial WGFs for various land uses were determined. A list of wastewater generation factors for existing areas and future development is show in Table 4-3. A more detailed breakdown of existing sewer flows is included in Table B-2 in Volume Two, Appendix B.

5.5 Projections of Buildout Sewer Flows within City Limits and Total Future Sewer Flows for General Plan

Future WGFs apply to areas of new development within the existing City limits and new expanded areas covered in the General Plan. WGFs for future flows were based on comparisons to WGFs in surrounding cities and information in the General Plan. Table 5-6 summarizes these master planning comparisons.

TABLE 5-6
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
MASTER PLAN COMPARISON OF WASTEWATER GENERATION FACTORS FROM SURROUNDING COMMUNITIES

Land Use	City Wastewater Generation Factor (gpd/ac)				
	Manteca	Lathrop	Modesto	Waterford	Riverbank[a]
Low Density Residential	1,338	1,584	-	1,215	1,500
Medium Density Residential	2,183	2,808	-	-	2,500
High Density Residential	3,789	-	-	-	4,000
Commercial	1,120	1,200	950	2,500	2,225
Industrial	2,010	670	950	2,000	1,500

[a] From Table 4-3

For buildout development within the City limits, sewer flow projections are summarized in Table 5-7. A detailed summary of buildout sewer flow projections within the City limits is included in Table B-3 in Volume Two, Appendix B.

TABLE 5-7
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
WASTEWATER GENERATION WITHIN EXISTING CITY SERVICE AREAS AT BUILDOUT

Land Use	Gross Area (ac)	Wastewater Generation Factor (gpd/ac)	Average Dry Weather Flow (gpd)
Medium Density Residential	1,558	2,500	2,501,000
Low Density Residential	148	1,500	178,000
Commercial	219	1,200	198,000
Industrial	244	1,500	227,000
Government	80	425	29,000
Parks	69	400	22,000
Total			**3,155,000**

Future sewer flow projections for the General Plan areas and the existing City are presented in Table 5-8. A detailed summary of future wastewater generation for the General Plan is presented in Table B-4 in Volume Two, Appendix B.

TABLE 5-8
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
PROJECTIONS OF TOTAL SEWER FLOW FOR GENERAL PLAN AREAS

Type of Land Use	Density (du/ac)	Area (ac)[a]	Wastewater Generation Factor (gpd/ac)[b]	Average Flow (gpd)[c]
Existing City Service Area at Buildout	-		-	3,155,000
Agricultural Resource Conservation Area	-	1,220.6	0	0
Buffer Greenway Open Space	-	399.6	0	0
Clustered Rural Residential	0.2	1,266.5	100	127,000
High Density Residential	18.0	72.8	4,000	204,000
Industrial-Business Park	-	263.4	1,500	276,000
Infill Opportunity Area:				
Downtown, Non-Residential	-	-	2,225	21,000
Downtown, Residential	0.9	-	2,225	23,000
West Riverbank, Non-Residential	-	-	1,850	8,000
West Riverbank, Residential	1.6	-	1,850	37,000
Low Density Residential	5.0	1,232.1	1,500	1,294,000
Medium Density Residential	10.0	655.9	2,500	1,148,000
Mixed Use Office Retail Residential:				
Non-Residential	-	144.2	1,760	142,000
Residential	18.0	13.7	1,760	17,000
Multi Use Recreation	-	139.3	425	59,000
Park	-	134.7	400	54,000
School-Civic	-	164.0	425	70,000
Total				**6,635,000**

[a] From Table 5-4.
[b] From Table 4-3.
[c] Average dry weather flow.

5.6 Summary of Sewer Flow Projections

A summary of existing and future sewer flows is included as Table 5-9.

TABLE 5-9
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF SEWER FLOW PROJECTIONS

Condition	Average Flow (gpd) [a]
Existing Sewer Flows within City Limits[b]	1,861,000
Future Sewer Flows within City Limits[c]	3,155,000
Future Sewer Flows within City Limits and General Plan[d]	6,635,000

[a] Average dry weather flow.
[b] See Table B-2 in Appendix B (Volume Two).
[c] See Table 5-7.
[d] See Table 5-8.

6 Hydraulic Evaluation of Existing Trunk Sewer System

Certain deficiencies in the existing collection system were identified from interviews with City maintenance staff along with a field review of existing conditions. A computer model of the major sewer lines in the system was created to further evaluate the hydraulic performance of the existing trunk sewer network. This chapter will describe the methodology used to create the computer model, the software used, and the results of the hydraulic evaluation.

6.1 Objectives

A model of the existing trunk sewers was created to achieve the following objectives:

1. Identify potentially problematic areas in the existing sewer system.

2. Evaluate the capacity of the existing sewer system.

6.2 Model of Existing Collection System

A computer model was generated to determine reaches of the existing collection system which may have hydraulic deficiencies. The following sections will describe the methodology used to generate the model and the subsequent results.

a. Description of SewerCAD

The software used to model the existing collection system was Haestad Methods, SewerCAD (Version 5.6). SewerCAD can analyze the performance of a collection system under various flow conditions such as dry weather, wet weather, steady-state, or unsteady-state. For the analysis of the existing collection system, a model using PWWF was executed.

For reference, information on pipes and manholes was input into the program. Additionally, the flow analysis method was used in the model. Once that information was input, information regarding wastewater flow was added. SewerCAD can accept manually input flows or can estimate expected flows using WGFs included in the software program. SewerCAD also contains PF curves and I/I rates which can be used for unsteady-state and wet weather flow analysis. Using the physical information for a collection system, model scenarios can be executed for various flow conditions.

b. Physical Components of Model

Due to the limited amount of historical information available on the existing trunk sewer system, manhole rim elevation, pipe invert, and pump station information was collected by City personnel.

Because the primary purpose of modeling the existing City collection system was to identify major hydraulic deficiencies, the model consisted of a simplified version of the actual collection system. The following components of the existing system were considered for inclusion in the model:

1. Sewers downstream of existing pump stations that are 10-inches in diameter or larger.

2. Corresponding manholes for sewers 10-inches in diameter or larger.

Table 6-1 lists the reaches which were included in the model based on the aforementioned data and criteria. Plate 6-A depicts the model network layout of the existing system including the manholes along these alignments.

TABLE 6-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
EXISTING SEWERS INCLUDED IN MODEL

Abbreviation	Description of Alignment
CW	Downstream of Candlewood Pump Station
ES	Downstream of Estelle Pump Station
JK	Downstream of Jackson Pump Station
ZP	Zerillo Park Line
ST	Trunk lines in Stanislaus St. (west of R/R)
TL	Downstream of Talbot Pump Station
TR	Downstream of Terminal Pump Station
TW	Downstream of Townsend Pump Station
KT	Trunk lines in Kentucky Ave.
CA	Trunk lines in California Ave.
TF	Trunk lines in Terminal Ave. to Fourth St.
SR	Trunk lines in Sierra Ave. (east of R/R)
SF	Trunk lines in Santa Fe Ave. (east of R/R)
P	Trunk lines in Condray Ave., First St. and to WWTP

The information gathered for the manholes and pipes (from existing system maps, a GPS survey of manhole rims, and field measurements of inverts performed by City personnel) are included in Volume Two, Appendix C. Where information for manholes and sewers was not available, certain simplifying assumptions listed in Table 6-2 were used.

TABLE 6-2
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
ASSUMED VALUES FOR UNAVAILABLE INFORMATION

Parameter	Assumed Value
Manhole rim elevation	Ground elevation
Manhole bottom elevation	Lowest connecting pipe invert elevation

c. <u>Flow Information</u>

For purposes of the 2007 Master Plan, areas of known cross-connections with the City storm drain system are assumed to be addressed and separated; therefore, any storm water flows are not included in the model inputs.

Once the pipes and manholes were selected for the model, the wastewater flows assigned to key manholes were estimated. The manholes selected for loading were based on their upstream service areas. The manholes and corresponding flows are presented in Volume Two, Appendix C.

SewerCAD automatically assigns the flow from a manhole to the associated outlet pipe. Areas draining into the manholes in the model were identified using available information for the collection system: pump station service areas, sewer sheds, and catchment zones. Plate 6-B depicts the boundaries of the sheds. Sewer sheds are logical groupings of land use areas based on topography and serviceability. Using GIS outputs and the information from the General Plan, land use areas were obtained. ADWFs could then be estimated using the land use designation, area, and corresponding WGF.

Using the established PF and I/I rates presented in Chapter Four, the PWWF for each area under existing and proposed land use conditions was calculated. These calculations are summarized in Volume Two, Appendix D. The PWWFs were used as input flows for the SewerCAD model.

d. <u>Hydraulic Parameters</u>

Manning's equation was used as the flow analysis method for the model. Table 6-3 lists the assumptions used for Manning's "n" and the pipe characteristics. A Manning's "n" of 0.013 is typically used for concrete pipe. However, because the pipes included in the model are existing, a more conservative "n" value of 0.015 was selected, in compliance with the design criteria summarized in Chapter Four.

TABLE 6-3
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
HYDRAULIC PARAMETER ASSUMPTIONS

Parameter	Assumed Value
Manning's "n"	0.015
Pipe Material	Concrete
Section shape	Circular

e. Model Scenarios

Using the assumptions and information presented in the preceding sections, two SewerCAD model scenarios were executed: 1) Existing Land Use Scenario, and 2) General Plan Land Use Scenario. The Existing Land Use scenario was based on the existing known land uses, with existing undeveloped (i.e. non-flow contributing) parcels removed from the flow estimates. The General Plan Land Use scenario was based on the land uses presented in the General Plan.

An analysis using the estimated PWWFs was performed for each scenario. The results are discussed in the following section.

6.3 Results of Computer Modeling

The results of the model scenarios were analyzed for average velocity and design capacity. Average velocity is an important parameter for ensuring that there is sufficient flow through the pipe to scour solids which may have been deposited. Ideally at PWWF, a minimum velocity of 2 ft/sec is attained. The 2007 Master Plan criterion for trunk sewer design capacity is a maximum of 70 percent full.

a. Existing Land Use Scenario

The Existing Land Use Scenario results indicate six pipe sections may flow more than 70 percent full at PWWF. Table 6-4 and Figure 6-1 identify pipe sections which are currently flowing above design capacity (70% full). Figure 6-2 identifies pipe sections which have low velocities. Additional results from the model are provided in Volume Two, Appendix D.

TABLE 6-4
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
EXISTING LAND USE SCENARIO
SEWERS WITH FLOW / DESIGN CAPACITY GREATER THAN 100%

Pipe Label	Pipe Size (inches)	Description	Flow / Design Capacity (%)
P-67	12	Upstream of trestle and 27-inch OD pipe	999.0
ZP-8	18	Between Topeka Street and Santa Fe Street	203.9
ES-4	15	Estelle Avenue, north of SR 108	139.4
ZP-10	18	Topeka Street	116.7
ZP-6	18	Jackson Avenue, south of Santa Fe Street	105.2
ZP-18	24	Zerillo Park	102.2

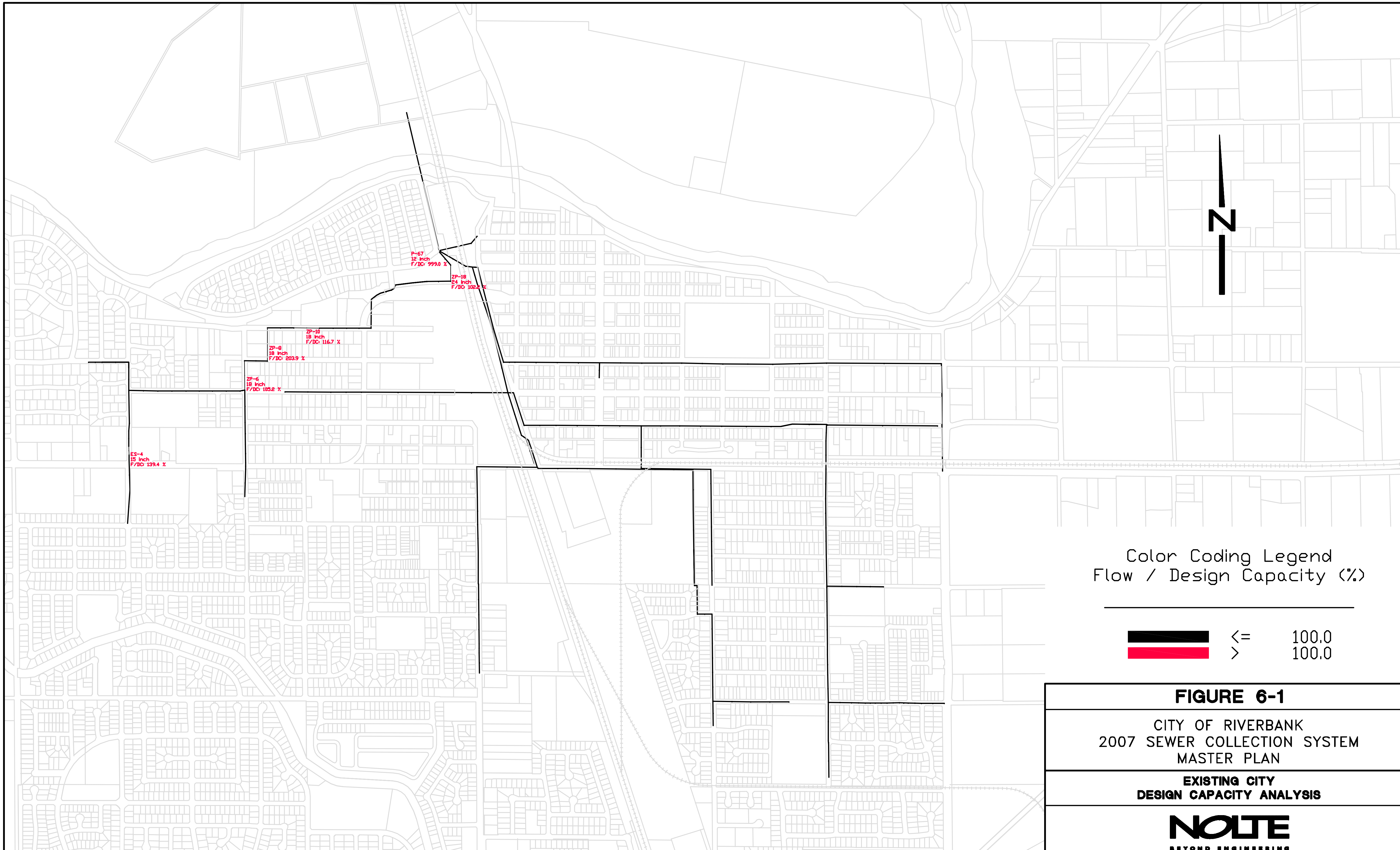


FIGURE 6-1

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

EXISTING CITY
DESIGN CAPACITY ANALYSIS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 6-1.dwg SM 11/13/2007

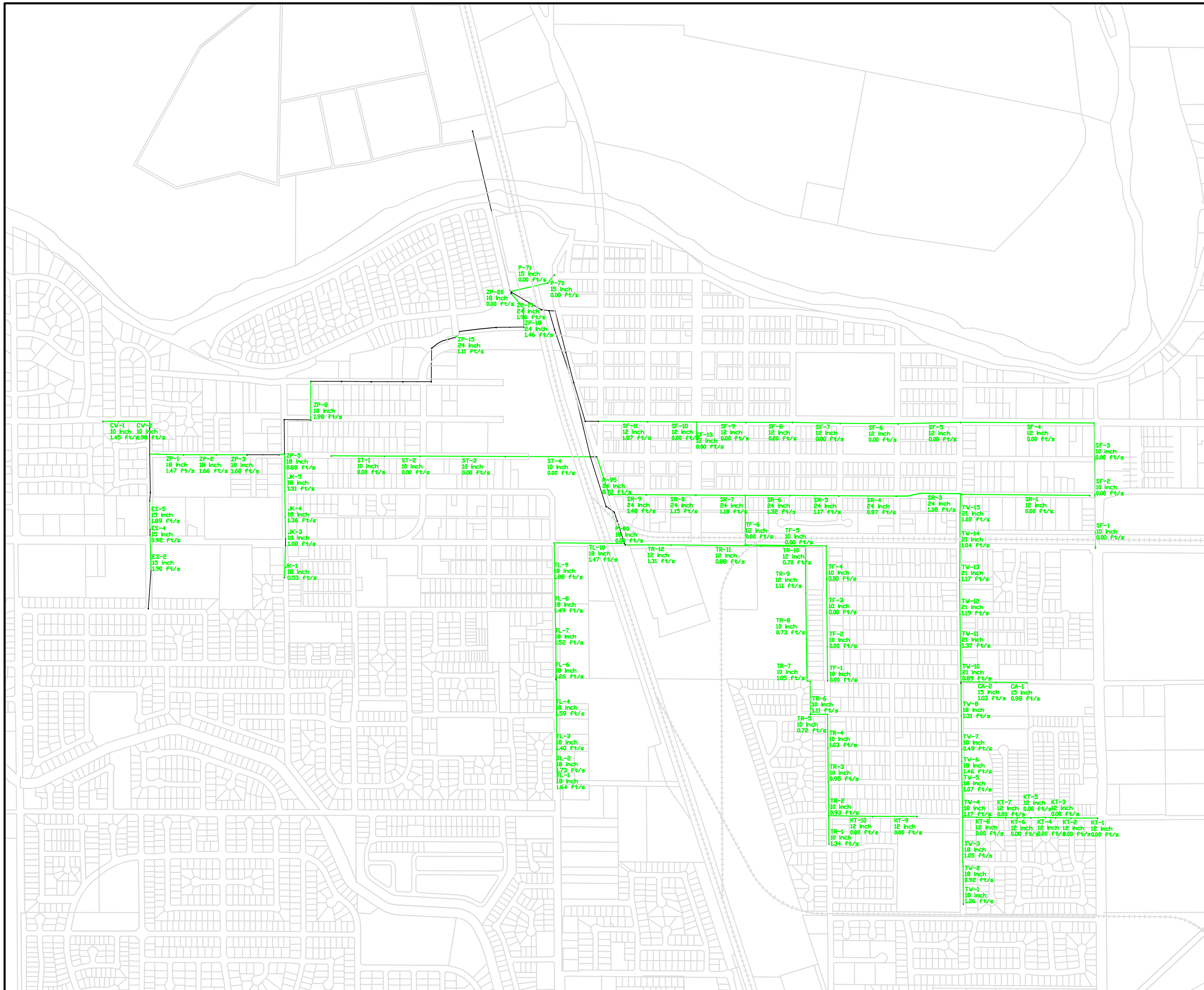


FIGURE 6-2

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

EXISTING CITY VELOCITY ANALYSIS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 6-2.dwg SM 11/13/2007

b. General Plan Land Use Scenario

The results of the General Plan Land Use scenario indicate that 32 pipe sections may flow over 70 percent full at PWWF. Table 6-5 and Figure 6-3 identify specific areas of concern with respect to design capacity. Figure 6-4 identifies areas which may have low velocity potential. Additional results from the model are provided in Volume Two, Appendix D.

TABLE 6-5
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
GENERAL PLAN LAND USE SCENARIO
SEWERS WITH FLOW / DESIGN CAPACITY GREATER THAN 100%

Pipe Label	Pipe Size (inches)	Description	Flow / Design Capacity (%)
P-67	12	Upstream of trestle and 27-inch OD pipe	999.0
P-95	24	First Street, north of Sierra Street	272.0
ES-4	15	Estelle Avenue, north of SR 108	265.3
SR-1	12	Sierra Street, west of Claus	217.4
ZP-8	18	Between Topeka Street and Santa Fe Street	207.6
P-83	10	First Street at Stanislaus Street	181.6
TR-5	10	Arizona Avenue, west of Terminal Avenue	179.5
TR-8	10	West of Terminal Avenue	177.2
P-77	30	Condray Avenue, north of Santa Fe Street	141.8
SR-8	24	Sierra Street, west of Third Street	140.8
SR-7	24	Sierra Street, east of Third Street	135.8
ZP-1	18	Stanislaus Street, east of Estelle Avenue	134.5
P-76	30	Condray-First Street, north of Stanislaus Street	131.9
SR-4	24	Sierra Street, east of Sixth Street	128.6
ZP-3	18	Stanislaus Street, east of River Mesa Drive	125.8
P-78	30	Condray Avenue, north of Topeka Street	123.9
ZP-2	18	Stanislaus Street, west of River Mesa Drive	119.7
ZP-10	18	Topeka Street	118.8
TR-10	12	Patterson Road, west of Terminal Avenue	113.8
ES-5	15	Estelle Avenue, south of Rio Verde	109.5
TR-12	12	Patterson Road, east of First Street	108.0

TABLE 6-5 (CONTINUED)
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
GENERAL PLAN LAND USE SCENARIO
SEWERS WITH FLOW / DESIGN CAPACITY GREATER THAN 100%

Pipe Label	Pipe Size (inches)	Description	Flow / Design Capacity (%)
TR-7	10	West of Terminal Avenue	107.1
SR-3	24	Sierra Street, west of Eighth Street	105.9
TW-7	18	Eighth Street, south of Arizona Avenue	105.6
ZP-6	18	Jackson Avenue, south of Santa Fe Street	105.1
P-68	24	Trestle over Stanislaus River	104.3
ZP-18	24	Zerillo Park	104.1
SR-6	24	Sierra Street, east of Fourth Street	103.7
TW-1	21	Eighth Street, north of Townsend Avenue	103.5
ES-2	15	Estelle Avenue, south of SR 108	102.8
TF-5	10	Patterson Road, west of Terminal Avenue	100.1
TF-3	10	Terminal Avenue, north of Kansas Avenue	100.1

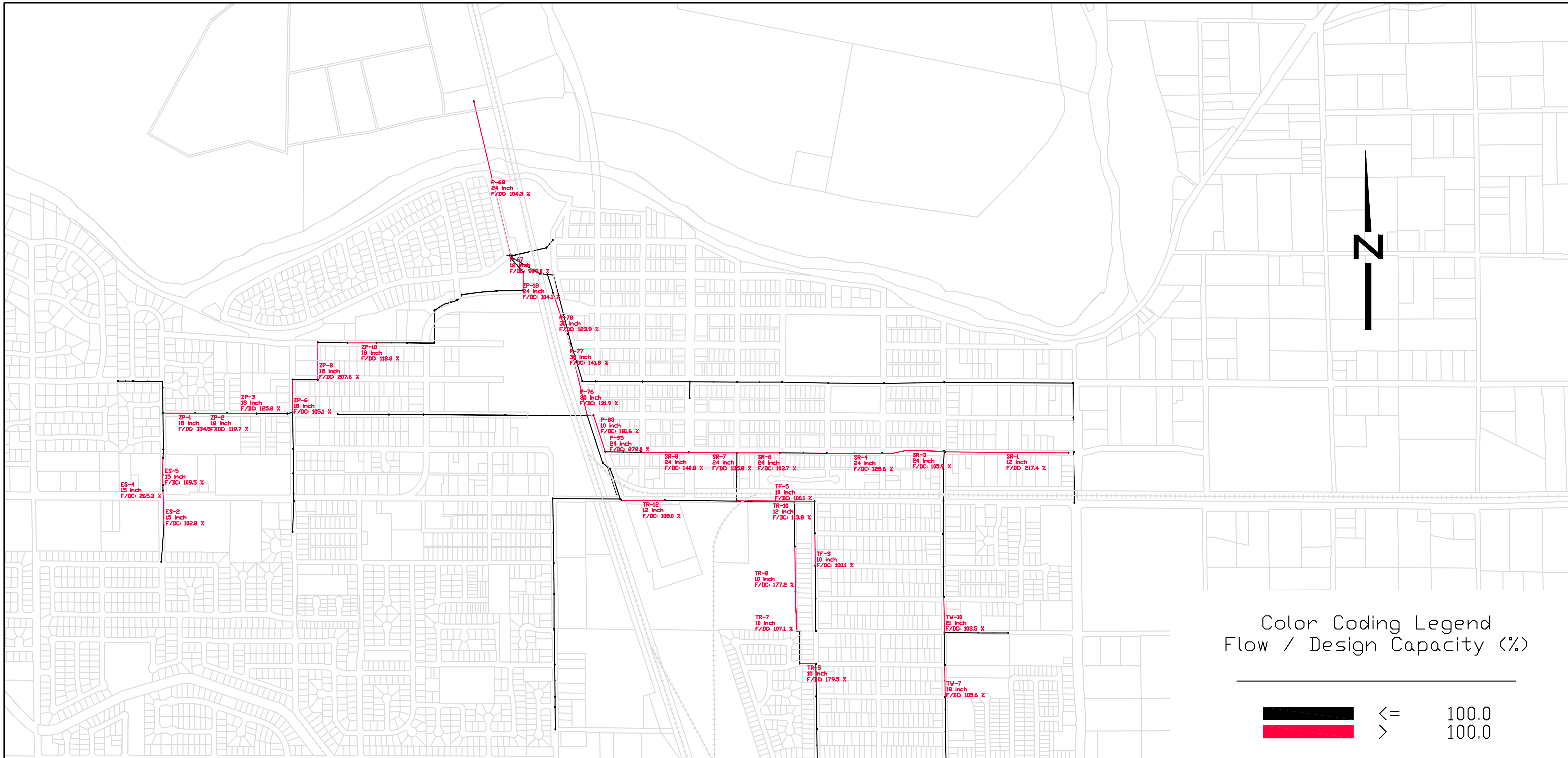


FIGURE 6-3

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

GENERAL PLAN LAND USE SCENARIO
DESIGN CAPACITY ANALYSIS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 6-3.dwg SM 11/13/2007

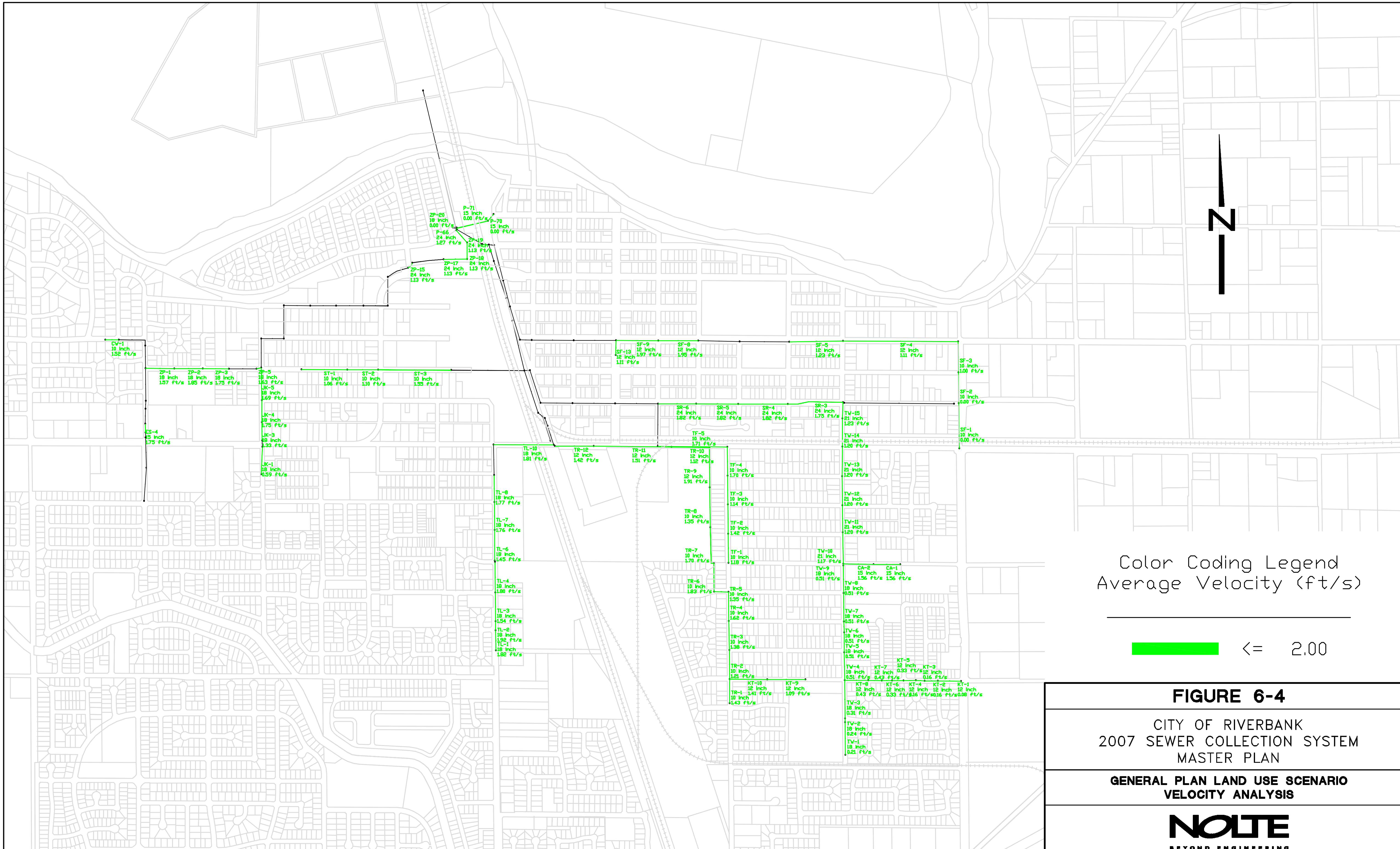


FIGURE 6-4

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

GENERAL PLAN LAND USE SCENARIO
VELOCITY ANALYSIS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 6-4.dwg SM 11/13/2007

6.4 Summary of Hydraulic Evaluation of Existing Trunk Sewer System

The results of the Existing Land Use at buildout and General Plan Land Use model scenarios identified trunk sewers which may be flowing near capacity at PWWF although no surcharging was predicted in either scenario. In general, the results indicate that the existing collection system does not have major deficiencies other than the existing cross-connections with the storm drain system. However, the pipe sections identified as flowing near or over capacity at buildout may require some type of improvement to alleviate capacity problems. The potentially problematic reaches identified by the models are in Sierra Street and the Condray-First Street area. The 27-inch trunk pipeline that is fed by all of the City wastewater flows and leads to the WWTP is also an area of concern because it is beyond design capacity at buildout and its physical condition and age of the trestle suggests the need for replacement.

The pipe sections identified as having low velocity may become areas of sources of odor due to excess deposition of solids. This condition may require additional maintenance activities.

Recommended improvements were modeled in addition to the existing system for purposes of evaluating solutions for existing hydraulic deficiencies. These solutions are discussed in Chapter Seven.

7 Recommended Collection System Strategy and Improvements

This chapter summarizes the recommended sewer collection system strategy for the City. Specifically, the following are discussed: 1) wastewater flow projections by sewer shed and 2) recommended conceptual infrastructure and pipeline alignments by service area. This chapter will also present suggested system improvements to mitigate hydraulic deficiencies identified in the existing collection system.

7.1 Overall Sewer Collection System Strategy

The existing City WWTP is located north of the Stanislaus River and the central section of the City. This treatment plant has existing permits, successful operations, and can be upgraded to meet future City needs. Because of the long-term utilization of the WWTP, it is planned that all wastewater from the General Plan area will continue to be conveyed to the current treatment site. As such, the sewage collection systems for new service areas should be designed to convey wastewater to the existing treatment plant.

The new General Plan is divided into three major service areas as identified in Figure 7-1, namely Central Riverbank, East Riverbank, and West Riverbank. Each area is further divided into sewer sheds (Plate 6-B) for flow estimating and improvement evaluation purposes.

7.2 Projected Flows

The wastewater generation for each of the three major service areas was determined based on the General Plan Land Use Map and the WGFs discussed in Chapter Four. A summary of the ADWF for each of the major collection areas is shown in Table 7-1 (see Volume Two, Appendix B).

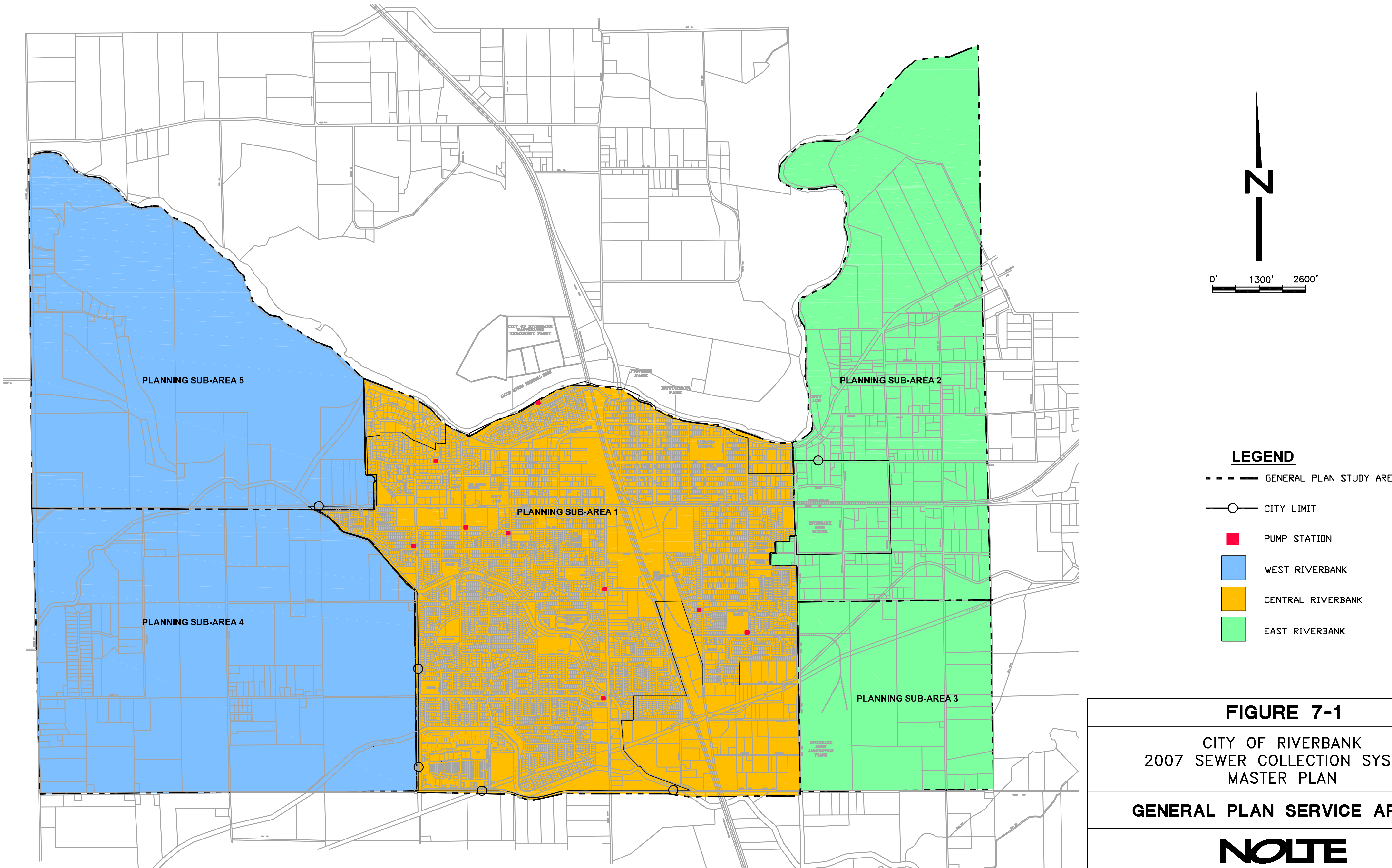


FIGURE 7-1

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

GENERAL PLAN SERVICE AREAS

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 7-1.dwg SM 11/13/2007

TABLE 7-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
AVERAGE DRY WEATHER FLOW AT BUILDOUT BY COLLECTION AREA

Area	Average Flow (gpd)[a]
Central Riverbank	3,421,000
East Riverbank	1,287,000
West Riverbank	1,927,000
Total	**6,635,000**

[a] Average dry weather flow

For each sewer shed area, the collection system must have sufficient capacity to convey PWWF. The City is divided into several collection areas by topography and associated trunk sewer mains. The system capacity needed to serve each major collection area and associated sheds is shown in Table 7-2. This information is used subsequently to develop specific strategies for each service area as presented in the remainder of this chapter.

TABLE 7-2
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PEAK WET WEATHER FLOWS BY SEWER SHED

Collection Area	ADWF (gpd)	PWWF (mgd)
Central Riverbank		
Crawford Road Pump Station		
Sewer Shed 4	73,000	0.24
Sewer Shed 5	377,000	1.07
Sewer Shed 6	688,000	1.83
Sewer Shed 7	221,000	0.59
Sewer Shed 8	447,000	1.4
	1,806,000	5.13
Condray-First Street		
Sewer Shed 10	307,000	0.83
Sewer Shed 14	1,337,000	3.69
	1,644,000	4.52
Zerillo Park		
Sewer Shed 13	779,000	2.06
River Cove		
Sewer Shed 15	89,000	0.27
Central Riverbank Subtotal	***4,318,000***	***9.92***
East Riverbank		
California		
Sewer Shed 9	392,000	1.24
North Bruinville		
Sewer Shed 11	311,000	0.97
Sewer Shed 12	136,000	0.6
	447,000	1.57
East Riverbank Subtotal	***839,000***	***2.81***
West Riverbank		
Sewer Shed 1	658,000	2.31
Sewer Shed 2	49,000	0.59
Sewer Shed 3	771,000	2.34
West Riverbank Subtotal	***1,478,000***	***5.24***
Total	**6,635,000**	**20.0**

7.3 Central Riverbank Sewer Collection System Strategy

Key components of the Central Riverbank sewer collection system strategy involve a new crossing of the Stanislaus River and improvements associated with the Crawford Road Pump Station. Each is discussed below and illustrated in Figure 7-2.

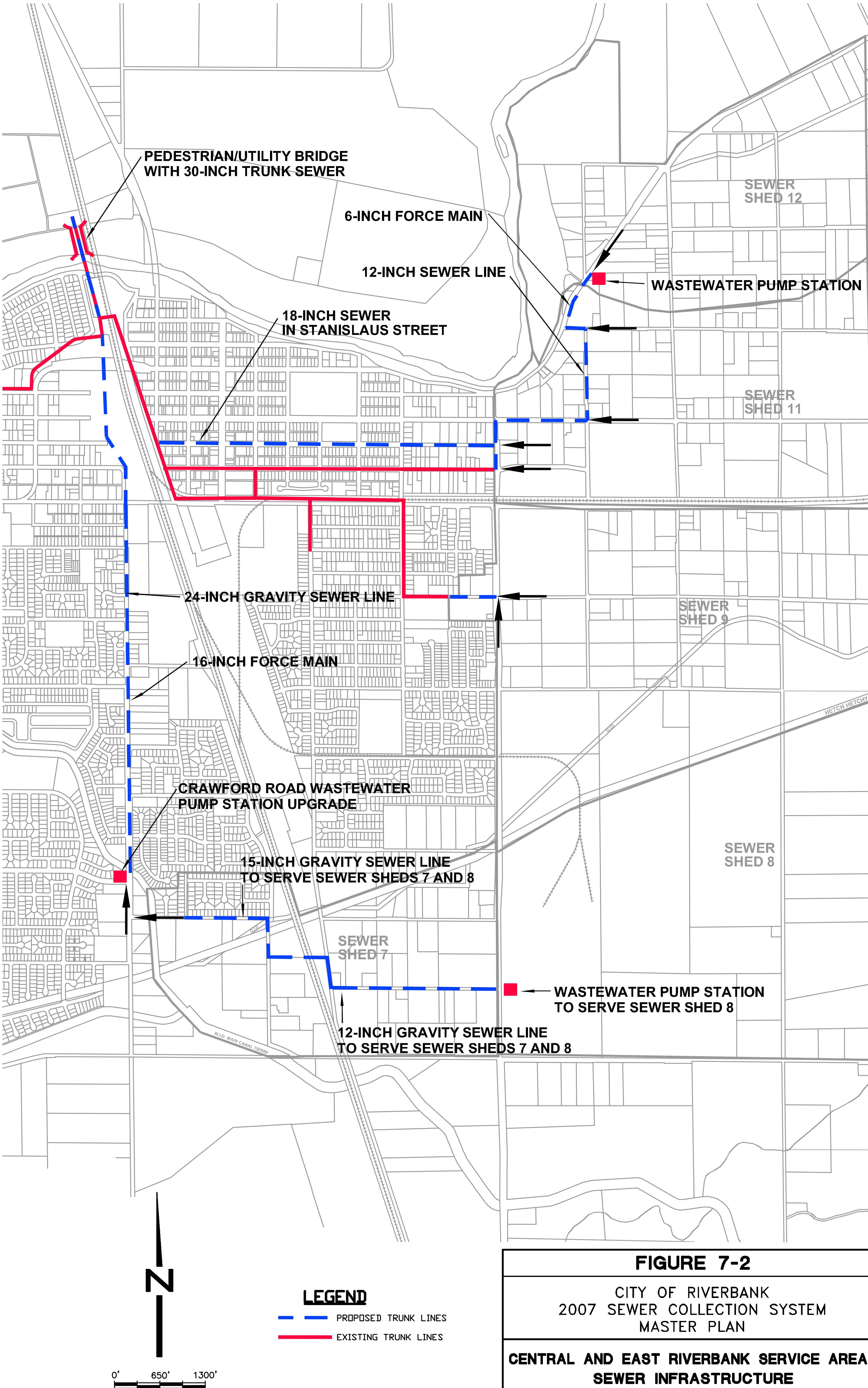
a. <u>New Stanislaus River Crossing</u>

The wastewater from the existing City systems is collected at a point west of the Stanislaus River Bridge and conveyed across the river on a trestle in a 27-inch OD pipeline to the WWTP headworks. As described in Chapter Six, the influent pipe to the WWTP is currently flowing above design capacity. Due to its physical condition, a replacement pipeline may be warranted. In a separate planning effort, the City is proposing a pedestrian bridge across the river to Jacob Myers Park. The new bridge could serve a dual purpose by also providing a second pipeline crossing to the plant. The existing 27-inch pipeline could be used for redundant capacity when maintenance is needed on the new pipeline.

b. <u>Crawford Pump Station, Force Main and Trunk Sewer</u>

The City recently completed the Condray-First Street project which consisted of installing a new 30-inch central trunk line in Condray Avenue and First Street. Included in the Condray-First Street project was an 18-inch line that extends to Patterson Road. According to the 2001 Master Plan, the 18-inch line would serve as the connection point for the future Roselle Avenue force main. As noted in Chapter Six, the 30-inch line in Condray Avenue-First Street would exceed design capacity at buildout. To alleviate this future bottleneck, a gravity line and force main are recommended in conjunction with an upgrade at the Crawford Road Pump Station.

For reference, the Crawford Road Pump Station was constructed initially with the Crossroads development. As part of the 2001 Master Plan recommendations, the pump station would be expanded to serve the southern area of the City including Sewer Sheds 4, 5, 6, 7, and 8 through a force main in Roselle Avenue. However, because of space constraints at the station, facility capacity could be better increased by constructing a 16-inch force main to Talbot Avenue followed by a 24-inch trunk sewer. The proposed 24-inch gravity sewer line would also then serve the old cannery area which is intended to be redeveloped.



LEGEND

PROPOSED TRUNK LINES

EXISTING TRUNK LINES

FIGURE 7-2

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

CENTRAL AND EAST RIVERBANK SERVICE AREAS SEWER INFRASTRUCTURE

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan-Final\MP-Figure 7-2.dwg SM 11/13/2007

7.4 East Riverbank Sewer Collection System Strategy

In accordance with the 2001 Master Plan, the City planned for wastewater service to an easterly area within the current sphere of influence. Sewer lines were constructed in Sierra Street and Eighth Street to California Avenue with excess capacity for future use within the service area. As highlighted in Chapter Six, the majority of the 24-inch sewer line in Sierra Avenue exceeds design capacity at buildout flows. As a recommendation to shunt flows away from Sierra Avenue, an 18-inch gravity line in Stanislaus Street is shown in Figure 7-2. In terms of eastside sewer sheds, Sewer Sheds 9 and 11 would flow by gravity into the respective existing trunk lines. Sewer Shed 12 is lower and would require a pump station to lift flows into recommended trunk lines in Sewer Shed 11. Sewer Shed 7 and 8, though located in the eastern part of the City, is south of the Hetch Hetchy right of way and would flow west to the Crawford Road Pump Station.

7.5 West Riverbank Sewer Collection System Strategy

The strategy for sewering West Riverbank includes a west side pump station and flow routing to the Crawford Road Pump Station. These concepts are discussed below and shown in Figure 7-3.

a. <u>West Side Pump Station and Force Main</u>

Most of the West Riverbank area is outside of the existing City sphere of influence and was not included in previous planning for collection system infrastructure. The Riverbank topography generally slopes from east to west; therefore, the westerly area cannot gravity flow into the existing collection system.

The majority of the West Riverbank area will require a separate collection system, including conveyance to the WWTP. While this area is generally flat, there is slope to the southwest, which is the furthest point from the WWTP. A pump station is recommended on the south side of the river at a point and elevation that facilitates collection from the largest portion of the west side (Sewer Sheds 1, 2, and 3). In conjunction with City plans for developing parkways and trails along the north side of the river from Jacob Myers Park to north of the planned West Riverbank development, a proposed pedestrian bridge could double as a utility crossing for the 16-inch pipeline. The 16-inch force main constructed adjacent to the planned trails would be more cost effective than installing sewer lines through the existing City.

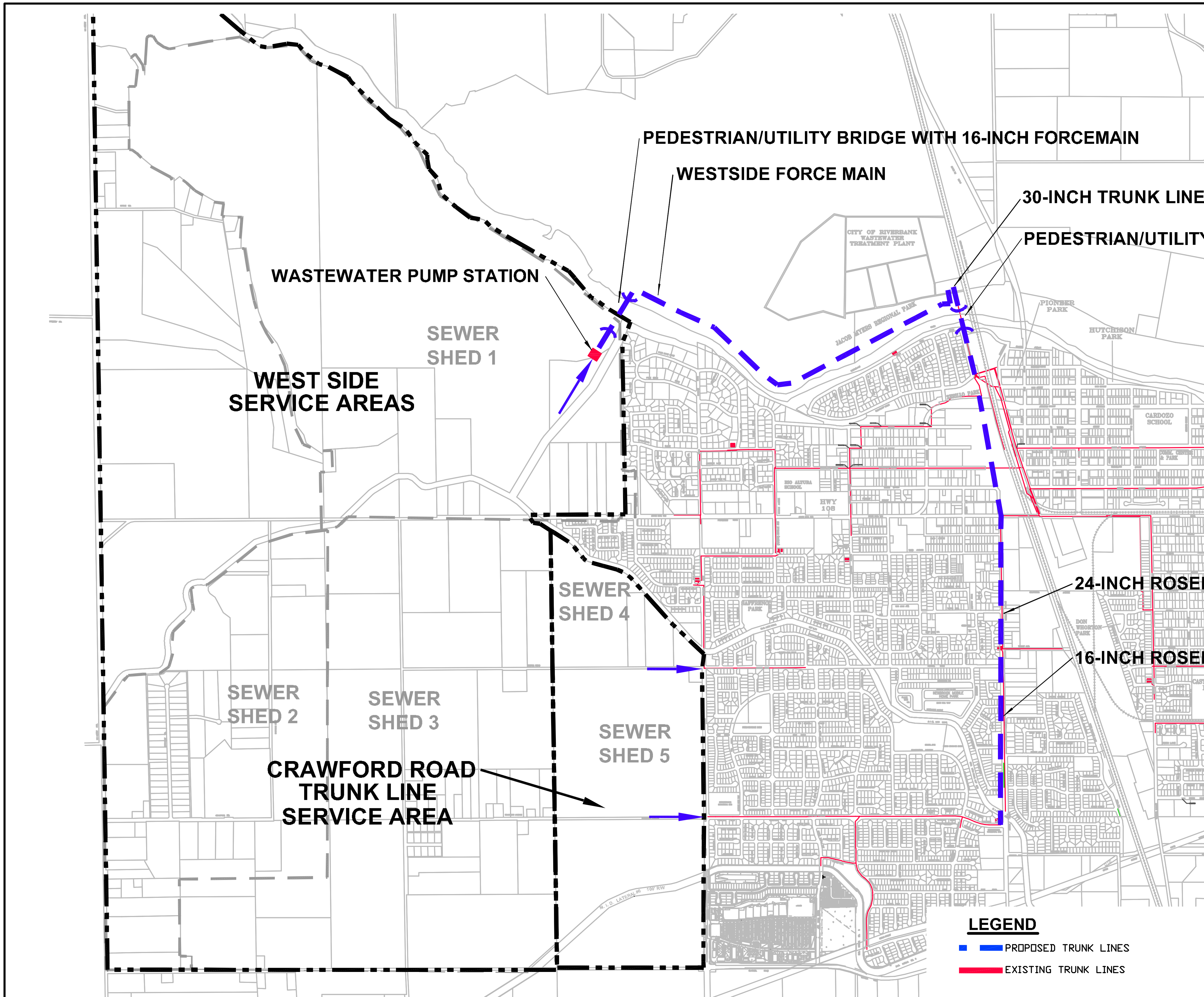


FIGURE 7-3

CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM
MASTER PLAN

WEST RIVERBANK SERVICE AREA
SEWER INFRASTRUCTURE

NOLTE
BEYOND ENGINEERING

N:\sa0154218\Cadd\Exhibits\Master Plan–Final\MP–Figure 7–3.dwg SM 11/13/2007

b. Crawford Road Trunk Sewer Upgrade

A portion of the area on the west side of Oakdale Road was included in the 2001 Master Plan for service by the Crawford Road Pump Station. A sewer line was constructed in Crawford Road to Oakdale Road with limited capacity for a portion of the West Riverbank area (Sewer Sheds 4 and 5). To accommodate buildout flows, the pipeline between Homewood Way and the Crawford Road Pump Station would need to be upgraded or paralleled to serve larger areas in West Riverbank.

8 Probable Construction Costs

This chapter summarizes the probable construction costs for the recommended collection system improvements.

8.1 Unit Costs

Unit costs were developed for gravity sewers, manholes, force mains and other elements identified as recommended improvements in Chapter Seven. Tables 8-1 and 8-2 summarize the unit cost information. The unit pipe costs reflect installation, including dewatering, and assume conventional pipe installation by means of open cut, unless otherwise noted. Capital costs may be higher if trenchless technology construction methods are employed. Concrete pipe was assumed for pipe material for sewers greater than 10-inches in diameter. A manhole diameter of 48-inches was assumed appropriate for all gravity sewer lines. Manholes are assumed to be spaced no more than 400 ft apart. Unit costs were used to estimate probable construction costs for the recommended system improvements.

TABLE 8-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
UNIT COSTS FOR SEWERS

Pipe Diameter, in.	Pipe Cost, $/lf		
	0-10 ft depth	10-20 ft depth	20-30 ft depth
6	70	282	--
8	74	286	--
10	79	293	--
12	83	300	--
15	89	313	--
18	102	328	780
21	126	344	790
24	148	367	820
27	165	384	830
30	186	430	880
33	214	435	890
36	240	460	930

TABLE 8-2
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
UNIT COSTS FOR SYSTEM COMPONENTS

Item	Unit Cost, $/ea
Connection to Existing Manhole	2,000
Adding a Flowline to an Existing Manhole	2,000
48-inch PVC Lined Manhole (10-20 ft depth)	10,000
48-inch PVC Lined Manhole (20-30 ft depth)	11,000

8.2 Probable Construction Costs for Recommended Improvements

Probable construction costs for the suggested improvements to the existing collection system and completion of the recommended trunk sewer collection system network are presented in the following sections.

a. Central Riverbank

Probable construction costs for the recommended improvements to the existing collection system are presented in Table 8-3. A discussion of the proposed infrastructure is provided below.

TABLE 8-3
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PROBABLE CONSTRUCTION COSTS FOR
CENTRAL RIVERBANK SYSTEM IMPROVEMENTS

Buildout Area/Item	Quantity	Unit Cost, $	Unit	Total Cost, $
New Stanislaus River Crossing				
Pedestrian/Utility Bridge	1	3,500,000	EA	3,500,000
Pipeline Trestle	800	700	LF	560,000
30-inch Trunk Line	1,450	250	LF	363,000
Subtotal				*4,423,000*
Crawford Pump Station, Force Main and Trunk Sewer				
Phase 1				
Crawford Pump Station Wet Well Modifications	1	400,000	LS	400,000
Subtotal				*400,000*
Phase 2				
24-inch Trunk Line (0-10 ft depth) – Roselle Avenue	1,100	148	LF	163,000
24-inch Trunk Line (10-20 ft depth) – Roselle Avenue	2,000	367	LF	734,000
Manholes	8	10,000	EA	80,000
Connection to Existing Manhole	1	2,000	EA	2,000
Subtotal				*979,000*

TABLE 8-3 (CONTINUED)
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PROBABLE CONSTRUCTION COSTS FOR
CENTRAL RIVERBANK SYSTEM IMPROVEMENTS

Buildout Area/Item	Quantity	Unit Cost, $	Unit	Total Cost, $
Phase 3				
24-inch Trunk Line (10-20 ft depth) – Cannery area	2,100	367	LF	771,000
Manholes	6	10,000	EA	60,000
Connection to Existing Manhole	1	2,000	EA	2,000
Subtotal				*833,000*
Phase 4				
Crawford Pump Station Larger Pumps and Electrical Upgrade	1	500,000	LS	500,000
16-inch Force Main	3,100	200	LF	620,000
Subtotal				*1,120,000*
Total				7,755,000
Contingency, 25%				1,939,000
Subtotal				9,694,000
Design, 10%				969,000
Construction Management, 15%				1,454,000
Probable Cost				**$12,117,000**

1. The new Stanislaus River crossing will include a new pedestrian bridge and 30-inch pipeline. The pipeline would be sized to accommodate the General Plan buildout PWWF, with the exception of Sewer Sheds 1, 2, and 3.

2. The Crawford Road Pump Station upgrade would require new 75 hp pumps to accommodate flows from Sewer Sheds 4, 5, 6, 7, and 8. The force main would extend 3,100 ft from the pump station to Talbot Avenue. To avoid the cost of pumping wastewater beyond Talbot Avenue, 4,500 ft of 24-inch gravity sewer line is required with

associated manholes. This gravity sewer line would also serve the old cannery area and parallel the Condray-First Street trunk sewer line. A 700-foot gravity line connection to the existing trunk swerline will be necessary to construct the project in phases.

b. East Riverbank

The total probable construction cost for the recommended collection system for East Riverbank is summarized in Table 8-4. An infrastructure discussion is presented below.

TABLE 8-4
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PROBABLE CONSTRUCTION COSTS FOR
EAST RIVERBANK SYSTEM IMPROVEMENTS

Buildout Area/Item	Quantity	Unit Cost, $	Unit	Total Cost, $
Stanislaus Street Trunk Sewer				
Phase 1 – Lower Reach				
18-inch Trunk Line (10-20 ft depth)	1,500	328	LF	492,000
Manholes	4	10,000	EA	40,000
Connection to Existing Manhole	1	2,000	EA	2,000
Subtotal				*534,000*
Phase 2 – Upper Reach				
18-inch Trunk Line (10-20 ft depth)	3,400	328	LF	1,115,000
Manholes	9	10,000	EA	90,000
Connection to Existing Manhole	1	2,000	EA	2,000
Subtotal				*1,207,000*
Sewer Shed 12 Pump Station, Force Main and Gravity Line				
Sewer Shed 12 Pump Station	1	700,000	LS	700,000
6–inch Force Main	1,000	45	LF	45,000
12-inch Sewer Line (10-20 ft depth)	3,500	300	LF	1,050,000
Manholes	9	10,000	EA	90,000
Subtotal				*1,885,000*

TABLE 8-4 (CONTINUED)
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PROBABLE CONSTRUCTION COSTS FOR
EAST RIVERBANK SYSTEM IMPROVEMENTS

Buildout Area/Item	Quantity	Unit Cost, $	Unit	Total Cost, $
Sewer Sheds 7 and 8 Trunk Sewers and Pump Station				
12-inch Trunk Line (10-20 ft depth)	3,300	300	LF	990,000
15-inch Trunk Line (20-30 ft depth)	2,900	780	LF	2,262,000
Manholes (10-20 ft depth)	8	10,000	EA	80,000
Manholes (20-30 ft depth)	8	11,000	EA	88,000
Bore and Jack	3	50,000	EA	150,000
Pump Station	1	900,000	EA	900,000
Subtotal				*4,470,000*
Total				8,096,000
Contingency, 25%				2,024,000
Subtotal				10,120,000
Design, 10%				1,012,000
Construction Management, 15%				1,518,000
Probable Cost				**$12,650,000**

1. The Stanislaus Street trunk line would be approximately 4,900 ft in length and have 13 manholes, including one connection to an existing manhole. The trunk sewer could be constructed in two phases with the lower portion of the trunk sewer west of Fourth Street needed first to prevent overloading of the Sierra Street and Santa Fe Street sewerlines.

2. A new Pump Station is needed to lift flows from Sewer Shed 12, which would then flow by gravity into the Stanislaus Street trunk line. The lift station would require 10 hp pumps and discharge through an 8-inch force main, approximately 1,000 ft long. The gravity lines connecting Sewer Shed 12, through Sewer Shed 11, to the new Stanislaus Street trunk line, would consist of approximately 3,500 ft of 10 to 12-inch pipelines.

3. A trunk sewer line is needed to convey wastewater from Sewer Sheds 7 and 8 to the Crawford Road trunk line and pump station. Bore and jack crossings will be needed at

the MID main canal, Hetch Hetchy waterlines and the railroad tracks. Because of the distance from Sewer Shed 8, a wastewater pump station will also be needed.

c. West Riverbank

The total probable construction cost for the recommended collection system for West Riverbank is summarized in Table 8-5. An infrastructure discussion is summarized below

TABLE 8-5
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PROBABLE CONSTRUCTION COSTS FOR
WEST RIVERBANK SYSTEM IMPROVEMENTS

Buildout Area/Item	Quantity	Unit Cost, $	Unit	Total Cost, $
West Side Pump Station and Force Main				
Pump Station	1	1,100,000	EA	1,100,000
16-inch Force Main	7,900	175	LF	1,383,000
Pedestrian/Utility Bridge	1	3,500,000	EA	3,500,000
Connection to Headworks	1	5,000	EA	5,000
Subtotal				*5,988,000*
Crawford Road Trunk Sewer Upgrade				
24-inch Trunk Line (20-30 ft depth)	2,500	820	LF	2,050,000
Connection to Manholes	16	2,000	EA	32,000
Subtotal				*2,082,000*
Total				8,070,000
Contingency, 25%				2,017,000
Subtotal				10,087,000
Design, 10%				1,009,000
Construction Management, 15%				1,513,000
Probable Cost				**$12,609,000**

1. The West Side Pump Station and force main would serve Sewer Sheds 1, 2, and 3. The force main would be approximately 7,900 ft long, extending from the proposed pump station location to the WWTP. The pipeline would cross the Stanislaus River via a new pedestrian bridge. The pump station would house 150 hp pumps.

2. A portion of the sewer line on Crawford Road (upstream of the Crawford Road Pump Station) would require replacement to adequately handle flows from Sewer Sheds 4 and 5. Connections to eight existing manholes would be necessary as part of the 24-inch trunk line work.

d. Summary

A summary of probable system costs is provided in Table 8-6.

TABLE 8-6
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
SUMMARY OF PROBABLE SYSTEM COSTS FOR SUGGESTED FACILITIES

Buildout Area	Total Cost, $
Central Riverbank	12,117,000
East Riverbank	12,650,000
West Riverbank	12,609,000
Total Probable Cost	**$37,376,000**

9 Capital Improvements Program

This chapter presents the recommended Capital Improvements Program (CIP) to address existing deficiencies and future growth for the City of Riverbank.

9.1 Assumptions Used in Developing CIP

The wastewater collection system CIP was based on the following assumptions:

1. Phasing of the facilities is based upon City growth projections.

2. Sewer lines and force mains will be located in dedicated public right-of-way.

3. A contingency of 25% has been applied to all unit costs of construction. The contingency has been added before design and construction management fees are added.

4. Design costs have been estimated at 10% and construction management costs have been estimated at 15%, each as a percentage of the projected construction cost.

5. The pipeline unit cost includes street restoration and appurtenances. Manholes and connections have been cataloged separately.

6. The bore and jack costs include the cost for both the casing and the carrier pipe material.

7. The pump station costs are for a complete facility including wet well and electrical components.

9.2 Discussion of CIP Facilities and Priorities

The City wastewater collection system will convey all flow to the existing treatment plant at buildout. Significant growth is expected in East, West and Central (South) Riverbank that will more than double the existing wastewater flows. The existing City wastewater collection system is constrained by numerous physical obstructions, including the Stanislaus River, canals, and railroad tracks, and is surrounded by significant growth areas. As such, it is critical to have adequate trunk line capacity to collect wastewater from all areas prior to the anticipated growth. Because wastewater is collected in gravity systems that seldom have redundant pipelines or alternate routes, trunk lines must be designed and constructed with the full capacity needed at buildout. Critical components of the system must be in place prior to extensions and connections to collection lines that would increase the flow beyond the existing capacity.

The Riverbank area topography generally slopes from east to west. Therefore, most of the planned growth areas on the eastside should be able to flow by gravity to the existing collection point to the treatment plant. However, the west area would need to be pumped through a separate network because it was not considered in the previous master plan. The southern portion of Riverbank also cannot flow by gravity to the treatment plant because of the longer distance and the elevation. The Crawford Pump Station was constructed as the key component of the present and future wastewater collection system for the large area of South Riverbank.

The following summarizes the recommended improvements described in previous chapters, and prioritizes the CIP into the following phases of current needs, near term, and development driven.

a. Current Needs

1. Crawford Pump Station Wet Well Modifications – The Crawford Pump Station is a critical component of the wastewater collection system for a large area of new and anticipated growth. The Crawford Pump Station system would also probably be needed to serve the first phase of the west side development until sufficient wastewater is generated to utilize a new force main project. Currently, a project has been designed to modify the wet well to construct a sump to correctly place the pumps below the existing horizontal pipe designed as wet well operational storage. It is important to construct these wet well modifications to eliminate existing hydraulic deficiencies before the flows increase and render bypass pumping during construction more difficult and expensive. As such, the top priority need and wastewater collection system improvement is the Crawford Pump Station wet well modification project.

2. Roselle Trunk Sewer Line (North of Talbot) – Currently the Crawford Pump Station discharges into a gravity sewer line in Roselle Avenue just north of the canal where the wastewater flows in a gravity sewer line to the Talbot Pump Station. The Talbot Pump Station lifts the wastewater into another section of gravity sewer line in Roselle Avenue, where it flows to Patterson Road and the new Condray/First Street trunk sewer. The section of sewer north of the Talbot Pump Station has limited capacity and is restricting the size of pumps in the Talbot station. The second priority would be to bypass this area with a new trunk sewer from the Talbot Pump Station to the Patterson Road/First Street manhole. This is identified as Phase 2 of the Crawford Pump Station and discharge pipelines system upgrade.

3. Stanislaus Street Trunk Sewer (Lower Reach) – The Stanislaus Street trunk sewer is needed to provide adequate capacity to serve areas east of the railroad. It is anticipated that the area will continue to grow with many relatively small residential developments. Therefore, the Stanislaus Street trunk sewer should be included in the CIP and constructed prior to the growth exceeding the design capacity of the existing sewer. A current need is to construct the lower reach of the Stanislaus Street sewer to Fourth Street to prevent overloading the sewer in Sierra Street and Santa Fe Street.

b. <u>Near-term Needs</u>

1. Cannery Area Trunk Sewer – A new 24-inch trunk sewer is needed from Patterson Road through the old cannery area, under SR108 to near the collection point for wastewater to cross the trestle to the treatment plant. The trunk line is needed to serve the redevelopment of the old cannery area, to prevent overloading of the Condray/First Street trunk line. This project is considered the third phase of the Crawford Pump Station infrastructure to serve the south and west areas.

2. Crawford Pump Station Upgrade and Force Main – Before the growth exceeds the capacity of the Crawford Pump Station and the capacity of the sewer in Roselle Avenue to the Talbot Pump Station, a force main should be constructed to the new gravity sewer near Talbot Avenue. The Crawford Pump Station will also need to be upgraded with larger pumps and electrical equipment as part of the fourth phase of improvements.

3. Stanislaus Street Trunk Sewer (Upper Reach) – The upper reach of the Stanislaus Street trunk sewer should be completed as a near term CIP to prepare required infrastructure for anticipated growth.

c. <u>Development Driven</u>

1. New Stanislaus River Crossing – The existing wastewater pipeline and trestle crossing the Stanislaus River will need to be replaced to assure reliable wastewater service with adequate capacity for planning area needs and to prevent environmental risks and costly mitigation. A new pedestrian/utility bridge could provide better access to Jacob Myers Park and provide needed utility service. This should be included in the CIP with costs planned for and allocated as part of impact fees.

2. Sewer Sheds 7 and 8 Trunk Sewer and Pump Station – A trunk sewer needs to be constructed through Sewer Shed 7 with adequate capacity to serve the buildout needs of Sewer Sheds 7 and 8 while bringing wastewater to the Crawford Pump Station. The route shown on Figure 7-2 avoids Claribel Road which could be the location of

the North County Expressway project. A pump station would also be needed to serve Sewer Shed 8.

3. Sewer Shed 12 Trunk Sewer, Pump Station and Force Main – A trunk sewer will be needed from Sewer Shed 12, flowing through Sewer Shed 11 to the new trunk sewer in Stanislaus Street. This sewer would be part of the Sewer Shed 11 development and upsized to include the capacity needed for Sewer Shed 12. A pump station and force main would be needed for Sewer Shed 12 because of its lower elevation and distance.

4. Crawford Road Trunk Sewer Upgrade – A portion of the west side area is planned to be served by the Crawford Pump Station. Additionally the first phase of the west side development would need to be routed through the Crawford Pump Station until enough wastewater is generated to utilize a new force main along the Stanislaus River.

5. West Side Pump Station and Force Main – New wastewater infrastructure is needed for the anticipated west side development and would include a new pedestrian/utility bridge, pump station, and force main to the wastewater treatment plant.

9.3 Probable Costs for Recommended CIP

A summary of probable costs for current needs, near-term needs, and development driven projects is provided in Table 9-1.

TABLE 9-1
CITY OF RIVERBANK
2007 SEWER COLLECTION SYSTEM MASTER PLAN
PROBABLE PROJECT COSTS FOR RECOMMENDED CIP

CIP Phase/Project	Total Cost [a], $
Current Needs	
Crawford Pump Station Wet Well	$625,000
Roselle Trunk Sewer North of Talbot	$1,530,000
Stanislaus Street Trunk Sewer (Lower Reach)	$834,000
Subtotal	$2,989,000
Near-Term Needs	
Cannery Area Trunk Sewer	$1,302,000
Crawford Pump Station Upgrade and Force Main	$1,750,000
Stanislaus Street Trunk Sewer (Upper Reach)	$1,886,000
Subtotal	$4,938,000
Development Driven	
New Stanislaus River crossing	$6,911,000
Sewer Sheds 7 and 8 Trunk Sewer	$5,578,000
Sewer Shed 8 Pump Station	$1,406,000
Sewer Shed 12 Trunk Sewer	$1,781,000
Sewer Shed 12 Pump Station and Force Main	$1,164,000
Crawford Road Trunk Sewer Upgrade	$3,253,000
West Side Pump Station and Force Main	$9,356,000
Subtotal	$29,449,000
Total Probable Costs	**$37,376,000**

[a] Includes contingency, design , and construction management allowances.

References

[1] *City of Riverbank General Plan,* to be adopted 2007.

[2] *City of Riverbank, Sewer System Master Plan*, prepared by Garcia-Davis-Ringler Engineering, November 2001.

[3] *Flow Monitoring Field Data Report conducted by SFE Global NW,* prepared by Nolte Associates, Inc., June 2007.

[4] *City of Riverbank, Summary of Proposed Design Criteria Technical Memorandum*, prepared by Nolte Associates, Inc., April 2007.

[5] *City of Riverbank, Wastewater Treatment Plant, 2006 Annual Monitoring Report*, prepared by Nolte Associates, Inc., January 2007.