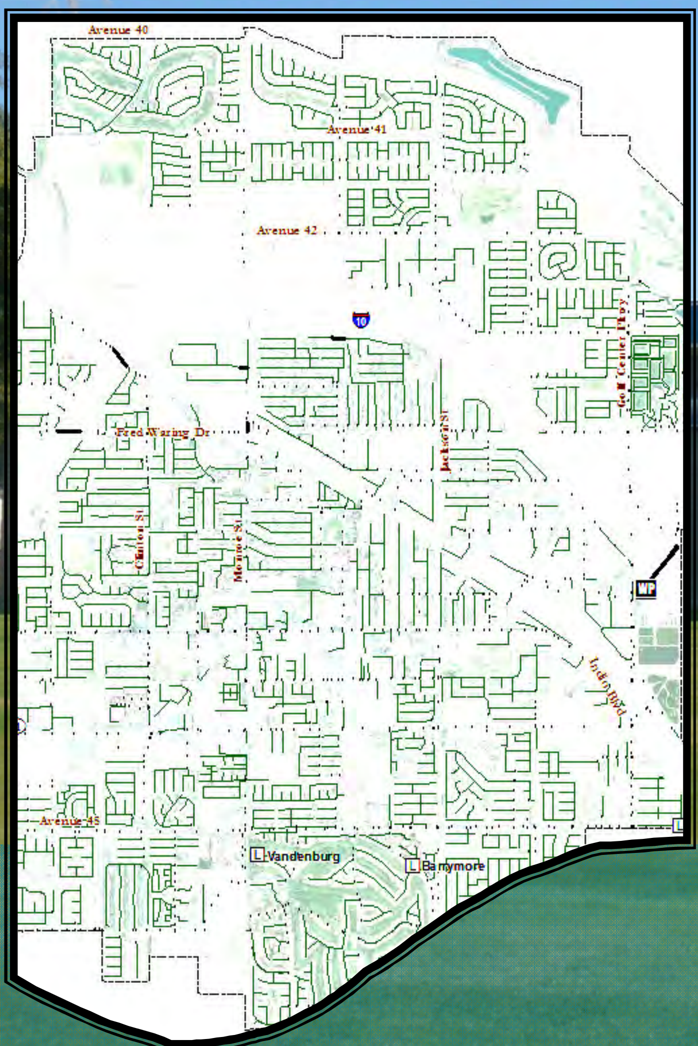
Collection System Master Plan

Valley Sanitary District
Indio, Calif.



MWH

June 2013

VALLEY SANITARY DISTRICT

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Section 1
Introduction

This section of the Collection System Master Plan (Master Plan) report for Valley Sanitary District (VSD) provides an overview of the Master Plan project. A brief description of the project background, the scope of work, and a description of the report organization follow, and a listing of abbreviations and definitions used in this report are included in this section.

1.1 AUTHORIZATION

This Master Plan has been developed under Task Authorization No. 1 between VSD and MWH Americas, Inc. (MWH) dated May 30, 2012. All work under this Task Order is governed by the provisions of the Master Services Agreement for Environmental Engineering and Planning Consulting Services between VSD and MWH, dated April 19, 2012.

1.2 PROJECT BACKGROUND

The VSD service area primarily consists of residential areas with moderate commercial, industrial, and public land use encompassing much of the City of Indio, portions of the City of La Quinta and City of Coachella, and unincorporated areas of the County of Riverside. VSD provides collection system services to a population of approximately 76,000. The original Sewer Master Plan was prepared in 2003 by Dudek & Associates, Inc. Since then, growth and infrastructure improvements to support growth within the VSD service area have demonstrated the need to update the previous Sewer Master Plan. The intent of the updated Master Plan is to assist VSD in planning for near-term and build-out development.

As part of the Master Plan, a sewer hydraulic model is developed to evaluate the collection system capacity for existing, near-term, as well as future flow conditions. A Capital Improvement Program (CIP) is developed based on hydraulically deficient pipes identified by the model. The purpose of the CIP is to help VSD identify the prioritized collection system infrastructure projects required to support the growth expected to occur within the VSD service area. It is recommended that VSD update this Master Plan every five years to account for changes in the growth pattern that could impact the sewer flows, which in turn could impact the infrastructure requirements.

1.3 OBJECTIVE AND SCOPE OF WORK

The key objectives of the Master Plan are to:

- Provide an update to the 2003 Sewer Master Plan
- Create and calibrate a computer-based hydraulic model
- Evaluate the existing sewer collection system
- Address system deficiencies for existing conditions, as well as build-out and 5-year (i.e., year 2018) interim conditions.

- Develop a phased capital improvement program with an emphasis on flow, age, and material deficiencies from the hydraulic model.

The scope of work for this Master Plan consists of the following tasks:

- Task 1: Provide Project Management, Communication and Meetings
- Task 2: Data Collection and Modeling Review
- Task 3: Hydraulic Sewer Model Development
- Task 4: Flow Monitoring and Sewer Model Calibration
- Task 5: Sewer Model Analysis
- Task 6: Sewer System Improvements
- Task 7: Collection System Master Plan Report

1.4 DATA SOURCES

In preparation of this Master Plan, VSD staff provided several reports, maps, electronic files, and other sources of information. In addition, material was obtained from outside sources, including the City of Indio, Riverside County, and the United States Census Bureau. Pertinent material included planning and development information, aerial photography, and sewer system GIS information. In addition, multiple meetings and extended interaction with VSD staff were conducted throughout the master planning process to obtain a thorough understanding of the District's information and needs.

Various reference documents including previous studies were used for the preparation of this report. A list of references is provided in **Appendix A**.

1.5 ACKNOWLEDGEMENTS

MWH wishes to acknowledge and thank all VSD staff for their support and assistance in completing this project. Special thanks to Joseph Glowitz (General Manager), Ron Buchwald (District Engineer), Mike Butvidas (Development Services Supervisor), and Steve Shepard (Collection System Supervisor).

1.6 PROJECT STAFF

The following MWH staff was principally involved in the preparation of this Collection System Master Plan:

Project Manager:	Alok Pandya, P.E., PMP
Project Engineer:	Jinny Huang, P.E.
Staff Engineer:	Oliver Slosser, E.I.T.
	Jackie Silber, GISP
Technical Review:	Raniah Ziadah, P.E.
	Ajit Bhamrah, P.E.

1.7 COLLECTION SYSTEM MASTER PLAN ORGANIZATION

This Master Plan is divided into seven sections, similar to the tasks performed in the scope of work. **Section 2** provides a description of the VSD service area. **Section 3** discusses the existing sewer system. **Section 4** provides an overview of the development of the hydraulic model as well as a discussion on calibration. **Section 5** describes the proposed collection system and the evaluation of the system using the hydraulic model. **Section 6** is an evaluation of pipe condition based on age and CCTV data. **Section 7** presents the recommended improvements for the VSD collection system, and, **Section 8** presents the Capital Improvement Program (CIP) along with anticipated costs.

1.8 ACRYONYMS AND ABBREVIATIONS

To conserve space and improve readability, abbreviations have been used in this report. Each abbreviation has been spelled out in the text the first time it is used. Subsequent usage of the term is usually identified by its abbreviation. The abbreviations used in this report are shown below.

F°	Degrees Farenheit
AM	Abandoned Manhole
AOC	Area of Concern
Ave.	Avenue
Blvd.	Boulevard
CIP	Capital Improvement Program
CVAG	Coachella Valley Association of Governments
CVWD	Coachella Valley Water District
Dr.	Drive
DS	Downstream
DSMAN	Downstream Manholes
EDU	Equivalent Dwelling Unit
EL	Elevation
ENR	Engineering News Record
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute, Inc.
d/D	Depth to diameter ratio
FM	Force Main
E.I.T.	Engineer-in-Training
ft.	Feet
GIS	Geographic Information System
GISP	Geographic Information Systems Professional
gpd	Gallons per Day
gpm	Gallons per Minute
hgl	Hydraulic Grade Line
hp	Horsepower
Hwy	Highway
ID	Identification
in.	Inch

INV	Invert
JCT	Junction
Master Plan	Collection System Master Plan
mgd	Million Gallons per Day
MH	Manhole
min	Minute
MSA	MSA Consultants, Inc.
MWH	MWH Inc.
NA	Not Applicable
NAD83	North American Datum of 1983
NAVD29	North American Vertical Datum of 1929
NAVD88	North American Vertical Datum of 1988
O&M	Operation and Maintenance
P.E.	Professional Engineer
PMP	Project Management Professional
PMP-#	Pump
PS	Pump Station
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance and Quality Control
Rd.	Road
sec	Second
SCAG	Southern California Association of Governments
sq. ft.	Square Feet
St.	Street
STN	Station
SWMM	Storm Water Management Model
TDH	Total Dynamic Head
TM	Technical Memorandum
U.S.	United States
USGS	United States Geological Survey
USMAN	Upstream Manhole
VCP	Vitrified Clay Pipe
VSD	Valley Sanitary District
WW	Wet Well
WWTP	Wastewater Treatment Plant

Section 2
Service Area Description and Population

This section describes the Valley Sanitary District's (VSD) existing service area. A discussion of population, land use, climate, and geography within the service area is presented in this section.

2.1 VALLEY SANITARY DISTRICT SERVICE AREA

VSD was formed in 1925 and primarily serves the city of Indio, California. The city of Indio encompasses approximately 96 percent of the VSD service area, while the remaining 4 percent is comprised of portions of the City of La Quinta and City of Coachella, as well as unincorporated land in Riverside County.

VSD operates and maintains 246 miles of sanitary sewer line, and delivers over 6 million gallons per day (gpd) of wastewater to its 11 million gallons per day (mgd) wastewater treatment plant (WWTP) on Van Buren Street and Enterprise Way. The City boundary and the sewer service area boundaries are shown in **Figure 2-1**.

2.2 EXISTING GEOGRAPHICAL DESCRIPTION

The size of the VSD service area is approximately 19.9 square miles. VSD sits mostly within the city of Indio which borders the cities of Coachella, Bermuda Dunes, and La Quinta. VSD sits at an average elevation of 18 feet (ft.) above sea level, with a high elevation of 142 ft. above sea level and a low elevation of 54 ft. below sea level. VSD and the City of Indio are bordered by three mountain ranges which contribute to its warm climate. VSD is approximately 20 miles from the city of Palm Springs, 15 miles from the Salton Sea, and 134 miles from the city of Los Angeles.

2.2.1 Climate

VSD is located in a desert region where temperatures typically range between 60 to 90 degrees Fahrenheit (°F) as shown in **Table 2-1**. The warmest month of the year is July with an average maximum temperature of about 107.3 (°F), while December is the coldest month of the year with an average minimum temperature of 44.2 (°F). VSD's climate is affected by its proximity to the three mountain ranges that surround the area, which keep temperatures warmer throughout the year. Humidity is relatively low during high temperatures.

Table 2-1 shows the average monthly temperatures in Indio, California. Annual precipitation data from the last ten years (i.e., 1993 to 2012) is presented in **Table 2-2**.

VSD experiences an average of approximately 2.9 inches of rainfall each year (based on annual precipitation data from 1912 to 2012). Precipitation is especially sparse between the months of April and July. The greatest rainfall occurs during the winter months. On average, January is the wettest month of the year with an average rainfall of approximately 0.61 inches. Average monthly precipitation that occurs in the area is shown in **Table 2-1**. The annual amount of rainfall listed in **Table 2-2** is based from 20 years of data, whereas monthly averages in **Table 2-3** are based on 100 years of data (i.e., 1912 through 2012).

Table 2-1
Average Monthly Temperatures

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max °F	71.9	75.3	81.3	87.5	95.7	103.1	107.3	106.6	102.0	91.9	79.6	71.0	**89.5**
Mean °F	58.3	61.6	68.1	74.1	81.7	88.6	93.8	93.4	88.0	77.8	65.7	57.6	**75.8**
Min °F	44.6	48.0	54.8	60.7	67.7	74.2	80.3	80.3	74.0	63.7	51.8	44.2	**62.1**

Source: National Oceanic and Atmospheric Administration National Data Center Climatological Normals Data Tables for Station USC00044259 (Indio Fire Station).

Table 2-2
Annual Precipitation

Year	Rainfall (inch)
1993	**6.40**
1994	**1.57**
1995	**4.39**
1996	**1.19**
1997	**1.64**
1998	**Non Detect**
1999	**1.11**
2000	**0.59**
2001	**1.04**
2002	**0.98**
2003	**1.63**
2004	**2.87**
2005	**1.15**
2006	**Non Detect**
2007	**Non Detect**
2008	**Non Detect**
2009	**1.12**
2010	**5.08**
2011	**1.48**
2012	**1.83**

Source: U.S. Historical Climatology Network, data from station 044259, INDIO FIRE STATION, California

Table 2-3
Average Monthly Precipitation

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Rainfall (in)	0.61	0.46	0.30	0.10	0.05	0.01	0.12	0.25	0.31	0.21	0.24	0.49

Source: U.S. Historical Climatology Network, data from station 044259, INDIO FIRE STATION, California. Based on data from 1912 to 2012.

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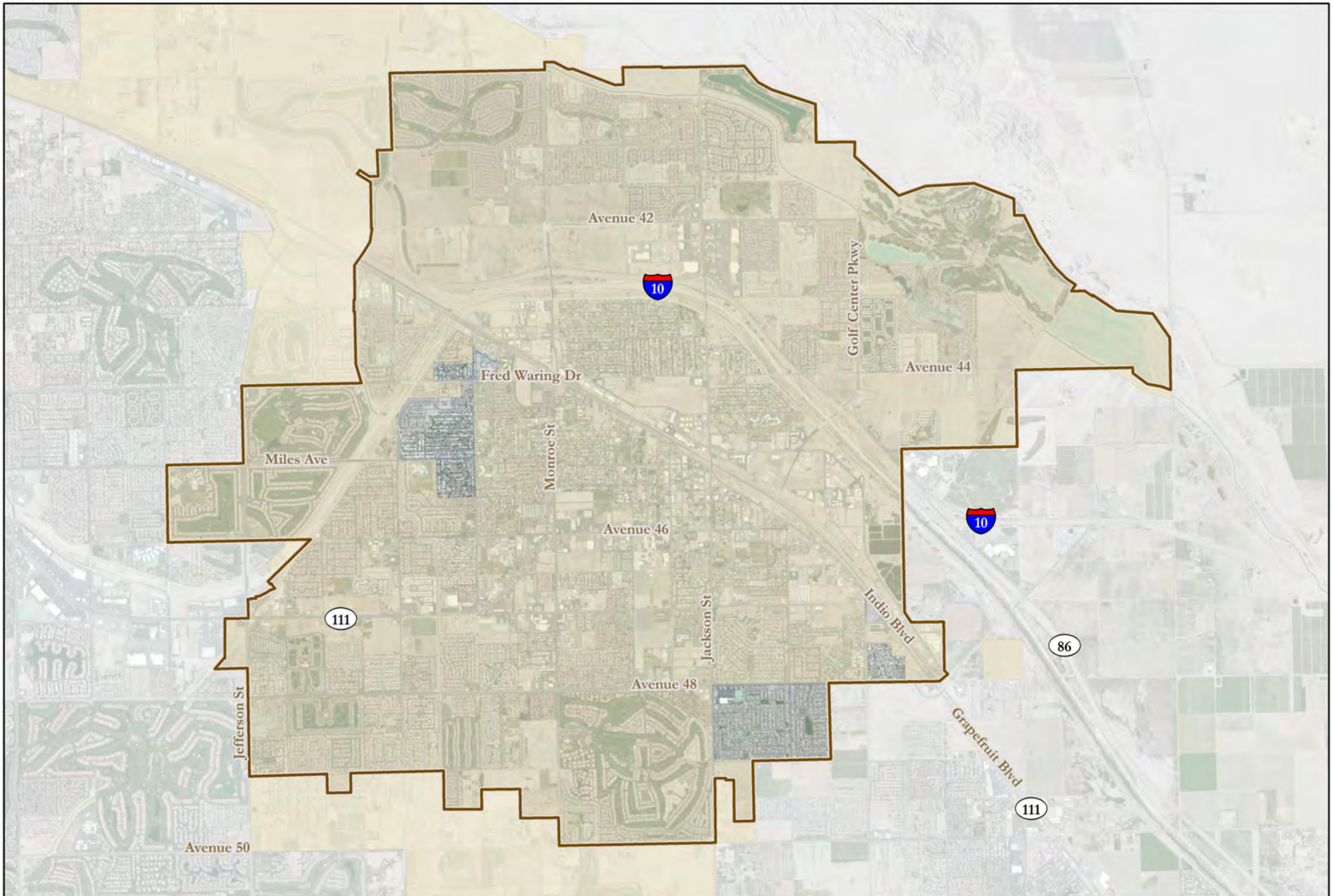

Key to Features

- Vally Sanitary District Boundary
- City of Indio

N

0 0.25 0.5 1 Miles

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Date: June 14, 2013

District and City Boundary

Figure 2-1

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2.2.2 Existing Land Use

The City of Indio is largely open space which encompasses 52.5 percent of the land based on the zoning land-use Geographic Information System (GIS) information from the City of Indio. Zoning information is verified for this Collection System Master Plan (Master Plan) by overlaying the land use data with aerial imagery, and adjusting any areas within the City to the appropriate land use category. For areas where land use may not have been available from the City of Indio information, such as City of La Quinta or City of Coachella parcels, land use was assigned from aerial imagery. The original land use information provided by VSD contained 22 different categories, which are listed in **Figure 2-2**. MWH reviewed VSD's land use data and consolidated it into eight distinct categories: Commercial, Industrial, Mixed Use, Residential (high, medium, and low density), Open, and Public (a final category for vacant areas and septic was created, but it is assumed these area are not contained in the future land use categories). During calibration these categories were further subcategorized to reflect different regions in the model. This generalized land use for the existing system is mapped in **Figure 2-3**.

MWH reviewed existing land use information and observed inconsistencies between the land uses designated in the general plan and aerial images. Existing land use for the VSD area was refined to appropriately match one of the land use categories developed during the calibration process.

Based on the land use, about 19.2 percent of the VSD service area is residential low (i.e., low-density residential), 8 percent is residential medium (i.e., medium-density residential such as townhomes, multi-family homes, condominiums, mobile homes), and 7.7 percent is residential high (i.e., high-density residential such as apartment buildings).

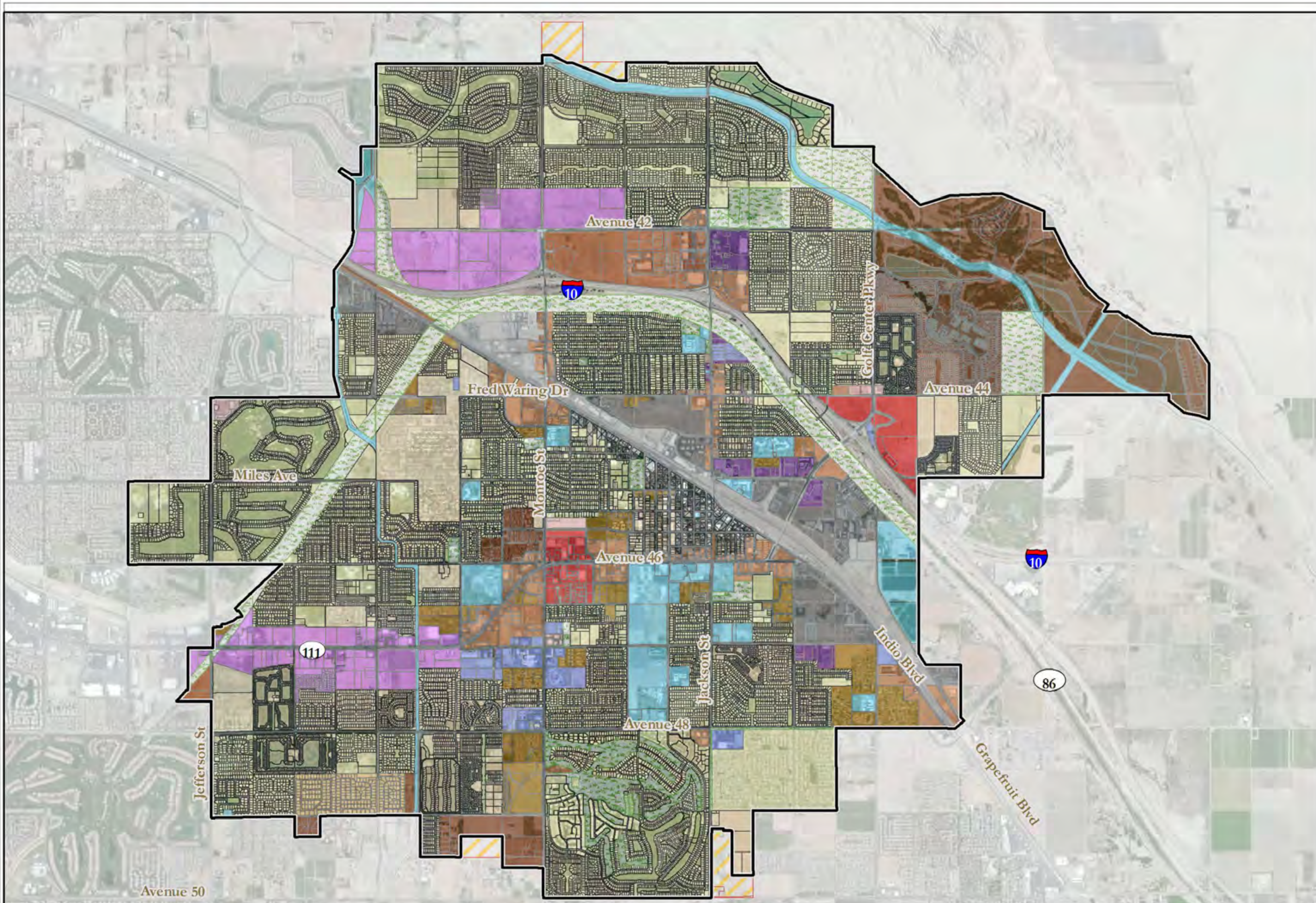
The second largest land use category is commercial which comprises 4.8 percent of VSD. Commercial land use includes shops, garages, restaurants, malls, offices, and schools. Industrial land use makes up 3.3 percent of the VSD service area. **Table 2-4** shows the breakdown of generalized land use category and the percentage of area each category that occupies the existing VSD service area.

VSD also provided a zoning map for build-out of the service area. This zoning map is shown on **Figure 2-4**. Similar to the process utilized for the existing system, the land use categories shown on **Figure 2-4** were also categorized into the eight generalized categories mentioned above. A map of the generalized build-out use is shown **Figure 2-5**.

Table 2-4
Existing Land Use

Land Use	Area (acres)	Area (sq. mi.)	Percentage of Total Area of VSD (%)
Commercial	617	0.96	4.8
Industrial	425	0.66	3.3
Mixed Use	119	0.19	0.9
Open	6,763	10.57	52.5
Public	359	0.56	2.8
Residential High	987	1.54	7.7
Residential Low	2,475	3.87	19.2
Residential Medium	1,030	1.61	8.0
Vacant and Septic[1]	107	0.17	0.8
Total	**12,882**	**20.13**	**100.0**

[1] : This category is not present in the Build-out Land Use (**Table 2-6**) as there is not anticipated to be any septic or vacant land in the projected scenario as a conservative estimate.



Key to Features

- Valley Sanitary District Boundary
- Future Annexation
- Business Park
- Commercial Office
- Community Commercial
- Country Estates
- Country Estates Transitio
- Downtown Commerce
- Industrial Park
- Manufacturing
- Mixed Use (DA)
- Mixed Use (SP)
- Neighborhood Commercial
- Open Space
- Public
- Regional Commercial
- Residential - High
- Residential - Low
- Residential - Medium
- Roadway

N 0 0.25 0.5 Miles

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Date: August 19, 2013

General Land Use

Figure 2-2

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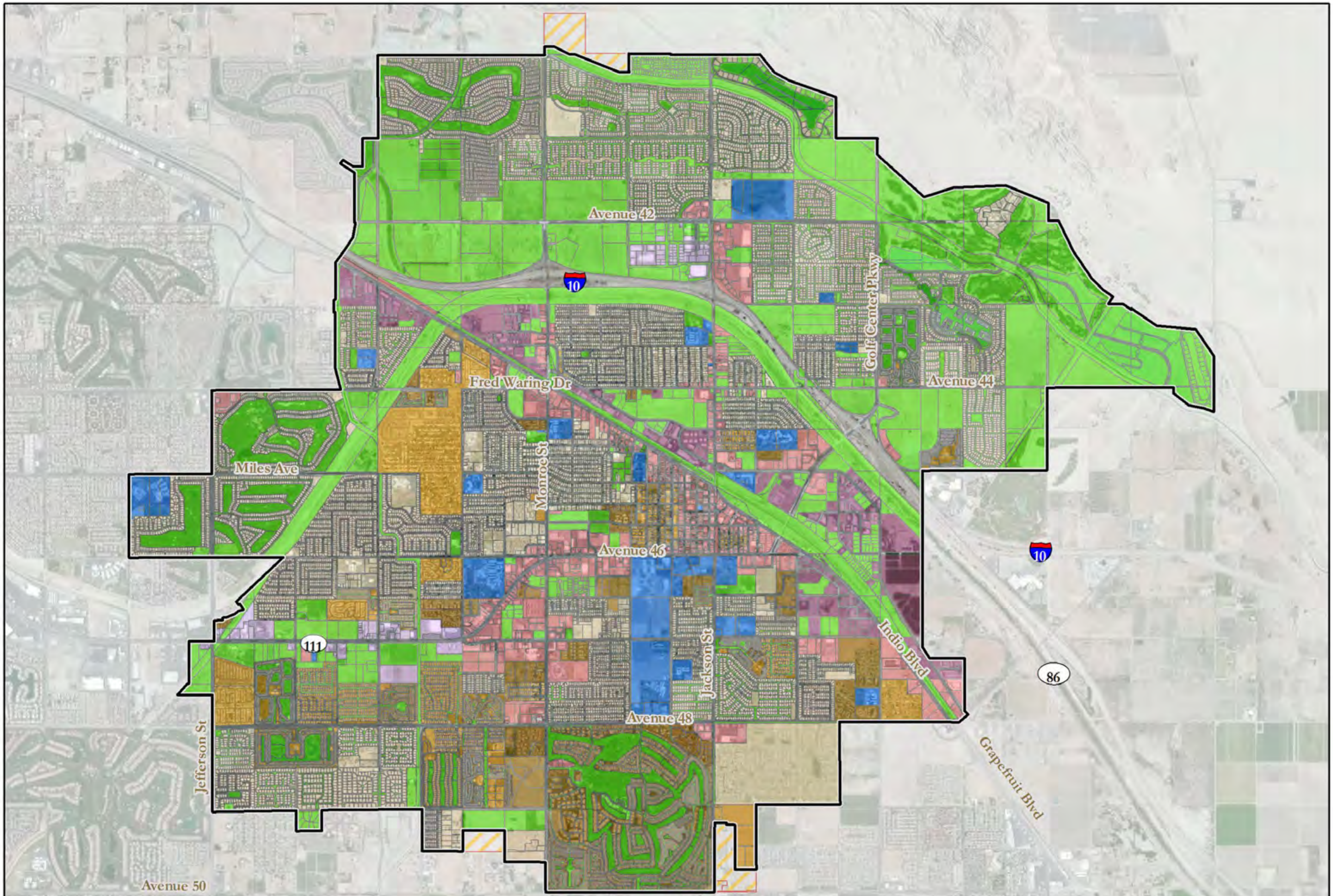

Key to Features

- Valley Sanitary District Boundary
- Commercial
- Industrial
- Mixed Use
- Open Space
- Public
- Residential High
- Residential Medium
- Residential Low
- Future Annexation

N 0 0.25 0.5 Miles

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Date: August 19, 2013

Generalized Existing Land Use

Figure 2-3

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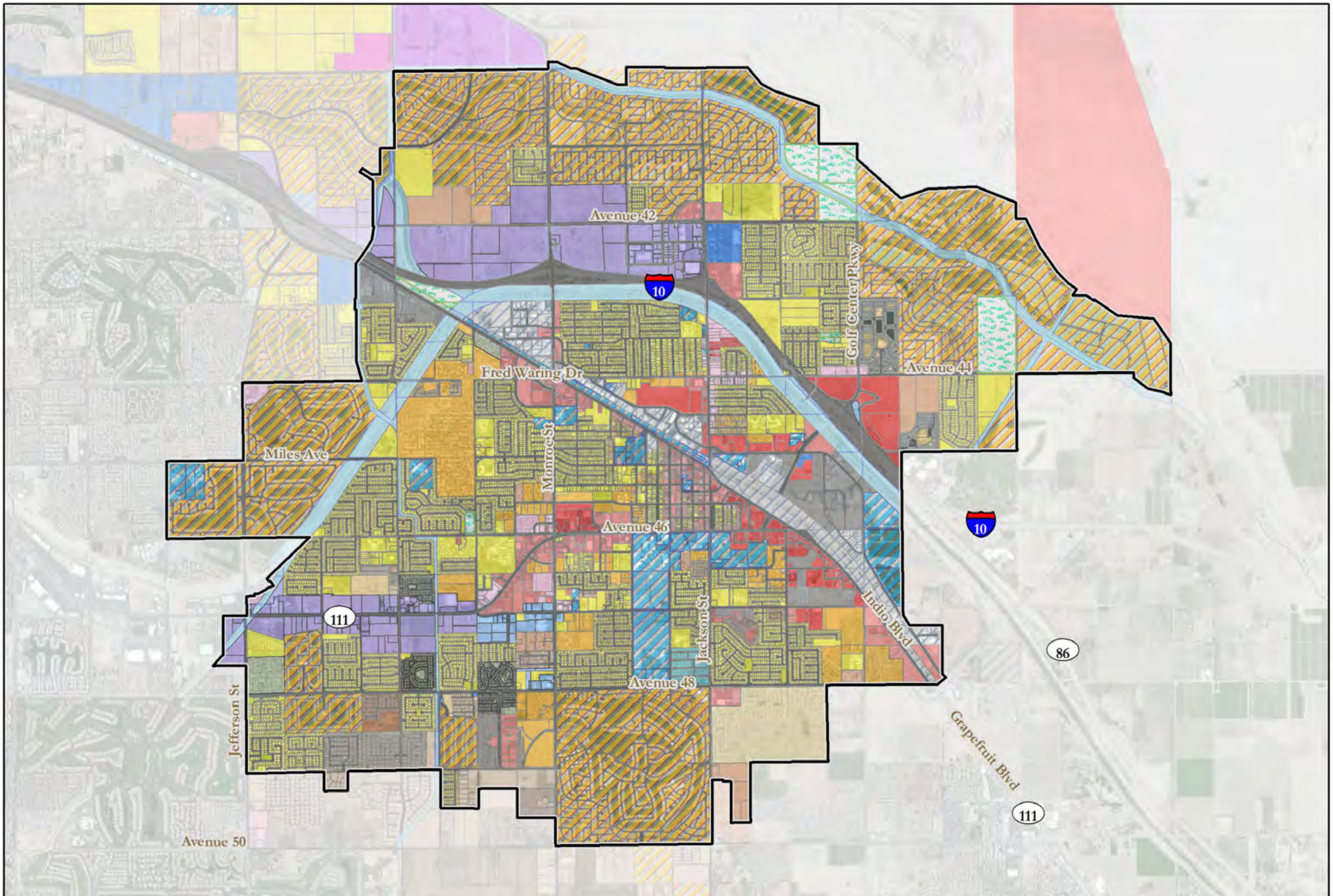

Key to Features

- Valley Sanitary District Boundary
- AAC - Accessway
- BP - Business Park
- CC - Community Commercial
- CE-2 - Country Estates 2
- CE-PD - County Estates Planned Development
- CEIR -1 - Country Estates Indio Ranchos – 1
- CEIR -1/2 - Country Estates Indio Ranchos – 1/2 (CEIR-1/2)
- CEIR -2 - Country Estates Indio Ranchos – 1/2
- CET - Country Estates Transition
- CO - Commercial Office
- CO - PMP - Commerical Office Project Master Plan
- EE - Equestrian Estates
- IP - Industrial Park
- M - Manufacturing
- MHPD - Mobile Home Planned Development
- MU (DA) - Mixed Use Development Agreement
- MU (SP) - Mixed Use Specific Plan
- MUSP 300 - Mixed Use
- NC - Neighborhood Commercial
- OS - Open Space
- P - Public
- PMP - Project Master Plan
- RC - Regional Commercial
- RH - Residential High
- RL - Residential Low
- RLCI - Residential Low Central Indio
- RM - Residential Medium
- RM-MH - Residential Medium (Mobile Home Park/R.V. Park)
- RM-SP - Residential Medium - Specific Plan
- RM/MHPD - Residential Medium (Mobile Home Planned Development)
- RR - Resource Recovery
- SP - Specific Plan
- ST - Streets
- VILLAGE CO - Village Core
- WSC - Water way

N
0 0.25 0.5 1 Miles

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Date: August 19, 2013

Existing Zoning (2010)

Figure 2-4

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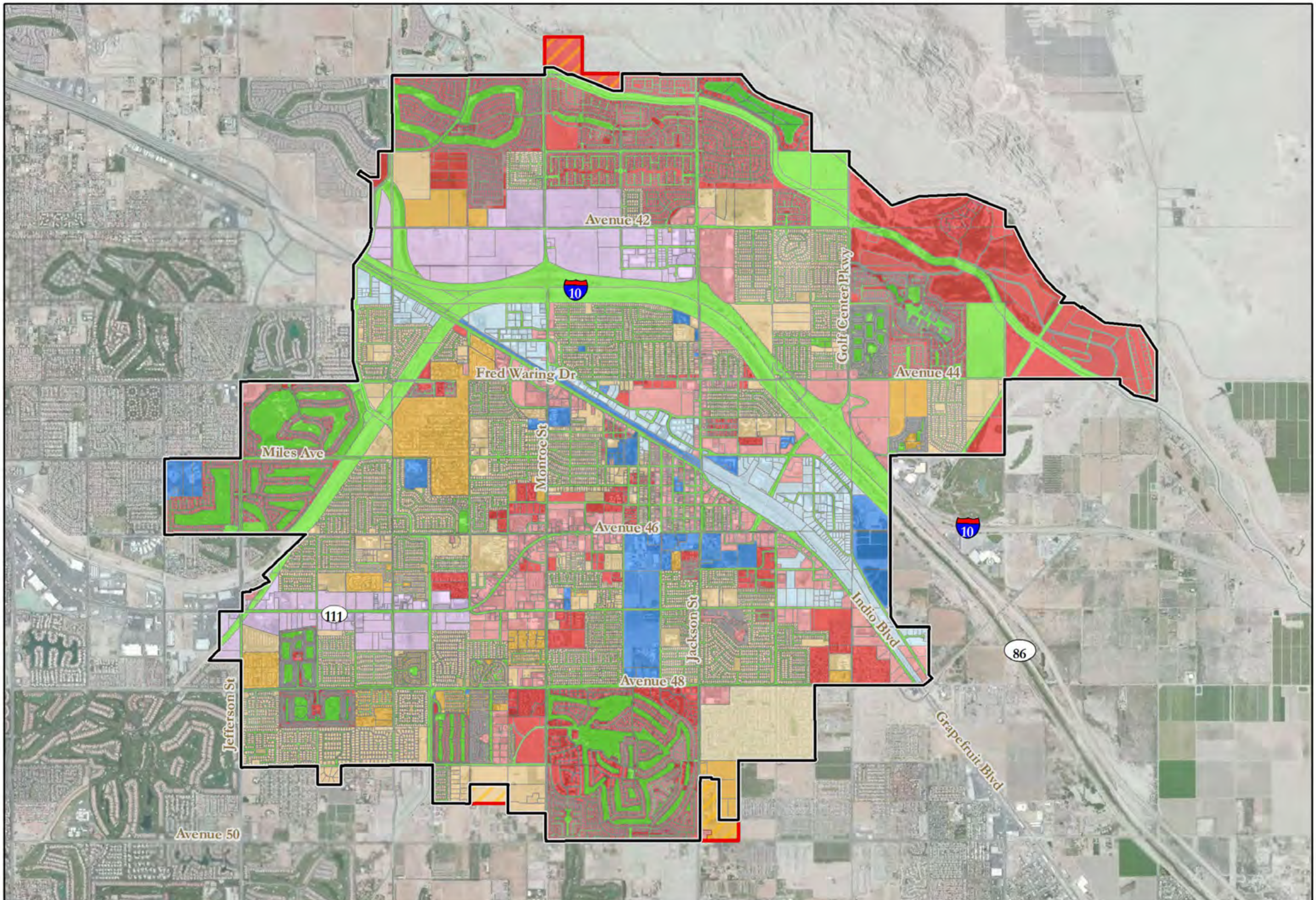

Key to Features

- Valley Sanitary District Boundary
- Future Valley Sanitary District Boundary
- Future Annexation
- Commercial
- Industrial
- Mixed Use
- Open
- Public
- Residential High
- Residential Medium
- Residential Low

N 0 0.275 0.55 Miles

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Date: August 19, 2013

Generalized Future Zoning

Figure 2-5

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2.2.3 Existing Population

According to the 2010 U.S. Census Bureau, the City of Indio has a population of 76,036 with an average of 3.22 persons per household between 2007 and 2010. The 2000 Census cited a population of 49,166 in 2000, a change of 26,920 people, or 54.8 percent. According to the Southern California Association of Governments (SCAG), "During this 10-year period, the city's population growth rate of 54.8 percent was higher than the Riverside County rate of 41.7 percent," and "in 2010 the city's population was ranked 8th out of 27 cities in the county."

In addition to the residents of Indio, large annual festivals such as the Coachella Music Fest and local attractions such as golfing and spas draw thousands of visitors to Indio each year. Higher population densities are found in the central portion of VSD, north of Avenue 48 and south of the 10 freeway (I-10).

Population information is used to verify flow data for the VSD system, and to determine the increase in flow generation within the area based on growth rate of the population. Population information is provided by 2010 U.S. Bureau of Census data and population projections are based 2012 Coachella Valley Association of Governments (CVAG) data for the City of Indio. Since projections are not available for unincorporated areas within the VSD service area, this area is assumed to have a similar growth rate as the City of Indio. Population projection data is provided for each Census tract and evaluated from year 2010 through 2035 in five year increments, as shown in **Table 2-5**. Population within the VSD service area is expected to increase almost 60 percent from year 2010 to 2035.

Table 2-5
Existing and Projected Population within VSD Service Area

Year	VSD Population
2010	76,036
2015	87,486
2020	100,387
2025	106,923
2030	113,681
2035	120,676

Source: 2012 Coachella Valley Association of Governments

Because future zoning information for VSD was available, future land use was used to project demand for the build-out scenario. Population projections developed are used to verify these projected flows.

2.3 PROJECTED FUTURE CONDITIONS

Future conditions consider anticipated future developments and build-out conditions within the VSD service area. Data from the City of Indio's and Riverside County General Plan land use GIS information is used to develop build-out conditions, and planned development information gathered from VSD staff is used to develop a projected 5-year conditions. Sewer flows are predicted based on land use and individual development information, and are input into the sewer hydraulic model to assess the needs of VSD's sewer system to meet growth-related increases.

2.3.1 Future Land Use

The City of Indio currently has roughly 52.5 percent open space. Much of this land becomes utilized in the projected build-out scenario and changes land use categories. In addition, conversion of lower density development to higher density land use leads to more flow in the VSD system. Information has been collected on major developments within VSD's boundary that are in various stages of the development process. These development areas were provided by VSD and are shown in **Appendix B** and are in the following processes:

- Developments that have applied for a permit
- Developments that have completed the conceptual review
- Developments that are in the process for entitlement
- Developments that have entitlements granted
- Developments are in the process of having the plans checked
- Developments that are under construction as of July 2013

Twenty-one (21) specific developments were identified by VSD for this Master Plan.

Build-out zoning information is also based on the City of Indio and Riverside County general plans, and grouped into the same categories as developed during calibration. In reviewing the future zoning, oddities in select areas of the system were observed, where land use in the general plan was modified from a high density type land use to lower density type land use (e.g., residential to open space or residential to commercial). In this case, MWH would select the land use with the higher density land use type as the modified future zone. Selecting a higher density land use for the build-out scenario would provide for a more conservative estimation of flow for that area. A major difference between existing land use and future zoning includes the decrease in the amount of open land which decreases from about 52 percent to less than 28 percent of the overall district area. There are also areas of existing residential low land use that is zoned for residential high in the future, which decreases residential low from about 19.2 to 9.9 percent. Conversely, high density residential land use increases from 7.7 to 34.5 percent in the build-out scenario. Future land use information used for this Master Plan is presented in **Figure 2-4** and **Figure 2-5**. **Table 2-6** summarizes land use for the build-out scenario.

Table 2-6
Build-out Land Use

Land Use	Area (acres)	Area (sq. mi.)	Percentage of Total Area of VSD (%)
Commercial	1,063	1.66	8.25
Industrial	542	0.85	4.21
Mixed Use	777	1.21	6.03
Open	3,574	5.58	27.74
Public	457	0.71	3.54
Residential High	4,437	6.93	34.45
Residential Low	1275	1.99	9.90
Residential Medium	758	1.18	5.88
Total	**12,882**	**20.13**	**100**

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Section 3
Existing Sewer System

This section describes VSD's existing sewer infrastructure. The existing wastewater collection system consists of over 246 miles of pipes, 5 active pump stations, 8 siphons, and a wastewater treatment plant (WWTP). The collection system is comprised primarily of polyvinyl chloride (PVC) and vitrified clay pipe (VCP). The oldest known sewer pipes that are still in operation were connected to the system in 1935. Roughly half of VSD's pipes have been built within the last 20 years. The location of the existing sewer system is shown in **Figure 3-1**.

3.1 GRAVITY SYSTEM

Information described in this section for the wastewater collection system is based upon VSD's GIS database received on June 2012. The attributes of the gravity pipes used from the GIS data include the diameter, depths, invert elevations, conduit material, and year of connection.

During the development of the Master Plan, gaps in the GIS database were found through the system. These gaps included missing invert elevations, pipe diameters, pipe material, and ground elevation. These data are essential to perform a hydraulic simulation of the sewer system. Gaps within the system were worked through with VSD staff and are discussed in **Section 4**. In other instances, assumptions were made to fill in the missing information by reviewing pipe profiles, and interpolating and extrapolating invert and ground surface elevations.

3.1.1 Pipes

The collection system consists of pipes ranging from 4- to 54-inches in diameter. 8-inch or smaller diameter pipes make up roughly 75 percent of the gravity sewer system. **Table 3-1** presents the distribution of pipe sizes for the VSD collection system. The entire gravity system colored by the size of the gravity main is shown in **Figure 3-2**. Pipes without given diameters in the provided GIS information were identified and assigned pipe diameter by VSD.

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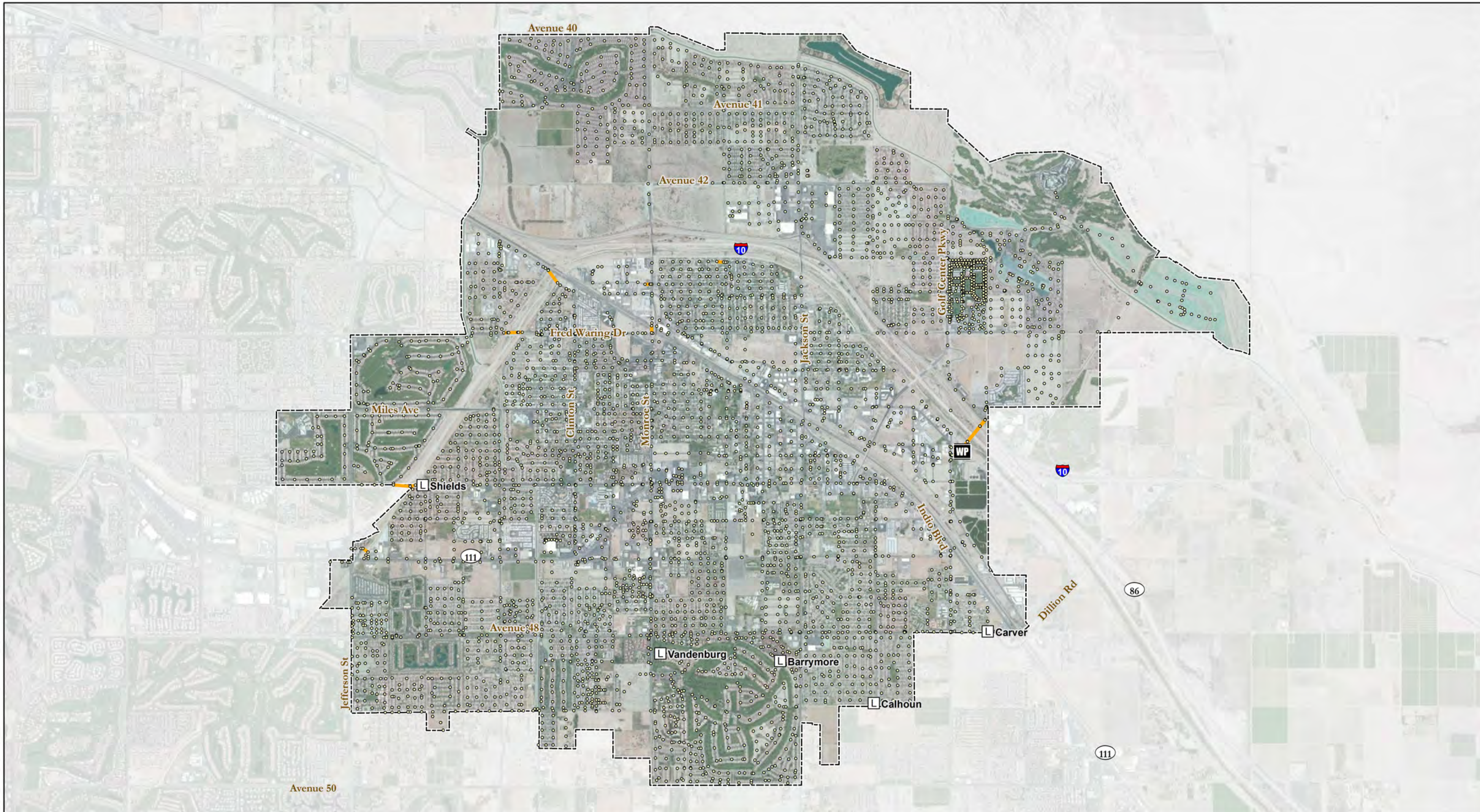

Key to Features

- Manhole
- Lift Station
- Wastewater Treatment Plant
- Siphon
- Sewer Pipeline
- Valley Sanitary District Boundary

N 0 0.5 1 Miles

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Date: June 14, 2013

Valley Sanitary District Sewer System

Figure 3-1

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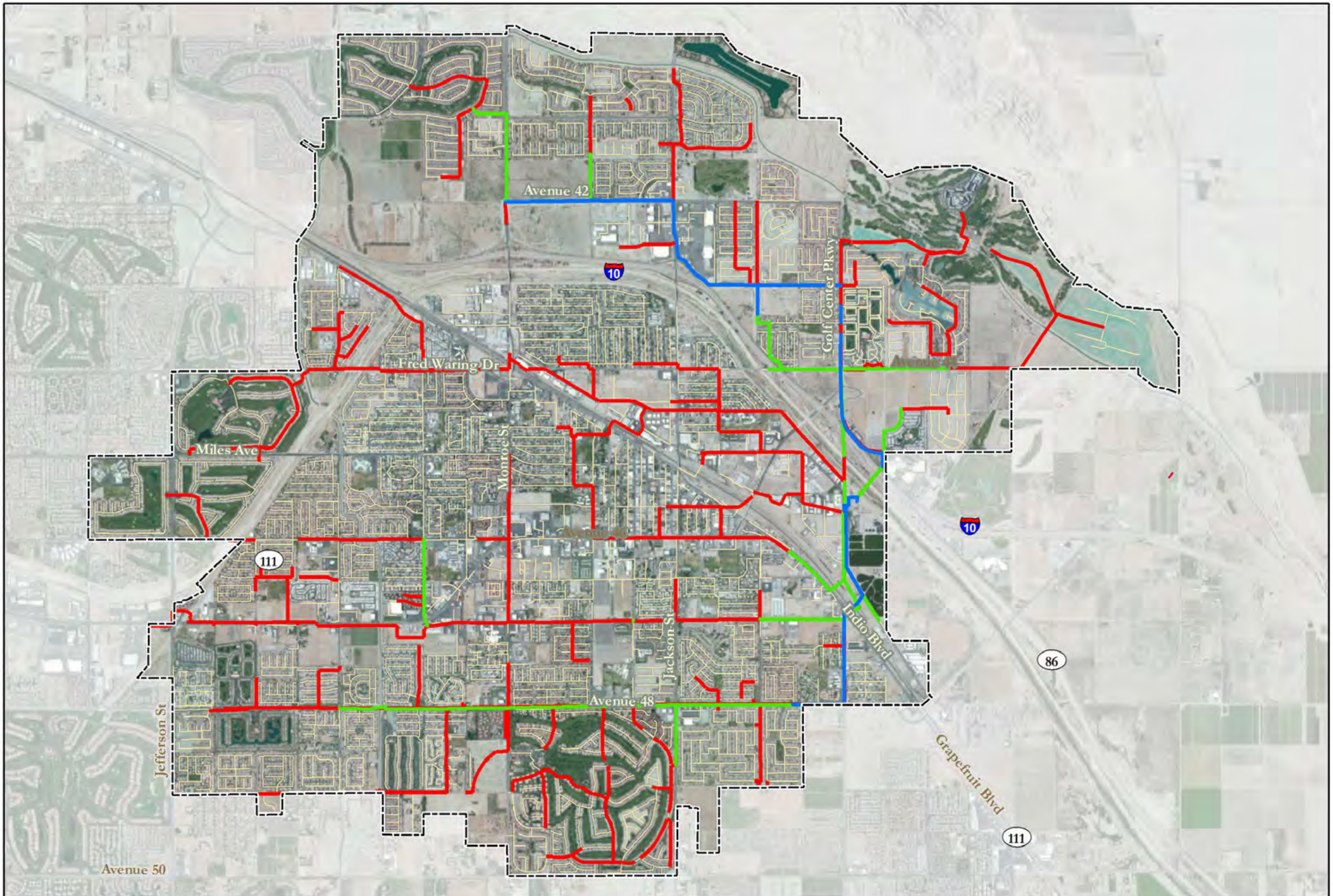

Key to Features

8-inch or less
9-inch to 15-inch
16-inch to 24-inch
Greater than 24-inch
Valley Sanitary District Boundary

0 0.25 0.5 Miles

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Date: October 10, 2013

Valley Sanitary District
Gravity Sewer by Diameter

Figure 3-2

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Table 3-1
Pipes by Diameter Summary

Diameter (in)	Total Length (feet)	Total Length (miles)	Percentage of Total Length (%)
8 or less	970,454	183.8	75%
10	114,208	21.6	9%
12	57,873	11.0	4%
15	74,482	14.1	6%
16	1,271	0.2	0%
18	34,681	6.6	3%
21	3,942	0.7	0%
24	12,491	2.4	1%
27	15,439	2.9	1%
30	2,730	0.5	0%
36	7,113	1.3	1%
42	708	0.1	0%
48	3,253	0.6	0%
54	117	<1	<1%
TOTAL	**1,298,762**	**246.0**	**100%**

The majority of VSD's pipes were installed within the last 20 years as shown in **Table 3-2**. Over 52 percent of the sewers were installed after 1989, and 42 percent were installed between 2000 and 2009. **Figure 3-3** graphically depicts the number of pipe segments installed by year.

Table 3-2
Pipes by Connection Year

Period (years)	Length (feet)	Length (miles)	Percentage of Total Length (%)
1935-1959	160,863	30.5	12%
1960-1969	104,748	19.8	8%
1970-1979	147,683	28.0	11%
1980-1989	141,170	26.7	11%
1990-1999	137,659	26.1	11%
2000-2009	601,227	113.9	46%
2010-present	5,412	1.0	0%
Total	**1,298,762**	**246.0**	**100**

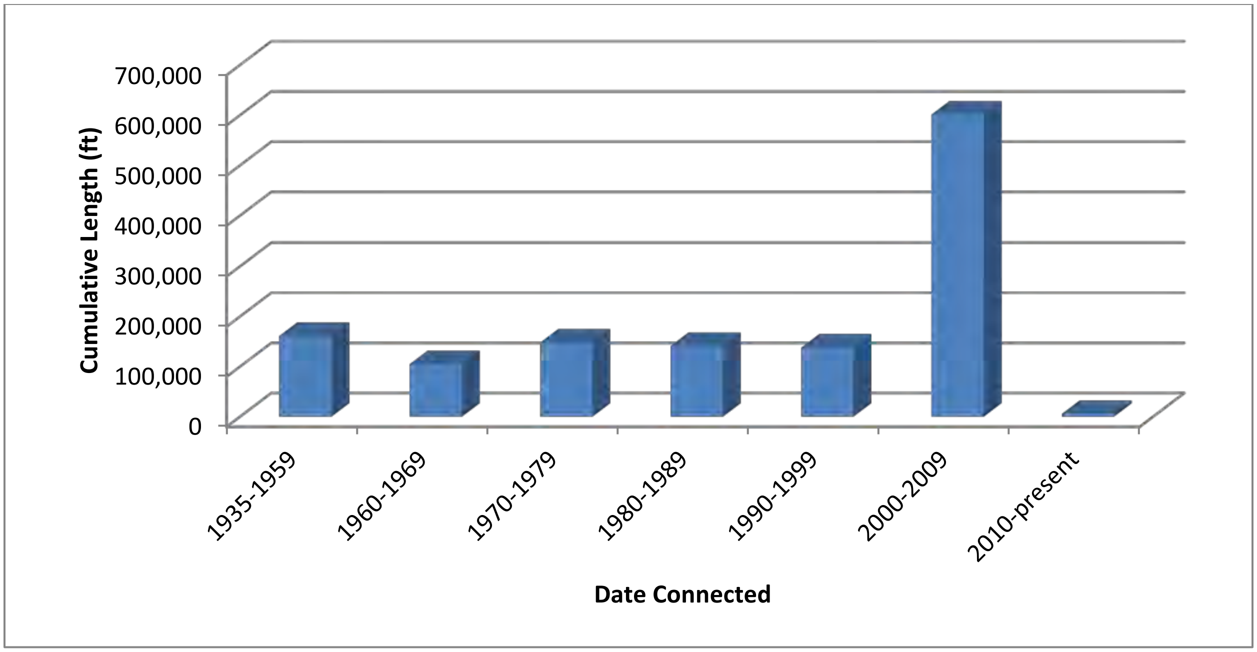

Figure 3-3
VSD Sewers by Connection Year

Figure 3-4 shows the gravity sewer breakdown by age range. Roughly 20 percent of the pipes were installed before 1970, and about 46 percent of VSD pipes have been connected since 2000. Because of high percentage of pipes added to the system in this century, it is recommended that replacement of pipes be planned in a phased manner, preferably starting before the expected lifespan of the pipes. The amount of pipes added to the system between 2001 and today represents a huge portion of the overall system and if replacement is left until they begin to fail, they could all fail at around the same time which could represent an extremely costly period for VSD.

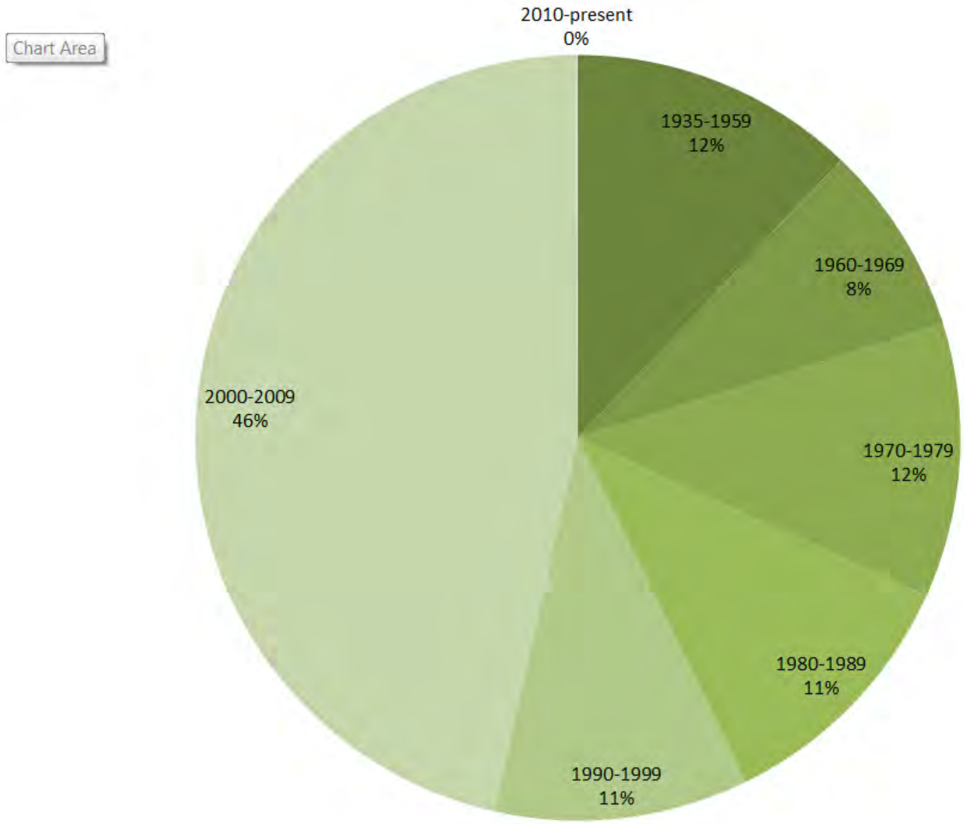

Figure 3-4
VSD Sewer Distribution by Connection Age

3.1.2 Siphons

The VSD collection system has eight inverted siphons. Inverted siphons are essentially a gravity pipe with an uphill section of vertical jump that are used to carry flow under a channel, river, or other interfering structure. Gravity flow is maintained by the upstream head that provides the energy required for flow through the siphon.

Inverted siphons can be comprised of one or multiple barrels. All siphons in the VSD system are single barrel pipes with the exception of the triple barrel pipes crossing the Coachella Valley Water District (CVWD) stormwater channel located east of Van Buren Street and 45th Avenue. This siphon includes one 16-inch, one 20-inch, and one 24-inch diameter pipe. Based on the record drawings of this siphon, there is a fourth barrel designated for future recycled water (16-inch) which is not included in the sewer model. **Table 3-3** lists the siphons for the VSD system that are input into the sewer model.

Table 3-3
Summary of VSD Siphons

No.	Siphon Start Node	Siphon Stop Node	Siphon Model ID	Diameter (in)	No. of Barrels	Location
1	10B-M035	10B-M040	10B-M035_10B-M040	15	1	Northeast of Jefferson St. and Highway 111
2	9C-M265	9C-M270	9C-M265_9C-M270, CDT-11	12	1	East of Westward Ho Dr. and Spyglass Hills St.
3	6D-M115	6D-M120	6D-M115_6D-M120, CDT-21, CDT-23, CDT-25	15	1	Along Fred Waring Dr. east of Madison St.
4	5D-M072	5E-M005	5D-M072_5E-M005	12	1	South of Indio Blvd., north west of the intersection of Jonquil Ave. and Wild Rose St.
5	6F-M330	6F-M335	6F-M330_6F-M335	15	1	Avenue 44 and Indio Blvd., west of Monroe St., running under Railroad tracks
6	6F-M030	6F-M205	6F-M030_6F-M205, CDT-17, CDT-19	8	1	Intersection of Oleander Ave. and Monroe St.
7	5G-M080	5G-M085	5G-M080_5G-M085, CDT-13, CDT-15	8	1	On Crest Ave. between Grove St. and Arabia St.
8	8J-M125	8J-M130	8J-M125_8J-M130_3, CDT-43, 8J-M125_8J-M130_2, CDT-35, CDT-45, CDT-37, CDT-29, CDT-31, CDT-33	16,20,24	3	CVWD stormwater channel east of Van Buren St. and 45th Ave.

3.1.3 Flow Diversion

The VSD system has several places where flow has been diverted to relieve the original pipe when it can no longer accommodate peak flow. Flow is splits between sewers at interconnection points that may occur at a common manhole or a connecting section of sewer line constructed between the parallel sewers.

Flow splits were identified throughout the VSD system and verified with VSD staff. Several areas that appear to have flow splits were confirmed to be currently be non-existent due to operational measured requiring flow to be blocked and preventing diversion of flows. This review resulted in identification of six flow division areas. These locations are listed in **Table 3-4**. Flows at these locations are separated based on system hydraulics.

Table 3-4
Major Flow Split Locations

Manhole ID	Inflow Pipe Size (in)	Street	Flow Description
13H-M020	15	On Barrymore St. south of Odlum Dr.	13H-M020_13H-M021 is a dry overflow with all flow typically found in 13H-M020_13H-M025
6E-M225	8	Corner of Clinton St. and Fred Waring Dr.	6E-M067_6E-M215 is a dry over flow with all flow typically found in 6E-M067_6E-M225
12I-M090	8	La Playa St. and Del Mar	12I-M090_12I-M245 is a dry over flow with all flow typically found in 12I-M090_12I-M100
6G-M265	10	Sola Street and Avenue 44	Flow found in both 6G-M265_6G-M285 and 6G-M265_6G-M270
6E-M067	8	Corner of Clinton St. and Fred Waring Dr.	6E-M225_6E-M090 is a dry over flow with all flow typically found in 6E-M225_6E-M230
10I-M125	18	Tamarisk Avenue and Indio Blvd.	Pipes between 10I-M125 and 10I-M142 are a two-way dry overflow for lines along Indio Blvd. and Dr. Carreon Blvd.

3.2 COLLECTION PUMP STATIONS

Collection pump stations help carry flow from one pipe to another pipe at a higher elevation. VSD currently operates five pump stations (PS) within its sewer system, including Calhoun PS, Carver PS, Shields PS, Vandenberg PS, and Barrymore PS. The locations of these pump stations are shown in **Figure 3-1**.

3.2.1 Pump Stations

VSD operates all 5 of the 6 pump stations within its collection system. There are two pumping units for each pump station, with varying capacity from 2 to 15 horsepower (hp). VSD's two largest pump stations are the Calhoun Pump Station at 15 hp and Barrymore Pump Station at 10 hp.

The Shadow Hills Pump Station, located between Avenue 43 and Hopi Avenue, south of Calhoun Street, was reported in the 2003 Sewer Master Plan by Dudek and Associates as being taken offline in 2006. Wastewater flows that were previously sent to the Shadow Hills Pump Station are now diverted to a 36-inch diameter gravity pipe along Golf Center Parkway to the east. Additionally, Calhoun Pump Station located in the south east section of VSD's service area came online in 2005, after the previous 2003 Sewer Master Plan. Pump station information is based on record drawings, as-builts, GIS information, pump manufacturer information, and discussion with VSD staff.

Table 3-5
Pump Stations

Station No.	Station Name	Year Installed	No. of Pumps	Horsepower Per Pump	Pump Capacity	Modeled (Y/N)
1	Calhoun	2005	2	15	630	Y
2	Carver	1967	2	5	320	Y
3	Shields	2001	2	8.7	300	Y
4	Vandenberg	2007	2	2	110	Y
5	Barrymore	1979	2	10	800	N

3.2.2 Force Mains

Force mains are pressurized pipes that carry flow from a pump station to a discharge point, usually a gravity sewer manhole. The VSD collection system contains approximately 1,325.8 ft. of force main ranging from 4- to 12-inches in diameter. These force mains service the five pump stations described above. Force main information based on VSD's GIS database is provided in **Table 3-6**.

Table 3-6
VSD Collection System Force Main

Pump Station	Size (inch)	Length (ft.)
Carver	6	38.3
Calhoun	6	99.1
Barrymore	8	379.4
Vandenberg	4	129.1
Shields	6	679.9

3.3 WASTEWATER TREATMENT PLANT

The VSD collection system all flows to one outfall, the Wastewater Treatment Plant (WWTP) located at the north-east intersection of Van Buren Street and Enterprise Way, just southwest of Interstate 10. The current capacity of the WWTP is 11 million gallons per day (MGD). The WWTP is currently undergoing improvements that are expected to increase capacity to 13.5 MGD by the end of the year. Ultimately, the plant is expected to have an 18 MGD capacity. As part of the data collection task of this project, historical flows for the WWTP were provided by VSD. **Figure 3-5** shows flows for the WWTP for 2010, the last year for which complete data was given.

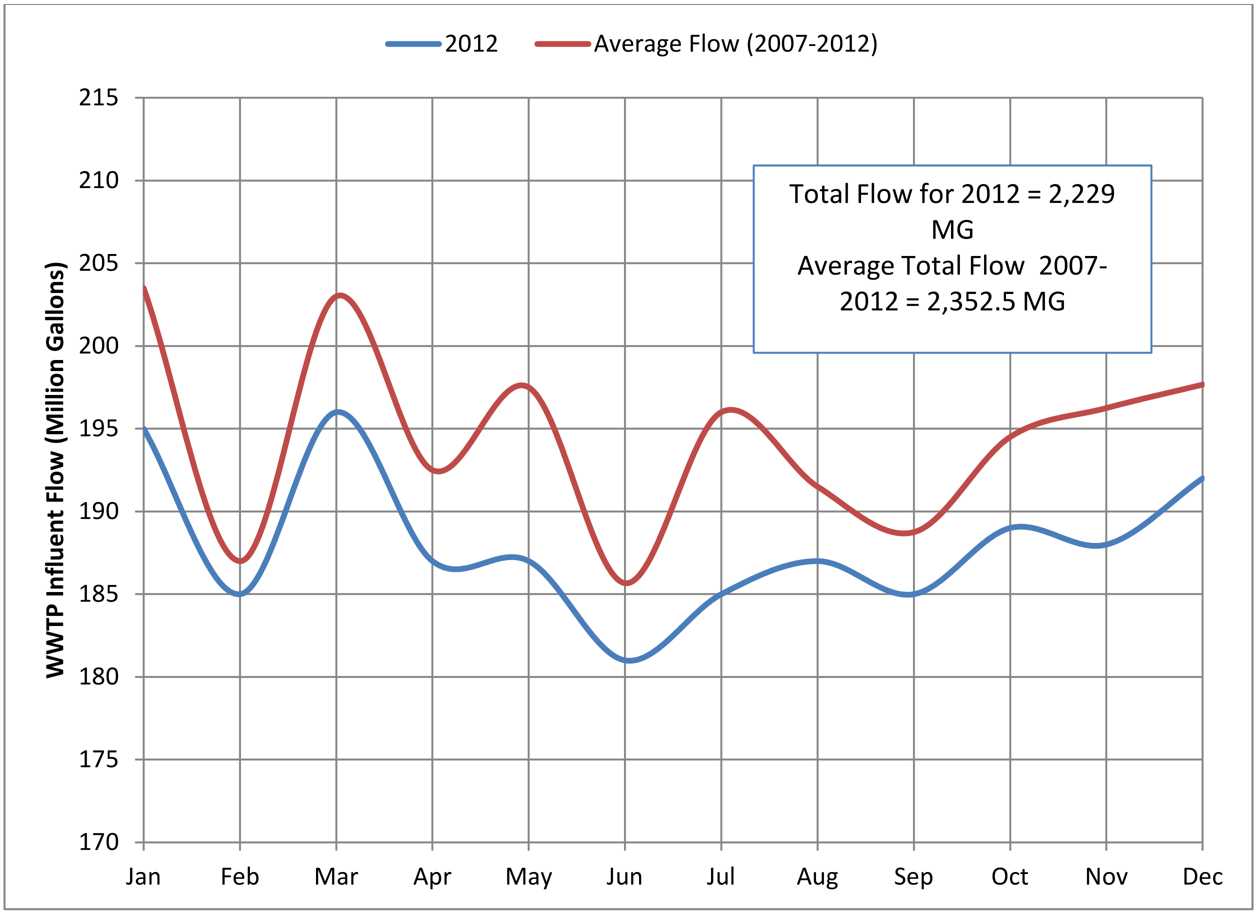

Figure 3-5
Wastewater Treatment Plant Inflow

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Section 4
Model Development and Calibration

This section describes the steps involved in developing the model, including data collection, model construction, and flow allocation. The discussion of data collection includes information on how data was prioritized and used for the model, and also discusses the assumptions and methods used for filling in missing or incomplete data. This section details the creation of different elements of the model, including siphons and sewer facilities such as pump stations. The process of creating sewersheds in the model, which are used in allocating flow throughout the system and projecting future flows based on land use, is also discussed in this section. Finally, a discussion on calibration of the model is contained in this section.

4.1 MODEL DEVELOPMENT

Bentley's SewerGEMS® V8i, SELECTseries 2 software is used to model the VSD sewer system. SewerGEMS is a fully dynamic model based upon EPA SWMM 5 engine, and utilizes the explicit solutions of the St. Venant equations, which permits accurate analysis of reverse flows and backwater conditions. SewerGEMS can be run in the ESRI ArcGIS, Version 10 environment, which allows for a modeling system that can be fully integrated with (Geographic Information System) GIS software and permits all the advanced ArcGIS functions to be utilized. The VSD model is built using the ArcGIS integrated version of SewerGEMS. SewerGEMS includes several tools used throughout model development including ModelBuilder to construct the model using GIS asset information and LoadBuilder to allocate flow.

4.1.1 Data Collection

VSD provided detailed information for the development of the model. Key information included:

- GIS file of sewer manholes
- GIS file of sewer mains
- GIS file of pump stations
- GIS file of 2- foot elevation contours
- GIS file for the VSD service area boundary
- GIS files for street centerlines and parcels
- GIS information for land use general plan
- Digital aerial photography coverage for VSD
- Topographical data for VSD
- Pump station information including design drawings, pump curves, and set points
- Design drawings of siphons
- Sewer atlas maps
- Previous sewer studies for different areas within the system
- Information on annexation areas and major planned developments
- 2003 Sewer Master Plan prepared by Dudek and Associates, Inc.

A full list of reference for this report can be found in **Appendix A.**

4.1.2 Model Construction

The first step in the model development process is to create the existing sewer network and to locate the various sewer system facilities. The sewer network is built using GIS files of the sewer pipes, manholes, and other sewer facilities in GIS shapefile format (.shp). These shapefiles are projected in the State Plane Coordinate System North American Datum of 1983 (NAD83), California Zone VI. The attribute information from shapefiles are organized into categories known as fields, which contain information such as names, installation year, material, lengths or depths, invert elevations, and other attributes of a pipelines or manhole. The ModelBuilder tool is used to import shapefiles into the model, and link data from its shapefile fields to the appropriate SewerGEMS model attributes. The names of the shapefiles used to create the model and the field mapping to the model are shown in **Table 4-1**.

Since part of the VSD service area is below sea level (i.e., negative ground and invert elevations), a value of 500 feet (ft.) is applied to all nodes in the model to prevent potential confusion in converting between negative and positive elevation values. Therefore, the true elevation of any junction in a model will be the elevation displayed in the model minus 500 ft.

Since the start of the building the VSD system, two different datum for referencing the elevation of the system has been recorded. Originally, a North American Vertical Datum of 1929 (NAVD29) was used in the system, though this was eventually replaced by the North American Vertical Datum of 1988 (NAVD88). A majority of the elevations in the VSD system is based on NAVD88, though there may be instances where some elevations use NAVD29. The difference in elevation between the two references was found to be roughly 2.4 ft. These discrepancies have been resolved during the development of the model through elevation adjustments and interpolation.

Table 4-1
GIS Shapefile Field Mapping to Sewer Model

VSD Shapefile Name	Shapefile Description	Field Title	Description	SewerGEMS Attribute
SWNETMHG.shp	VSD Manholes	MAG_MANHOL	Manhole name	Label
		MAG_DEPTH	Manhole depth	Elevation (invert)[1]
		MAG_RIM_EL	Manhole Rim Elevation	Elevation (Rim)
SWNETG.shp	VSD Pipes	NTG_USMAN	Upstream manhole name for pipe	Start Node
		NTG_DSMAN	Downstream manhole name for pipe	Stop Node
		NTG_DIA	Pipe diameter	Diameter (in)
		NTG_US_INV	Upstream invert elevation for pipe	Start node invert elevation (ft.)
		NTG_DS_INV	Downstream invert elevation for pipe	Stop node invert elevation (ft.)
		NTG_SLOPE	Pipe slope	Slope (ft./ft.)
SWSTATNG.shp	VSD Pump Stations	SNG_STN_NA	Station name	Property Label

[1] Manhole Depth provided in GIS was subtracted from rim elevation to obtain invert elevation

4.1.3 Nomenclature

Easy identification of model elements is important as it provides for better understanding and use of the model. The model requires a unique identification value for each element. Identification for the manholes in the model is based on VSD's manhole ID. Identification for the pipes in the model is based on its connecting upstream and downstream manhole ID or node ID. For example, a pipe with upstream node 7G-M310, and downstream node 7G-M315, the assigned nomenclature is 7G-M310_7G-M315. Facilities in the model are labeled by its facility name followed by the element type. The nomenclature PMP-# and WW is used to define a pump and wet well, respectively. For example, the Carver Lift Station facility is composed of two pumps and a wet well; in the model the pumps are labeled CarverPMP-1 and CarverPMP-2, while the wet well is labeled CarverWW.

In the model, pipes are represented as links and manholes are represented as nodes. Not every node in the model will represent a manhole. Additional nodes may need to be added along a pipe to model changing invert elevations or offsets that do not occur at a manhole, such as the case of siphons. New nodes in the model that are not associated to a VSD manhole are labeled as JCT-##, where the ## represent a value designed by the SewerGEMS software.

4.1.4 Model Cleanup and QA/QC

Once GIS information is input into the model using ModelBuilder, a thorough quality assurance and quality control (QA/QC) of the entire system is conducted of the pipeline and manhole data. This QA/QC step is critical as a number of areas were found in the VSD existing GIS information that had incorrect elevation data, missing GIS information, or disagreement of information from multiple sources supplied by VSD. In order to execute this QA/QC process, a number of tools within the SewerGEMS model were employed, including Hydraulic Reviewer Tool, TRex Wizard, Profile Manager, and the validation tool. In addition to these proprietary functions of the SewerGEMS software, manual checks of data are performed to ensure accuracy. The following QA/QC checks were performed:

- Review pipes with missing manhole connections
- Delete abandoned manholes
- Verify pipe lengths
- Verify manhole information (e.g., rim elevations and manhole depths)
- Verify pipeline information (e.g., upstream and downstream invert elevations, upstream and downstream rim elevations, zero diameter)
- Review inconsistencies between rim elevation and invert elevation from the conduit and manhole information
- Profile check of all pipelines in the system

Discrepancies with the VSD GIS data and any issues with integrating to the SewerGEMs model were resolved and discussed below.

Review Pipes with Missing Manhole Connections

Pipes and manholes are connected by spatial proximity using a tolerance of one foot. For pipes that do not have a manhole within the tolerance area of one of its ends, a node is created by SewerGEMS, since all pipes in a model must have a connecting node. SewerGEMS identified 37 pipes with a missing manhole connection thereby automatically creating 37 nodes. The connectivity between pipes with missing manholes connections and its appropriate manhole is determined through atlas maps and manhole IDs designated within the GIS database for the pipe in question. Once the correct connection between the pipe and manhole is made in the model, any nodes that were automatically created by SewerGEMS are then deleted, so that only known manholes from the GIS are represented in the model.

Delete Abandoned Manholes

Once all pipe and manhole connections are verified, any manholes and associated pipes that had been abandoned are identified and deleted from the model. VSD marks these manholes in their GIS data with an “AM” in the name (e.g. “12D-AM160”). Forty-three manholes were identified as abandoned based on this nomenclature, and were removed from the model. Pipes connected to abandoned manholes were also removed from the model.

Manholes with a “C” in their name in place of an “M” are classified as cleanouts (e.g. “4I-C015”). There are 229 manholes in the model that are classified as cleanouts by VSD’s GIS data.

These manholes were left in the model based on the fact that some of them were vital to the connectivity of certain areas of the system, and removing them would have left sections of the system hydraulically isolated. Flows are not assigned to cleanouts.

Verify Pipe Lengths

Pipe lengths are verified in the model against the pipe lengths supplied through the GIS data. The SewerGEMS software calculates length of pipes during the ModelBuilder import data step. These calculated lengths are compared against the lengths defined in the GIS data to verify proper integration of the GIS data into the model. Manual comparison of these lengths shows comparable values for all pipe lengths within a tolerance of 0.75 ft., with 98.9% of lengths within 0.1 ft. from each other. Also, the few pipes exceeding the tolerance did not have major differences between the calculated model length and GIS data, thereby not having a significant impact on the hydraulics of the system.

Verify Manhole and Pipe Information

Once connectivity and pipe length are verified, it is necessary to verify all elevations assigned in the model. These values include invert elevation of the downstream and upstream end of a pipe; rim elevation of a manhole; ground elevation of a manhole; and invert elevation of a manhole. Based on the pipe and manhole shapefile information, the following missing information was reviewed and fixed in the model:

- Manholes (4,810 total manholes)
  - 750 manholes without rim elevations
  - 1,105 manholes without depths
- Pipes (4,985 total pipelines)
  - 408 pipes missing upstream invert elevations
  - 404 pipes missing downstream invert elevations
  - 428 pipes missing rim elevation of connecting upstream manhole
  - 424 pipes missing rim elevation of connecting downstream manhole
  - 18 pipes with 0 diameter

Each issue was individually evaluated and missing data is populated based on GIS information of the surrounding pipes and manholes. Pipes with missing sizes were checked using the atlas maps and verified with VSD staff as shown in **Table 4-2**.

Table 4-2
Pipes with Missing Sizes in GIS Data

Pipe ID	Diameter in Model (inches)
10G-M225_10H-M215	8
12G-M290_12G-M225	(Pump Discharge in Barrymore Pump Station)
12G-M295_12G-M290	15 (Feed pipe to Barrymore Pump Station)
12H-M395_12H-M370	8
13G-M180_13G-M025	8
13H-M020_13H-M021	15
13H-M021_13H-M022	15
13H-M022_13H-M035	15
13H-M060_13H-M015	15
14G-M155_14G-M190	15
4H-M145_4H-M040	8
5J-M635_5J-M630	12
5J-M610_5J-M605	36
6F-M350_6F-M365	15
6J-M780_6J-M775	36
6K-M135_6K-M110	8
7D-M095_7D-M090	8
8H-M210_9H-M245	6

Review Inconsistencies in Data

There are also areas in VSD’s GIS data with redundant information for the same point. For instance, pipe data provides most rim elevations for the upstream and downstream manholes the pipe connects to, and in some cases these elevations would conflict with the rim elevation reported for the connecting manhole(s). There are 532 occurrences identified where a pipe’s GIS information includes a rim elevation for an upstream or downstream manhole that conflicts with the rim elevation reported for that corresponding manhole’s GIS information.

The majority of these inconsistencies were resolved when reviewing missing elevation information for both manholes and pipes. In the case where two values are provided for the same data point, the most conservative value is used in the model. For example, if depth values for a manhole (i.e., distance between the invert elevation and ground level) conflict between the data provided in the manhole shapefile and pipe shapefile, the lower depth value or most shallow depth is modeled.

For areas where invert elevation data is not provided or cannot be determined or interpolated using GIS data from neighboring pipes or manholes, these elevations are calculated using the nearest known invert elevation along the pipeline and a minimum design slopes as shown in **Table 4-3**. This would be applied in areas at the upstream end of a pipe network, in which the invert elevation of the most upstream manhole is missing along with several manholes downstream along the pipe.

Table 4-3
Minimum Design Slope for Pipes

Pipe Diameter (inches)	Minimum Slope
4	2.0%
6	0.5%
8	0.4%
10 or greater	0.3%

Global Pipe Profile Check

The last QA/QC check performed is a manual profile check for each pipe in the VSD sewer network. This process involves visually verifying segments of pipes and manholes utilizing the "Profiles" function of SewerGEMS. Each profile is checked to ensure that:

- Elevation data is filled in and displaying properly in the model
- Pipes connect to an upstream and downstream manhole
- Manholes have a rim elevation that is greater than the invert elevation
- Offsets from a pipe's downstream or upstream invert elevation and a manholes invert elevation does not potentially cause a flow interruption or unrealistic flow regime
- Flow slopes in a downhill direction unless a pump station is present to provide energy to the system.

4.1.5 Assigning Ground Elevations

Upon completion of the model cleanup and QA/QC, ground elevations are assigned to all nodes in the system. SewerGEMS includes an elevation for the manhole rim and an elevation for the ground elevation. Ground elevations are assigned in the model using the 2-foot contour shapefile supplied by VSD and TRex Wizard tool in SewerGEMS. Rim elevations supplied from the pipe and manhole GIS data are compared to the ground elevations determined in the model.

When comparing the rim elevations and ground elevation, roughly 28 percent of all modeled nodes are within 2 ft. of each other, while the remaining 72 percent of manholes had a rim/ground elevation difference of greater than 2 ft. Possible causes of this elevation difference could include inaccuracy of the contour layer, inaccuracy of the manhole shapefile, and improper projection of the contour layer in SewerGEMS. It is not thought that the vertical datum has anything to do with this discrepancy. Regardless of the cause, the lowest elevation between the rim and ground elevations is used to model the node as a conservative estimate.

4.1.6 Summary of Model Development

The digitized network contains approximately 4,800 manholes and 5,000 pipe segments, which extend over 246 miles within the City of Indio and unincorporated areas of Riverside County. The analyzed database includes all collection system pipelines 10-inches in diameter and greater. Additional pipes with diameters smaller than 10-inches are added in order to capture flow from a larger network of small pipes. There are approximately 200 miles of pipelines smaller than 10-

inches in diameter in the sewer system. The modeled database includes approximately 76 miles of pipeline, which is approximately 29 percent of the entire network. All information imported from the VSD GIS information described above, and any additional information taken from atlas maps or through discussion with VSD staff, is included in the SewerGEMS database.

4.2 SEWER FACILITIES

The modeled VSD sewer system includes five lift stations: Barrymore, Vandenberg, Carver, Calhoun, and Shields. There are also eight siphons and one outfall at wastewater treatment plant on Van Buren Street in the VSD system. A description of how these sewer facilities are modeled in SewerGEMS is described below.

4.2.1 Pump Stations

Pump stations (PS) are modeled with a wet well, a pump, a discharge node and a force main as shown in **Figure 4-1**. Details on modeling the wet well and pump station in the model are described below.

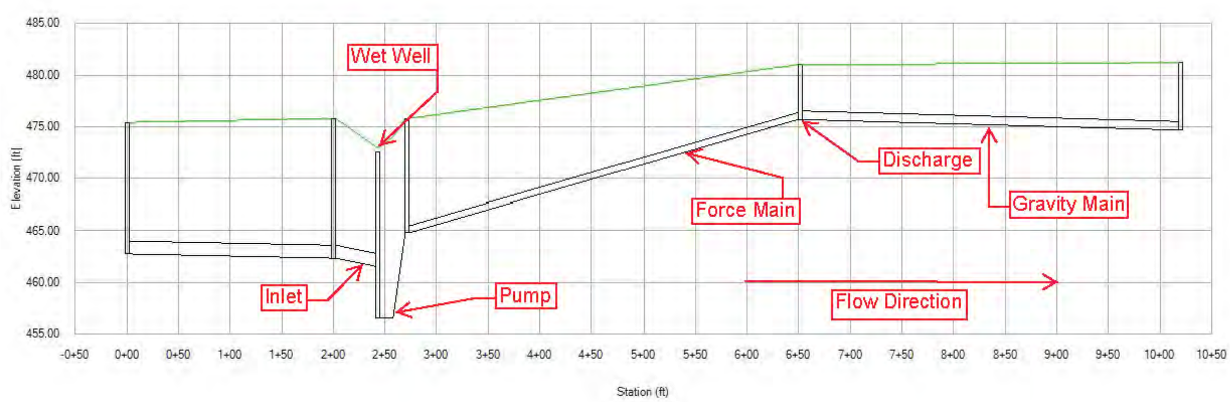


Figure 4-1
Profile of a Lift Station in SewerGEMS

Wet Well

Information necessary to modeling a wet well includes its layout, geometry, area of the wet well as a function of depth, the invert (base) elevation, and the ground elevation or elevation at the top of the well. This information is obtained from record drawings, GIS information, exhibits, and discussion with VSD staff.

Invert elevations of the inlet and outlet pipes of the pump station are also needed to calculate the downstream and upstream offset to accurately simulate any storage utilized by backing up into the inlet pipe. Four of the five wet wells in the system are modeled as circular wells with a constant area versus depth since the height of the wet well is uniform, with Barrymore PS being the exception. The wet well at Barrymore PS is modeled with a variable area to depth curve type well based on its geometry as shown in **Figure 4-2**. Information of the modeled wet wells is presented in **Table 4-4**.

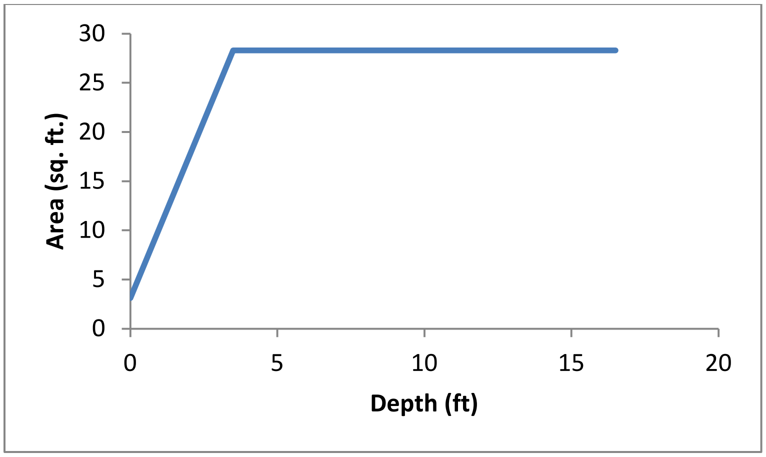


Figure 4-2
Depth-Area Curve for Barrymore Pump Station

Table 4-4
Wet Wells in VSD Model

Model ID	Description	Invert Elevation (ft.)	Maximum Depth[1] (ft.)	Wet Well Area (sq. ft.)
BarrymoreWW	VSD Wet Well at Barrymore Lift Station	456.56	16.50	**Figure 4-2**
CalhounWW	VSD Wet Well at Calhoun Lift Station	435.75	34.65	113.1
CarverWW	VSD Wet Well at Carver Lift Station	447.60	7.30	38.5
ShieldsWW	VSD Wet Well at Shields Lift Station	515	21	50.3
VandWW	VSD Wet Well at Vandenberg Lift Station	484.75	15.25	28.3

[1]: Calculated by subtracting invert (base) elevation from ground elevation

Pumps

Flow from the wet well is transferred via pumping units. Each pumping unit in the model is defined by the pump's start and stop levels, as well as its pump curve. The model includes a total of ten pumps (i.e., two pumps for each lift station). Each pump is modeled with a multi-point curve based on the manufacturer's pump curve data provided by VSD, manufacturer's data, or best available information and knowledge. Pump curves were available for Shields PS, Calhoun PS, and Vandenberg PS. Pump curves for Barrymore PS and Carver PS are obtained from the pump manufacturer, Smith and Loveless.

Other information needed to model a lift station include the elevations for the point connecting the pump unit and force main, as well as the elevation of the discharge point (elevation leaving the force main). The discharge node is taken from the force main record drawings, which ensures that the appropriate total dynamic head (TDH) is simulated. After the discharge node, flow is carried by gravity again as depicted in **Figure 4-1**. Information of the modeled pumping units is presented in **Table 4-5**.

Table 4-5
Pumping Units in VSD Model

Model ID	Description	Year of Pump Curve	Model Pump ID Curve	Startup Depth (ft.)	Shutoff Depth (ft.)
BarrymorePMP-1	Lead Pump for Barrymore Lift Station	Not provided (Pump Installed 1967)	Barrymore Curve	461.56	459.56
BarrymorePMP-2	Lag Pump for Barrymore Lift Station	Not provided (Pump Installed 1967)	Barrymore Curve	461.56	459.56
CalhounPMP-1	Lead Pump for Calhoun Lift Station	2005	Calhoun Curve	445.75	443.75
CalhounPMP-2	Lag Pump for Calhoun Lift Station	2005	Calhoun Curve	445.75	443.75
CarverPMP-1	Lead Pump for Carver Lift Station	Not provided (Pump Installed 1979)	Carver Curve	451.6	449.1
CarverPMP-2	Lag Pump for Carver Lift Station	Not provided (Pump Installed 1979)	Carver Curve	451.6	449.1
ShieldsPMP-1	Lead Pump for Shields Lift Station	2001	Shields Curve	522.65	520.65
ShieldsPMP-2	Lag Pump for Shields Lift Station	2001	Shields Curve	522.65	520.65

4.2.2 Siphons

The VSD sewer model includes eight inverted siphons. Locations and profiles of these siphons are provided by VSD. A summary of the siphons modeled for the VSD sewer system is provided in **Table 3-3**. Sections of pipe along a siphon are separated by nodes in the model. Nodes that do not represent an actual manhole are modeled as bolted junctions to prevent surcharging at these points. A profile of a typical siphon in the model is shown in **Figure 4-3**.

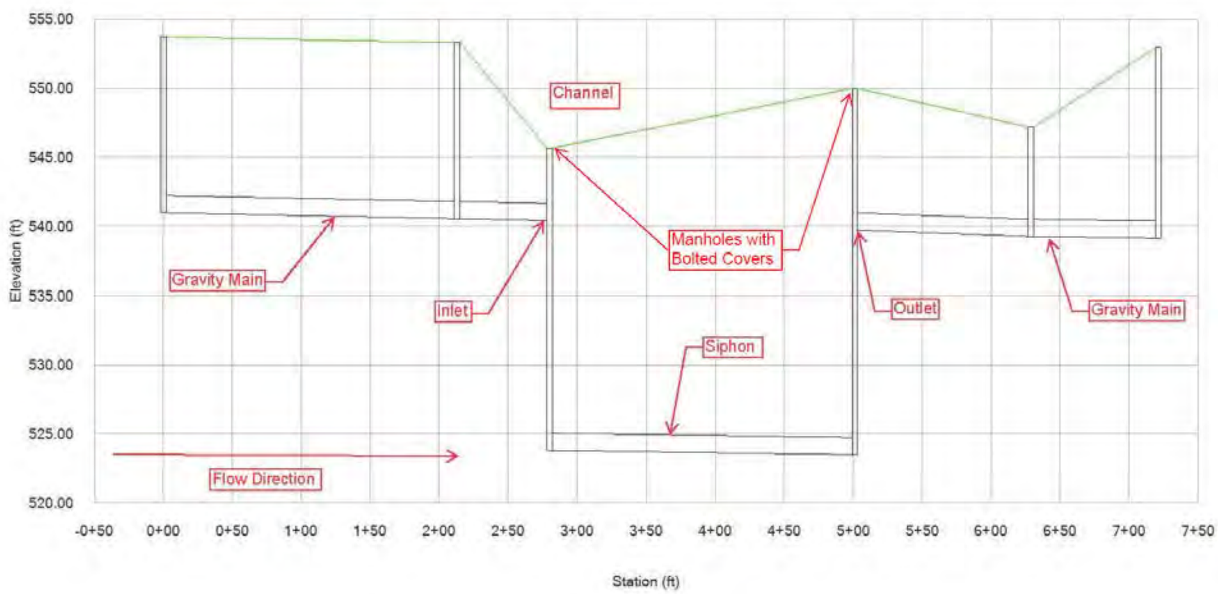


Figure 4-3
Profile of Modeled Siphon

4.2.3 Wastewater Treatment Plant

All flow in a hydraulic model must have at least one outfall towards which it is flowing. In the VSD system, the outfall for the system is the wastewater treatment plant (WWTP) located at the north-east intersection of Van Buren Street and Enterprise Way, just southwest of Interstate 10. The WWTP is modeled as an outfall with an elevation of 447.50 ft., the elevation of the WWTP's inlet pipe.

In addition to the flow monitoring data, VSD provided flow data from the wastewater treatment plant that served as further verification of modeled results. The data included flows from the weeks that flow monitoring was conducted and an average flow volume and hourly flows were recorded from the data. This data was compared to modeled results from the outfall of the system to ensure overall flows for the system were comparable to actual flows.

4.3 BASE DRY WEATHER WASTEWATER FLOWS

Dry weather flows, commonly referred to as base flows, are flows that occur in a sewer system when there is no contribution to flow from wet weather conditions (infiltration of surface water). Wastewater base flow is usually comprised of the following primary components:

- Residential domestic sewage
- Commercial sewage
- Industrial sewage
- Groundwater infiltration

Sewage generation is allocated in the SewerGEMS model using the LoadBuilder function. LoadBuilder allows a user to assign loading data to nodes when the data is not already associated with individual nodes. The parameters used to generate flow in the VSD model are land use, flow patterns for the different land uses, and the unit flow rates for each land use. The allocation of both existing and future sewer flow generation is discussed below. Base wastewater flow within the model is calculated in the following manner for each catchment:

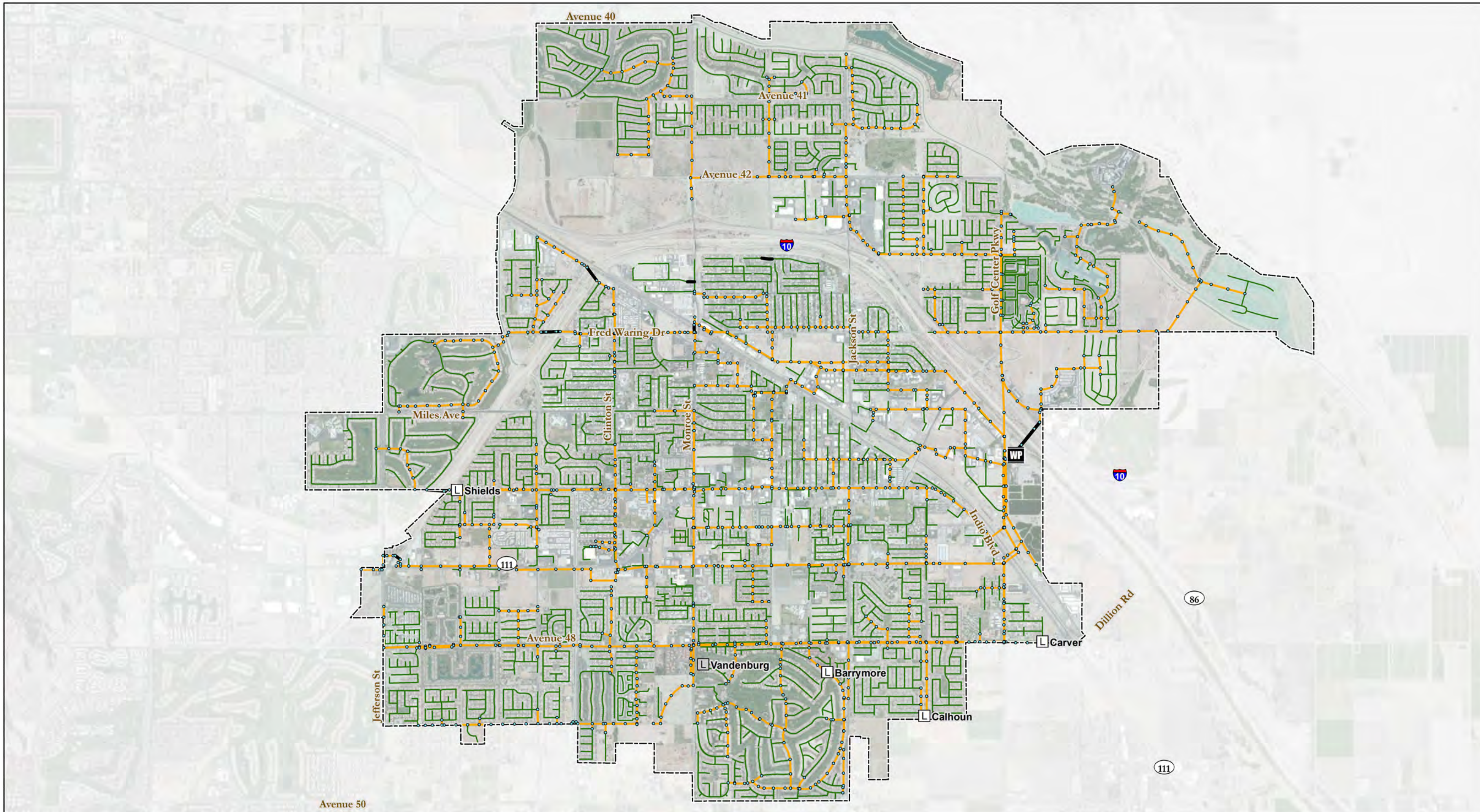
> Total Flow = ∑ (area of land use × unit flow rate factor (gallons per acre) of land use × diurnal multiplier) + groundwater infiltration

As discussed in the base wastewater sections below, dimensionless diurnal patterns are developed for all base flow sources such that the model can predict the full dry weather flow cycle for typical 24-hour period. A unit factor of gallons per acre per day of sewer generation for all land use categories is determined from flow calibrations. Variations in the wastewater flow are ultimately captured by the different diurnal patterns for each land use category.

4.3.1 Allocation of Wastewater Flows

To allocate flows of the existing sewer system, hydraulic units of land known as sewersheds divide the entire service area. Flows within each sewershed are assigned to a single discharge point, with one receiving node (discharge point) associated with each subcatchment. The subcatchments are created to define sewershed areas that will encapsulate the entire service area.

The hydraulic model is divided into 404 polygon subcatchments averaging approximately 31.5 acres in size, with a median size of 23.5 acres. This sewershed size provides a sufficient level of resolution to uniformly apply the wastewater flow components (diurnal curve, land use, etc.). The receiving node of each sewershed is the most downstream node and is selected to receive the flows collected within the sewershed. **Figure 4-4** highlights the pipelines that are being analyzed in the model, while the sewersheds defined in the SewerGEMS model are shown in **Figure 4-5**.



Key to Features

- WP Wastewater Treatment Plant
- L Lift Station
- L Modeled Lift Station
- Sewer Pipeline
- Siphon
- Modeled Sewer Pipeline
- Modeled Manholes
- Valley Sanitary District Boundary

N

0 0.5 1 Miles

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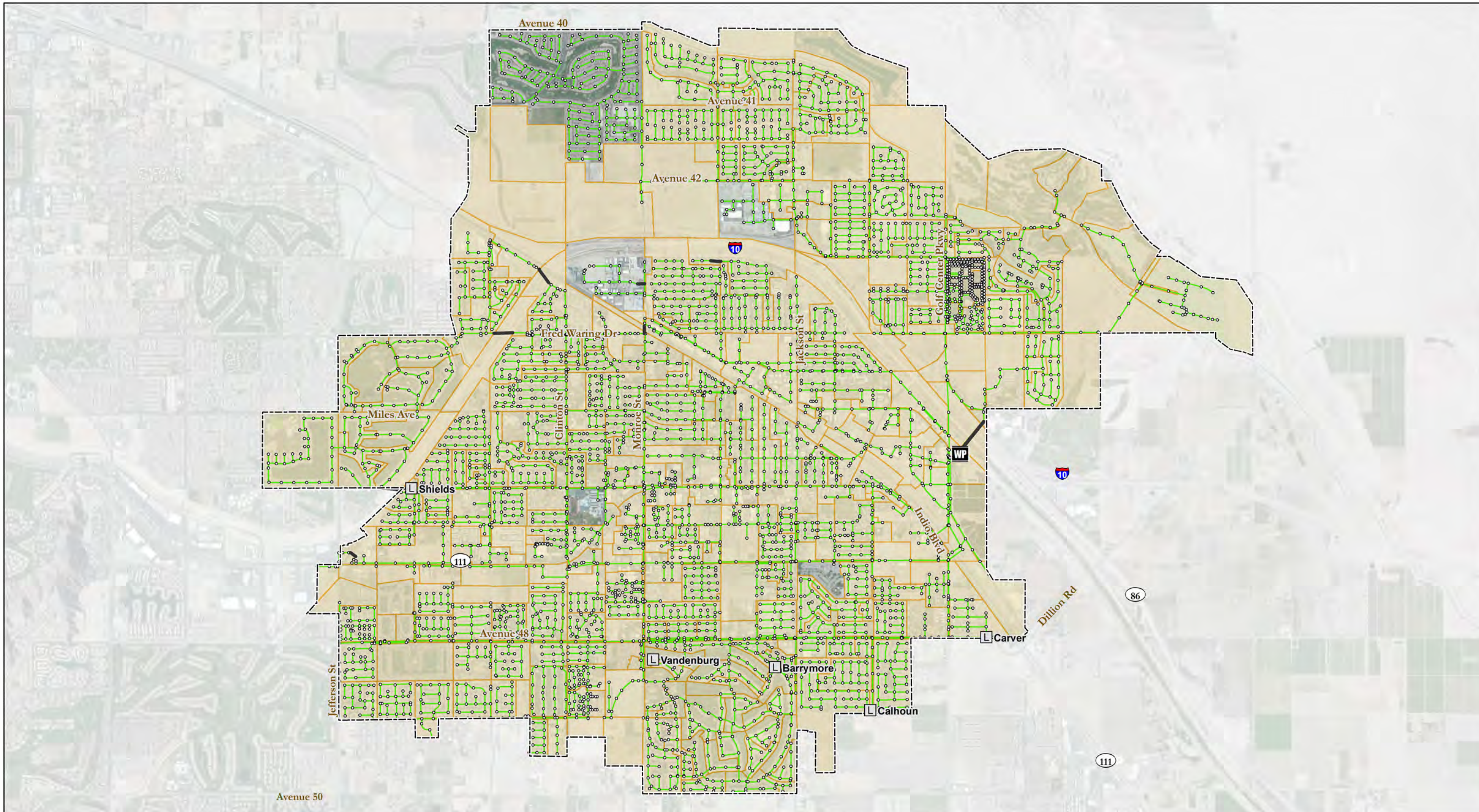
Date: June 14, 2013

Valley Sanitary District Modeled Sewer System

Figure 4-4

MWH



Key to Features

- Manhole
- Modeled Lift Station
- Wastewater Treatment Plant
- Siphon
- Sewer Pipeline
- Sewershed
- Valley Sanitary District Boundary

N

0 0.5 1 Miles

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Date: **June 14, 2013**

Valley Sanitary District Sewersheds

Figure 4-5

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The VSD model began with eight different land use categories: low-density residential, medium-density residential, high-density residential, commercial, industrial, open, public, and mixed use. For the VSD system, the industrial land use category is a catch-all term that covers light industrial, agricultural processing, etc. The open use category includes areas that do not contribute any wastewater flows to the sewer system, such as existing vacant land, access ways, streets, waterways, parks, and select public areas with vacant land. Therefore, the flow generation for open land is zero. A summary of existing dry weather base flows allocated to the model is approximately 5,645 gallons per minute (gpm) or 8.13 million gallons per day (mgd) as shown in **Table 4-6**.

By applying the same wastewater duty factors and diurnal adjustments developed above to the future land use in SewerGEMS, the future dry weather base flow is calculated to be about 13,830 gpm or 19.9 mgd, as shown in **Table 4-7**. The “fixed” land use category listed in **Table 4-7** is used to add point loads to system. In the case of the build-out system, the jail expansion for the detention facility on Highway 111 is given a point load as specific loading data was provided by VSD. Point loads are also used for any known developments in the 5-year planning scenario.

Table 4-6
Existing Dry Weather Flow Allocation

Land Use	**Load (gpm)**
Commercial Central	462
Commercial High_FM	40
Commercial North	155
Commercial North Central	28
Commercial North Central High	40
Commercial South	154
Commercial South Central	301
Commercial Subtotal	**1180**
Industrial North Central	134
Industrial South Central	31
Industrial Subtotal	**165**
Residential 13C-M085	59
Residential Central	439
Residential High	501
Residential North	1,030
Residential North Central	134
Residential South	711
Residential South Central	291
Residential South Low	476
Residential Subtotal	**3641**
Existing Jail	50
Mixed Use	356
Open	0
Public	252
Total	**5,645**

Table 4-7
Future Dry Weather Flow Allocation

Land Use	Load (gpm)
Fixed	107
Commercial Central	611
Commercial High_FM	40
Commercial North	509
Commercial North Central	98
Commercial South	252
Commercial South Central	477
Commercial Subtotal	2,094
Residential Central	341
Residential High	5,130
Residential North	758
Residential North Central	146
Residential South	1,635
Residential South Central	670
Residential Subtotal	8,680
Industrial	407
Mixed Use	2,330
Open	0
Public	320
Total	**13,830**

A flow generation profile is associated with each land use. Seven different diurnal profiles are created and input into the model to simulate flow generation variations over a 24-hour period. Open land use does not require a pattern as flow is not generated from open areas. These profiles were created with data collected during a one-week flow monitoring period from January 5th to January 11th, 2013, thus representing a typical winter day.

4.3.2 Infiltration

The final component of base flow generation is infiltration. Groundwater infiltration is water that leaks into sewer systems from either burst water mains or naturally occurring elevated groundwater levels. The amount of groundwater infiltration can be significantly affected by such variables as pipe condition, construction practices and standards (i.e., pipe seal types, puddle clay versus gaskets), proximity to surface waters, seasonal conditions, natural groundwater table levels, or burst water mains.

VSD typically experiences insignificant infiltration and inflows (I/I) through the year due to its dry climate. For systems similar to VSD, I/I are accounted for using conservative per capita flows. Based on discussion with VSD, areas within the system may receive more inflow during winter storm events. Sources of inflow can include uncapped cleanouts, misconnections to stormwater collection laterals (e.g., rain gutter downspout, outdoor drains, and storm drain), and uncovered manholes. Studies have also shown that for newly-constructed sewers, the infiltration component is insignificant. Manholes located in low-lying areas should be watertight in their design to avoid inflow problems caused by flash-floods. For the purposes of this sewer model, I/I flows were not evaluated.

4.3.3 Known Developments

Based on discussion with VSD staff, several existing major facilities may contribute a significant amount of wastewater flow to the collection system. Known developments were given an equivalent dwelling unit (EDU) approximation by VSD staff. Total loading for each known development was calculated based upon these EDU estimates. These additional flows are added to the 5-yr projection scenario. For the build-out scenario, these known developments (with the exception of the County of Riverside Indio Jail Facility Expansion) are not included as point loads and the excess flow they contribute is captured by the future land use. In order to verify this assumption, flows for the 5-year scenario and the build-out scenario were compared to ensure the build-out scenario showed equal or greater flow for all areas that have known developments in the future. Some of the developments discussed with VSD staff are listed below:

- County of Riverside Indio Jail Facility Expansion
- Fantasy Springs Casino
- John F. Kennedy Memorial Hospital
- Indian Palms Country Club
- Indio County Date Festival
- Annexation: north of 50th Avenue and east of Jackson Street
- Annexation: 40th Avenue and east of Monroe Street
- Annexation: south of 49th Street and west of Monroe Street

A full map of known developments as provided by VSD staff is shown in **Appendix B**.

4.4 CALIBRATION

Once the model is developed, it is calibrated to dry weather flow conditions based on flow monitoring data. Ten sites throughout the VSD service area are selected to gather flow data. Three major objectives guide the locations of the flow monitors:

1. Capture as much flow as possible.
2. Isolated areas of residential or industrial/commercial land uses to the extent possible to help develop unit flows and diurnal profiles during model calibration.
3. Select areas of known hydraulic issues based on results from the 2003 Sewer Master Plan, such as choosing locations that were previous monitored or select areas to investigate possible flow splitting.

Flow monitoring data is used to determine a typical flow pattern generated from different types of land uses, and then to calibrate the entire system. Five of the flow monitors are strategically placed to capture flow from a particular land use. For example, a flow monitoring site whose sewershed predominately includes low-density residential homes will exhibit a pattern that may be unique to that land use, and can be applied to other low-density residential areas in the system. The calibration process and results are discussed below.

4.4.1 Flow Monitoring

- A flow monitoring program was implemented in order to correlate the actual collection system sewer flows with the estimated flows in the hydraulic model. The objectives of the flow monitoring program included: Develop flow generation rates for various land use categories;
- Develop the diurnal curve for various land use categories;
- Collect representative sewer flows in the collection system to calibrate the hydraulic model to the dry weather flow conditions.

The locations of the ten flow monitors are shown on **Figure 4-6**. Flow Monitors No. 1 through No. 5 obtain flows for specific land use types, while Flow Monitors No. 6 through No. 10 obtains flows from large sewershed areas and are used for calibrating the model. Details on each monitored location and further information on the flow monitoring program is presented in **Appendix C**. Flow monitoring was conducted for a consecutive two-week period from January 5, 2013 through January 18, 2013. Flow monitoring data collected from all ten locations are shown in a report provided by US3 and shown in **Appendix D**.

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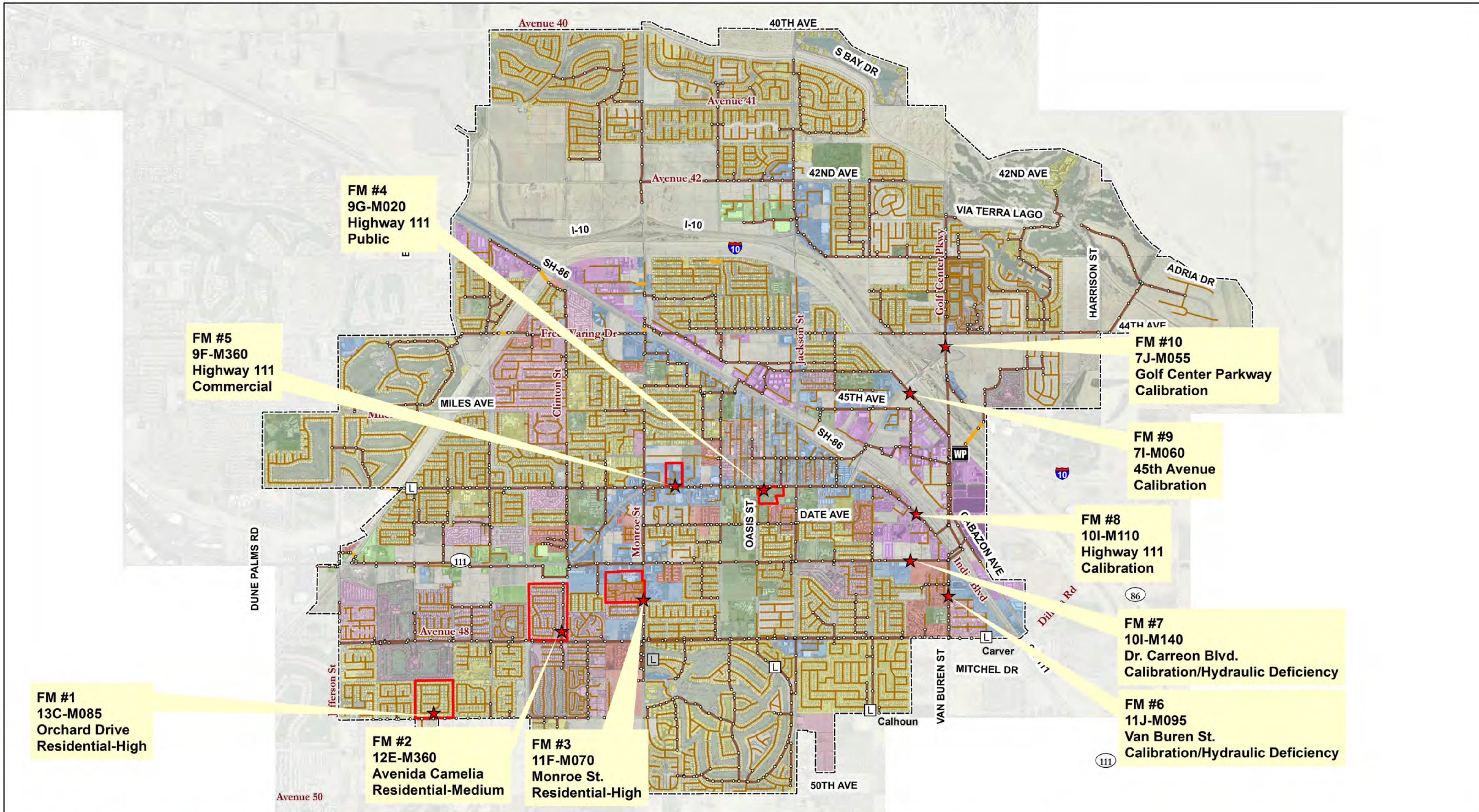

Key to Features

- FlowMeterLocations
- Lift Station
- Modeled Lift Station
- Wastewater Treatment Plant
- Manhole
- FlowMeterCatchmentAreas
- Valley Sanitary District Boundary
- Siphon
- Modeled Sewer Pipeline
- Sewer Pipeline

0 0.5 1 Miles

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Date: June 14, 2013

Valley Sanitary District Flow Monitoring Sites

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Figure 4-6

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4.4.2 Diurnal Patterns and Peaking Factors

Flow patterns for general land use types used for the VSD sewer system are generated from the flow monitoring data specific to the VSD system. Based on data provided by US3, diurnal patterns and peaking factors were developed for the VSD system. The following subsections describe how these patterns and peaking factors were developed. A summary of the land use types for the flow monitoring location is shown in **Table 4-8**.

Table 4-8
Flow Monitoring Locations

Monitor No.	Purpose	Location	Manhole ID	Pipe Diameter
1	Residential – Low Density Land Use	Orchard Drive and 49th Avenue	13C-M085	8
2	Residential – Medium Density Land Use	Avenida Camelia and Calle Diamante	12E-M360	15
3	Residential – High[1] Density Land Use	Monroe Street, 500 ft. north of Victoria Street	11F-M070	10
4	Public Land Use	South of Highway 111, 200 ft. east of Oasis Avenue	9G-M020	8
5	Commercial Land Use	Highway 111, 500 ft. west of Rubidoux Street	9F-M360	8
6	Calibration/ Hydraulic Deficiencies[2]	Van Buren Street, 150 ft. north of Manila Avenue	11J-M095	30
7	Calibration/ Hydraulic Deficiencies[2]	Dr. Carreon Blvd, 1,300 ft. east of Calhoun Street	10I-M140	18
8	Calibration	Highway 111, 300 ft. south of Maple Avenue	10I-M110	18
9	Calibration	Northeast area of Golf Center Parkway and 45th Avenue intersection, and west of Whitewater River	7I-M060	15
10	Calibration	Golf Center Parkway, 400 ft. south of 44th Avenue	7J-M055	36

1 Captures some commercial land use.
2 Hydraulically deficient based on 2002 Sewer Master Plan.

Diurnal Curves

As part of creating diurnal patterns and peaking factors for calibration of the modeled system, a representative weekday and weekend day must be selected. Over the two-week flow monitoring period, flow versus time graphs were plotted, as shown on **Figure 4-7** and **Figure 4-8**. From these plots, week one was determined to have the highest flow and most pronounced peaks. Thus, week one was used to select the representative weekday and weekend day. The corresponding weekday and weekend day from week two was used for validation of calibrated flows. Comparison graphs from Flow Monitors No. 1 through No.5 for week one and week two are shown on **Figure 4-7** and **Figure 4-8**, respectively. From these graphs, it can be clearly seen that week one represents a higher overall flow for the system and thus a more conservative estimate of representative flow.

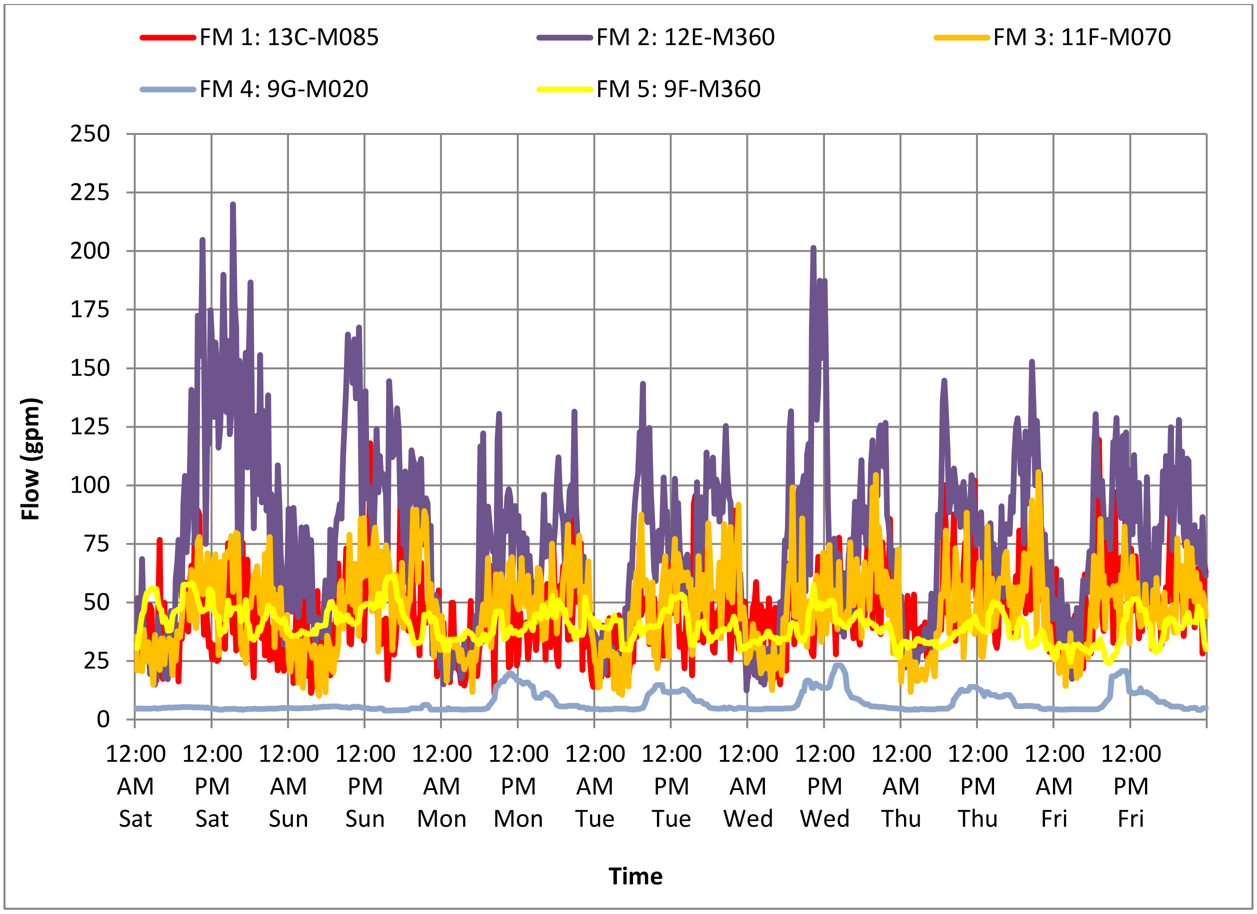

Figure 4-7
Comparison of Week One Flows from FM 1 – FM 5

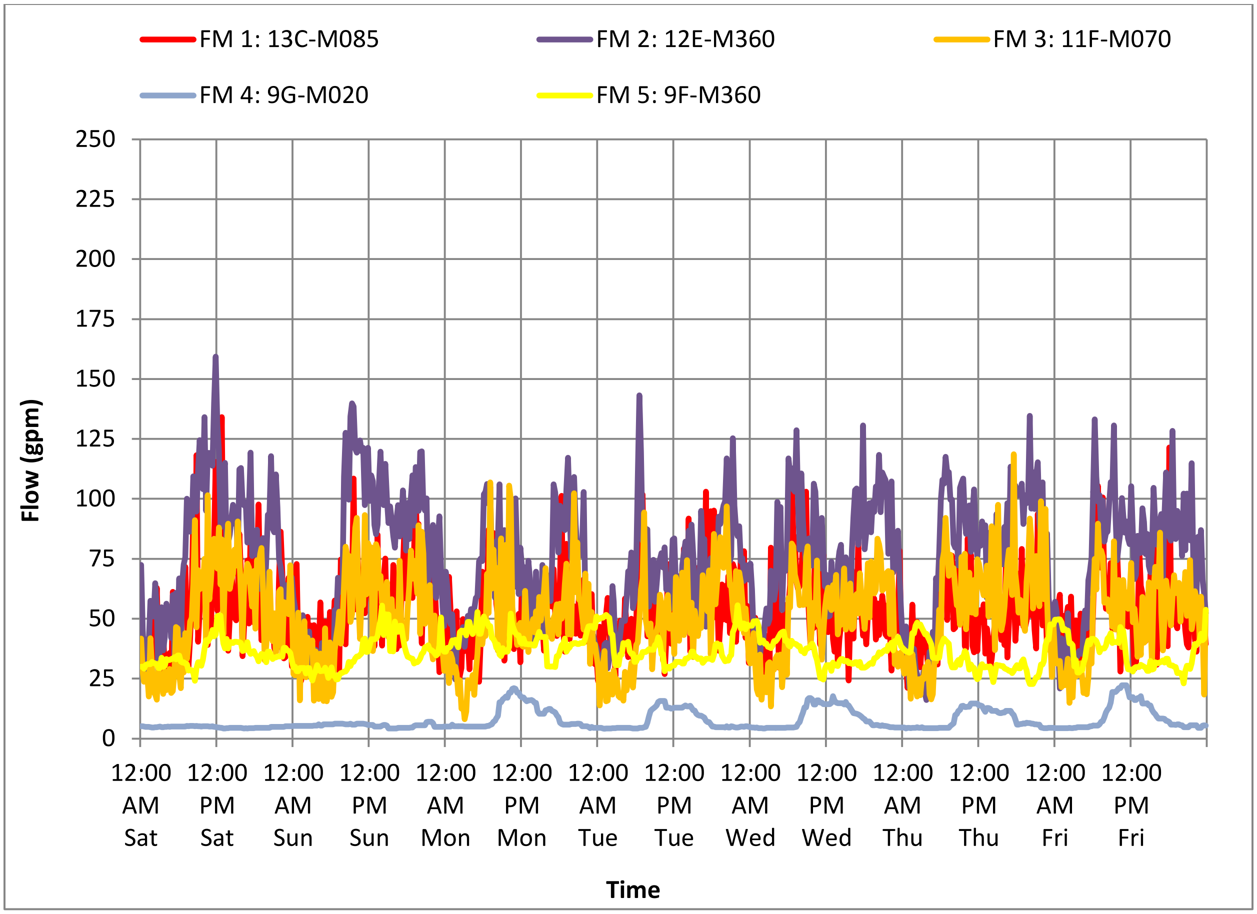

Figure 4-8
Comparison of Week Two Flows from FM 1 – FM 5

Once a representative week was selected, one typical weekday and one typical weekend day is selected to represent flows in the system. Each monitor has different days that show the highest flow. Therefore, a day was selected that showed higher flows for the largest majority of the flow monitors. In order to select the representative weekday and weekend day, flows for each day in week one were graphed for each flow monitor, and the highest flow day was selected from these plots. In order to compare flows uniformly, flow was converted to a dimensionless flow, Q, by taking the average flow for each hour and dividing it by the average flow for that day.

The days selected for calibration days are Sunday, January 6th, and Tuesday, January 8th. Sunday, January 13th and Tuesday, January 15th were therefore selected as validation days. Flows generated in the model were calibrated to week one flows, and were then also compared to validation day flows to ensure that the modeled flows were within tolerance limits for both days.

During the two week period that flow monitoring was conducted, no significant rainfall occurred in the VSD system. Thus, all data collected during the flow monitoring period is considered base dry weather flow, and the analysis of the system assumed a negligible contribution for surface water infiltration.

Patterns for each land use category were developed from flow monitoring data through Flow Monitor No.'s 1 through No.5. **Table 4-9** shows the land use categories for each flow monitor.

Table 4-9
Diurnal Pattern Allocation

Land Use	Flow Monitor Number	Monitor ID
Open	N/A[1]	N/A
Public	4	9G-M020
Commercial	5	9F-M360
Industrial[2]	5	9F-M360
Residential Low Density	1	13C-M085
Residential Medium Density	2	12E-M360
Residential High Density	3	11F-M070
Mixed Use	Average of Residential Medium and Commercial	Average of 12E-M360 and 9F-M360

[1]: A fixed pattern with a constant multiplier of 1 was used for open as no flow is assigned to this land use type and thus no pattern is necessary.
[2]: the industrial land use category is a catch-all term that covers light industrial, agricultural processing, etc.

Once these patterns were input into the model along with base flow for each land use, a calibration run was done to assess the accuracy of the modeled system compared to the real data. From the results of this comparison, the diurnal patterns above were adjusted for each land use, and additional land uses were added where necessary for different areas of the system. **Figure 4-9** through **Figure 4-14** shows the final diurnal patterns for each land use category that were used in the existing system calibration. It is of note that due to the necessity of altering each pattern in an iterative process of calibrating flows for all monitors, the final diurnal patterns presented in **Figure 4-9** through **Figure 4-14** may not average to a dimensionless value of 1.0. This means that average flows for each land use category must be multiplied by the average dimensionless value for their respective pattern in order to get the effective average daily flow for each land use. **Appendix E** presents the diurnal multiple and description for each land use category, as well as the calibration results discussed below.

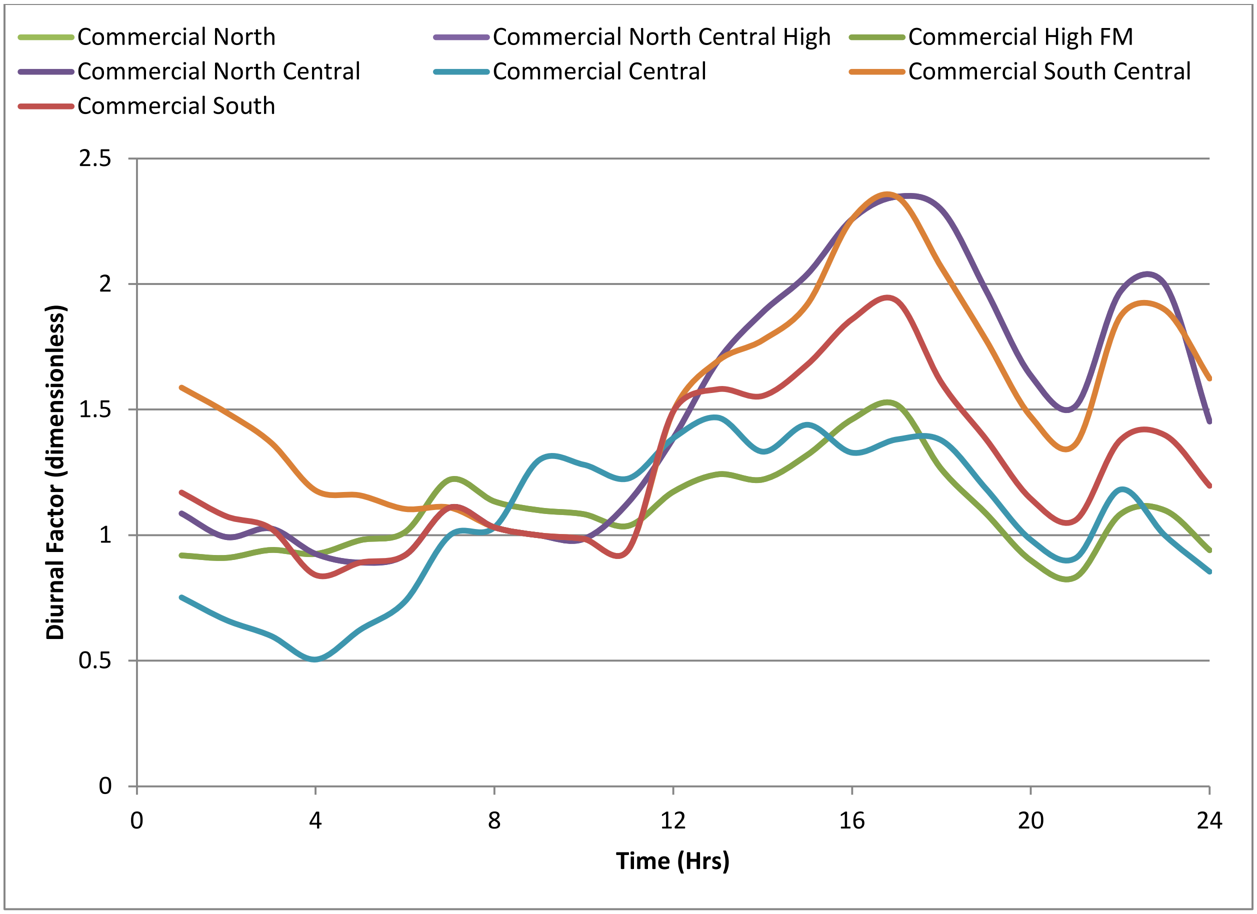

Figure 4-9
Commercial Diurnal Curves, Weekend Calibration Day

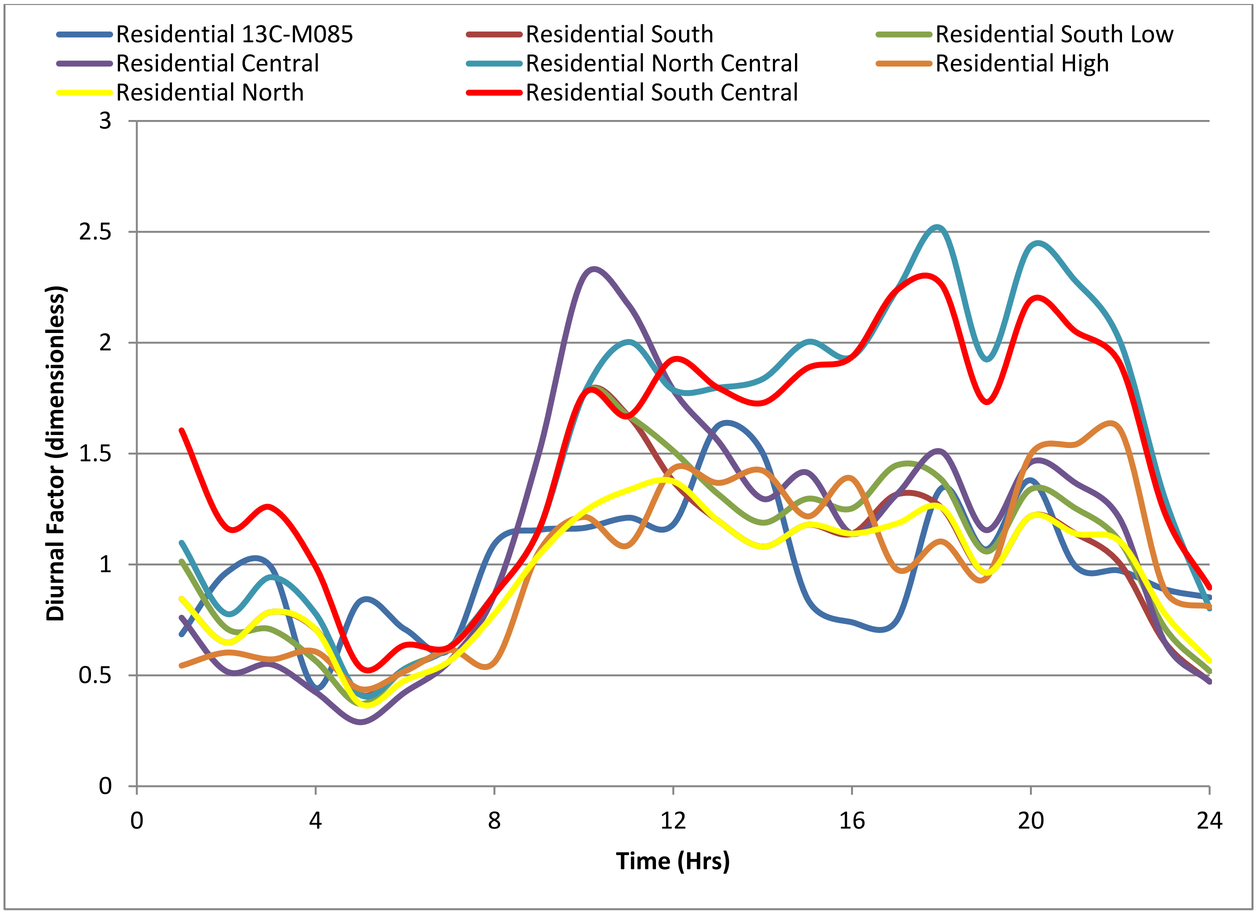

Figure 4-10
Residential Diurnal Curves, Weekend Calibration Day

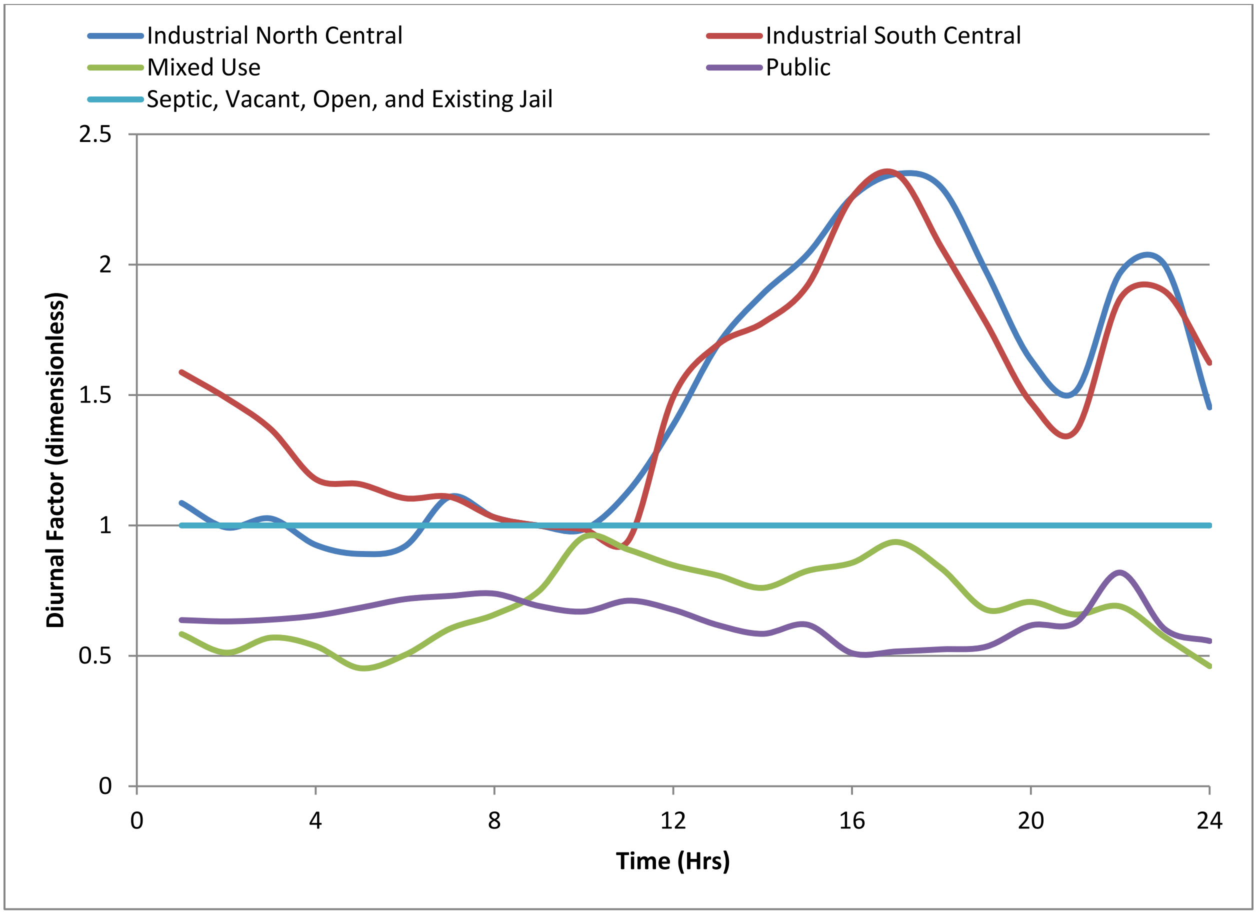

Figure 4-11
Other Diurnal Curves, Weekend Calibration Day

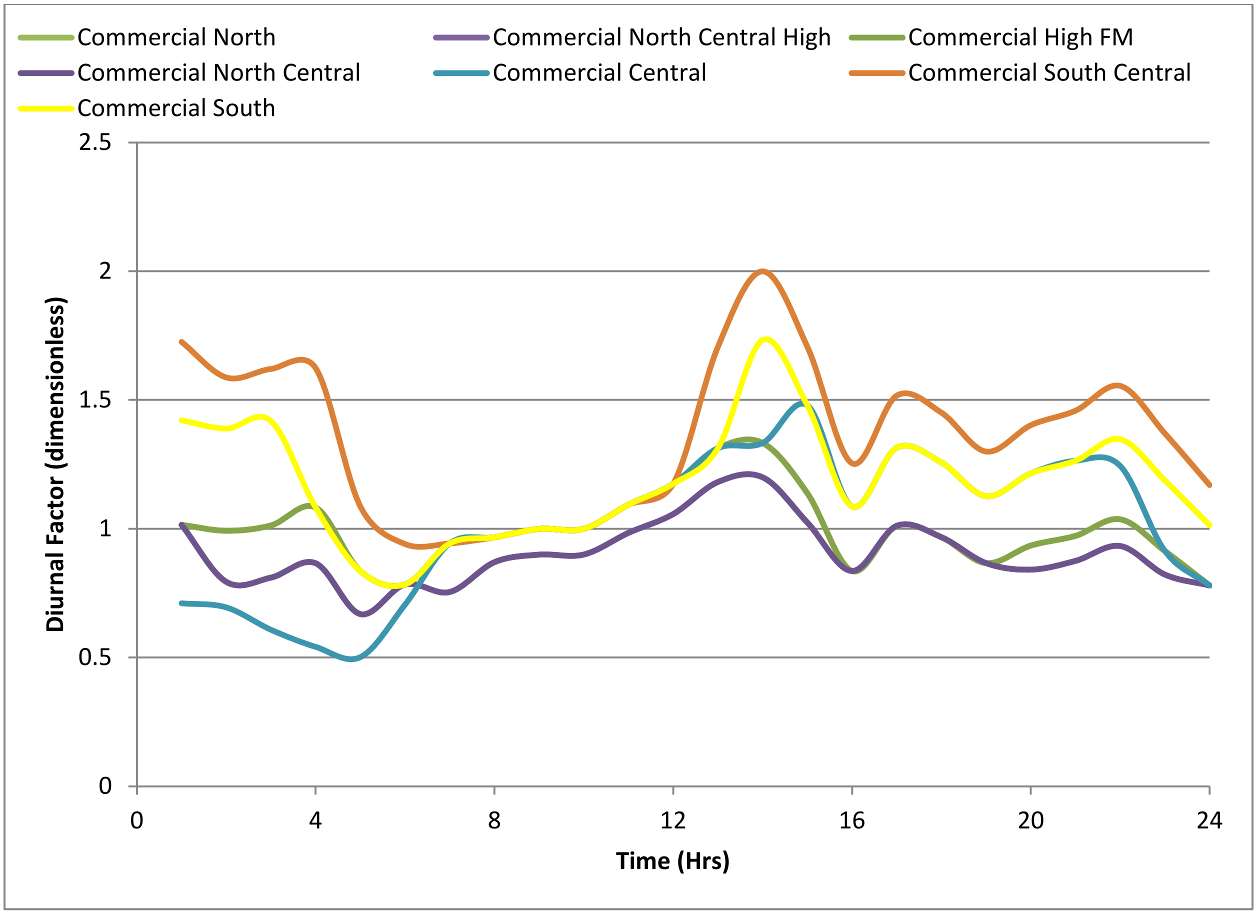

Figure 4-12
Commercial Diurnal Curves, Weekday Calibration Day

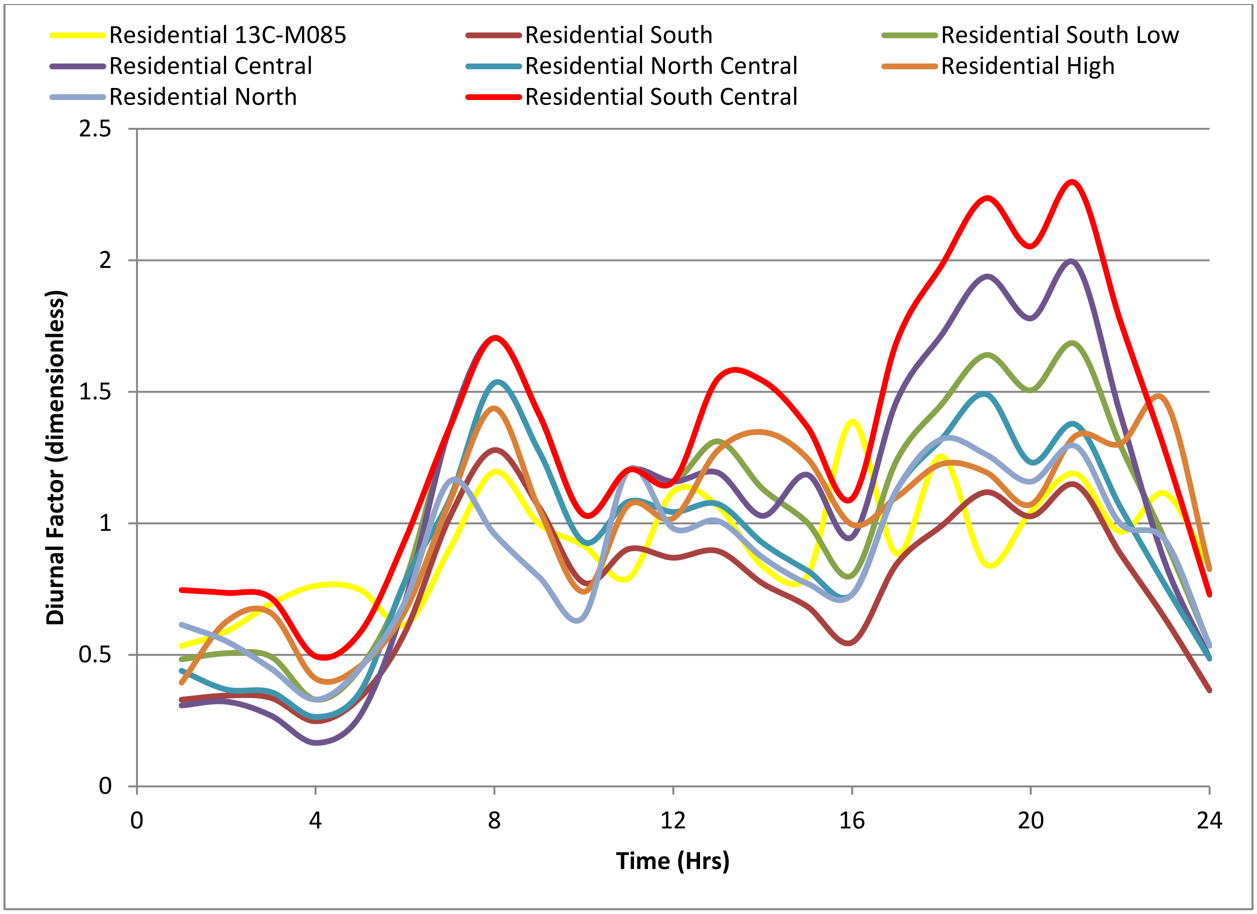

Figure 4-13
Residential Diurnal Curves, Weekday Calibration Day

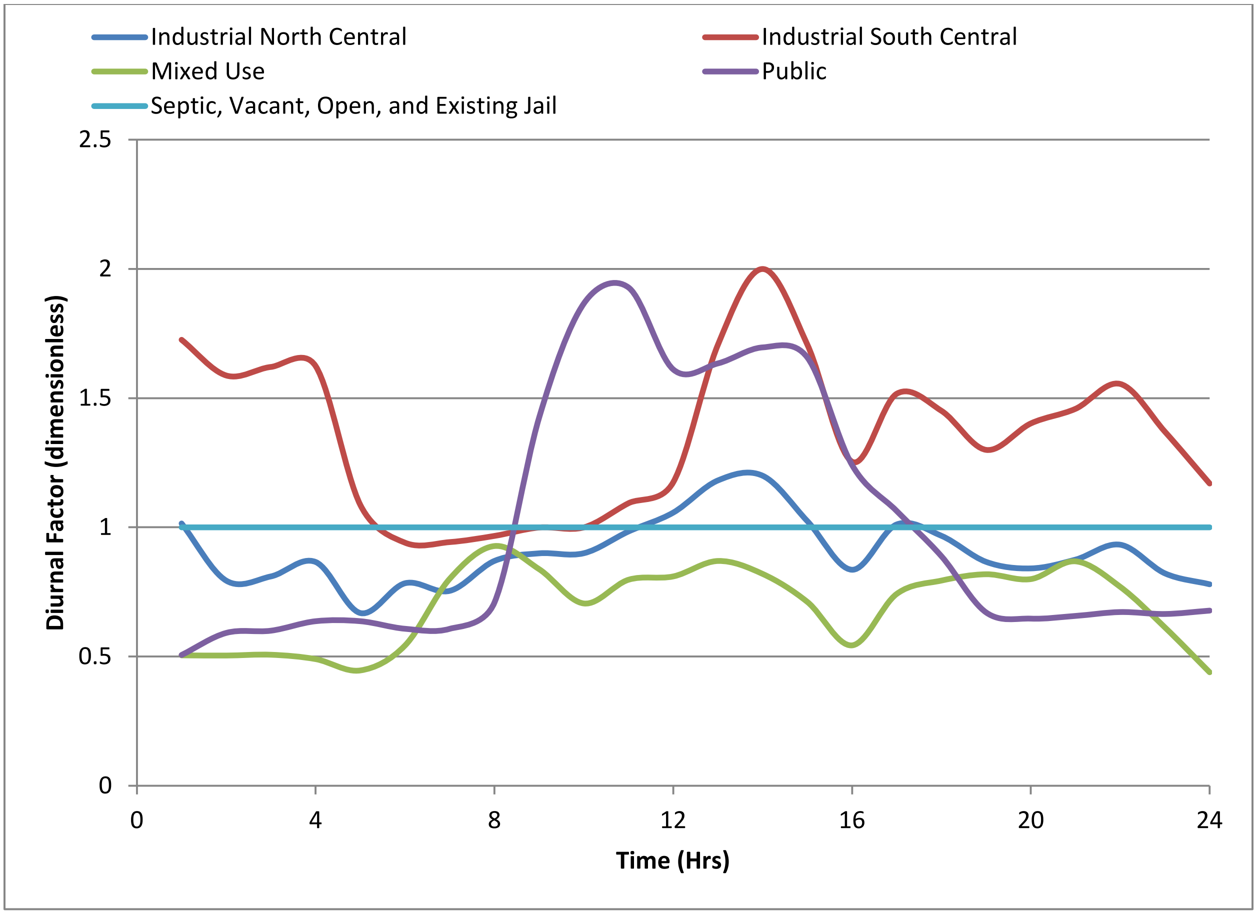

Figure 4-14
Other Diurnal Curves, Weekday Calibration Day

4.4.3 Calibration Results

Once all diurnal curves had been altered and input into the system, a final run was done to assess the difference between modeled results and the flow monitoring data. A threshold value of 15 percent was used to calibrate flows, meaning the diurnal curves and duty factors would be adjusted until modeled results were within 15 percent of the flow monitoring data. One exception to this rule is FM 8, which reports roughly 20 percent higher flows than monitored data. This 20 percent is acceptable as an overestimation of flow due to the importance of matching maximum flow for each calibration FM. In other words, changing this one FM to match the flow monitoring data would adversely affect several other FM points, and thus this overestimation was seen as acceptable so as to get the closest match between monitored and calibrated flows for all 10 monitors.

Table 4-10 and **Table 4-11** summarize calibration results for the modeled weekend and weekday, respectively. Calibration plots for each flow monitor for the weekend and weekday calibration day can be found in **Appendix E**.

Table 4-10
Weekend Day Calibration Results

Flow Monitor Number	Monitor ID	Purpose	Calibration Day Average Flows (gpm)	Model Average Flows (gpm)	Difference Between Calibration Day and Flow Monitor Data (%)
1	13C-M085	Low Density	44.7	49.1	9%
2	12E-M360	Medium Density	69.3	75.4	9%
3	11F-M070	High Density	48.9	57.6	16%
4	9G-M020	Public	4.9	4.9	1%
5	9F-M360	Commercial	43.6	43.9	1%
6	11J-M095	Calibration	1290.0	1466.1	13%
7	10I-M140	Calibration	1700.2	1518.2	-11%
8	10I-M110	Calibration	519.1	638.6	21%
9	7I-M060	Calibration	459.6	425.2	-8%
10	7J-M055	Calibration	952.8	918.1	-4%
N/A	Outfall-1	Calibration	4848.1	5642.8	15%

Table 4-11
Weekday Calibration Results

Flow Monitor Number	Monitor ID	Purpose	Calibration Day Average Flows (gpm)	Model Average Flows (gpm)	Difference Between Calibration Day and Flow Monitor Data (%)
1	13C-M085	Low Density	41.9	44.1	5%
2	12E-M360	Medium Density	53.2	56.7	6%
3	11F-M070	High Density	48.2	55.3	14%
4	9G-M020	Public	7.3	7.7	5%
5	9F-M360	Commercial	39.6	40.1	1%
6	11J-M095	Calibration	1212.0	1271.8	5%
7	10I-M140	Calibration	1587.5	1453.6	-9%
8	10I-M110	Calibration	514.6	626.1	20%
9	7I-M060	Calibration	367.8	380.3	3%
10	7J-M055	Calibration	875.4	828.1	-6%
N/A	Outfall-1	Calibration	4564.2	5098.7	11%

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Section 5
Sewer System Capacity Evaluation

This section summarizes the known (reported) hydraulic condition of the VSD collection system and the modeled (predicted) performance of the system. The section concludes with an overall characterization of the performance of the system based on the results of the reported condition, the predicted condition, and other available data. Evaluation of the collection system capacity is based on the planning and sewer design criteria developed for this Master Plan and provided in **Appendix F**.

5.1 SYSTEM EVALUATION

The sewer system hydraulic model is used to assess the existing system performance. In addition to evaluating the existing system during dry weather conditions, the model is able to evaluate operation of the system during future projected flow conditions (5-year planning and build-out scenarios). Wet weather conditions were not observed during the flow monitoring period; therefore, the model is primarily based on dry weather assessment criteria.

5.1.1 System Evaluation Criteria

Evaluation of a collection system during dry weather involves evaluation of both the capacity and general operational issues. Issues that might lead to dry weather problems include blockages due to roots, fats, oils, and grease. These problems can be exacerbated by the lack of sufficient flushing velocity in the pipe. Due to the random nature of these problems, it is impossible to accurately simulate their effects in a hydraulic model without site specific information. However, there is general information from the model that can assist with the identification of potential problem areas due to these causes. While there are many reasons for line blockages, one major component is that solids and debris will settle out in sewers that experience low velocities during dry weather. The hydraulic model can be used to identify potential problem areas within the sewer system.

System capacity evaluation criteria were established for the VSD system to determine the level of service the collection system must meet. Criteria are shown in the Sewer System Planning and Design Criteria Technical Memorandum (TM) shown in **Appendix F**. These evaluation criteria are used to evaluate the hydraulic model results.

The model is used to evaluate three different conditions: existing conditions, 5-year planning horizon, and future conditions. Future conditions attempt to model the worst case scenario (i.e. the system under full build-out conditions). For the VSD model, the existing weekend flow is slightly greater than the existing weekday flow and is therefore considered the worst case scenario. The criteria used to evaluate dry weather flow for all the flow conditions include:

- All modeled pipes in the existing and 5-year scenario with a d/D ratio (depth of flow in pipe divided by the pipe diameter) greater than the design criteria (d/D ratio of 0.5 or less for pipes smaller than 18 in. in diameter, ratio of 0.75 or less for pipes 18-in. or greater in diameter) are documented and reviewed

- All modeled pipes in the build-out scenario with a d/D ratio equal to or greater than 0.9 are reviewed for potential improvement

5.1.2 Existing System Evaluation

The VSD hydraulic model was used to evaluate the system deficiencies for the existing system. In order to evaluate the system, the model was run under the known existing conditions and flows, as calibrated to the flow monitoring data. Once the model was run, the maximum d/D for each pipe in the system that received flow was analyzed, and any pipes that flowed over design capacity were identified.

Pipes 18-inches or more in diameter with a d/D greater than 0.75, and pipes less than 18-inches in diameter that with a d/D over 0.50 were identified in the hydraulic model. Furthermore, any pipes with a d/D greater than 1.0 were identified as a surcharged pipe. **Table 5-1** shows the results of this analysis for each of the three scenarios for both a typical weekend day and weekday under existing conditions.

Table 5-1
Summary of Surcharged and Impacted Pipes

	Existing Scenario	5-Year Scenario	Build-out Scenario
Number of Surcharged Pipes	81	108	409
Number of Pipes above Design Capacity	235	295	832
Total Number of VSD Modeled Pipes	3422	3422	3422
% of Surcharged Pipes	2.4%	3.2%	12.0%
% of Pipes above Design Capacity	6.9%	8.6%	24.3%

Surcharged and over capacity areas are investigated to determine the significance of the overrun. Some surcharged areas reported in the model may be artificial due to insufficient data in an area or assumptions made during the model development process. Some examples are presented below:

1. Missing data for pipe inverts often results in interpolation of incorrect invert elevations which may cause surcharge in pipelines during a model simulation.
2. Other pipes reported as surcharged in the model may be due to flows from an upstream tributary area being loaded onto a single manhole that marks the start of the downstream modeled pipe network. While all the flow from such a tributary area may be accounted for in the model, all of the individual pipes in this area may not be modeled due to the pipes not being the most downstream node in their respective sewershed. Under this configuration, the model does not include the same natural attenuation of peak flows that would normally occur as flow is routed through the upstream pipe network. If the model

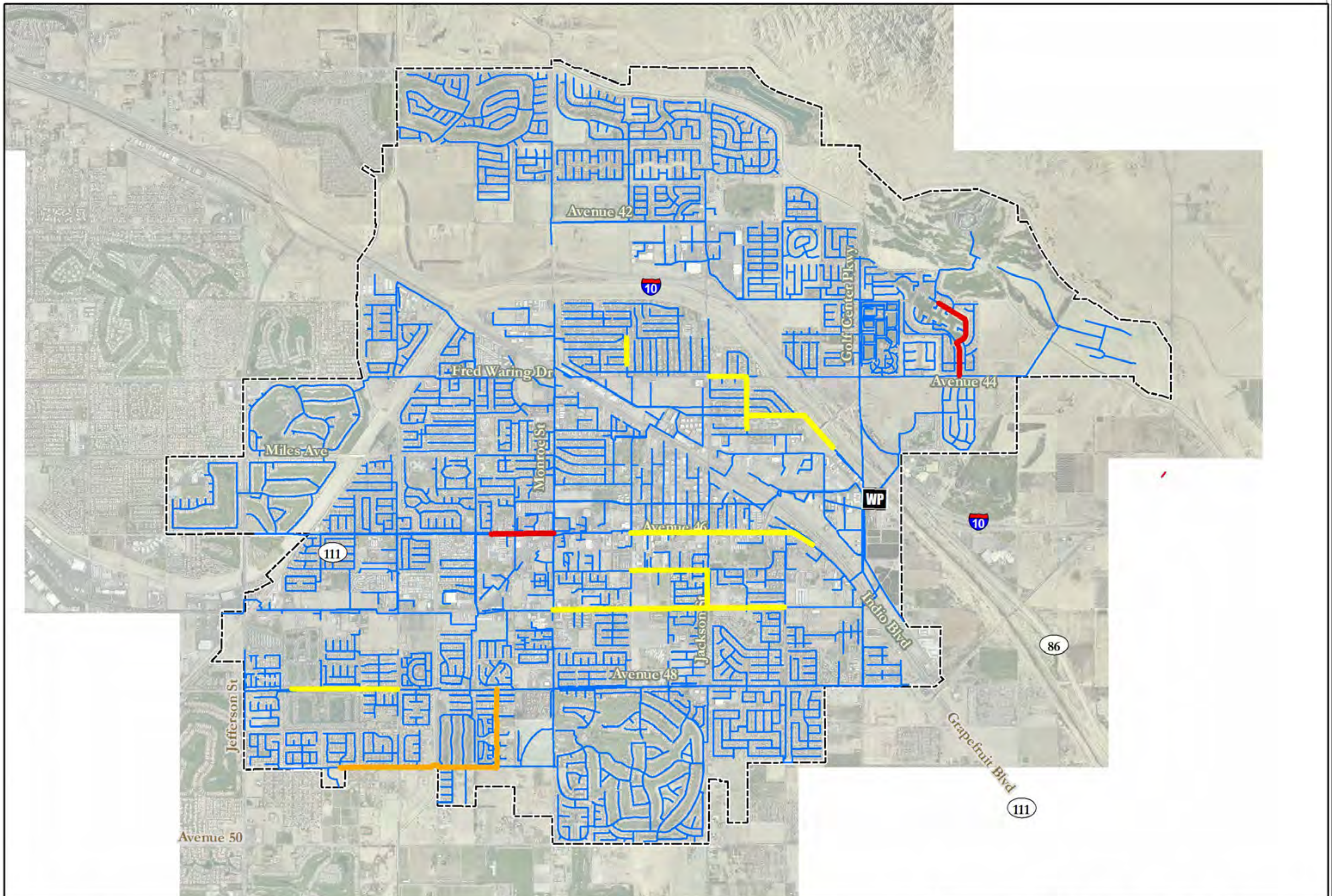
predicts surcharge in a single pipe located at the very upstream reach of the modeled network and is immediately downstream of an upstream catchment's load point, this surcharge can most often be ignored.

3. In conversations with Bentley it was explained that the SewerGEMS software sometimes encounters problems when iterating flow calculation for pipes with no flows assigned to them. This software glitch may cause an instantaneous HGL reading for a pipe even if there is no flow in the pipe. Therefore, a pipe may show a maximum HGL above design capacity in some cases where there is no actual flow modeled in the pipe. Areas such as these were removed from **Figure 5-1** as they did not represent actual capacity issues in the system. Bentley has not indicated when this program glitch may be resolved.

The following sections discuss all areas modeled as impacted for the existing, 5-year, and build-out scenarios. Any area of the system that registered a surcharged or over capacity pipe was verified by reviewing hydraulic profiles. From this process, certain areas of the system were identified as areas of concern (AOCs) for one or more of the scenarios. These areas are discussed in more detail the following sections. **Table 5-2** lists these AOCs and gives the pertinent cross streets for the impacted areas. **Figure 5-1** shows where these areas are found on the VSD district map. In **Figure 5-1**, yellow areas indicate pipes that were identified as AOCs during the existing system analysis; orange areas indicate additional pipes that were identified as AOCs during the 5-Year system analysis; and red areas indicate additional pipes that were identified as AOCs during the build-out system analysis.

Table 5-2
Areas of Concern (AOCs)

AOC Number	Location	Cross Street
Existing System Evaluation		
1	Dr. Carreon Blvd/ Highway 111	Dr. Carreon Blvd. from Monroe St. to Calhoun St.
2	Jackson St. and Dr. Carreon Blvd.	Date St. and Arabia St. to Dr. Carreon Blvd and Jackson St.
3	Highway 111 North	Highway 111 and Arabia St. to Oak Ave. and Indio Blvd.
4	Avenue 48 West	Avenua 48 between Jefferson St. and Shields Rd. to Avenue 48 and Madison St.
5	Dillon Ave./ Avenue 45	Palo Verde Ave. and Dillon Ave, ending between Avenue 45 and Interstate 10
6	Palo Verde St. / Avenue 44	Avenue 44 and Jackson St. to Palo Verde Ave. and Sonora Ave.
7	Sola St.	Along Sola street from Kenner Ave to El Paseo Ave.
5-Year Planning Horizon System Evaluation		
8	Desert Grove Dr.	Desert Grove Dr. between Avenue 49 and Avenue 48
9	Avenue 49	Orchard Dr. and Avenue 49 to Desert Grove Dr. and Avenue 49
Build-Out System Evaluation		
10	Lago Vista	Lago Brezza Dr. and Armonia Ct. to Avenue 44 and Lago Vista
11	Avenue 46	Avenue 46 from east of Clinton St. to Monroe st.



Key to Features

WP Wastewater Treatment Plant

Valley Sanitary District Boundary

AOCs identified in existing system analysis

Additional AOCs identified in 5-year system analysis

Additional AOCs identified in build-out system analysis

Pipes

0 0.5 1 Miles

N

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Date **October 11, 2013**

Valley Sanitary District Areas of Concern (AOC)

MWH.

Figure 5-1

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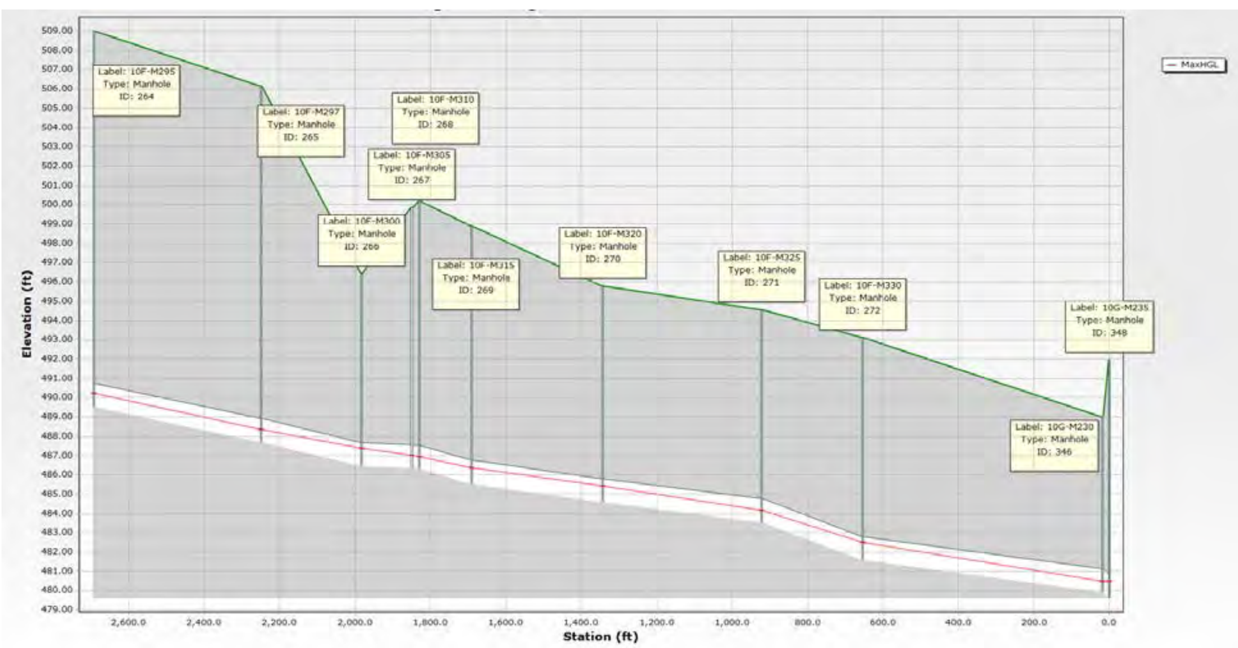
Dr. Carreon Blvd/ Highway 111

The most impacted area in the model for all three scenarios is the Dr. Carreon Blvd. and Highway 111 corridor in the southeast portion of the system. This area of the system sees surcharged and over capacity pipes which then affects tributary pipes along the main pipeline. Due to the severity of the flow problems in this area, several Capital Improvement Program (CIP) recommendations are made to address different sections of this street and to divert flows into nearby trunk lines and interceptors that are sized to handle such flows. **Figure 5-2** through **Figure 5-4** shows profiles for the main line along Dr. Carreon under existing conditions, while **Figure 5-5** through **Figure 5-7** shows the 5-year scenario, and **Figure 5-8** through **Figure 5-10** shows the build-out scenario. In these figures, the red tick marks at each manhole location denote the maximum HGL for each manhole. The profiles are presented in three segments as follows:

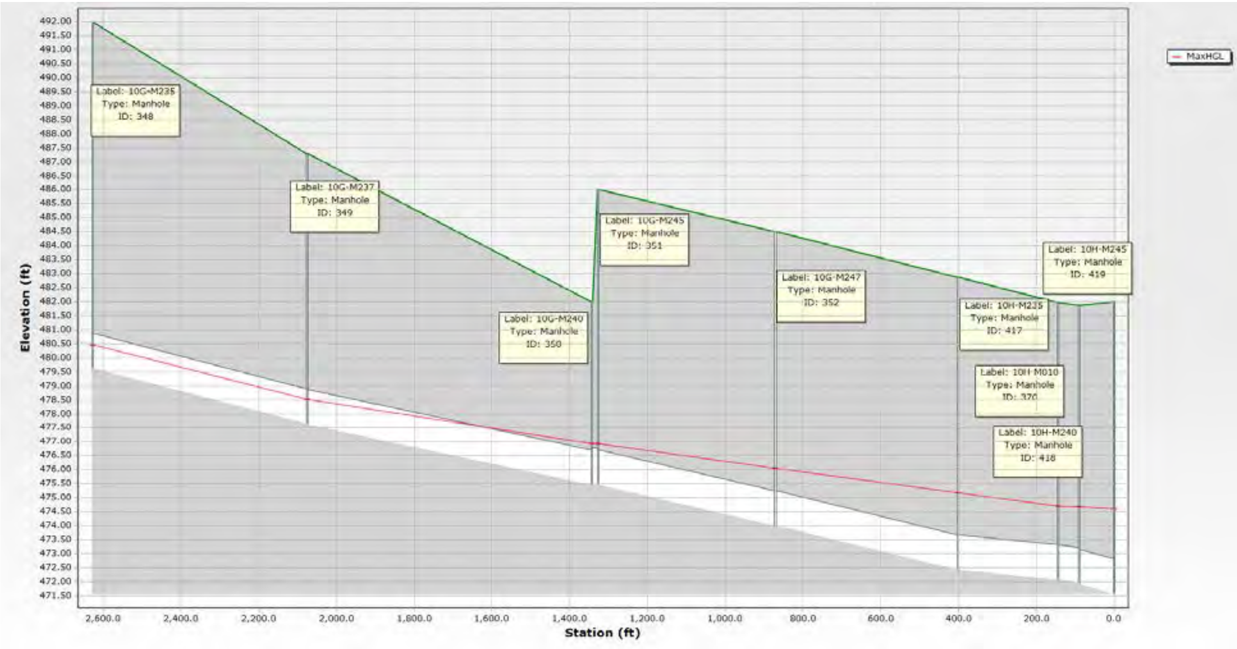
- **Segment 1:** runs from manhole 10F-M295 to 10G-M235. This corresponds to the pipeline running under Dr. Carreon Blvd from Monroe St. to Arabia St.
- **Segment 2:** runs from manhole 10G-M235 to 10H-M245. This corresponds to the pipeline running under Dr. Carreon Blvd from Arabia St. to Jackson St.
- **Segment 3:** runs from manhole 10H-M245 to 10I-M130. This corresponds to the pipeline running under Dr. Carreon Blvd from Jackson St. to Calhoun St.

Figure 5-2
Dr. Carreon Blvd/ Highway 111 under Existing Conditions (Segment 1)



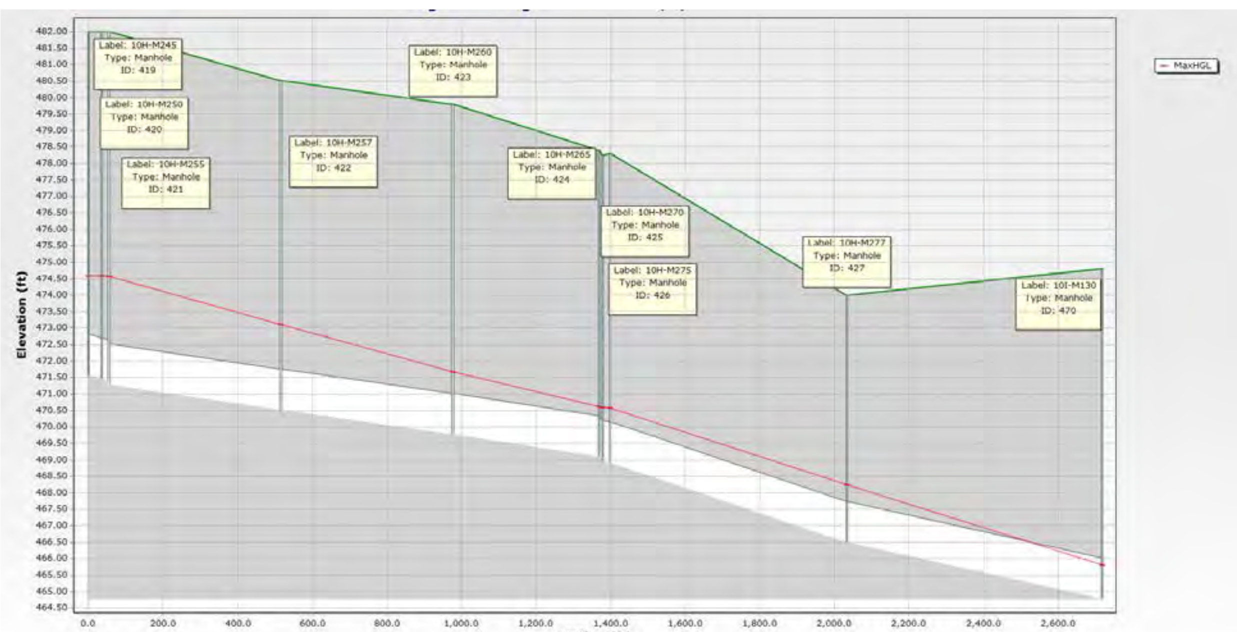
Start: Dr. Carreon Blvd and Monroe St. End: Dr. Carreon Blvd. and Arabia St.

Figure 5-3
Dr. Carreon Blvd/ Highway 111 under Existing Conditions (Segment 2)



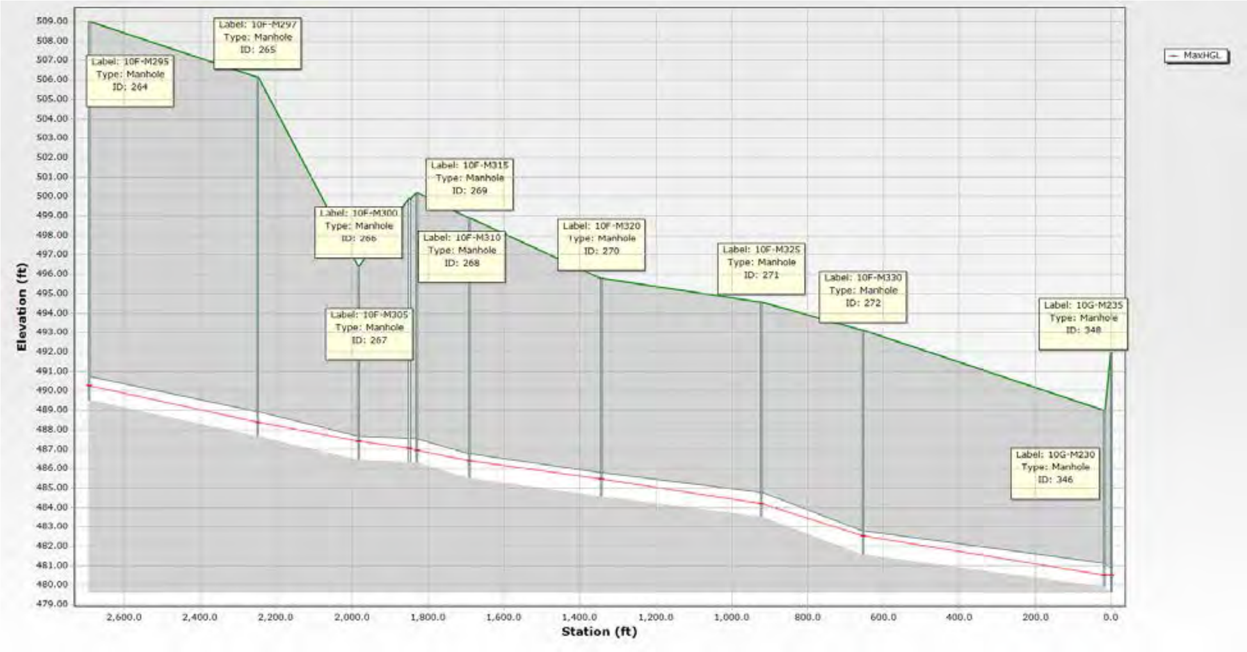
Start: Dr. Carreon Blvd. and Arabia St. End: Dr. Carreon Blvd. and Jackson St.

Figure 5-4
Dr. Carreon Blvd/ Highway 111 under Existing Conditions (Segment 3)



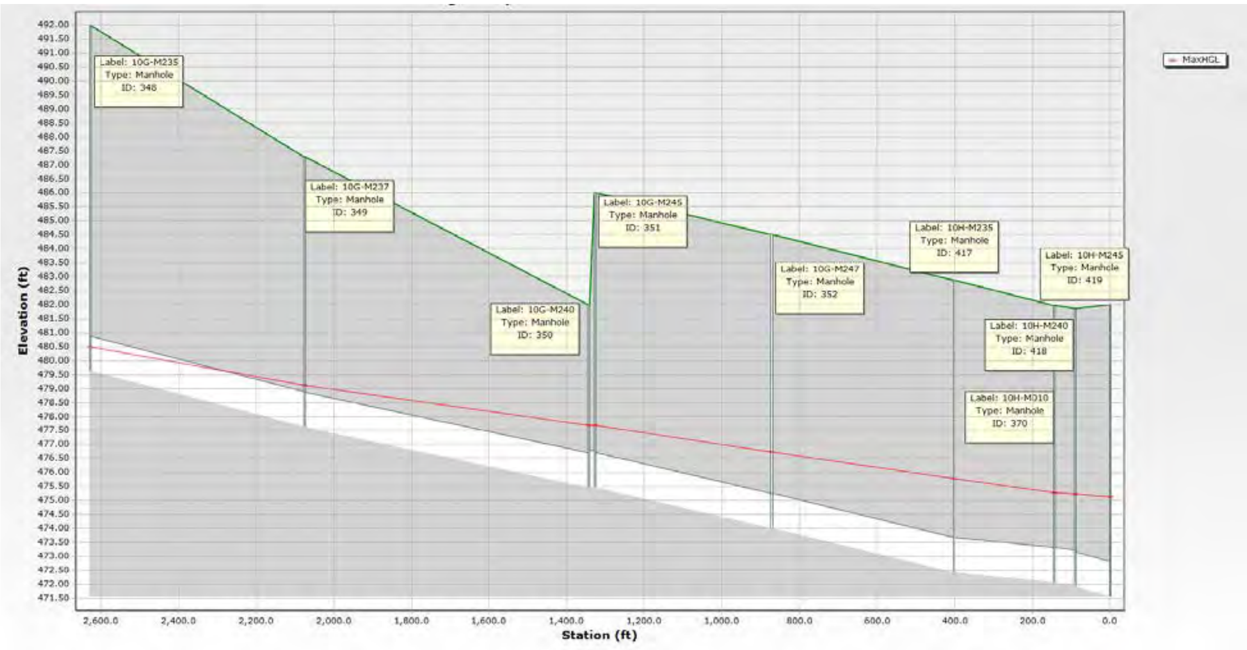
Start: Dr. Carreon Blvd. and Jackson St. End: Dr. Carreon Blvd. and Calhoun St.

Figure 5-5
Dr. Carreon Blvd/ Highway 111 under 5-Year Planning Conditions (Segment 1)



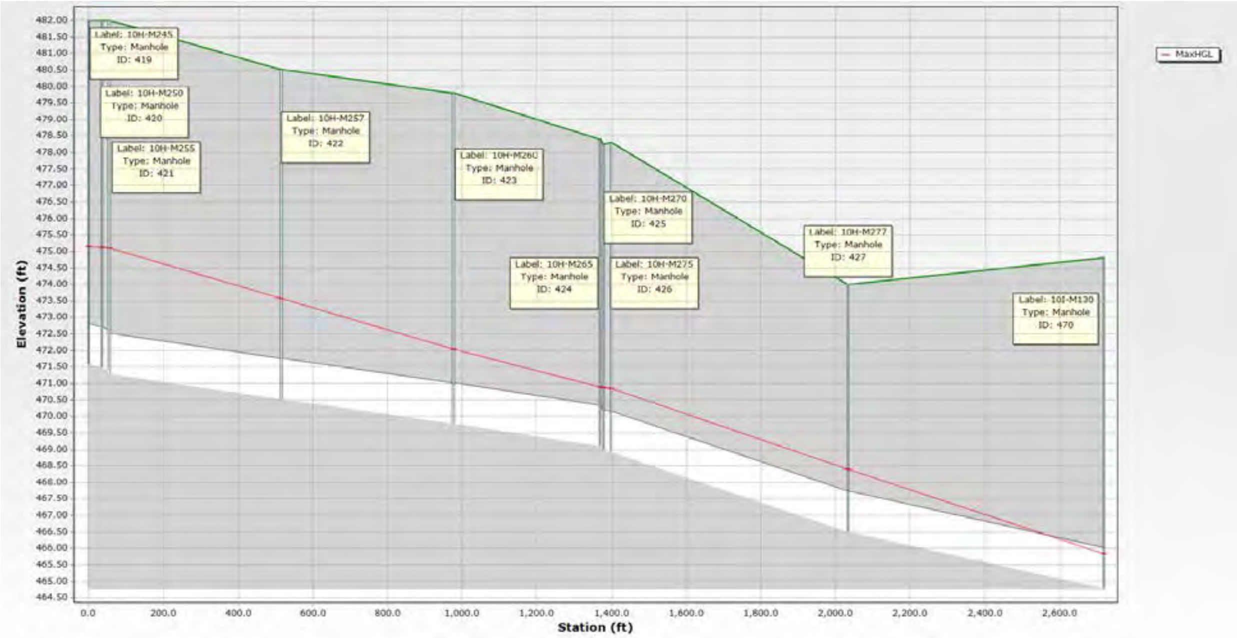
Start: Dr. Carreon Blvd and Monroe St. End: Dr. Carreon Blvd. and Arabia St.

Figure 5-6
Dr. Carreon Blvd/ Highway 111 under 5-Year Planning Conditions (Segment 2)



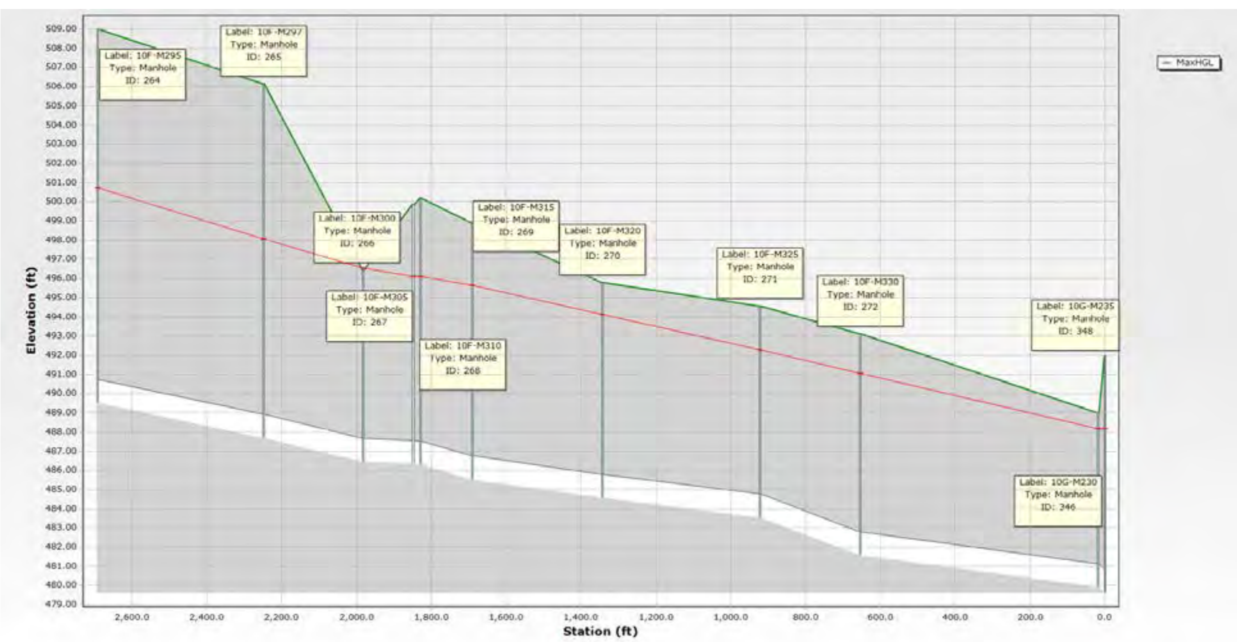
Start: Dr. Carreon Blvd. and Arabia St. End: Dr. Carreon Blvd. and Jackson St.

Figure 5-7
Dr. Carreon Blvd/ Highway 111 under 5-Year Planning Conditions (Segment 3)



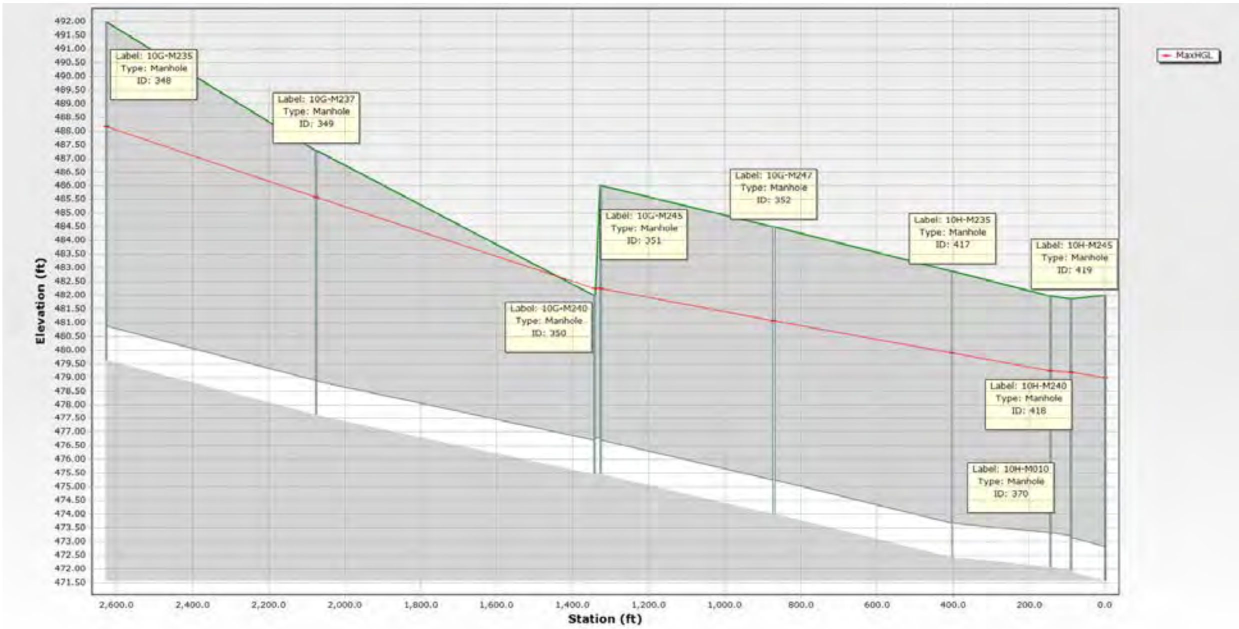
Start: Dr. Carreon Blvd. and Jackson St. End: Dr. Carreon Blvd. and Calhoun St.

Figure 5-8
Dr. Carreon Blvd/ Highway 111 under Build-Out Conditions (Segment 1)



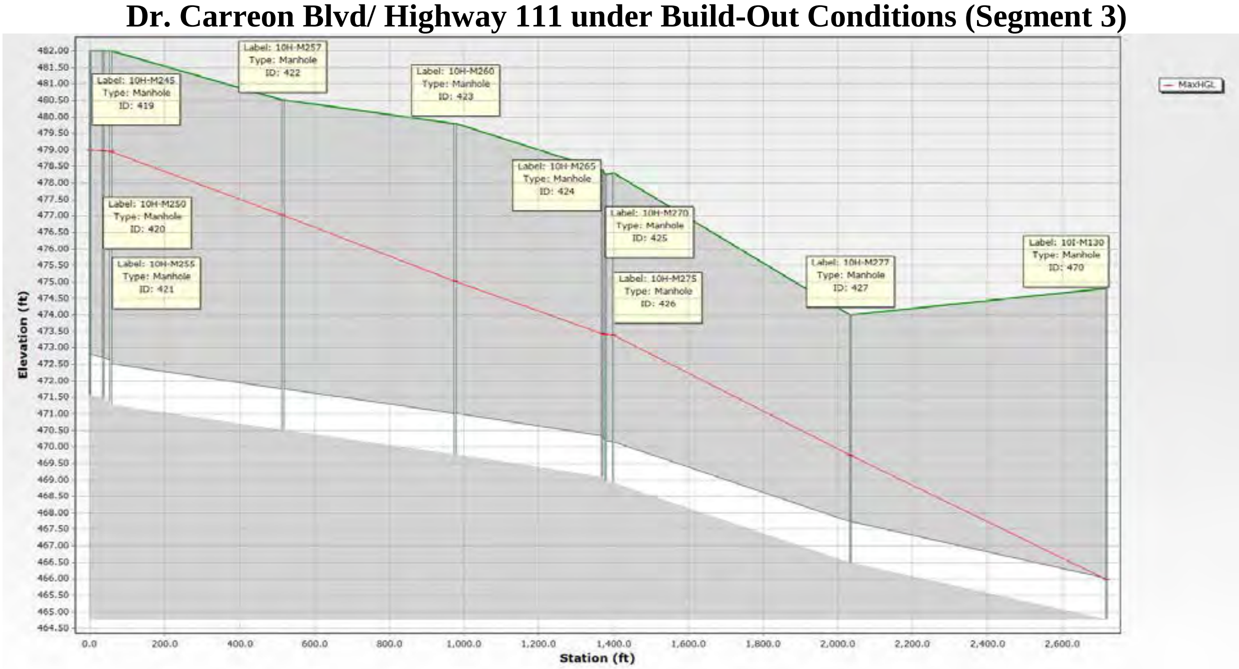
Start: Dr. Carreon Blvd and Monroe St. End: Dr. Carreon Blvd. and Arabia St.

Figure 5-9
Dr. Carreon Blvd/ Highway 111 under Build-Out Conditions (Segment 2)



Start: Dr. Carreon Blvd. and Arabia St. End: Dr. Carreon Blvd. and Jackson St.

Figure 5-10
Dr. Carreon Blvd/ Highway 111 under Build-Out Conditions (Segment 3)



Start: Dr. Carreon Blvd. and Jackson St. End: Dr. Carreon Blvd. and Calhoun St.

The previous profiles show that, even under existing conditions, the 15-inch pipeline running under Dr. Carreon Blvd. is showing surcharging at many manholes, and over-capacity pipes. As the planning scenario progresses, these issues are exacerbated and more pipes become surcharged. The severity of these capacity issues also cause full and over-capacity pipes in the lines feeding into the 15-inch pipeline along Dr. Carreon Blvd. These tributary issues can be seen in **Figure 5-1**.

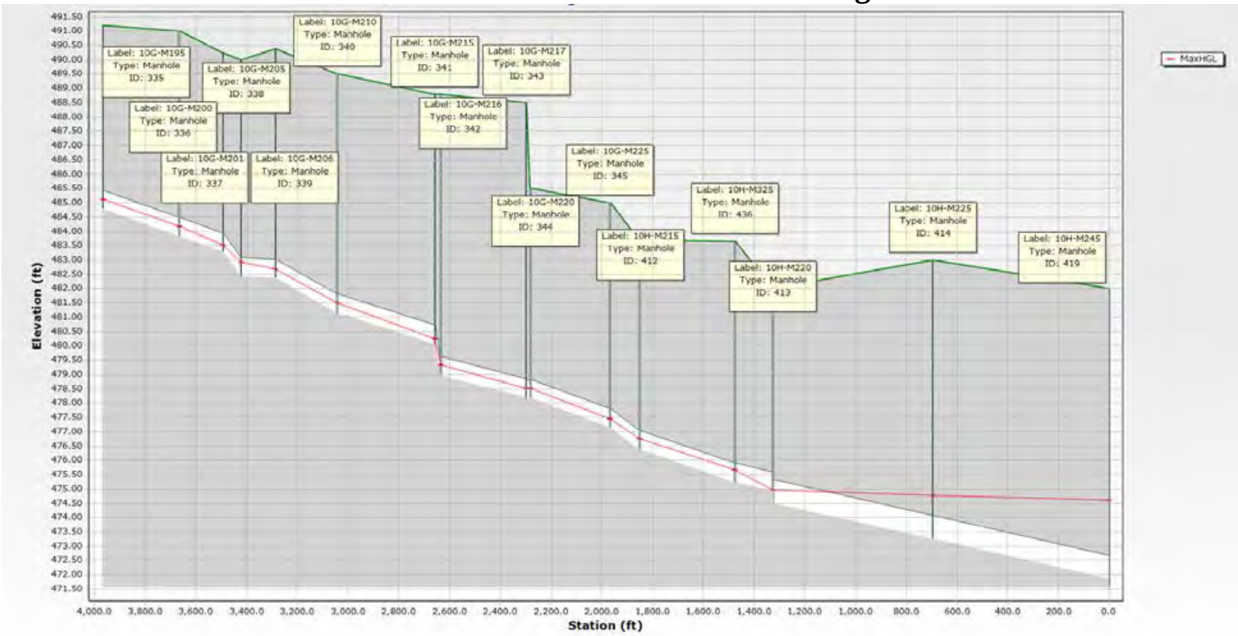
The cause of these hydraulic issues seems to be a pure capacity issue. Currently, there is too much flow being sent to this 15-inch line along Dr. Carreon Blvd. In order to address these hydraulic issues, the CIP will address ways to divert flow from Dr. Carreon Blvd. to trunk lines in the system that are capable of handling the amount of flow.

In the existing system, issues on Dr. Carreon extend from Calhoun St. in the east, to Clinton St. in the west. In the 5-year planning scenario, the same stretch of pipeline is affected as in the existing scenario; however, there are a higher percentage of surcharged pipes along that stretch. Finally, for the build-out scenario, impacts are seen from Calhoun St. to the east to Shield Rd. in the west, with an even higher amount of surcharged pipes and manholes, and a much more pronounce effect on tributary lines along that stretch.

Jackson St. and Dr. Carreon Blvd.

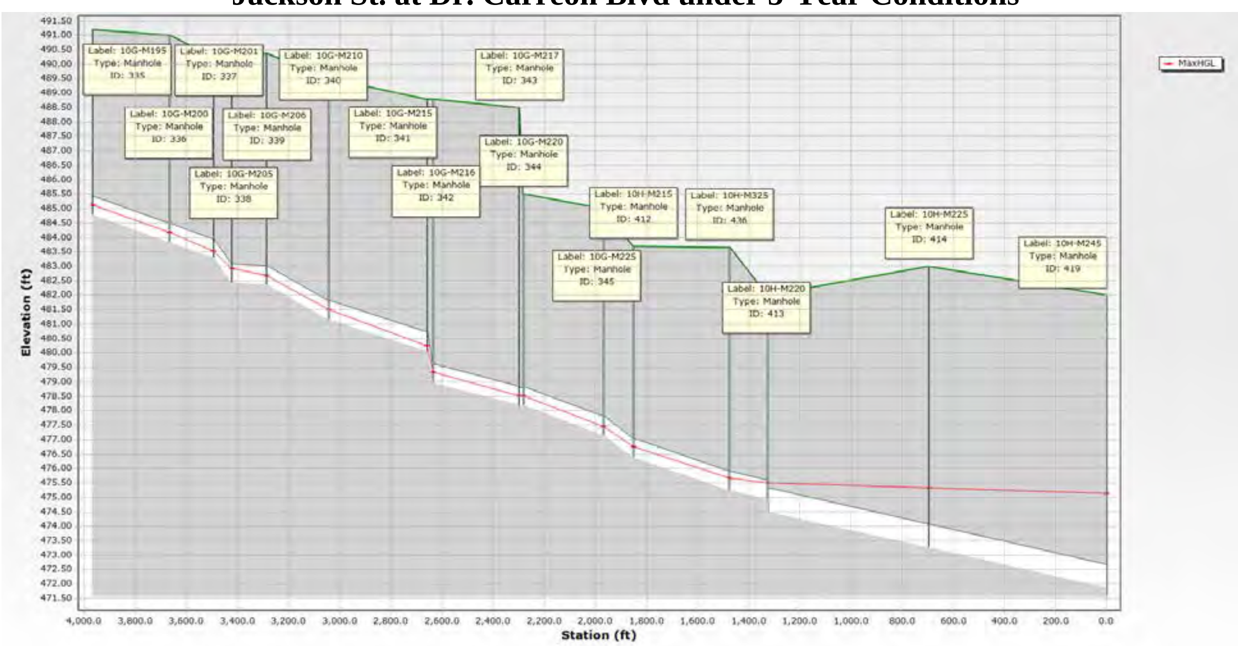
While most of the hydraulic issues tributary to Dr. Carreon Blvd. are due to backups in the lines as those pipes reach Dr. Carreon Blvd., the hydraulic capacity issue on Jackson St. north of Dr. Carreon Blvd is due both to backup along Dr. Carreon Blvd., as well as to the physical layout on of the pipes on Jackson. As shown on **Figure 5-11** through **Figure 5-13**, issues occur from manhole 10H-M245 to manhole 10G-M195. In the 5-year planning and build-out scenarios, issues occur along the same stretch; however the d/D for each pipe gets higher for each pipe section in the 5-year planning and build-out scenarios. This pipe section is the pipe that runs along Jackson St. from Date Ave. to Dr. Carreon Blvd., and then west to the intersection of Arabia St. and John Nobles Ave. (also referred to as Date Ave.).

Figure 5-11
Jackson St. at Dr. Carreon Blvd under Existing Conditions



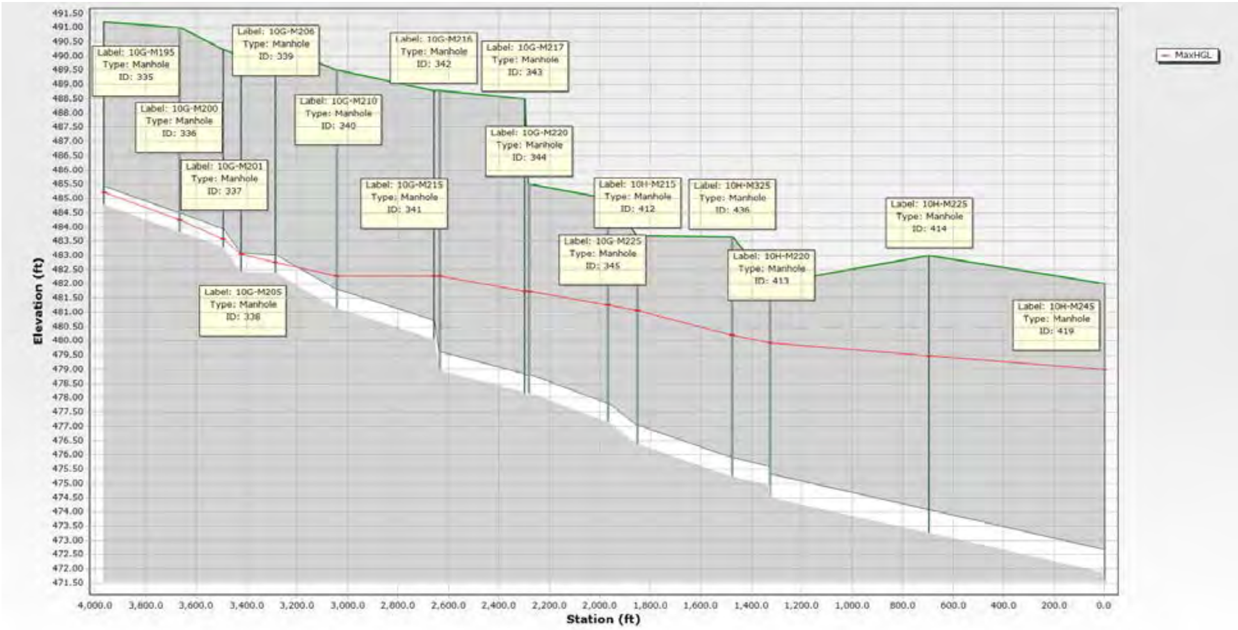
Start: Date St. and Arabia St. End: Dr. Carreon Blvd and Jackson St.

Figure 5-12
Jackson St. at Dr. Carreon Blvd under 5-Year Conditions



Start: Date St. and Arabia St. End: Dr. Carreon Blvd and Jackson St.

Figure 5-13
Jackson St. at Dr. Carreon Blvd under Build-Out Conditions



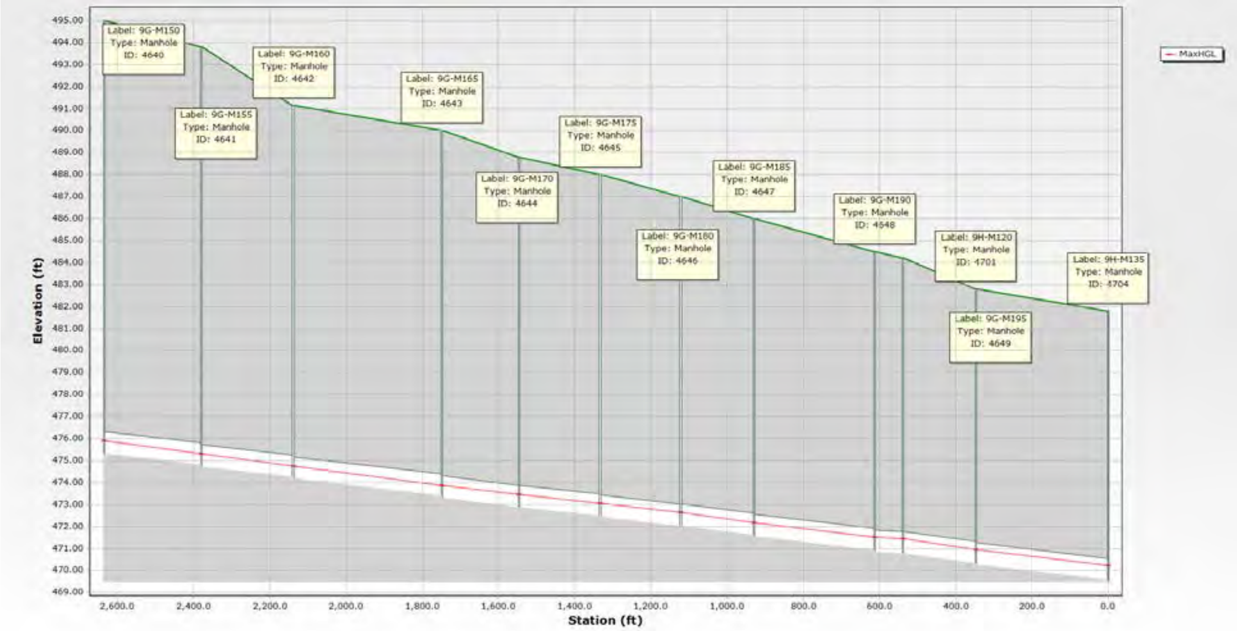
Start: Date St. and Arabia St. End: Dr. Carreon Blvd and Jackson St.

Highway 111 North

This area of the system shows capacity issues beginning at Oak Ave. and Indio Blvd. At this point, the line running under Indio Blvd (Highway 111) changes from a 15-inch pipeline to an 18-inch pipeline. It is at this change in pipe diameter size that the capacity issues begin. These capacity issues, which in the existing scenario consist only of over-capacity pipes and no surcharged pipes, extend from Oak Ave. and Indio Blvd. to the intersection of Highway 111 and Arabia St. In the 5-year and build-out scenarios, the impacted section is the same, but there are more surcharged pipes for each progressive scenario. **Figure 5-14** and **Figure 5-15** show profiles for this section for the existing conditions, while **Figure 5-16** and **Figure 5-17** show the 5-year planning scenario, and **Figure 5-18** and **Figure 5-19** the build-out scenario. The profiles are split into two segments where:

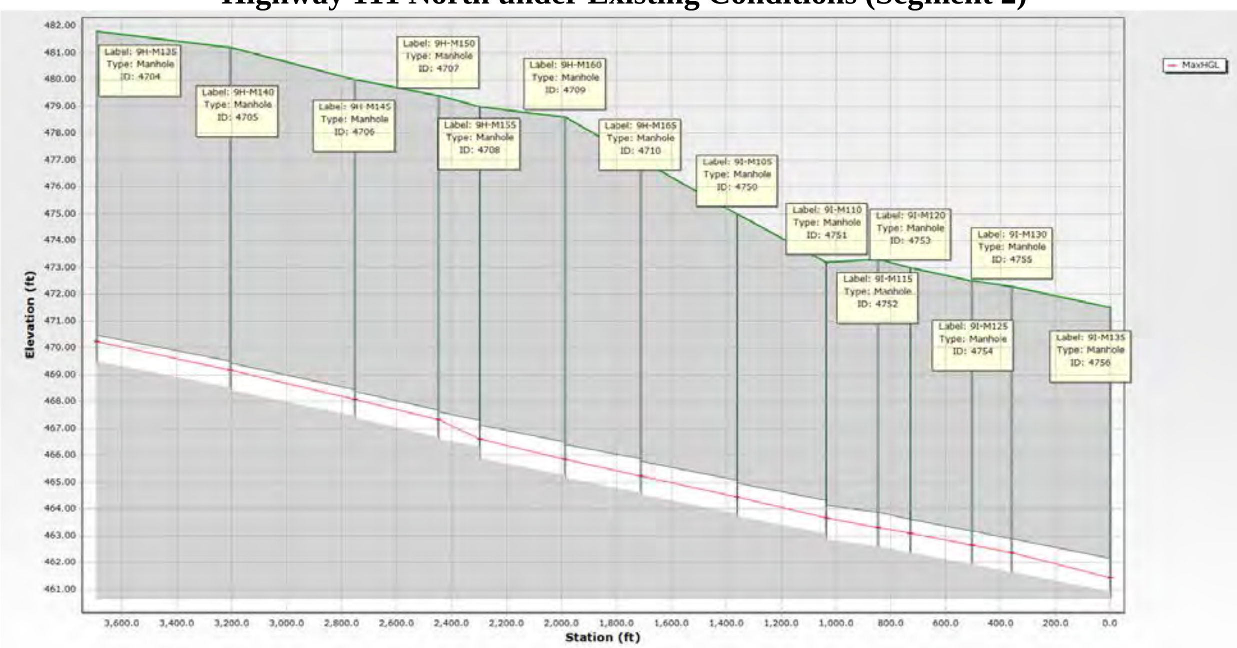
- **Segment 1:** Extends along Highway 111 from manhole 9G-M150 at Arabia St. to manhole 9H-M135 at Jackson St.
- **Segment 2:** Extends from manhole 9H-M135 at the intersection of Jackson St. and Highway 111, to manhole 9I-M135 at Oak Ave. and Indio Blvd.

Figure 5-14
Highway 111 North under Existing Conditions (Segment 1)



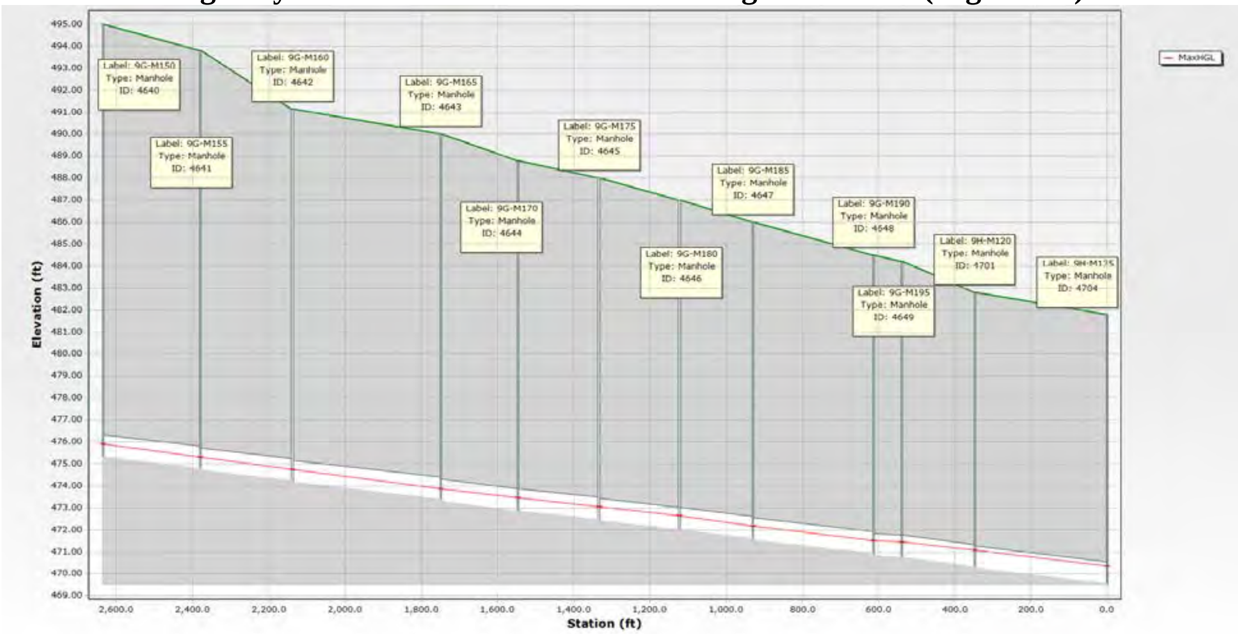
Start: Highway 111 and Arabia St. End: Highway 111 and Jackson St.

Figure 5-15
Highway 111 North under Existing Conditions (Segment 2)



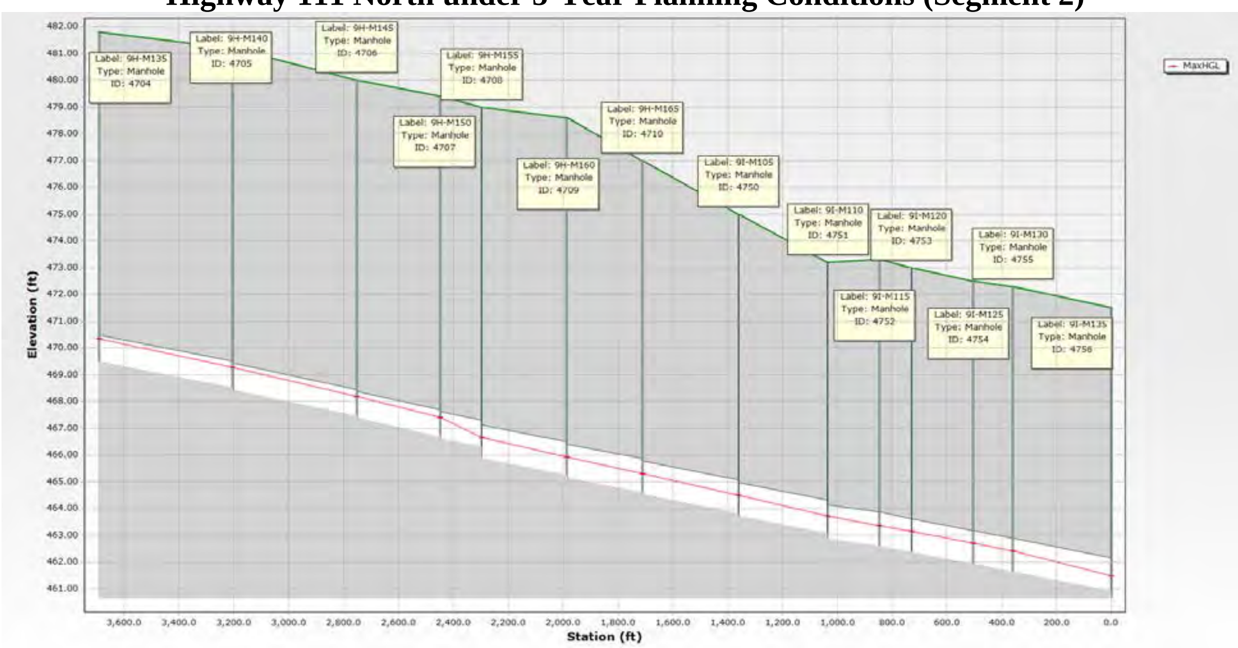
Start: Highway 111 and Jackson St. End: Oak Ave. and Indio Blvd.

Figure 5-16
Highway 111 North under 5-Year Planning Conditions (Segment 1)



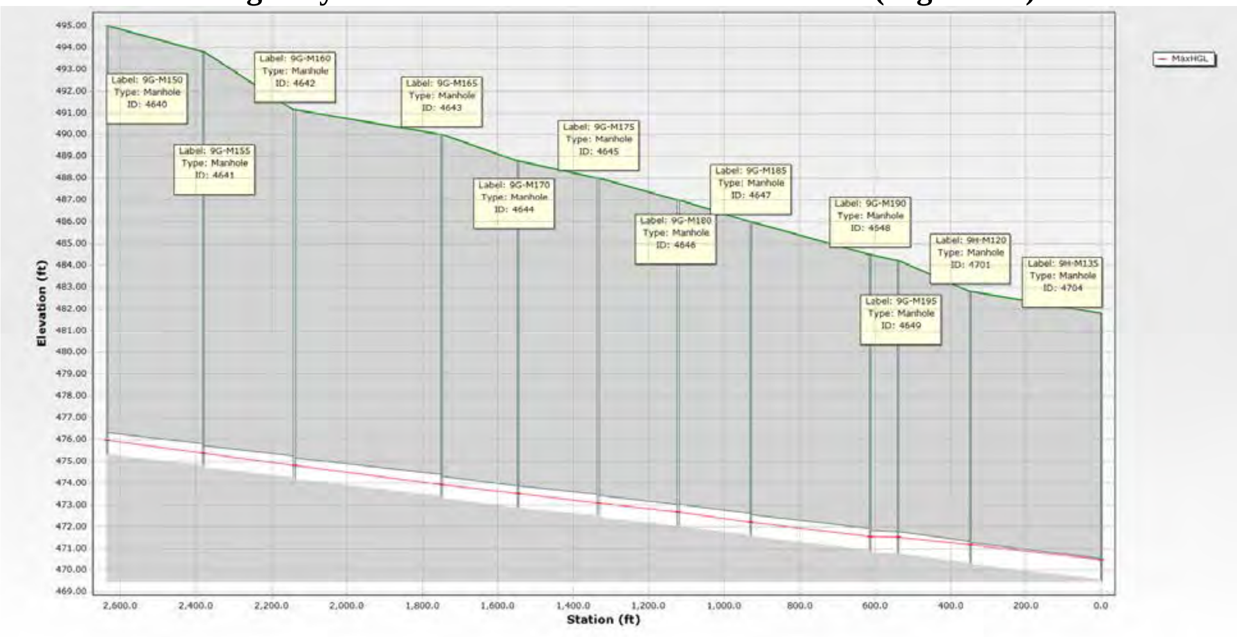
Start: Highway 111 and Arabia St. End: Highway 111 and Jackson St.

Figure 5-17
Highway 111 North under 5-Year Planning Conditions (Segment 2)



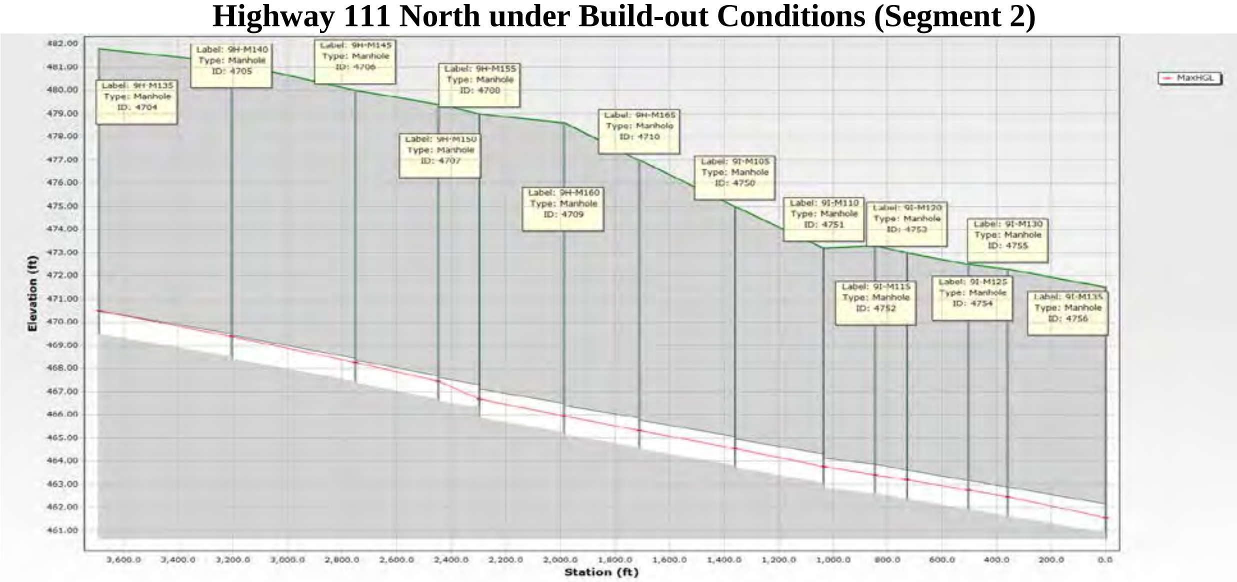
Start: Highway 111 and Jackson St. End: Oak Ave. and Indio Blvd.

Figure 5-18
Highway 111 North under Build-out Conditions (Segment 1)



Start: Highway 111 and Arabia St. End: Highway 111 and Jackson St.

Figure 5-19
Highway 111 North under Build-out Conditions (Segment 2)

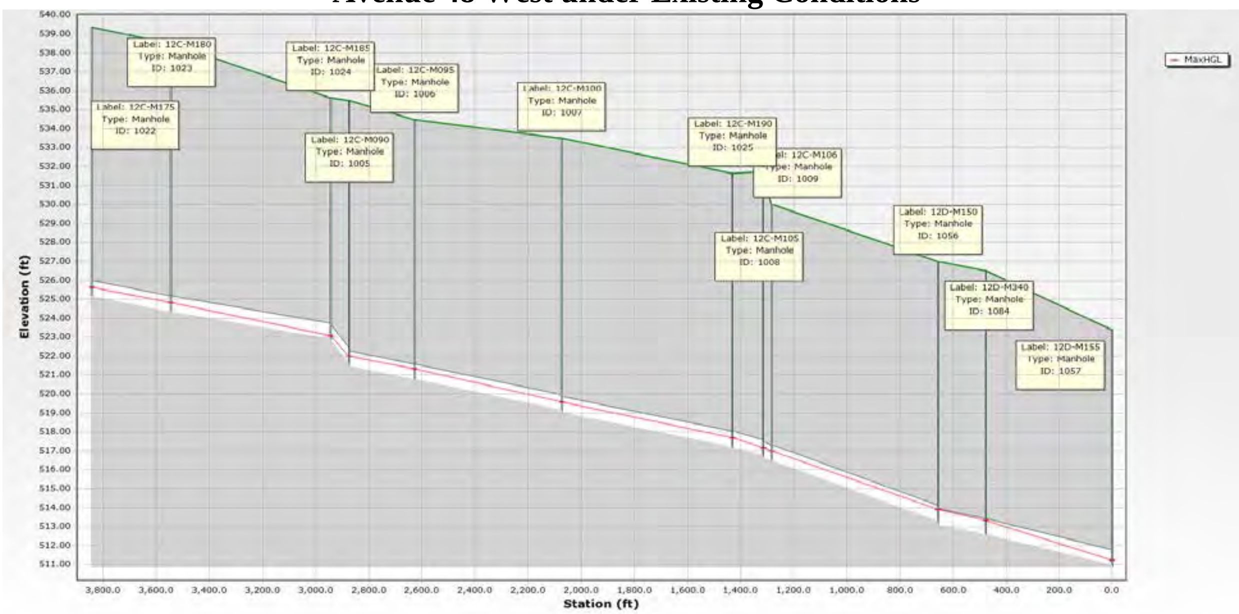


Start: Highway 111 and Jackson St. End: Oak Ave. and Indio Blvd.

Avenue 48 West

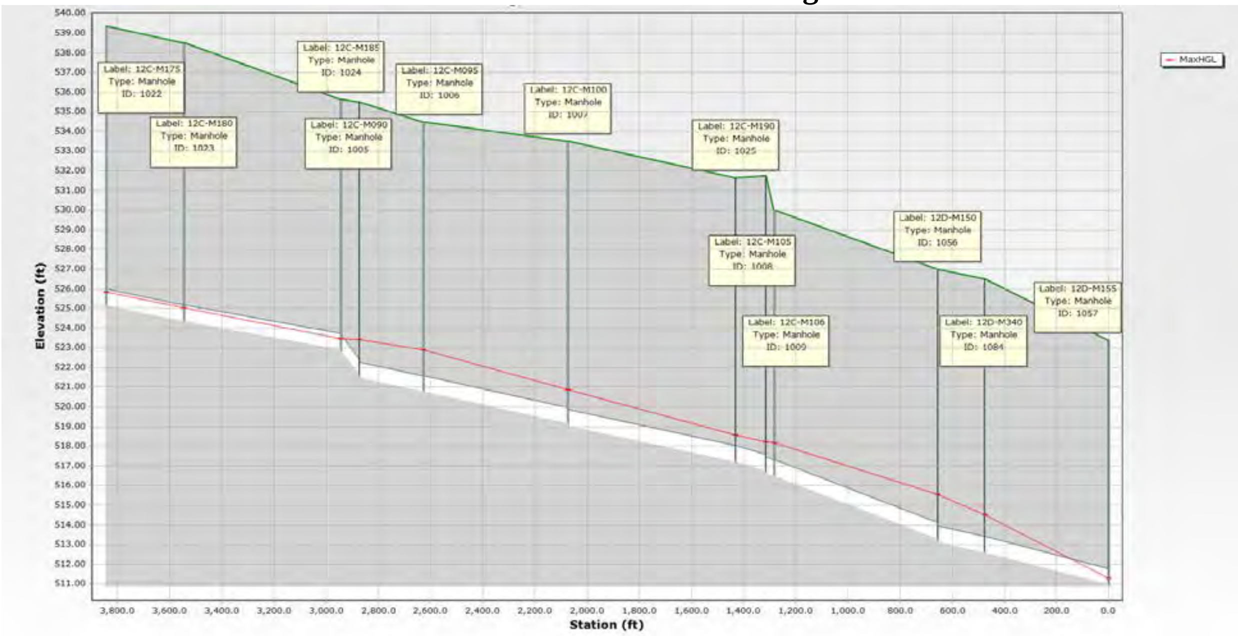
Avenue 48 shows capacity issues from Avenue 48 halfway between Jefferson St. and Shields Rd. to the intersection of Madison St. and Avenue 48. The hydraulic issues begin when the line running under Avenue 48 turns from an 18-inch diameter pipe to a 10-inch diameter pipe at Madison St. These hydraulic issues get progressively worse in the 5-year and build-out scenarios. **Figure 5-20** through **Figure 5-22** show profiles for this section of pipeline for all three planning scenarios.

Figure 5-20
Avenue 48 West under Existing Conditions



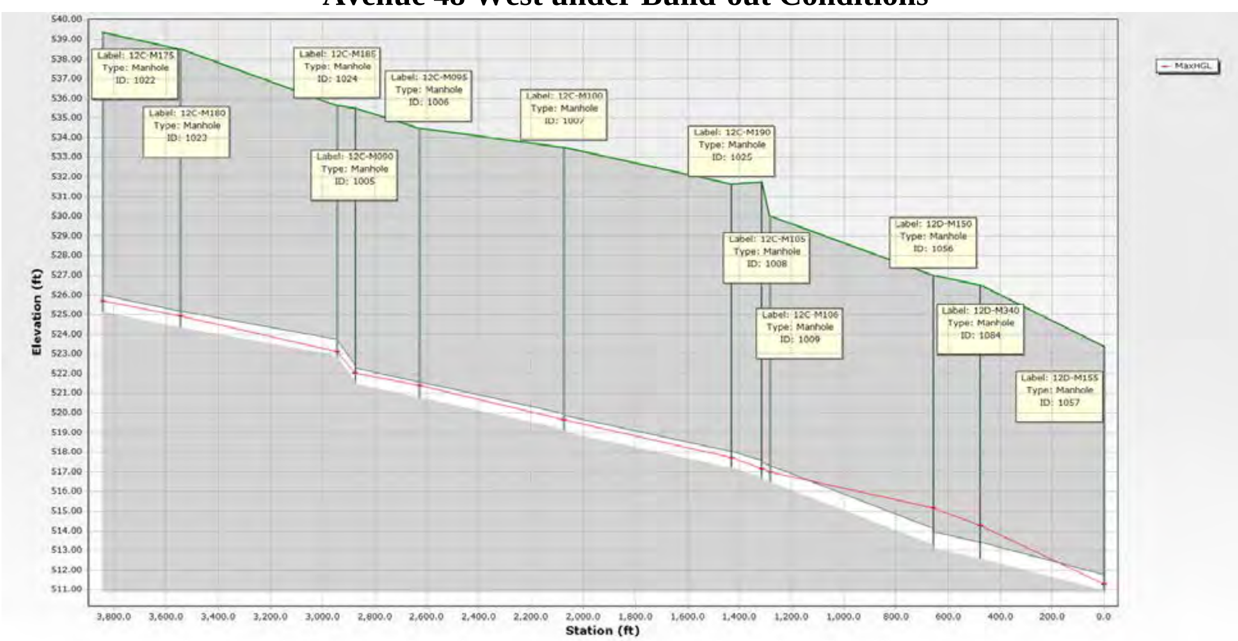
Start: Avenue 48 between Jefferson St. and Shields Rd. End: Avenue 48 and Madison St.

Figure 5-21
Avenue 48 West under 5-Year Planning Conditions



Start: Avenue 48 between Jefferson St. and Shields Rd. End: Avenue 48 and Madison St.

Figure 5-22
Avenue 48 West under Build-out Conditions

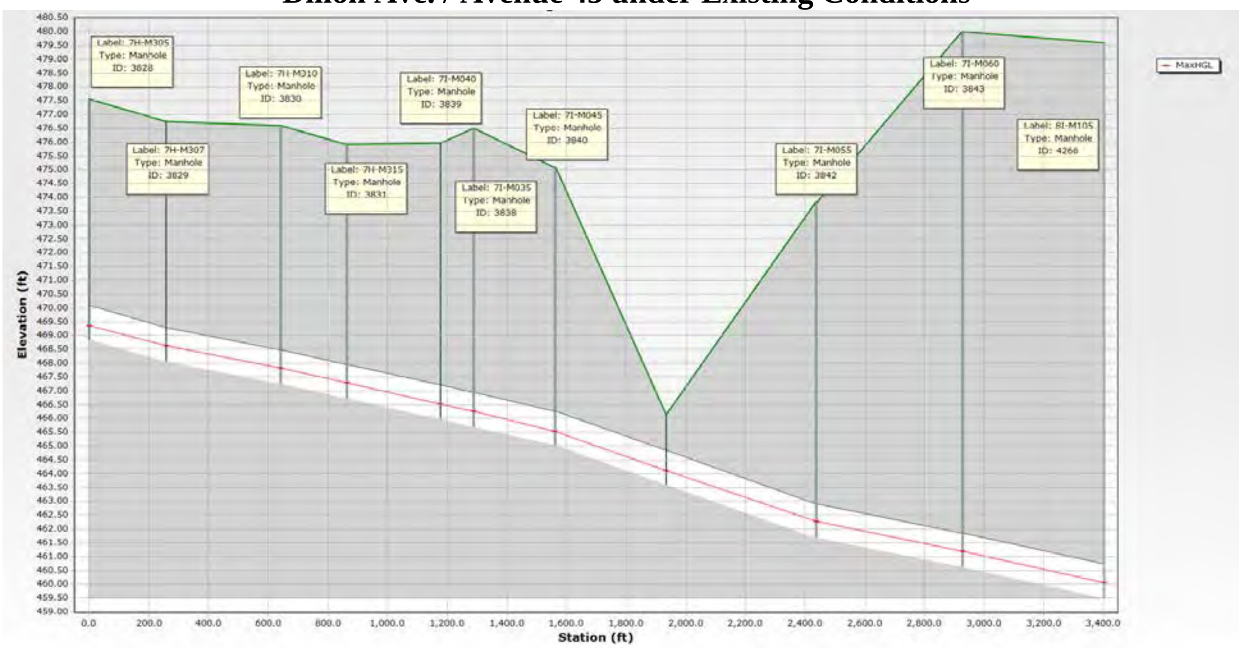


Start: Avenue 48 between Jefferson St. and Shields Rd. End: Avenue 48 and Madison St.

Dillon Ave. / Avenue 45

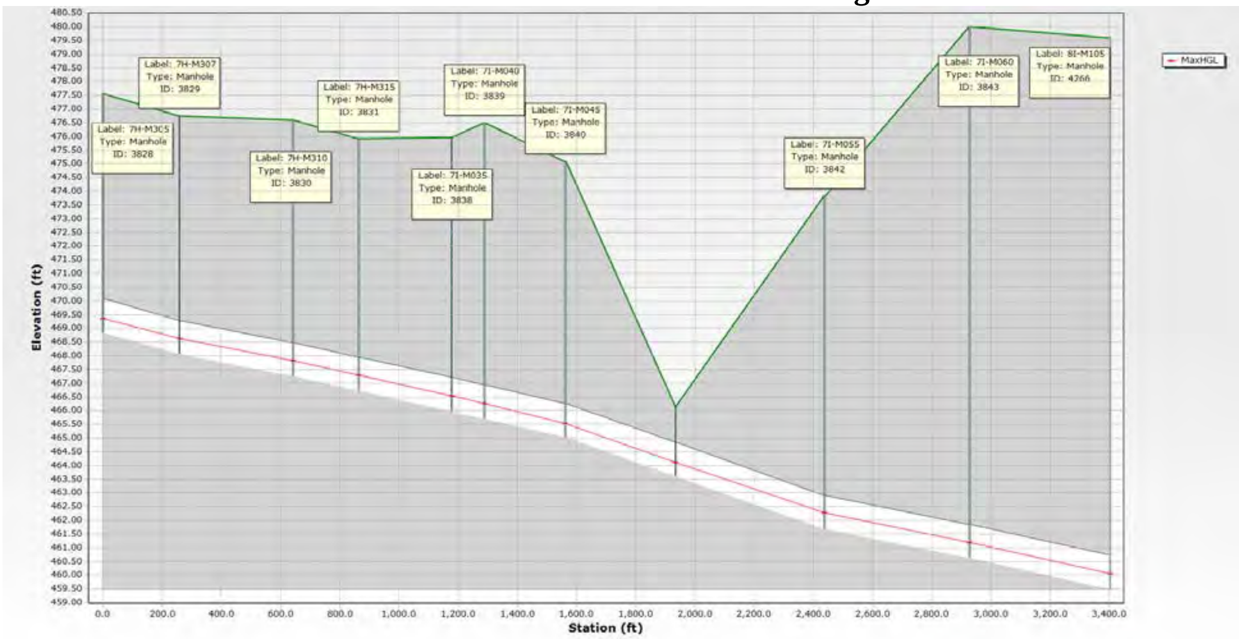
The existing system scenario shows over-capacity pipes from manhole 7H-M305 to manhole 8I-M105. While not all the pipes along this stretch are over-capacity in the existing system, the amount of hydraulic deficiency increases with the 5-year and build-out scenarios. This area of the system corresponds to the 15-inch pipes running from the intersection of Palo Verde St. and Dillon Ave., east on Dillon Ave., and then south east in an easement behind businesses adjacent to Avenue 45 just passed Golf Center Parkway. **Figure 5-23** through **Figure 5-25** shows the profiles for this segment of pipeline for all three scenarios.

Figure 5-23
Dillon Ave. / Avenue 45 under Existing Conditions



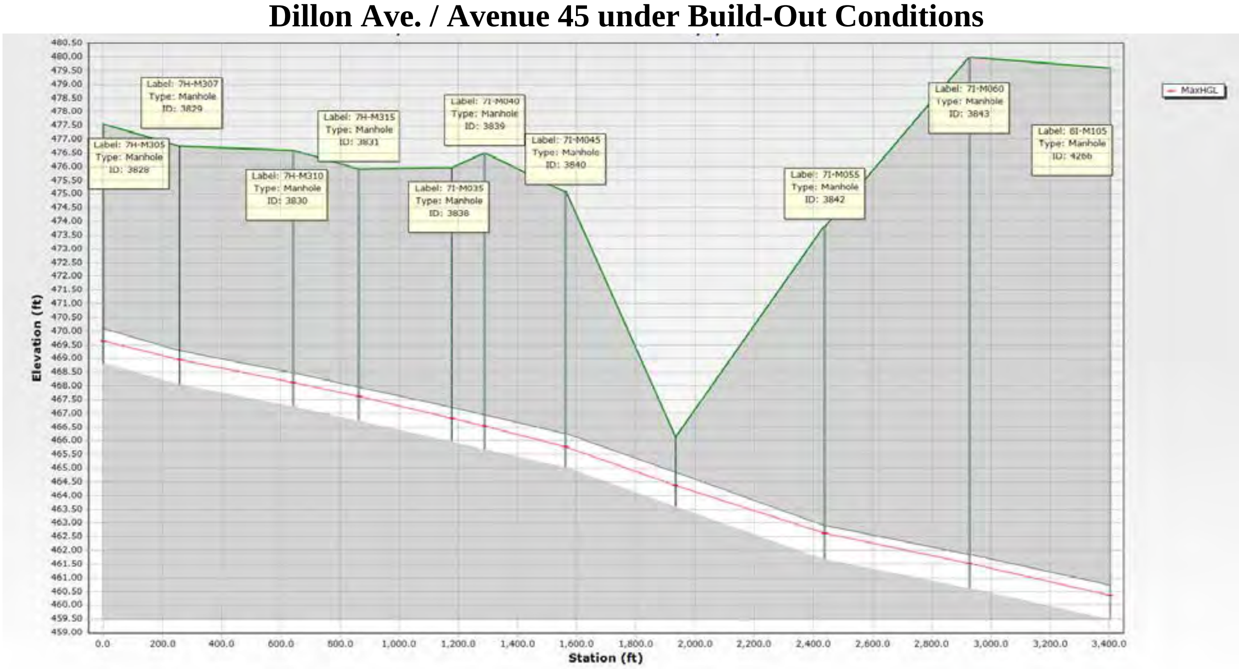
Start: Palo Verde Ave. and Dillon Ave End: Between Avenue 45 and Interstate 10

Figure 5-24
Dillon Ave. / Avenue 45 under 5-Year Planning Conditions



Start: Palo Verde Ave. and Dillon Ave — End: Between Avenue 45 and Interstate 10

Figure 5-25
Dillon Ave. / Avenue 45 under Build-Out Conditions

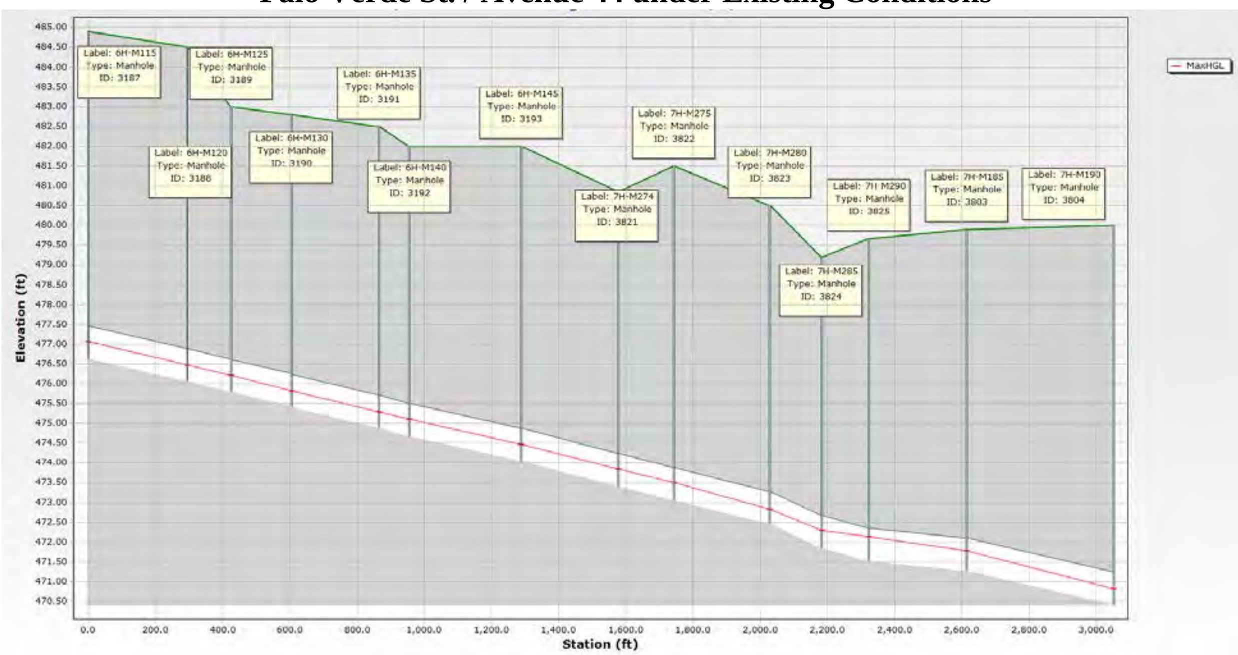


Start: Palo Verde Ave. and Dillon Ave — End: Between Avenue 45 and Interstate 10

Palo Verde St. / Avenue 44

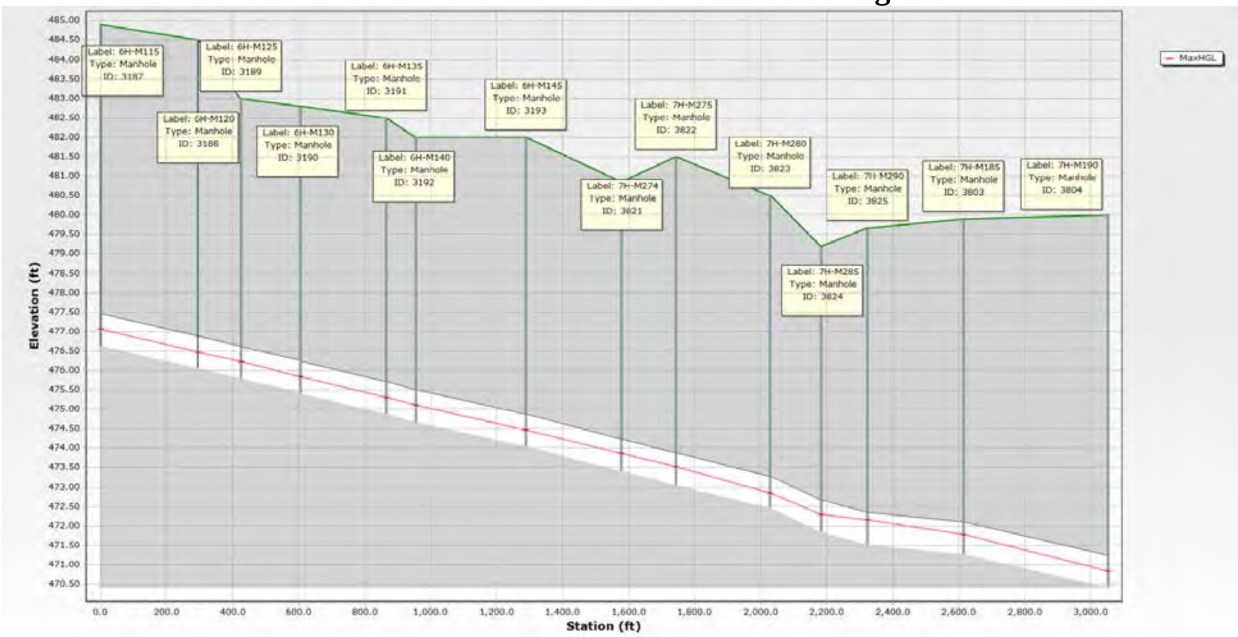
The existing system scenario shows over-capacity pipes from manhole 7H-M190 to manhole 6H-M115. Not all the pipes along this stretch are over-capacity in the existing system; however the amount of hydraulic deficiency increases with the 5-year and build-out scenarios. This area of the system corresponds to the 10-inch pipes running from the intersection of Avenue 44 and Jackson St., east on Avenue 44, and south on Palo Verde St. just past Dillon Ave. **Figure 5-26** through **Figure 5-28** shows the profiles for this segment of pipeline for all three scenarios.

Figure 5-26
Palo Verde St. / Avenue 44 under Existing Conditions



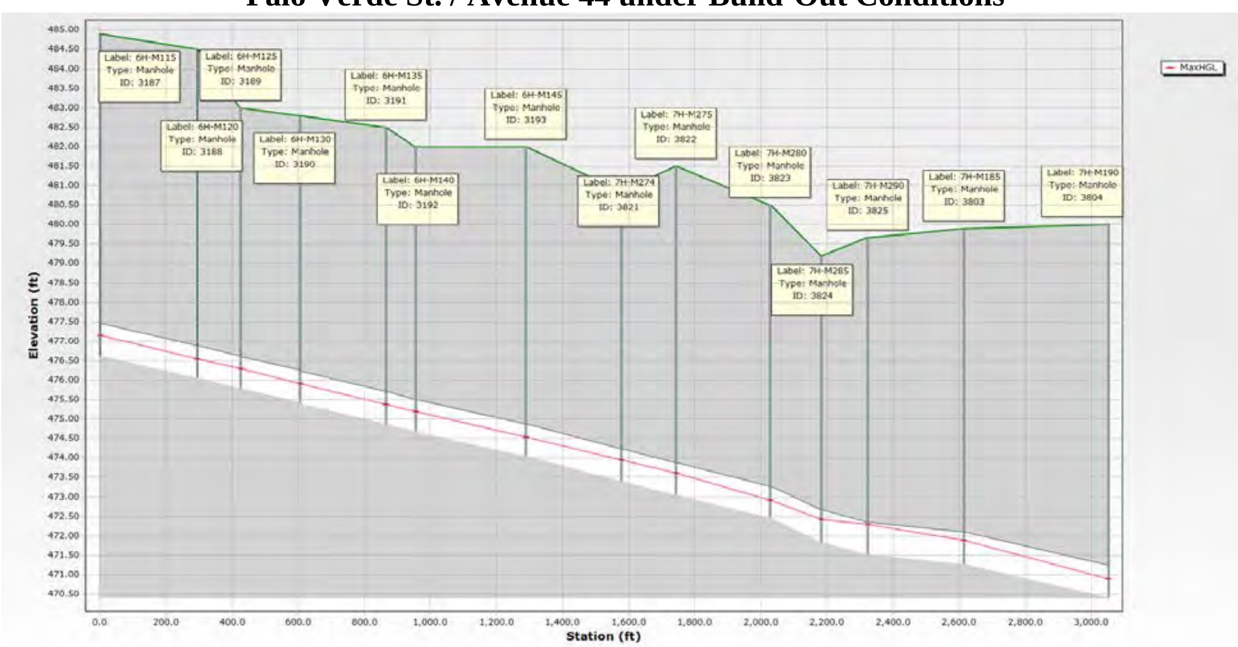
Start: Avenue 44 and Jackson St. End: Palo Verde Ave. and Sonora Ave.

Figure 5-27
Palo Verde St. / Avenue 44 under 5-Year Planning Conditions



Start: Avenue 44 and Jackson St. End: Palo Verde Ave. and Sonora Ave.

Figure 5-28
Palo Verde St. / Avenue 44 under Build-Out Conditions

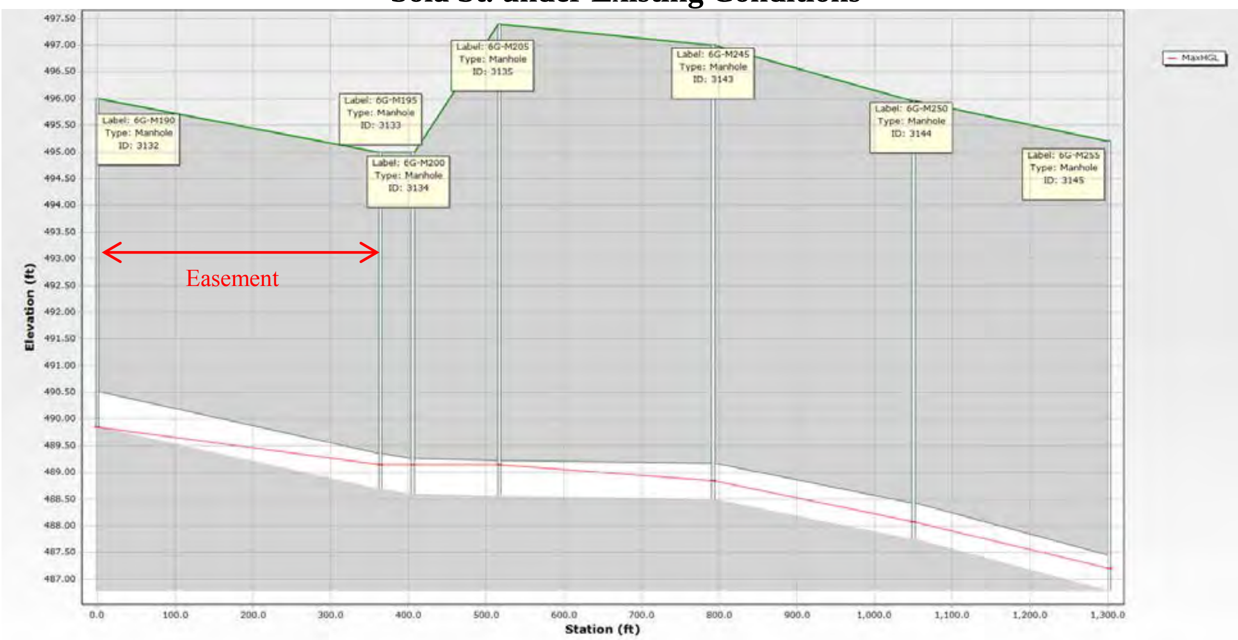


Start: Avenue 44 and Jackson St. End: Palo Verde Ave. and Sonora Ave.

Sola St.

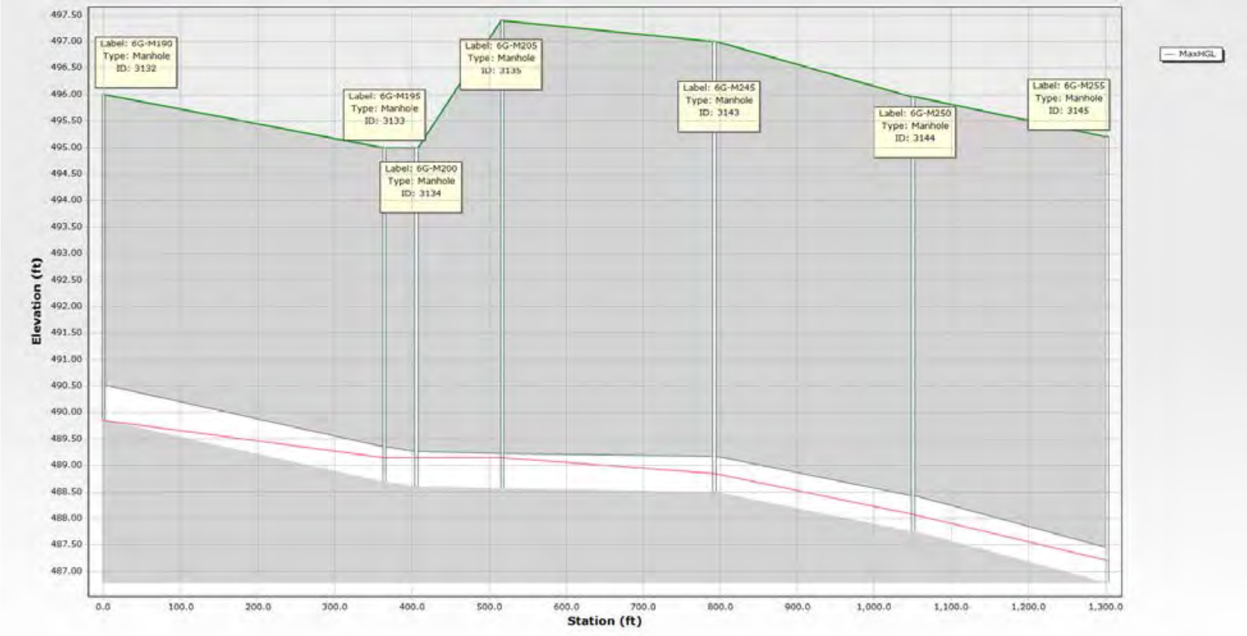
The existing system scenario shows over-capacity and surcharged pipes from manhole 6G-M190 to manhole 6G-M265. The amount of hydraulic deficiency increases with the 5-year and build-out scenarios. This area of the system corresponds to the 8-inch pipes running between Sola St. and Arabia St. from Oleander Ave to Kenner Ave (easement), and along Sola street from Kenner Ave to El Paseo Ave. **Figure 5-29** through **Figure 5-31** shows the profiles for this segment of pipeline for all three scenarios.

Figure 5-29
Sola St. under Existing Conditions



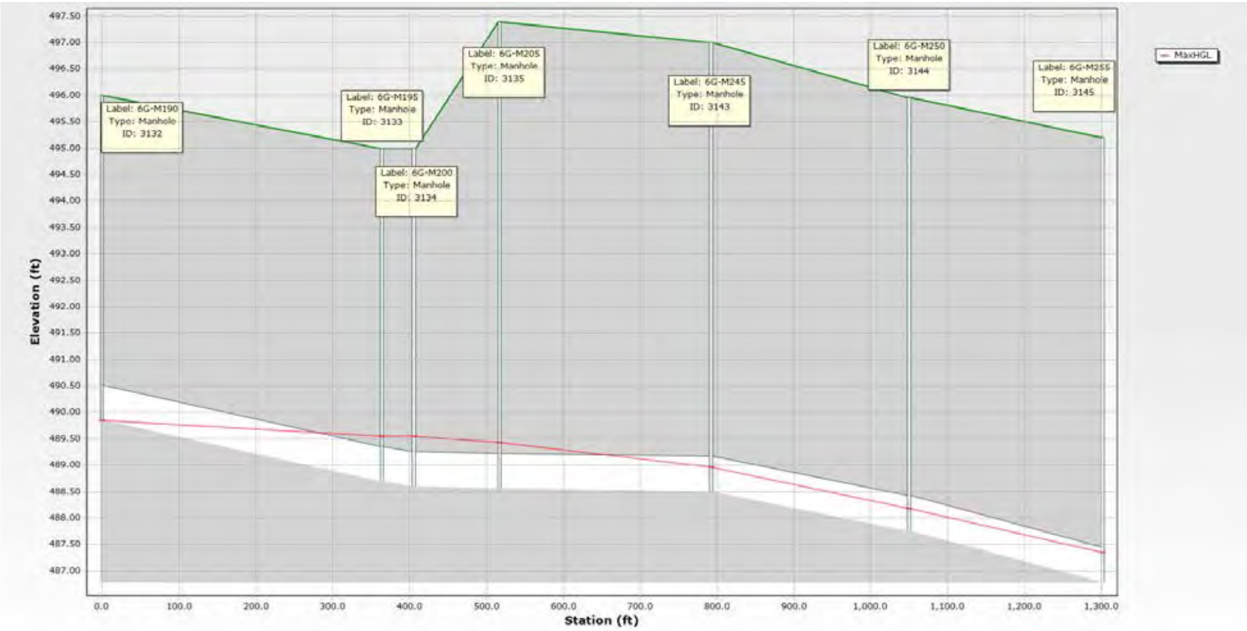
Start: Oleander Ave. between Sola St. and Arabia St. End: El Paseo Ave. and Sola St.

Figure 5-30
Sola St. under 5-Year Conditions



Start: Oleander Ave. between Sola St. and Arabia St. End: El Paseo Ave. and Sola St.

Figure 5-31
Sola St. under Build-Out Conditions



Start: Oleander Ave. between Sola St. and Arabia St. End: El Paseo Ave. and Sola St.

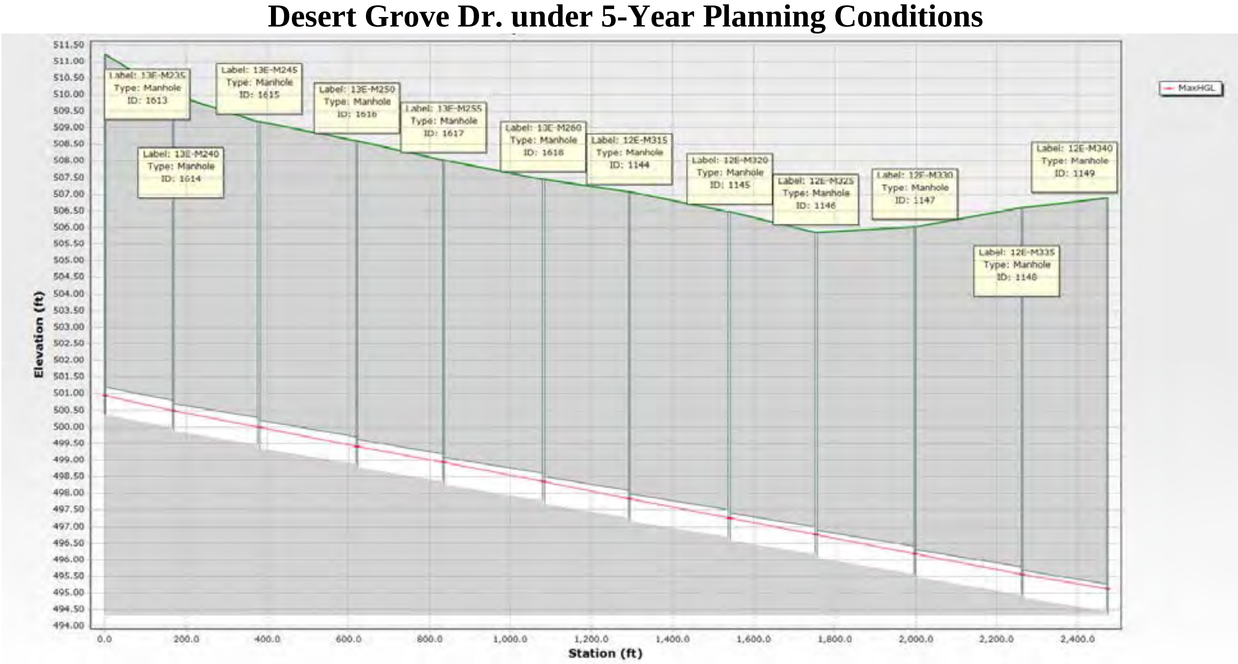
5.1.3 5-Year Planning Horizon System Evaluation

AOCs listed in this section are those that were not contained in the previous section for the existing system. These are areas that have exceeded design capacity or are surcharged due to the added load on the system anticipated in the next 5 years. **Appendix B** shows these loads as provided by VSD. Anticipated point loads due to specific development, as well as land use changes due to build-out conditions in certain areas of the system account for the added flow that is modeled in the 5-year planning scenario. Due to the fact that most areas identified as AOCs in the 5-year planning scenario were also identified in the existing system evaluation, only those that became AOCs in the 5-year analysis are addressed in this section. This includes only two additional AOCs. As with the existing system evaluation, all AOCs were visually checked in the model to ensure results were not due to a modeling error.

Desert Grove Dr.

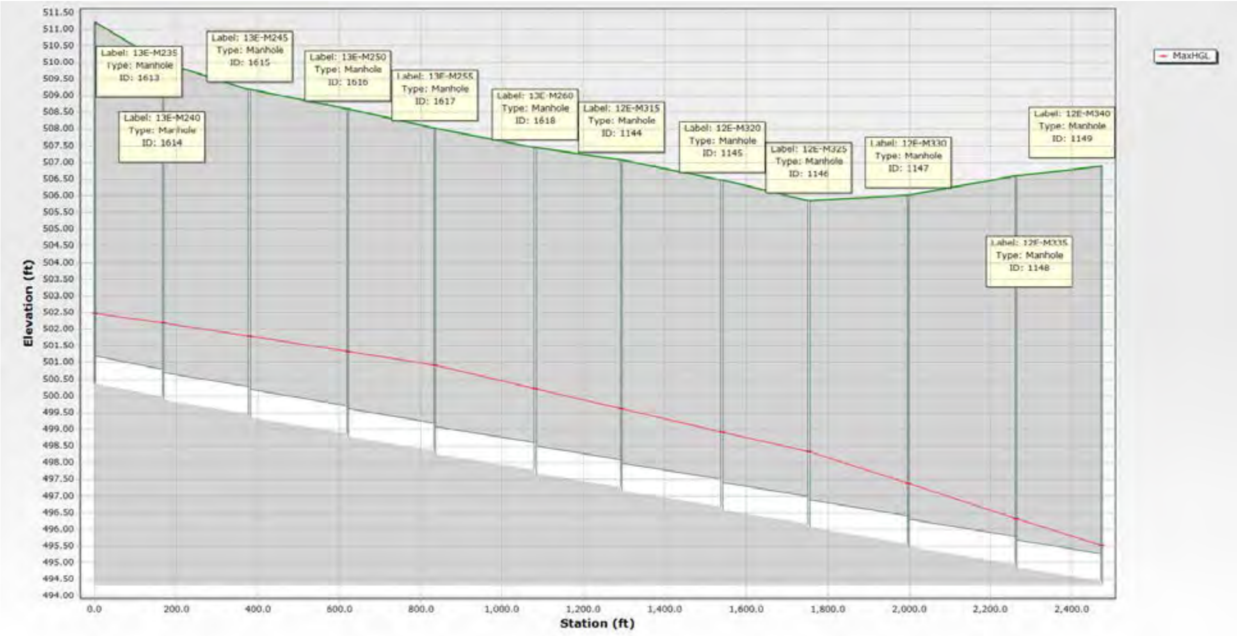
The 10-inch pipe running along Desert Grove Dr. from Avenue 49 to Avenue 48 (manhole 13E-M235 to manhole 12E-M385) shows both surcharging and over-capacity pipes in the 5-year planning scenario. The severity of the hydraulic deficiency increases for the build-out scenario. **Figure 5-32** and **Figure 5-33** show profiles for this area for the 5-year planning and build-out scenarios.

Figure 5-32
Desert Grove Dr. under 5-Year Planning Conditions



Start: Desert Grove Dr. and Avenue 49 End: Desert Grove Dr. and Avenue 48

Figure 5-33
Desert Grove Dr. under Build-Out Conditions

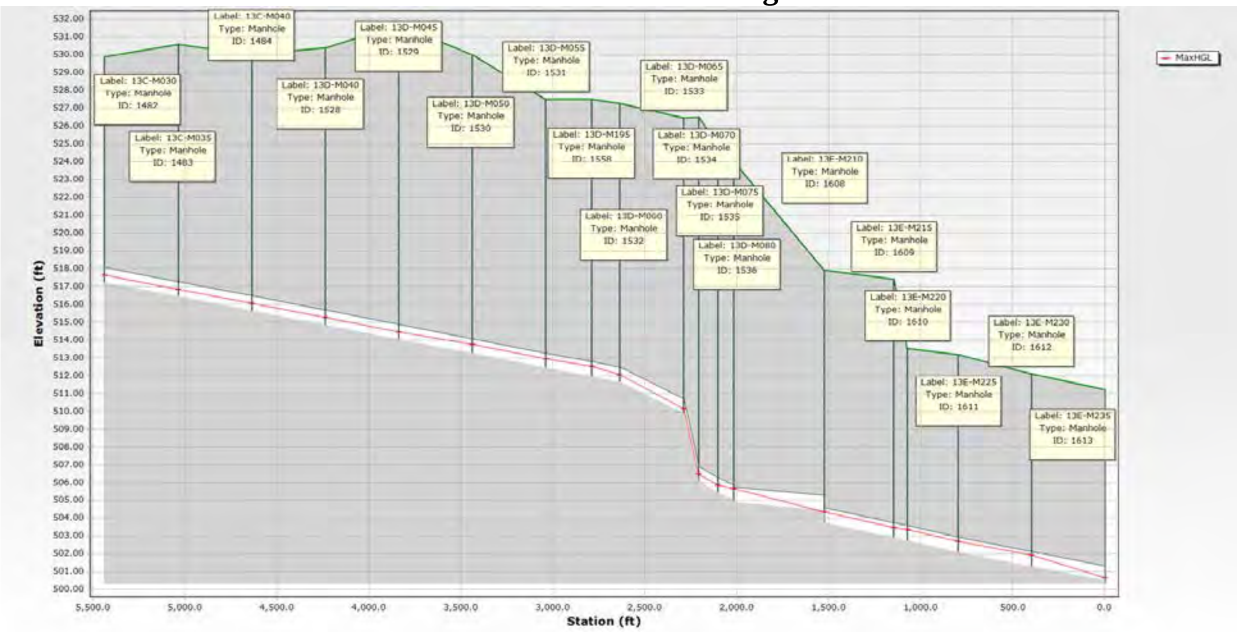


Start: Desert Grove Dr. and Avenue 49 End: Desert Grove Dr. and Avenue 48

Avenue 49

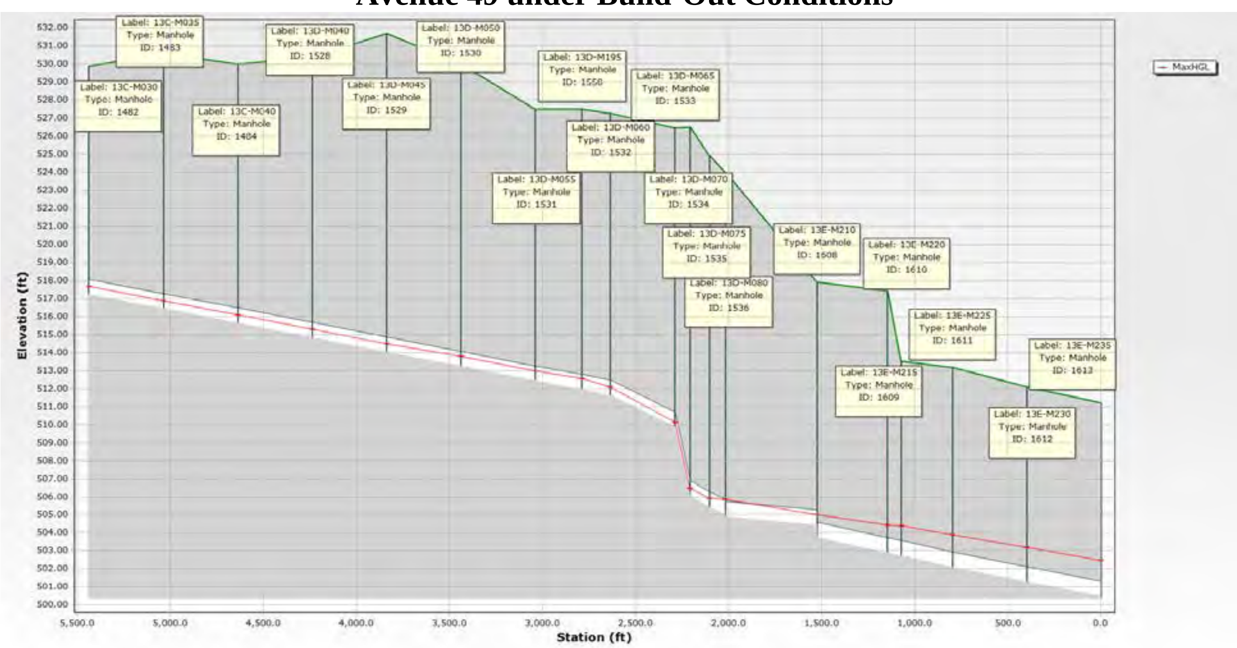
The 5-year planning scenario shows over-capacity and surcharge pipes along Avenue 49, from Madison St. to Desert Grove Dr. (from manhole 13D-M050 to manhole 13E-M235). In the build-out scenario, the severity of the hydraulic deficiencies is greater, and extends beyond Madison St. to Orchard Drive (manhole 13C-M030). **Figure 5-34** and **Figure 5-35** show profiles for this area for the 5-year planning and build-out scenarios.

Figure 5-34
Avenue 49 under 5-Year Planning Conditions



Start: Orchard Dr. and Avenue 49 End: Desert Grove Dr. and Avenue 9

Figure 5-35
Avenue 49 under Build-Out Conditions



Start: Orchard Dr. and Avenue 49 End: Desert Grove Dr. and Avenue 9

5.1.4 Build-Out System Evaluation

The build-out system evaluation seeks to quantify the projected hydraulic deficiencies that might occur given an estimate of the flows in the VSD system if all land within the current system is utilized to its fullest extent. In order to project this scenario, the land use projected in the City of Indio Master Plan was imported into the model, and the highest duty factors and patterns (developed during calibration) that are associated with those land uses were applied. Flows derived from this process total 18.07 MGD on a typical weekend day and 19.25 on a typical weekday.

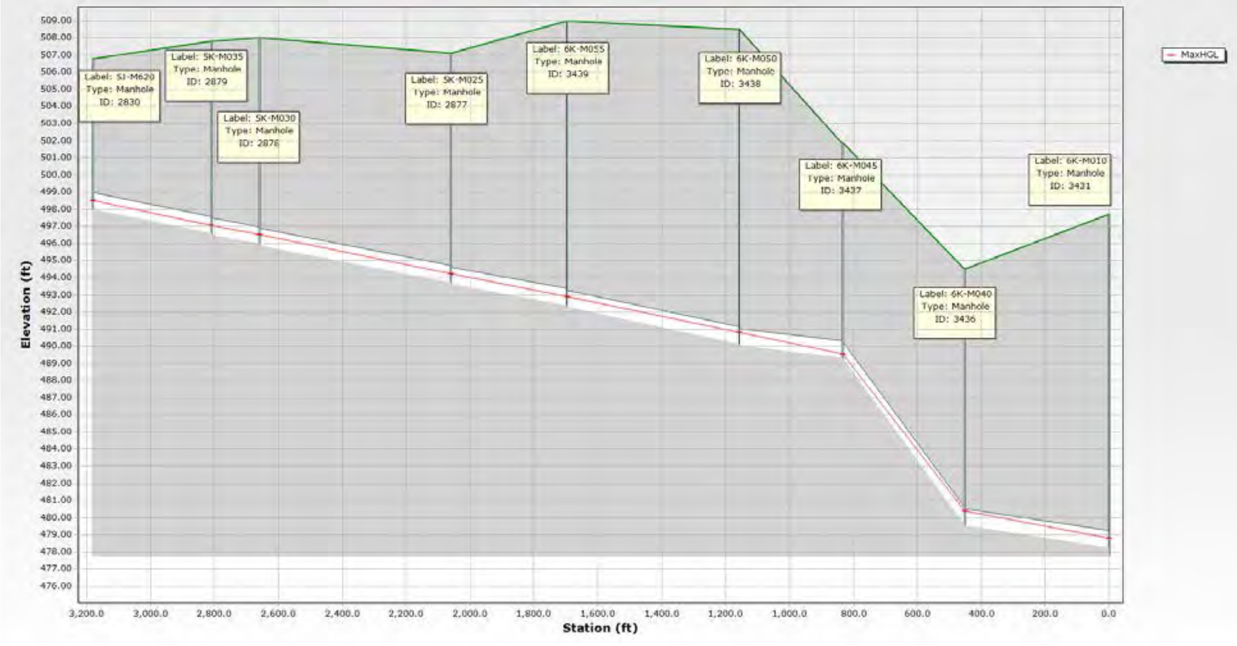
Because build-out flow represents the ultimate demand on the system, a different threshold is used to determine if an area constitutes an AOC. Instead of using a 0.5 threshold value for d/D for pipes less than 18-inches in diameter and a 0.75 threshold value for d/D for pipes equal to or greater than 18-inches in diameter, a threshold of 0.9 is used for all pipes since no additional flows are anticipated beyond the build out condition. For this reason, many of the pipes shown in **Figure 5-1** as being over design capacity are not listed in this evaluation as they are projected to fall under the 0.9 d/D threshold.

AOCs listed in this section are those that were not contained in the previous sections. These are areas that have exceeded design capacity or surcharged due to the added load on the system due to build-out. Due to the fact that most areas identified as AOCs in the build-out scenario were also identified in the existing system evaluation and the 5-year system evaluation, only those that became AOCs in the build-out analysis are addressed in this section. As with previous sections, all AOCs were visually checked in the model to ensure results were not due to a modeling error.

Lago Vista

The build-out system analysis shows hydraulic deficiencies for the 12-inch pipes running from the intersection of Lago Vista and Avenue 44 (manhole 6K-M010), north on Lago Vista and north along Lago Brezza to manhole 5J-M620. **Figure 5-36** shows the profile for this section of pipe during build-out conditions. While some of the deficiency in this pipe may be due to backup in the model caused by the issues on Avenue 44 and Terra Lago Parkway discussed previously, capacity in the pipe is not sufficient to handle the amount of flow projected to pass through the pipe. Therefore, CIP recommendations are made for this AOC.

Figure 5-36
Lago Vista under Build-Out Conditions

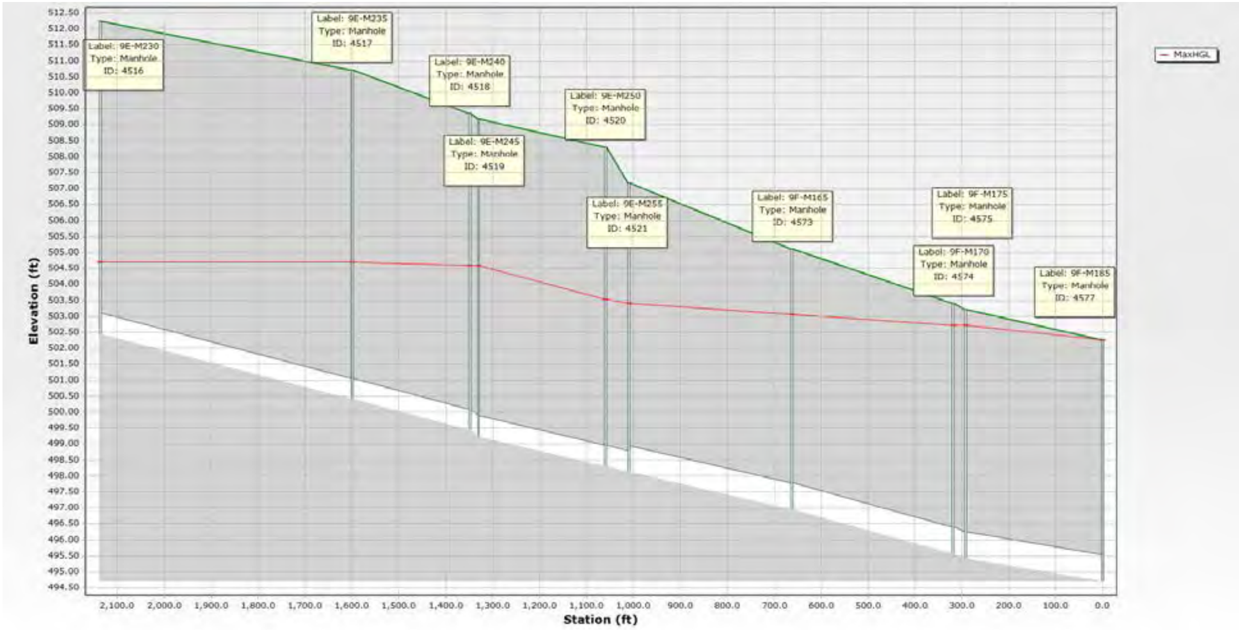


Start: Lago Brezza Dr. and Armonia Ct. End: Avenue 44 and Lago Vista

Avenue 46

This is an area of the system parallel to the Dr. Carreon Blvd. corridor that also shows deficiency. Based on the hydraulics of the system and areas downstream of this AOC, the issues caused are due to the issues on Dr. Carreon Blvd. Therefore, there are no CIP recommendations that are specific to this AOC and it is expected that recommendations to relieve Dr. Carreon Blvd. will also relieve this area of the system. **Figure 5-37** shows the profile from Clinton St. to Monroe St. along Avenue 46, which is a portion of the overall AOC but does not include all affected pipes.

Figure 5-37
Avenue 46 under Build-Out Conditions



Start: Avenue 46, east of Clinton St. End: Avenue 46 and Monroe St.

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Section 6
Pipeline Replacement Evaluation

This section of the Sewer Master Plan describes a pipeline replacement program for Valley Sanitary District (VSD) based on the observed condition data obtained through closed-circuit television (CCTV) and estimated condition based on age of the pipelines. This section presents a systematic, decision-making framework for prioritizing condition assessment activities, VSD's existing closed-circuit television (CCTV) assessment data, and pipeline replacement and rehabilitation prioritizations based on the CCTV data.

This section breaks down the analysis results into two categories:

1. Replacement or rehabilitation of pipelines that fall under high risk category due to age or known deterioration based on CCTV data.
2. Regular cleaning and televising of pipelines that are under medium to low risk category.

6.1 PRIORITIZATION OF FUTURE CONDITION ASSESSMENT ACTIVITIES

As of year 2013, VSD has performed CCTV on approximately 70 miles of pipeline (out of a total of 246 miles). Thus, over two-thirds of the system has not been televised. However, 43% of the pipes in the VSD system were installed since 2000 and will not require CCTV in the near future. Based on the review of VSD's Geographical Information System (GIS) data, approximately 20 miles of pipeline in the database are private pipelines that do not have a year of installation assigned. This subsection is intended to develop a systematic, numerical framework for prioritizing CCTV activities and pipeline replacement. Pipelines are ranked according to the combined probability and consequence of failure to the community as explained in the following subsections.

6.1.1 Predicted Condition Score (Probability of Failure)

The predicted condition score of the pipe before CCTV is performed indicates its probability of failure. The predicted condition score depends on predictive deterioration and failure history. The predicted condition score is a function of pipe material and age. Since majority of the VSD pipes are plastic pipes (PVC, Truss, Spirolite, etc.), the predicted condition score is only based on the age of the pipelines. Older pipes will have a higher predicted condition score. **Table 6-1** below specifically assigns a predicted condition score to each unique combination of pipe age and pipe material. The observed condition score is defined in **Table 6-4** in a later subsection discussing pipeline repair recommendations.

Table 6-1
Predicted Condition Score Assignment

Predicted Condition Score	Sewer Pipeline Age
5	Pre-1940 – all pipe materials
4	Post- 1940 and Pre-1955 – all pipe materials
3	Post-1955 and Pre-1970 – all pipe materials
2	Post-1970 and Pre-1985 – all pipe materials
1	Post-1985 – all pipe materials

The pipes of unknown age are private pipes and are not considered for this analysis.

6.1.2 Consequence of Failure Scores

Consequence of failure depends on pipe attributes such as size, depth, number of connected customers, and proximity to critical facilities (e.g., water bodies, stormwater channels, schools, hospitals, etc.). Consequence of failure scores can be expressed as high, medium, and low impact for the various pipes. Pipes most critical to system operation will rate higher on the consequence scale. **Table 6-2** broadly defines the consequence of failure scores, while **Table 6-3** specifically assigns to each sewer characteristic a consequence of failure score. The consequence of failure score is used for both identifying which pipes to CCTV and which pipes to replace or rehabilitate.

Table 6-2
Consequence of Failure Score Definition

Consequence of Failure Score	Scoring Definition
A (= 3)	High. The impact potentially disrupts significant or critical customers such as hospitals, large industries, etc. The impact potentially costs a great deal to repair under emergency situations. The impact potentially threatens environmentally sensitive areas.
B (= 2)	Medium. The potential impact to significant or critical customers is more of an inconvenience than a disruption of service. The cost of an emergency repair is only slightly more than a repair during normal working hours. There is little potential for impact to environmentally sensitive areas.
C (= 1)	Low. There is no impact to significant or critical customers. The repair can be delayed until normal working hours resume. There is minimal to no known impact to environmentally sensitive areas.

Table 6-3
Consequence of Failure Score Assignment

Sewer characteristics		Consequence of Failure score
Sanitary Trunk Sewers:	>= 15"	A
	>= 12" & <15”	B
Sewers under railways, stormwater channel; sewer serving hospitals		A
Sewers in downtown area (Civic Center, detention facility, etc.)		B
Sewers serving elementary, junior high, or high schools		B
All other sewers		C

6.2 PRIORITIZATION OF PIPELINE RENEWAL

The District has recently employed the approach of preventative maintenance rather than replacing the pipelines as they fail. This section presents a consistent, decision-making framework for identifying and prioritizing pipelines for repair prior to their failure. In order to identify those pipelines that are candidates for repair, their physical structural condition must first be assessed via closed-circuit television (CCTV).

6.2.1 Observed Condition Score from CCTV Data

The pipes were assessed for structural and Operations and Maintenance (O&M) conditions. However, only the structural defects from CCTV data are used for this analysis. VSD O&M staff will evaluate the O&M defects. VSD’s CCTV data has pipe condition scores assigned according to the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) Condition Grading System. The analysis presented in this section is based on the Quick Rating as described below.

Quick Rating

The Quick Rating is a shorthand way of expressing the number of occurrences for the two highest severity grades. The Quick Rating is a four character score as follows:

1. The first character is the highest severity grade occurring along the pipe length.
2. The second character is the total number of occurrences of the highest severity grade.
3. The third character is the next highest severity grade occurring along the pipe length.
4. The fourth character is the total number of the second highest severity grade occurrences.

If the total number of occurrences exceeds 9, then alphabetic characters are used as follows: 10 to 14 – A; 15 to 19 – B; 20 to 24 – C; etc. For example, a Quick Rating of 532A means there are 3 defects of condition score 5 and 10 - 14 defects of condition score 2.

The observed condition score used to calculate the risk rating is not the same as the structural defect rating in the CCTV report. The single-digit structural defect rating does not give as much information as the four-digit Quick Rating. Therefore, the criteria in **Table 6-4** were used to convert the Quick Rating into a single-digit observed condition score for risk rating calculation purposes. The description of each score is also included in that table.

Table 6-4
Observed Condition Score Definition (for sewers with CCTV data)

Observed Condition Score	Criteria	Description
5	1st digit of Quick Rating = 5, or 1st digit of Quick Rating = 4 and 2nd digit of Quick Rating ≥ 5	Defects requiring immediate attention. Pipe has failed or will likely fail within the next 5 years.
4	1st digit of Quick Rating = 4, or 1st digit of Quick Rating = 3 and 2nd digit of Quick Rating ≥ 5	Severe defects that will become grade 5 within the foreseeable future. Pipe will probably fail in 5 – 10 years.
3	1st digit of Quick Rating = 3, or 1st digit of Quick Rating = 2 and 2nd digit of Quick Rating ≥ 5	Moderate defects that will continue to deteriorate. Pipe may fail in 10 – 20 years.
2	1st digit of Quick Rating = 2, or 1st digit of Quick Rating = 1 and 2nd digit of Quick Rating ≥ 5	Defects that have not begun to deteriorate. Pipe unlikely to fail for at least 20 years.
1	1st digit of Quick Rating = 0 or 1	Minor defects. Failure unlikely in the foreseeable future.

This observed condition score is then multiplied by the consequence of failure to get the risk rating for determining which pipes to replace and rehabilitate, as discussed in the next subsection.

6.2.2 Risk Rating for Pipeline Renewal Prioritization

Based on the observed condition score from the CCTV data and the consequence of failure discussed early in section 6.1.2, the numerical risk rating was calculated. The risk rating methodology allocates equal weight to the consequence of failure score and the observed or predicted condition score. While the numerical risk rating provided a basis to identify pipes for replacement and rehabilitation, it should be used in conjunction with sound engineering judgment. In practice, pipes in the worst condition that pose minimal risk would be replaced prior to pipes in good condition that pose the highest risk. For example, based on the actual physical condition, it is more prudent to replace a pipe with a risk rating of 5 (condition = 5, consequence = 1) than to replace a pipe with a risk rating of 6 (condition = 2, consequence = 3).

Therefore, in the case of pipe renewal, a modified alphabetical risk rating, **Table 6-5,** was derived from the numerical risk rating that incorporates the rationale discussed above. The highest risk ratings are at the bottom right of the table while the lowest risk ratings are at the top left of the table.

Table 6-6 gives the priority letter definitions for the Risk Rating for Pipe Renewal given in the previous table.

Table 6-5
Risk Rating for Pipe Renewal Prioritization

Risk Rating = Condition x Consequence (246.7 miles of pipeline)		Condition Score (Observed or Predicted)				
		1 Excellent (159.5.0 mi)	**2 Good** (28.5 mi)	**3 Fair** (34.1 mi)	**4 Poor** (17.3 mi)	**5 Very Poor** (7.3 mi)
Consequence of Failure Score	**C = 1 Low Impact** (200 mi)	1 = G (133.8 mi)	2 = F (20.2 mi)	3 = E (26.9 mi)	4 = D (13.2 mi)	5 = C (5.9 mi)
	B = 2 Medium Impact (16.7 mi)	2 = F (7.0 mi)	4 = E (3.8 mi)	6 = D (1.8 mi)	8 = C (2.7 mi)	10 = B (1.4 mi)
	A = 3 High Impact (30.0 mi)	3 = E (18.6 mi)	6 = D (4.4 mi)	9 = C (5.4 mi)	12 = B (1.4 mi)	15 = A (0.1 mi)

Note: The red and white dashed border represents categories which are recommended for replacement/rehabilitation. For "4=D," roughly 7.5 miles of the 13.2 miles are recommended for replacement/rehabilitation as those are the pipes that have CCTV available and where their condition has been confirmed. The remaining 5.7 miles should have CCTV footage taken in order to confirm condition and need for replacement/rehabilitation

Based on the risk rating presented in **Table 6-5**, it is recommended that all pipelines with the ratings of A, B, or C (high risk category) be replaced according to the priorities shown in **Table 6-6**. Pipelines that fall under 4 = D risk rating (13.2 miles) are either "poor" in condition as observed in the CCTV data or are constructed between 1940 and 1955 (refer to **Table 6-1**). Approximately 7.5 miles of the pipelines with 4 = D risk rating has CCTV data. Since these pipelines have been confirmed to be in poor condition, they are recommended for replacement. The remaining length of pipeline that falls under this category that have not been televised, should be cleaned and televised on a priority basis before determining a future course of action for them. All other pipelines in the low risk category (6=D through 1=G) should be cleaned and monitored on a regular basis. Pipelines in the low risk category which have not been televised should be cleaned and televised over the next 10 years based on priority defined in **Table 6-6**.

Table 6-6
Priority Letter Definitions

Priority	Definition
A	Construct within 0 to 3 years
B	Construct within 3 to 5 years
C	Construct within 5 to 10 years, or re-evaluate priority as required.
4 = D (CCTV)	Construct within 10 to 15 years
4 = D (no CCTV)	Clean and televise within 0 – 3 years and reevaluate replacement/rehabilitation options
6 = D (Fair)	Keep monitoring the pipe that have CCTV data and televise pipelines that don't have CCTV data within 3 – 5 years

Table 6-6 (Continued)
Priority Letter Definitions

Priority	Definition
D = 6 (Good)	Keep monitoring the pipe that have CCTV data and televise pipelines that don't have CCTV data within 3 – 5 years
E	Keep monitoring the pipe that have CCTV data and televise pipelines that don't have CCTV data within 5 – 10 years
F	Keep monitoring the pipe that have CCTV data and televise pipelines that don't have CCTV data within 5 – 10 years
G	No action required.

Figure 6-1 is a pie chart of the pipe renewal risk rating distribution for pipelines in the VSD system (excludes private pipes). **Figure 6-2** is a map of the risk rating for pipelines.

Figure 6-1
Pipe Renewal Risk Rating Distribution

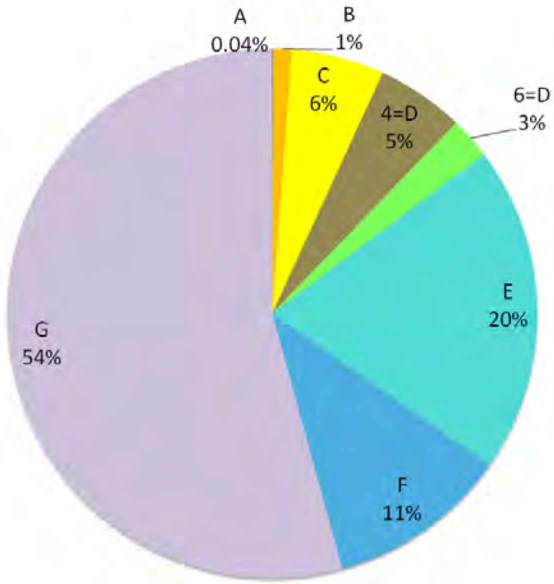
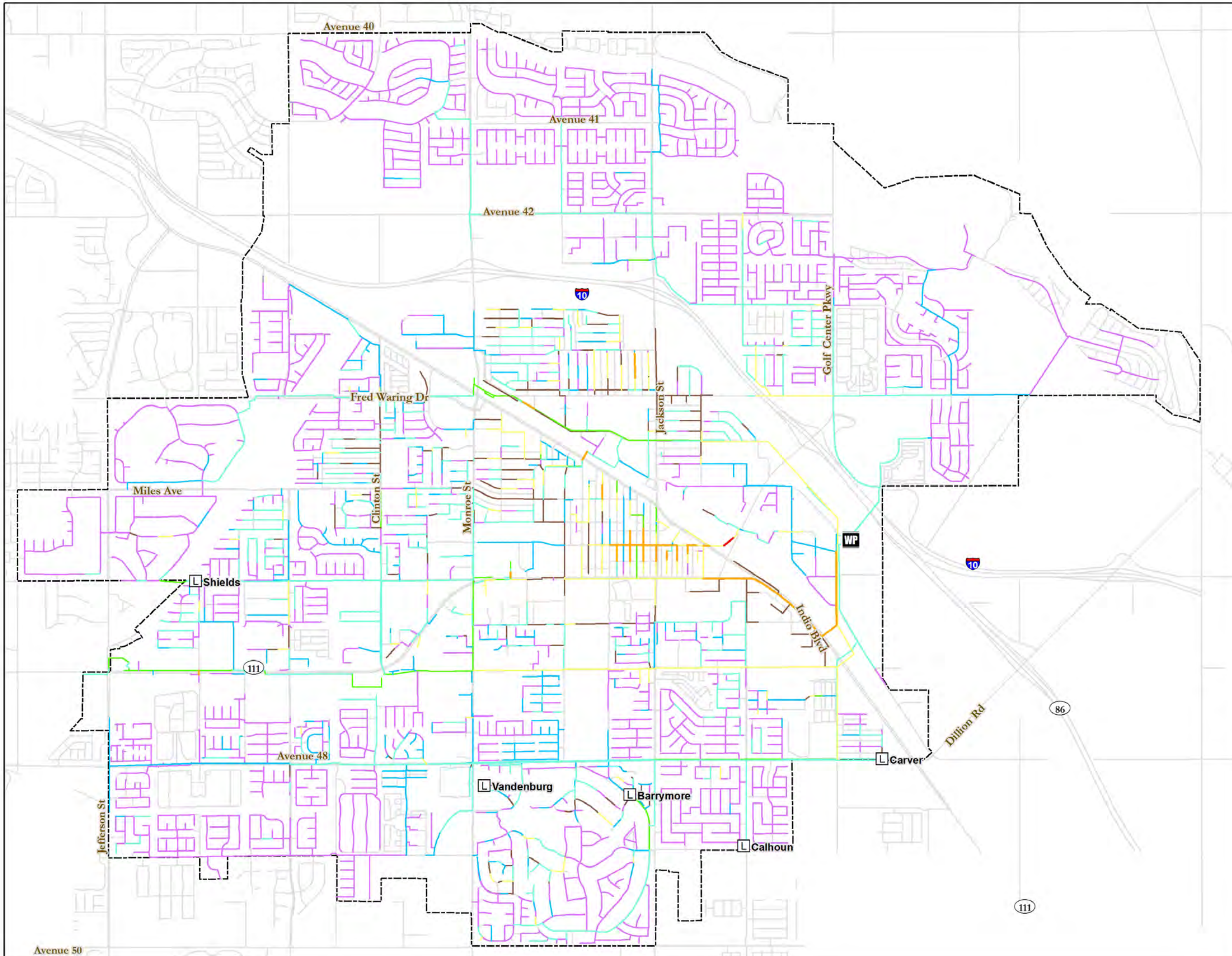


Table 6-7 is a prioritized list and planning level cost of pipes to be replaced or rehabilitated ranked from the highest risk rating to the lowest risk rating. Pipes with the highest alphabetical risk rating should be replaced or rehabilitated first. Of the 246 miles of pipeline, 24.3 miles need to be replaced or rehabilitated, which is equivalent to 9.9 percent of total pipeline length. This total length of pipe that needs to be replaced includes all pipes with a Risk Rating of A, B, and C, and those where D=4 and there is CCTV available. For the D=4 category, roughly 7.5 miles have CCTV available and need replacement/rehabilitation while the remaining 5.7 miles should be have CCTV footage taken in order to confirm condition.

The costs in **Table 6-7** reflect a conservative, planning level estimate of costs. This cost assumes full replacement of pipes and doesn't take into account the savings that could be realized through rehabilitation or partial replacement of the pipe sections. Actual cost for replacement will vary depending on individual conditions.



Key to Features

L Lift Station

WP Wastewater Treatment Plant

Valley Sanitary District Boundary

Pipeline Risk - Consequence of Failure Score

(A) Construct within 0-3 years

(B) Construct within 3-5 years

(C) Construct within 5-10 years

(D4) Construct within 10-15 years

(D6) Monitor pipes with CCTV data. Televise pipes without CCTV data within 3 – 5 years

(E) Monitor pipes with CCTV data. Televise pipes without CCTV data within 5 – 10 years

(F) Monitor pipes with CCTV data. Televise pipes without CCTV data within 10 – 12 years

(G) No action required

N

0 0.5 1 Miles

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Date: September 30, 2013

Risk Rating for Pipe Renewal Prioritization

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Figure 6-2

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Table 6-7
Pipeline Replacement Costs

Diameter (in)	Cumulative Length (ft.)	Average Cost per foot ($)	Total Cost ($)
Risk Rating = A			
10	349	$160	$55,800
Risk Rating = B			
8	5,679	$130	$738,300
10	1,388	$136	$188,800
12	398	$172	$68,500
15	2,696	$209	$563,500
24	4489	$315	$1,414,000
Risk Rating = C			
8	37,633	$129	$4,854,600
10	2,752	$152	$418,300
12	5,256	$179	$940,800
15	16,256	$190	$3,088,700
18	6,609	$259	$1,711,700
24 30	4,495 735	$297 $405	$1,335,000 $297,700
Risk Rating = D (D=4)			
8	36,194	$121	$4,379, 005
10	3,221	$135	$434,800
TOTALS			
Rounded (up to nearest 100)	128,150	-	$20,490,100

Assumptions:

- All pipes 6-inches in diameter were assumed to be replaced with 8-inch pipe
- All pipes 16-inches in diameter were assumed to be replaced with 18-inch pipe
- Any pipe without verified depth information is assumed to be 8 feet deep or less. Please note this is not a conservative estimate, but it is thought to be more accurate than assuming maximum depth
- Average Cost per Foot was calculated based on total cost divided by total length. Total Cost was calculated by finding the cost for the replacement of each individual pipe based on diameter, length, and depth as defined in Table 8-1
- Total costs are rounded to the nearest hundred

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Section 7
Recommended Improvements

This section presents recommended improvements for the VSD collection system. These improvements are phased according to the scenarios evaluated in the model: existing system, 5-year planning horizon, and build-out conditions. An estimate of costs associated with these improvements is addressed in **Section 8**.

7.1 RECOMMENDED IMPROVEMENTS FOR EXISTING SYSTEM

Improvements for the existing system are ordered according to the severity of the deficiency they address. Based on the hydraulic model and discussion with VSD, improvements to address capacity issues along Dr. Carreon Blvd. were identified to be a priority. Other priority improvements involve recommendations that relieve greater areas of concern (AOC). Locations of recommended improvement projects in the VSD collection system are shown on **Figure 7-1** and listed in **Table 7-1**.

7.1.1 Dr. Carreon Blvd. Relief Projects

According to modeled results, the first and most pressing capacity issue in the existing system lies on Dr. Carreon Blvd. This trunk line stretches along Highway 111 in the west to Dr. Carreon Blvd. in the east. The line ranges from 12-inch diameter at the intersection of Highway 111 and Madison St., to 18-inches at the intersection of Van Buren St. and Dr. Carreon Blvd. For the existing system evaluation, capacity issues are present in pipes between Clinton St. and Jackson St. along Dr. Carreon Blvd. These issues range from pipes over design capacity to pipes flowing at full capacity and beginning to surcharge up manholes. Due to the physical conditions of the pipes below Highway 111/Dr. Carreon Blvd., upsizing of the pipes is not the preferred method to relieve the trunk line. This is due to the depth of the existing sewer and the amount of traffic along the motorways above the trunk line. With this restraint in mind, the purpose of recommended upgrades becomes to relieve enough flow from Highway 111/Dr. Carreon Blvd. to abate existing capacity deficiencies.

Requa Interceptor

The project that will enable VSD to divert the most amount of flow from Highway 111/Dr. Carreon Blvd is the previously submitted Requa Interceptor. MSA Consulting, Inc. submitted an engineer's report November 2, 2009 with an alignment review for the Requa Interceptor. Alignments and elevations stated in that engineers report were used to model the Requa Interceptor in SewerGEMS. The Requa interceptor consists of approximately 20,900 feet of pipe ranging from 24-inch and 30-inch in diameter. **Table 7-2** shows a summary of the Requa Interceptor and the amount of infrastructure required for each stage of the interceptor. **Appendix H** presents the 2009 MSA Consultants Inc. report for the Requa Interceptor. It is of note that the phasing of this project reflected on **Table 7-2** is based off of the previous MSA Consultants study, but based on the model results from this Master Plan, the entire project is necessary to address current capacity issues and phasing of the project is not recommended.

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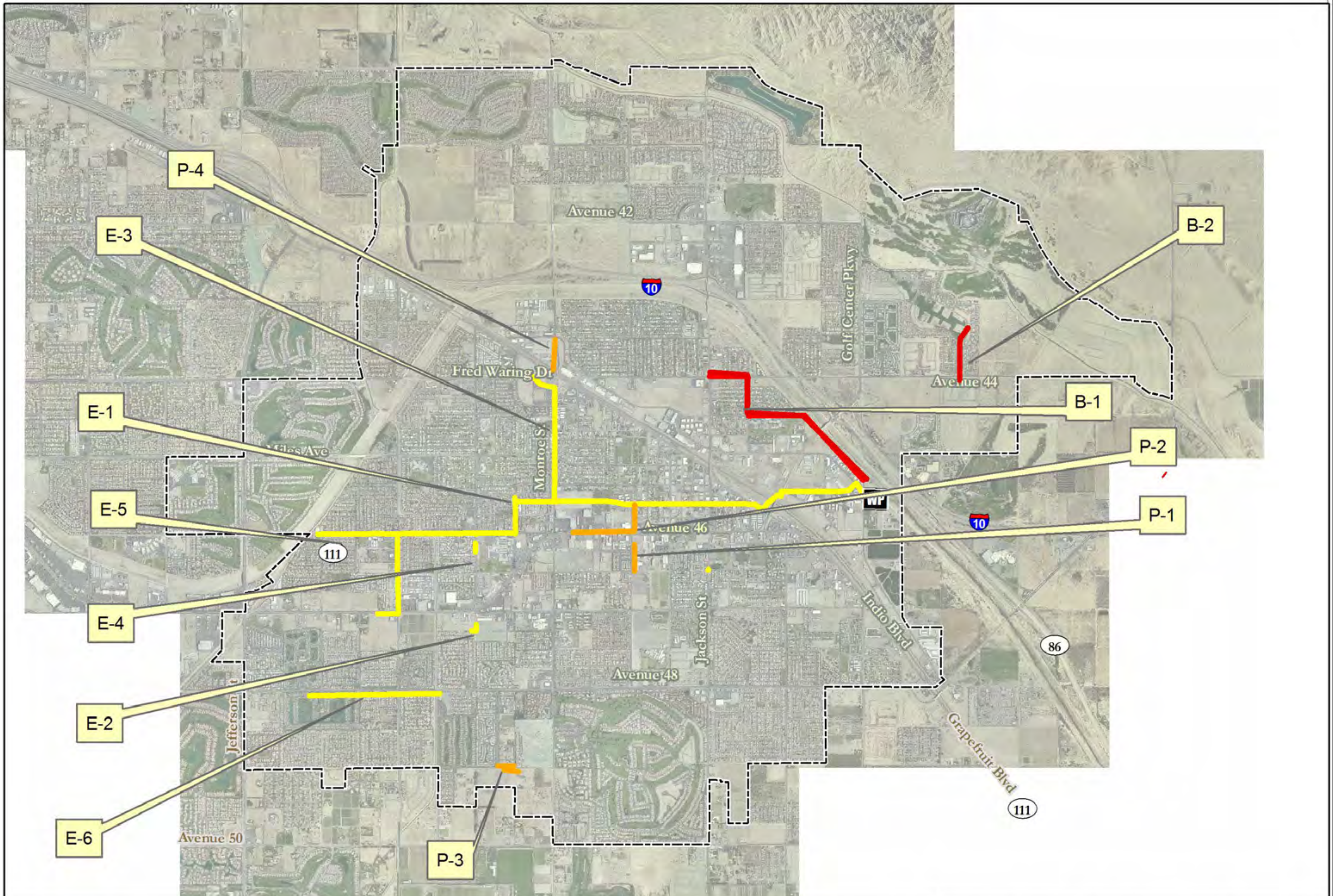

Key to Features

WP Wastewater Treatment Plant

Valley Sanitary District Boundary

2030 Build-Out System Improvement

2018 Planning Horizon System Improvement

2013 Existing System Improvement

N 0 0.5 1 Miles

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Date: September 3, 2013

Valley Sanitary District
Capital Improvement Program

MWH.

Figure 7-1

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Table 7-1
Recommended Improvements Summary

Project Number	Project Name	Description	Purpose	AOC Adressed	Phase	New or Upgrade	Operational Change	Size of Pipe (in)	Length of Pipe (ft.)	Total Length of Pipe (ft.)
E-1	Requa Interceptor	Interceptor from Madison street and Highway 111 to the WWTP	Relieve Dr. Carreon, take Shields PS offline, and service the jail expansion.	1, 2, 3, 12	Existing	New	No	24/ 30	20,906	20,906
E-2	Avenida Esmeralda Interceptor	15-inch line connecting Highway 111 to Avenue 48 via Calle Diamante	Temporary relief of Dr. Carreon Blvd.	1	Existing	New	No	15	368	368
E-3*	Monroe Interceptor Operational Change	Interceptor from Fred Waring Drive and Monroe Street south to the Requa Interceptor.	Take Monroe siphon offline and convey flows to the Requa Interceptor	1,5,6,7	Existing	N/A	Yes	N/A	N/A	N/A
E-4*	Clinton Street Operational Change	Operational change to send flows north on Clinton Street to the Requa Interceptor.	Relieve Dr. Carreon Blvd	1,5,6,7	Existing	N/A	Yes	N/A	N/A	N/A
E-5*	Shields Interceptor	Line from Shields PS east to Avenue 46.	Take Shield PS offline	1	Existing	New	No	10	1,427	1,427
E-6	Avenue 48 West Upgrade	Upsizing of 10-inch line extending west from along Avenue 48 from Madison St.	Relieve current and projected capacity issues for Avenue 48 West	4	Existing	Upgrade	No	15/18	670/ 2,875	3,545
P-1	Arabia Interceptor/ Jackson Street Operational Change	Bulkheading change and pipe improvements to divert flow from Dr. Carreon Blvd north to Highway 111	Relieve Dr. Carreon Blvd	1,2	5 year	New	Yes	8	850	850
P-2	Highway 111 Interceptor	Pipe connecting N. Hwy 111 to the Requa Interceptor	Relieve Dr. Carreon and increase Hwy 111 capacity in order to accommodate jail expansion	3	5 year	Both	No	12	2,979	2,979
P-3*	Avenue 49 Interceptor	Interceptor to convey flows from Avenue 49 to Monroe Street and then north to Avenue 48	Relieve Avenue 49 and Desert Grove Street	8,9	5 year	New	No	12	565	565
P-4	Industrial Pl./Market Interceptor	12-inch interceptor along Fred Waring Dr. from Industrial Pl. to Monroe St., sending flows down Market street	Relieve Sola Street, Palo Verde Street, Avenue 44, and Avenue 45	5, 6, 7	5 year	New	No	12	967	967
B-1	Ave 44/Palo Verde Interceptor and Upgrade	Interceptor to divert flows to 15-inch pipe along Avenue 44 from Palo Verde Street, as well as upsizing of surrounding pipes	Relieve Palo Verde and Avenue 45	6	Buildout	Both	No	12/18	2,639/4,942	7,581
B-2	Lago Vista Upgrade	Upsizing of pipes along Lago Vista to relieve capacity issues	Relieve Lago Vista	11	Buildout	Upgrade	No	15/18	1697	1697

Note: Prefixes to project number stand for Existing (E), Planned (P), and Build-out (B).

*These improvement projects are dependent upon the Requa Interceptor being built and in service.

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Table 7-2
Requa Interceptor Summary

Phase[1]	Down MH	Up MH	Size (in)	Length (ft.)	Slope	Q	V	Max Pipe Depth (ft.)
1A	1	4	30	2,062	0.0046	5.29	4.92	20
	4	5	30	1,342	0.0036	5.29	4.51	11
	5	1b	30	1,626	0.002	3.98	3.37	11
1B	1b	2b	30	1,373	0.002	3.98	3.37	12.5
	2b	3b	30	2,663	0.002	3.81	3.33	17
	3b	4b	30	932	0.0024	3.49	3.48	17
	4b	5b	30	1,747	0.0024	3.41	3.45	22
	5b	6b	24	1,326	0.0096	2.13	5.06	22
	6b	7b	24	1,069	0.002	2.1	2.86	12
	7b	8b	24	1,356	0.0021	1.98	2.88	13
	8b	9b	24	501	0.002	1.4	2.57	14
	9b	10b	24	2,169	0.002	1.34	2.53	19
	10b	15b	24	2,740	-	-	-	19

1: Phasing based on MSA Consultants study; both phases are recommended for the current capacity issues in the system.
Source: MSA Consultants Inc. *Engineer's Report: Requa Avenue Interceptor Alignment Review* November, 2009.

According to modeled results, this interceptor alone in the existing system would transport roughly 1,010 gpm of flow during a typical weekday and about 1,120 gpm during a typical weekend day. The Requa Interceptor will also act as a trunkline for several other interceptors in the system. The Requa interceptor would ultimately convey 1,215 gpm of flow during a typical weekday and 1,245 gpm during a typical weekend day with existing modeled flows.

Avenida Esmeralda Interceptor

The Avenida Esmeralda Interceptor consists of two sections of 15-inch pipe beginning south of the intersection of 47th Avenue and Highway 111, to the pipe at Avenida Esmeralda and Calle Diamante. The diverted flow would then travel south along Calle Diamante through existing pipes to the trunkline that runs along Avenue 48. This pipe would divert flows from the impacted trunkline running under Highway 111/ Dr. Carreon Blvd. This interceptor would serve as a temporary relief to the trunkline until such time that the full Requa Interceptor could be built. Once the Requa Interceptor is built, the Avenida Esmeralda Interceptor would add to the operational flexibility of the system and would help accommodate later improvements or changes to the system. In order to divert flows to this interceptor, bulkheading would need to occur at manhole 11E-M160 to stop flow from travelling to the 15-inch pipe 11E-M160_10E-M150, south of the intersection of 47th Avenue and Highway 111. **Table 7-3** gives a summary of the infrastructure required for this interceptor. **Figure 7-2** shows the location of this recommended improvement.

Table 7-3
Avenida Esmeralda Interceptor Summary

Start Node	Stop Node	Length (ft.)	Size (in)	Pipe Depth (ft.)
11E-M160	New Manhole	220	15	17
New Manhole	New Manhole	149[1]	15	17

[1]: Length is based off of distance to cleanout manhole (11E-C005) currently located north of Avenida Esmeralda which will be replaced with a new, serviceable manhole..

Figure 7-2
Avenida Esmeralda Interceptor Location

Monroe Interceptor Operational Change

The Monroe Interceptor is a line that was built in early 2007 from Fred Waring Dr., between Hoover Ave and Monroe St, south along Monroe to Requa Ave. This pipe is 18-inch in diameter and would divert flow from the north end of the system to the built Requa Interceptor. According to VSD, this interceptor is already built, but has not had flows diverted to it. As part of this CIP, it is recommended that this interceptor be brought online. Once online, this interceptor is expected to divert 273 GPM during a peak weekday and 288 GPM during a peak weekend day, based on modeled existing flows. As part of this interceptor, the following pipes along Monroe St. and along Fred Waring Dr. would be bulkheaded in order to divert flow into the Monroe interceptor:

- 8F-M240_8F-M245
- 8F-M235_8F-M240
- 8F-M230_8F-M235

- 7F-M125_7F-M130
- 6E-M250_6F-M325
- 6F-M260_6F-M265
- 7F-M080_7F-M085

This improvement is dependent upon the Requa Interceptor being built and in service.

Clinton Street Operational Change

The Clinton Street operational change will allow for flows that are currently sent south along Clinton Street to Highway 111 to be diverted north to Avenue 46, thereby relieving flow in the Dr. Carreon Blvd. line. Currently, there is bulkheading at manhole 9E-M164 that blocks flow from travelling through 9E-M164_9E-M163 and sends this flow south. As part of this operational change, that bulkheading would be removed, and instead bulkheading would occur at 9E-M290 (stopping flows from entering 9E-M290_10E-M155), 9E-M280 (stopping flows from entering 9E-M280_9E-M230) and at 9E-M285 (stopping flow from entering 9E-M280_9E-M285). This would send all flow from Clinton Street, between 46th Avenue and Highway 111, to the Requa Interceptor. This operational change would require no additional infrastructure or upsizing of current infrastructure, and will be able to relieve a portion of flows along Dr. Carreon Blvd. for all three planning scenarios. This improvement is dependent upon the Requa Interceptor being built and in service.

Shields Interceptor

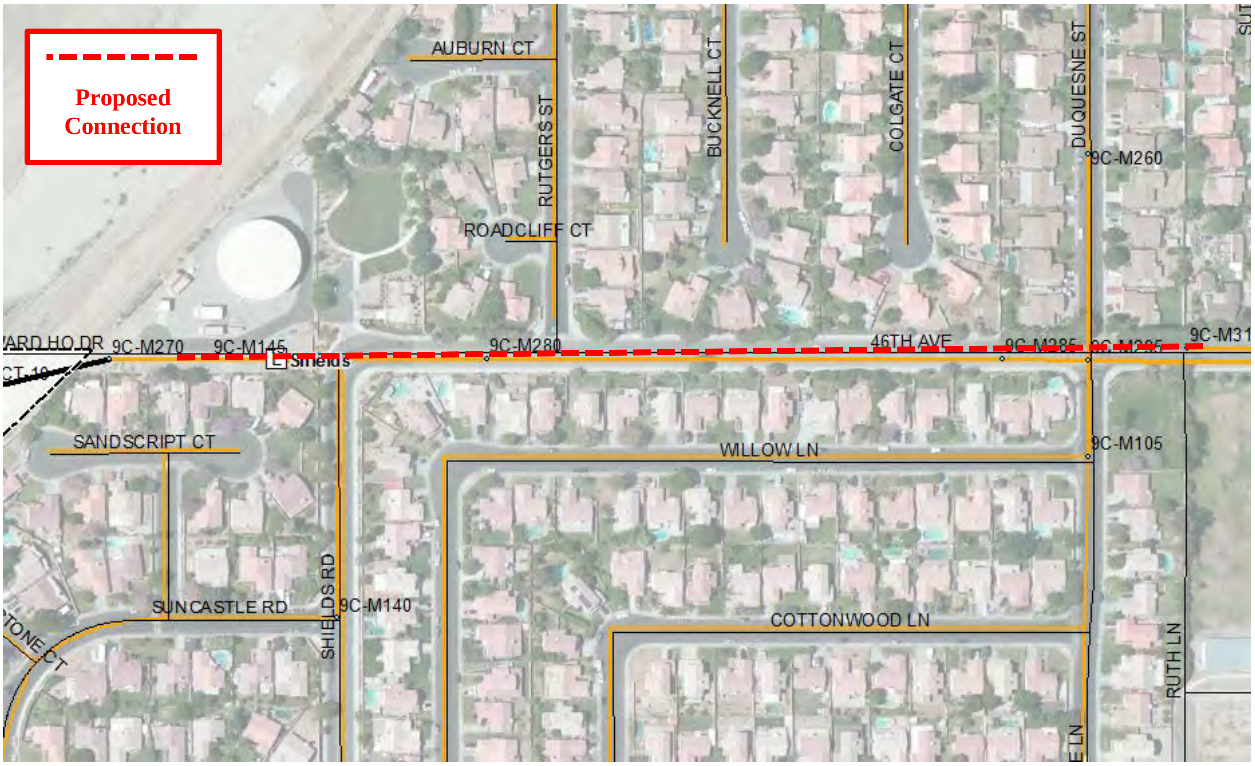
One of the possible benefits of the Requa Interceptor is that the flow taken off of the line running under Avenue 46/Highway 111 creates capacity for an interceptor to be built. The Shields interceptor would take flow that currently goes into the Shields Pump Station and send it east along Avenue 46 by gravity. This will allow VSD to take the Shields pump station offline, which will also relieve Dr. Carreon Blvd. as current flows from the pump station are sent south towards that line. The new pipes will be 10 inches in diameter which the model shows will handle anticipated flows in this line. Though some of the upstream pipes are 12 inches in diameter, the constriction should not cause any hydraulic problems and by making the new pipes 10-inches, there is no need for upsizing of any downstream pipes.

This interceptor was also reviewed in the MSA Consultants, Inc. engineering report (2009) and was modeled according to the elevations and lengths contained in that report. **Table 7-4** gives a summary of the proposed interceptor. **Figure 7-3** shows the location of this recommended improvement. This improvement is dependent upon the Requa Interceptor being built and in service.

Table 7-4
Shields Interceptor Summary

New Pipes				
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**
9C-M145	New Manhole	1277	10	13
New Manhole	9C-M315	150	10	13

Figure 7-3
Shields Interceptor Location



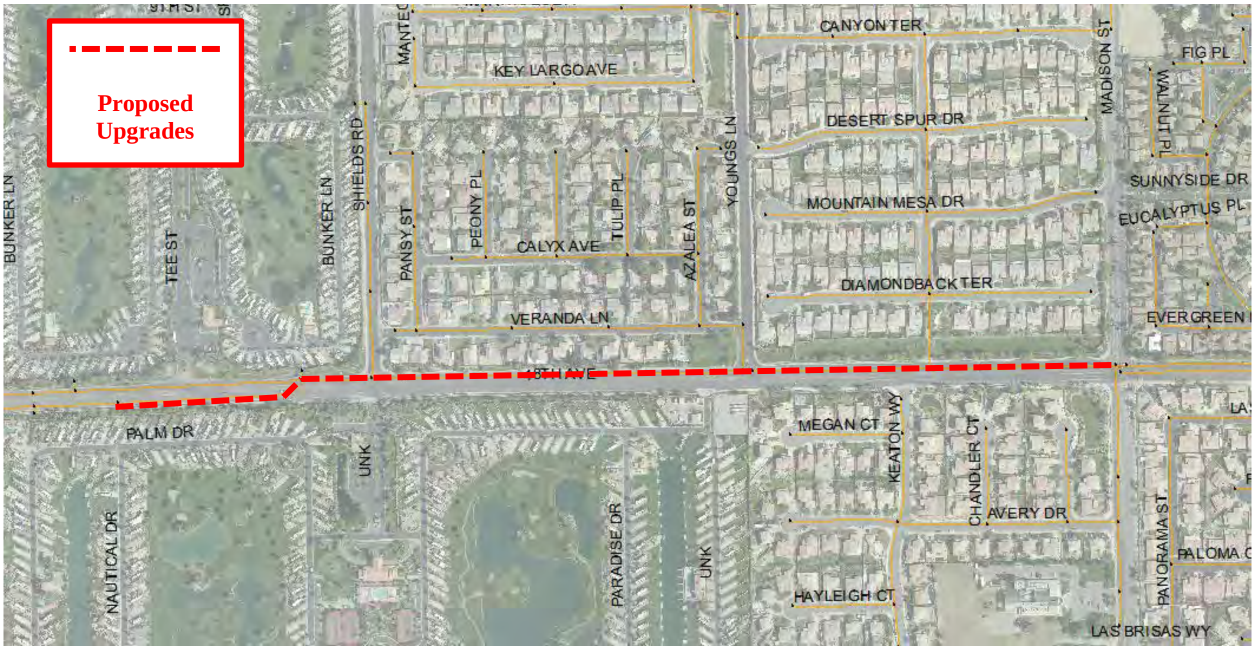
7.1.2 Avenue 48 West Upgrades

In order to address current capacity issues and projected issues along Avenue 48 in the west end of the system, roughly 3,545 feet of existing piping is recommended to be upgraded. The existing pipe is 10 inches in diameter from manhole 12C-M180 to manhole 12D-M155 on Avenue 48 and Madison St. For all upgrades to existing pipeline in this Master Plan, it is assumed that new pipeline will be added parallel to the existing infrastructure which will be abandoned in place. However, the exact method of replacement and upgrade will need to be evaluated on a case by case basis. The current capacity issues shown in the model should be confirmed with flow monitoring data before any final sizing is done for this improvement. The recommended sizes based on the current model are summarized in **Table 7-5. Figure 7-4** shows the location of the recommended improvements.

Table 7-5
Avenue 48 West Upgrades Summary

Pipe to be upgraded	Existing Size (in)	Recommended Size (in)	Length (ft.)	Pipe Depth (ft.)
12C-M180_12C-M185	10	15	601	14
12C-M185_12C-M090	10	15	70	14
12C-M090_12C-M095	10	18	248	14
12C-M095_12C-M100	10	18	553	14
12C-M100_12C-M190	10	18	643	14
12C-M190_12C-M105	10	18	116	14
12C-M105_12C-M106	10	18	33	14
12C-M106_12D-M150	10	18	626	14
12D-M150_12D-M340	10	18	180	14
12D-M340_12D-M155	10	18	476	14

Figure 7-4
Avenue 48 West Upgrades Location



7.2 RECOMMENDED IMPROVEMENTS FOR 5-YEAR PLANNING SCENARIO

In addition to the improvements listed above, additional improvements are recommended in order to handle anticipated flows for a build-out scenario and 5-yr planning horizon. These improvements are suggested in addition to those listed above and no project should be considered an alternative to any project above unless specifically described as such.

7.2.1 Arabia Interceptor/Jackson Street Operational Change

Although the Requa Interceptor is anticipated to take a significant amount of flow off of Dr. Carreon Blvd., according to the model, Dr. Carreon Blvd will still be above design capacity with the Requa Interceptor fully built. This is in part due to the fact that the Requa Interceptor is designed to connect to the trunkline at Highway 111 and Madison Street, in the west side of the system. There is a significant amount of flow that is added to the trunkline to the east of this connection and in order to utilize the Requa Interceptor to the fullest, and relieve enough flow from Dr. Carreon Blvd., more flow must be diverted. With this in mind, the Arabia Street Interceptor and Jackson Street Operational Change will allow more flow to be sent north to Highway 111 and away from Dr. Carreon Blvd.

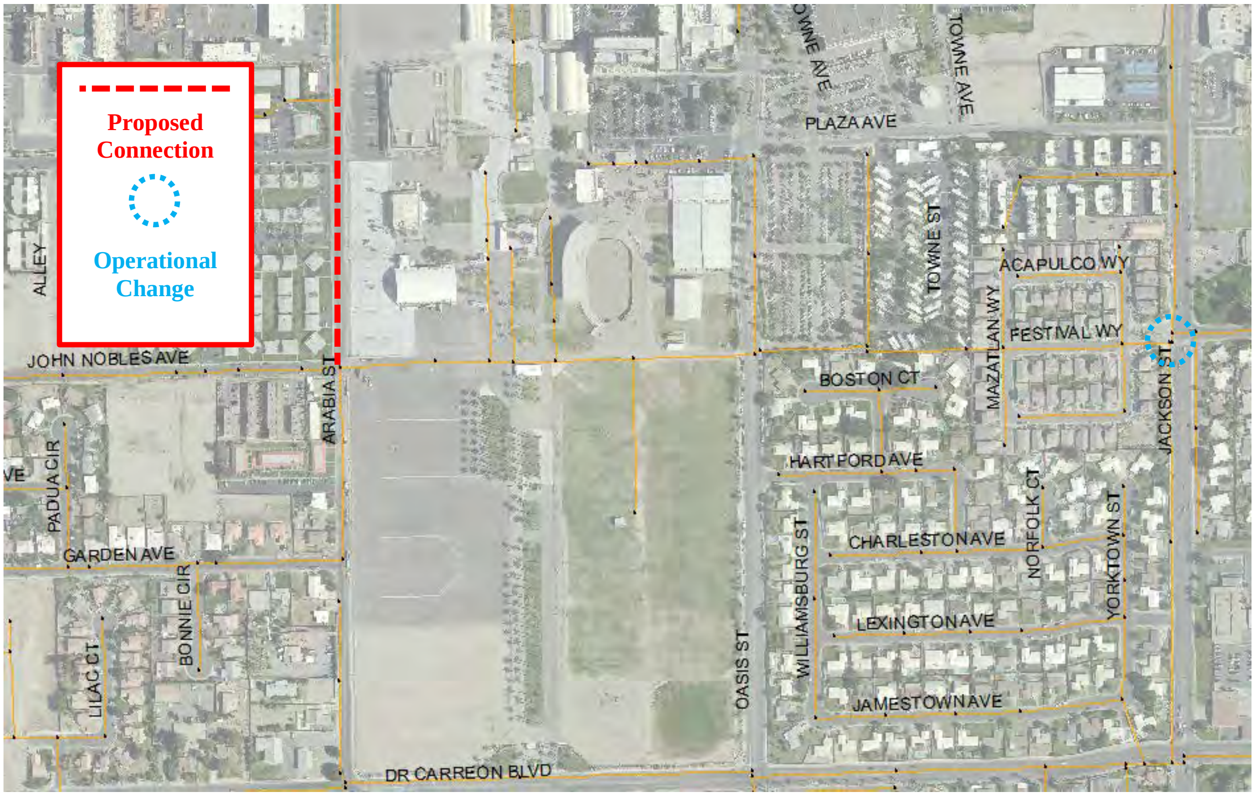
The Arabia Interceptor would consist of an eight inch line from manhole 10G-M195 on John Nobles Ave. and Arabia St. to manhole 9G-M215 on Arabia St. north of Plaza Ave. The new pipe would extend roughly 850 ft. In addition to the new line, bulkheading would need to occur in manhole 10G-M195 to prevent flow from entering the 8 inch line running east through the county fairgrounds. In conjunction with this diversion, an operational change directly to the east will keep additional flow from entering Dr. Carreon Blvd.

Currently, bulkheading exists at manhole 10H-M220, blocking flow from entering 10H-M220_10H-M230 and sending it south to 10H-M220_10H-M225 and eventually to the Dr. Carreon trunkline. For this CIP, it is recommended that the bulkheading at this manhole be reversed in order to send the flow through 10H-M220_10H-M230 and eventually north to Highway 111. A summary of the new pipe is shown in **Table 7-6** below. **Figure 7-5** shows the location of this recommended improvement.

Table 7-6
Arabia Interceptor/Jackson Street Operational Change Summary

New Pipes				
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**
10G-M195	9G-M215	850	8	8

Figure 7-5
Arabia Interceptor/Jackson Street Operational Change Location



7.2.2 Highway 111 Interceptor

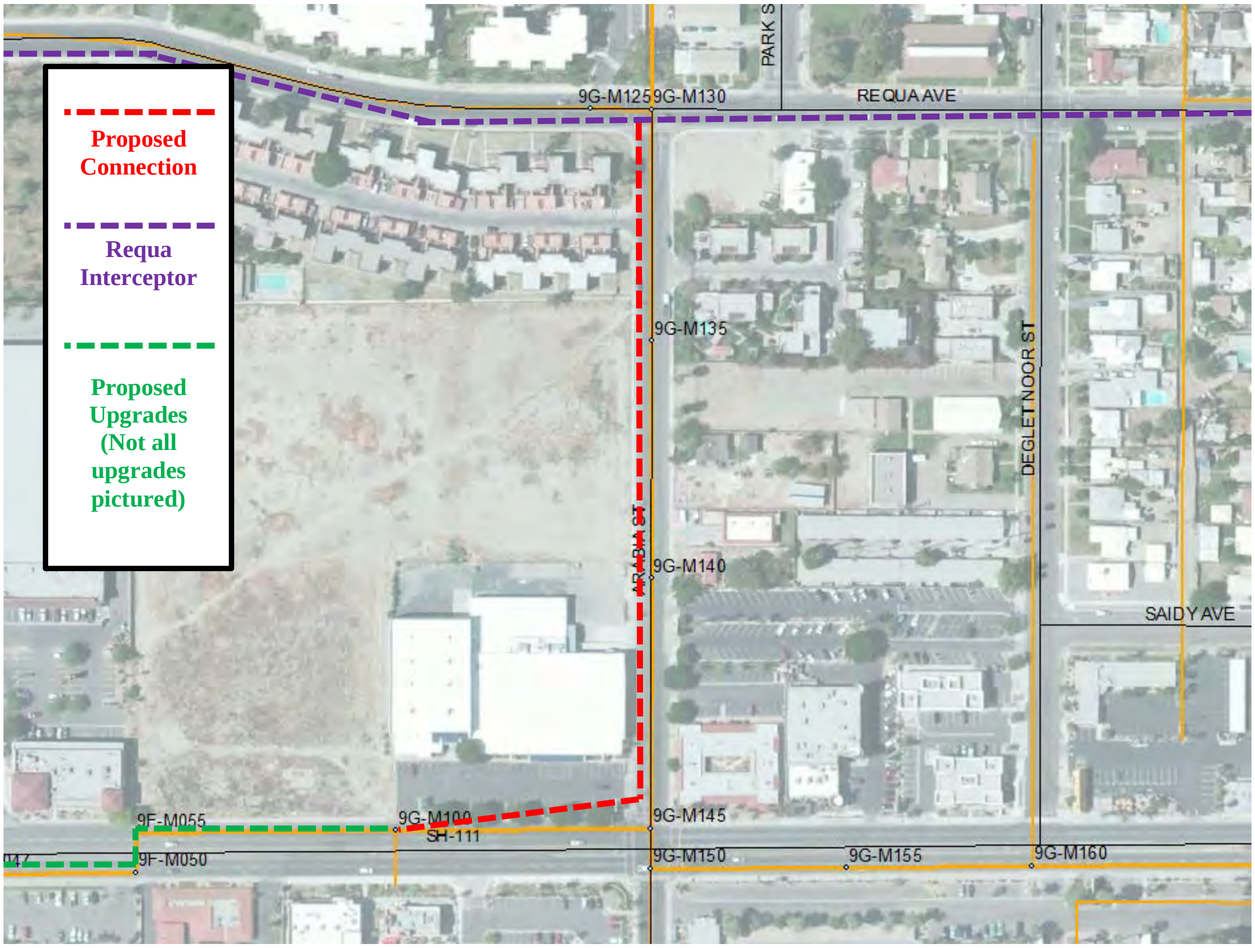
An interceptor at Highway 111 would allow for reduced flows on Highway 111 in the east part of the system, which will help that line accept flow from the south that will further alleviate the Dr. Carreon trunkline (see Jackson Interceptor description above). This interceptor would also allow capacity for the jail expansion that is anticipated to occur at the intersection of Highway 111 and Oasis St.

The location of the new interceptor will be at manhole 9G-M100 and will connect directly to the Requa Interceptor. This manhole was selected because downstream of 9G-M100, there is a significant drop in elevation in the pipes. The invert elevations to the west are lower than the invert elevations for neighboring manholes in the Requa Interceptor. Therefore, this is the most downstream location that a connection between the Highway 111 pipes and the Requa Interceptor can be made that would not require a pump station to raise the hydraulic grade line. In addition to the interceptor that would be built, upsizing of some of the immediately upstream pipes would be necessary in order to relieve capacity deficiencies already present in the pipes. **Table 7-7** below summarizes the recommended improvements. **Figure 7-6** shows the location of this recommended improvement.

Table 7-7
Highway 111 Interceptor Summary

New Pipes				
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**
9G-M100	REQUA MH	1,229	12	17
Pipes to be upsized				
Pipe to be upgraded	**Existing Size (in)**	**Recommended Size (in)**	**Length (ft.)**	**Pipe Depth (ft.)**
9F-M035_9F-M305	8	12	296	12
9F-M305_9F-M040	8	12	160	12
9F-M040_9F-M045	8	12	454	12
9F-M045_9F-M047	8	12	218	12
9F-M047_9F-M050	8	12	231	12
9F-M050_9F-M055	8	12	52	12
9F-M055_9G-M100	8	12	340	12

Figure 7-6
Highway 111 Interceptor Location



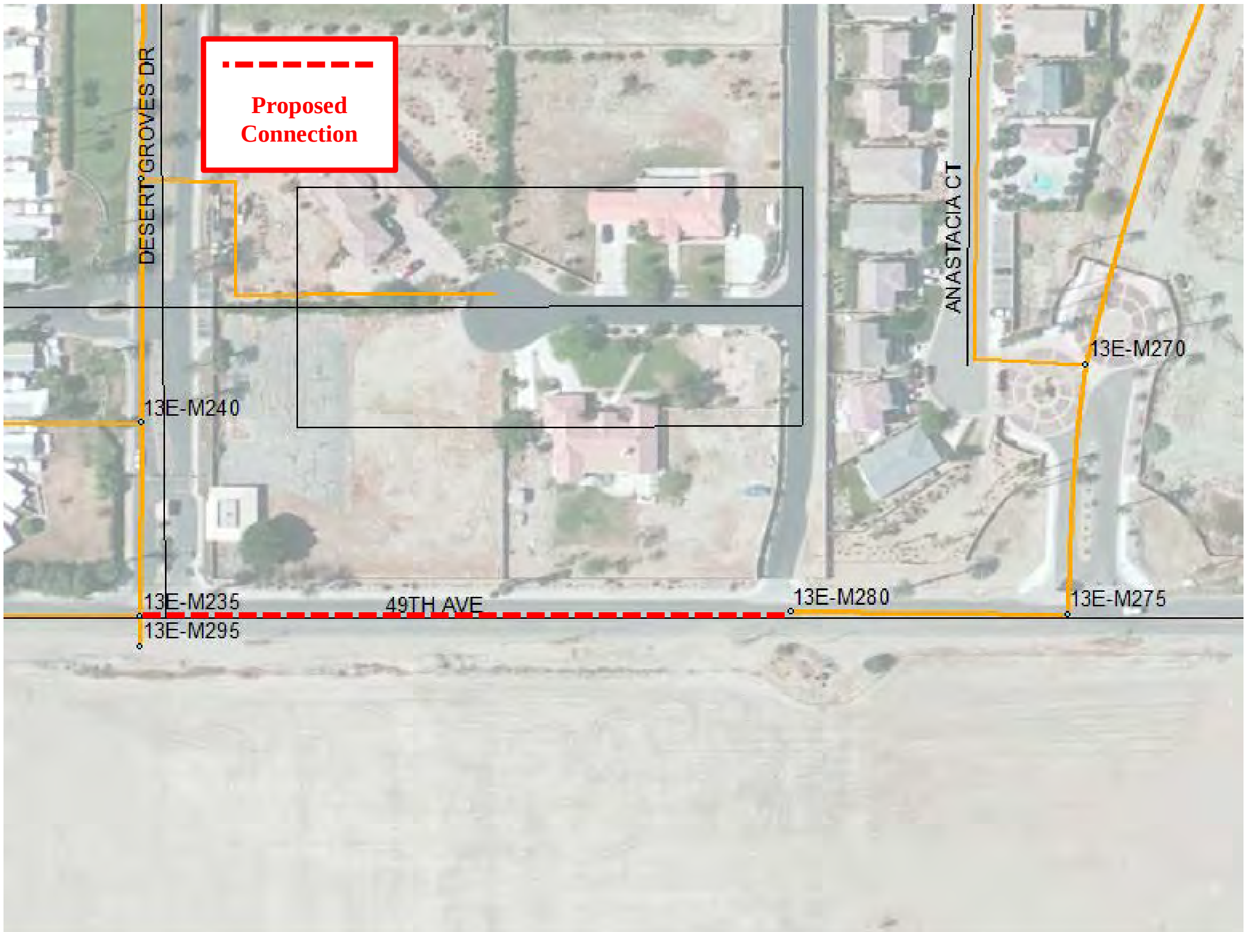
7.2.3 Avenue 49 Interceptor

Capacity deficiencies in the pipes along Avenue 49 and Desert Grove Drive require construction of an interceptor to convey flows to Avenue 48. The previous VSD Master Plan (Dudek and Assoc., 2003) called for a 15-inch pipe along Avenue 49 to Monroe St., then north to Avenue 48. As an alternative to this alignment, a line from Avenue 48 to Avenue 49 along Madison St. was also proposed. For this CIP, the interceptor from manhole 13E-M235 to manhole 13E-M280 is the preferred alternative as it requires the least amount of new infrastructure and should be sufficient to relieve capacity issues along Desert Grove Drive. In addition, no bulkheading will occur at manhole 13E-M235 so flow can travel east or north along Desert Grove Dr., thereby allowing for greater relief upstream. This improvement is dependent upon the Requa Interceptor being built and in service. **Table 7-8** summarizes this interceptor. **Figure 7-7** shows the location of this recommended improvement.

Table 7-8
Avenue 49 Interceptor Summary

Start Node	Stop Node	Length (ft.)	Size (in)	Pipe Depth (ft.)
13E-M235	13E-M280	565	12	12

Figure 7-7
Avenue 49 Interceptor Location



7.2.4 Industrial Pl./Market Drive Interceptor

In order to relieve capacity deficiency in the north central area of the VSD service area, specifically on Sola St. and Palo Verde St., a downstream interceptor is recommended. Assuming that the operational change of bringing the Monroe Interceptor online, as previously described in this section, is implemented, excess capacity on the pipe along Market St. can be utilized in order to relieve other areas of the system. In order to utilize this capacity, a 12-inch pipe from manhole 6F-M215 to manhole 6F-M340 is recommended to divert flows to Market St. Improvement for the Industrial Pl./Market Interceptor is summarized in **Table 7-9**. **Figure 7-8** shows the location of this recommended improvement.

Table 7-9
Industrial Pl./Market Drive Interceptor Summary

Start Node	Stop Node	Length (ft.)	Size (in)	Pipe Depth (ft.)
6F-M215	6F-M340[1]	967	12	9

1: 6F-M340 was used to make the downstream connection for the new pipe as the invert elevation of 6F-M290 was too high to maintain proper slope

Figure 7-8
Industrial Pl./Market Interceptor Location

7.3 RECOMMENDED IMPROVEMENTS FOR BUILD-OUT SCENARIO

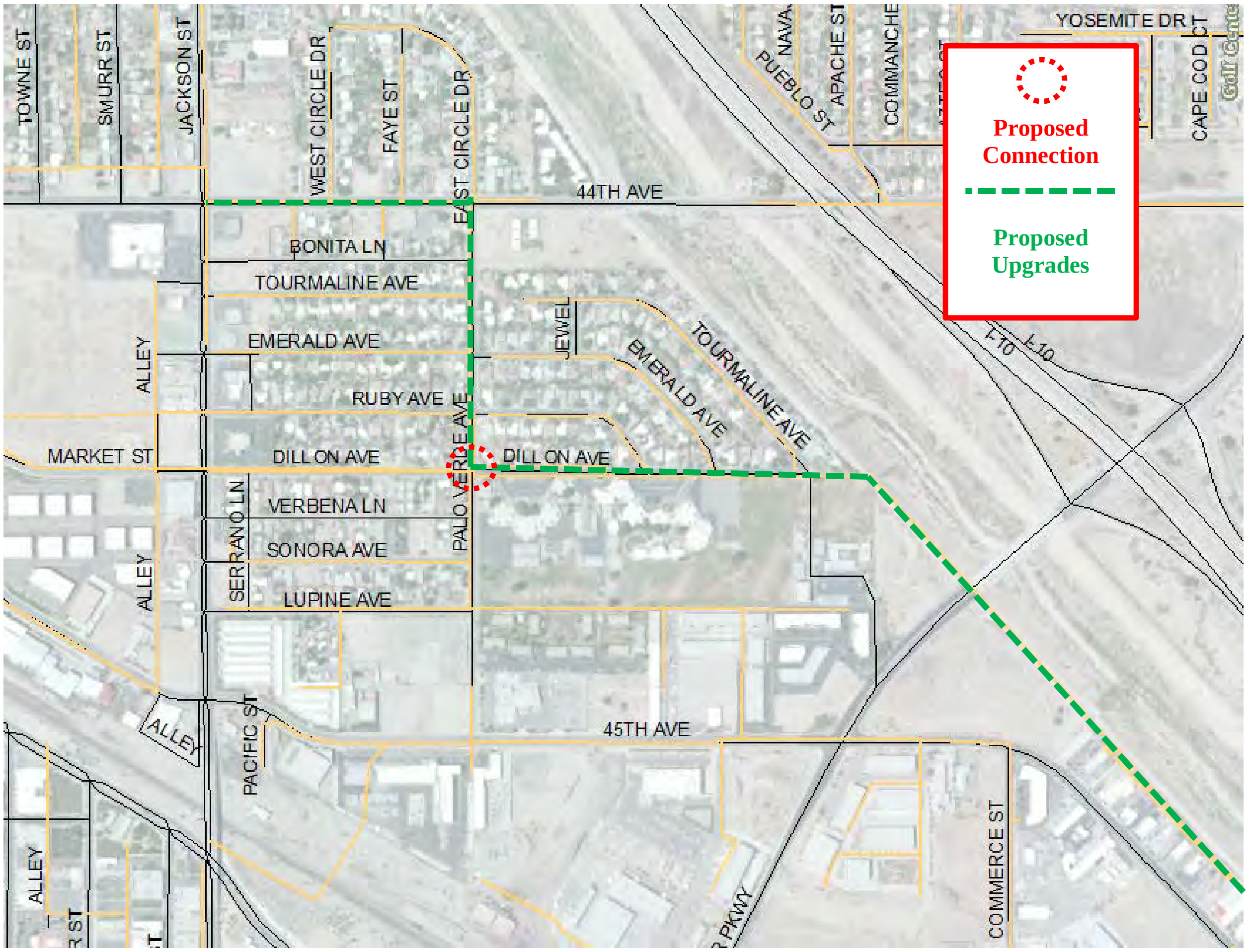
7.3.1 Avenue 44/Palo Verde Interceptor and Upgrade

Due to capacity issues along Avenue 44 and Palo Verde St., upsizing of existing pipes will be required in order to accommodate build-out system flows. Based on flows for the build-out system, a diversion is recommended in order to take advantage of the decreased flows along Dillon Avenue that are anticipated from previous recommended improvements. **Table 7-10** summarizes additions and improvements sized to the ultimate build-out system. **Figure 7-9** shows the location of this recommended improvement.

Table 7-10
Avenue 44/Palo Verde Interceptor and Upgrade Summary

New Pipes				
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**
7H-M185	7H-M305	25	12	9
Pipes to be upsized				
Pipe to be upgraded	**Existing Size (in)**	**Recommended Size (in)**	**Length (ft.)**	**Pipe Depth (ft.)**
Reach 1				
7H-M305_7H-M307	15	18	258	9
7H-M307_7H-M310	15	18	383	10
7H-M310_7H-M315	15	18	222	10
7H-M315_7I-M035	15	18	315	10
7I-M035_7I-M040	15	18	111	11
7I-M040_7I-M045	15	18	273	11
7I-M045_7I-M050	15	18	372	9
7I-M050_7I-M055	15	18	504	13
7I-M055_7I-M060	15	18	489	20
7I-M060_8I-M105	15	18	475	20
8I-M105_8I-M110	15	18	239	20
8I-M110_8I-M115	15	18	598	14
8I-M115_8J-M055	15	18	703	14
Reach 2				
6H-M115_6H-M120	10	12	294	9
6H-M120_6H-M125	10	12	130	9
6H-M125_6H-M130	10	12	181	8
6H-M130_6H-M135	10	12	260	8
6H-M135_6H-M140	10	12	91	8
6H-M140_6H-M145	10	12	332	8
6H-M145_7H-M274	10	12	290	8
7H-M274_7H-M275	10	12	165	9
7H-M275_7H-M280	10	12	285	9
7H-M280_7H-M285	10	12	155	8
7H-M285_7H-M290	10	12	140	8
7H-M290_7H-M185	10	12	291	9

Figure 7-9
Avenue 44/Palo Verde Interceptor Location



7.3.2 Lago Vista Upgrade

Due to capacity deficiencies on Lago Vista, it will be necessary to upgrade the 12-inch pipe that connects to the 18-inch pipe running along Avenue 44. The upgrades to this line are sized according to buildout conditions, though deficiencies are present according to modeled existing conditions. The upgrade specific to Lago Vista are described in **Table 7-11**. **Figure 7-10** shows the location of this recommended improvement.

Table 7-11
Lago Vista Upgrade Summary

Pipe to be upgraded	Existing Size (in)	Recommended Size (in)	Length (ft.)	Pipe Depth (ft.)
6K-M055_6K-M050	12	15	539	19
6K-M050_6K-M045	12	18	325	19
6K-M045_6K-M040	12	18	382	15
6K-M040_6K-M010	12	18	452	20

Figure 7-10
Lago Vista Upgrade Location

Section 8
Capital Improvement Program

This section presents a summary of Valley Sanitary District's (VSD's) capital improvement program (CIP) and planning level cost estimates for the recommended projects.

8.1 COST ESTIMATING BASIS

The CIP project cost estimates in this section are planning level cost estimates. The appropriate use of this estimate is for planning and may not be an actual representation of design to construction activities and costs. This estimate has an expected accuracy range of -20 percent to +100 percent. This range depends on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Accuracy could exceed this range in unusual circumstances. The estimate was prepared using a combination of parametric estimating factors and local experience in delivering projects similar to those that constitute VSD's CIP.

Costs were based on MWH's experience with costs of similar projects in the Coachella Valley. The original costs were developed in March 2010. In order to estimate change in costs from March 2010 to June 2013, price indices from Engineering News Record (ENR) were used to create and adjustment factor that was applied to all costs. The ENR Construction Cost Index for March 2010 was 8671, while the same index has a value of 9542 for June 2013. Therefore, an adjustment factor of 1.1 (9542 divided by 8671) will be used to adjust historical price estimates, and all values are then rounded up to the nearest $5 as a conservative estimate. **Table 8-1** shows a summary of the prices used for this cost estimate. All improvements are assumed to take place under asphalt road, and operations and maintenance costs are not included in this estimate. A summary of costs for all estimates for this project can be found at the end of this section.

Due to fluctuations in the market, uncertainty associated with the previous estimates and other factors, this estimate should only be used for planning purposes and a more rigorous estimate is recommended for any further activity. Additionally, manhole costs were not included in this planning level estimate due to the variability in each manhole requirement. For these projects, manhole costs will need to be addressed at a later stage of development. Finally, the costs associated with operational changes are not estimated as part of this report.

Table 8-1
Price Estimating Basis

Pipeline Description	Diameter (in)	Pipe Depth (ft.)	Road Condition	March 2010 Cost ($/lf)	ENR Adjustment Factor	June 2013 Cost ($/lf)
8-inch Gravity	8	6	Asphalt	104	1.10	115
8-inch Gravity	8	8	Asphalt	105	1.10	115
8-inch Gravity	8	12	Asphalt	120	1.10	135
8-inch Gravity	8	16	Asphalt	136	1.10	150
8-inch Gravity	8	20	Asphalt	158	1.10	175
8-inch Gravity	8	23	Asphalt	181	1.10	200
10-inch Gravity	10	6	Asphalt	111	1.10	125
10-inch Gravity	10	8	Asphalt	113	1.10	125
10-inch Gravity	10	12	Asphalt	126	1.10	140
10-inch Gravity	10	16	Asphalt	142	1.10	160
10-inch Gravity	10	20	Asphalt	165	1.10	185
10-inch Gravity	10	27	Asphalt	260	1.10	290
12-inch Gravity	12	6	Asphalt	140	1.10	155
12-inch Gravity	12	8	Asphalt	143	1.10	160
12-inch Gravity	12	12	Asphalt	157	1.10	175
12-inch Gravity	12	16	Asphalt	175	1.10	195
12-inch Gravity	12	20	Asphalt	199	1.10	220
15-inch Gravity	15	8	Asphalt	163	1.10	180
15-inch Gravity	15	12	Asphalt	178	1.10	200
15-inch Gravity	15	16	Asphalt	196	1.10	220
15-inch Gravity	15	20	Asphalt	221	1.10	245
18-inch Gravity	18	8	Asphalt	178	1.10	200
18-inch Gravity	18	12	Asphalt	194	1.10	215
18-inch Gravity	18	16	Asphalt	212	1.10	235
18-inch Gravity	18	20	Asphalt	236	1.10	260
24-inch Gravity	24	8	Asphalt	226	1.10	250
24-inch Gravity	24	12	Asphalt	242	1.10	270
24-inch Gravity	24	16	Asphalt	261	1.10	290
24-inch Gravity	24	20	Asphalt	286	1.10	315
30-inch Gravity	30	6	Asphalt	309	1.10	340
30-inch Gravity	30	8	Asphalt	319	1.10	355
30-inch Gravity	30	12	Asphalt	341	1.10	375
30-inch Gravity	30	16	Asphalt	368	1.10	405
36-inch Gravity	36	8	Asphalt	391	1.10	435
36-inch Gravity	36	12	Asphalt	414	1.10	460

8.2 CAPITAL IMPROVEMENT PROJECTS

8.2.1 Recommended Improvements for Existing System

Requa Interceptor

Costs for the Requa Interceptor were based off of the lengths provided in the 2009 MSA Consultants, Inc. report for the Requa Interceptor (**Appendix H**). This information, in conjunction with the costs in **Table 8-1,** forms the basis for this cost estimate. **Table 8-2** summarizes the anticipated costs for the Requa Interceptor.

Table 8-2
Requa Interceptor Costs

Phase	Down MH	Up MH	Size (in)	Length (ft.)	Max Pipe Depth (ft.)	Unit Cost ($/lf)	Total Construction Cost ($)
1A	1	4	30	2,062	20	405	835,200
	4	5	30	1,342	11	355	476,500
	5	1b	30	1,626	11	355	577,300
1B	1b	2b	30	1,373	13	375	514,900
	2b	3b	30	2,663	17	405	1,078,600
	3b	4b	30	932	17	405	377,500
	4b	5b	30	1,747	22	405	707,600
	5b	6b	24	1,326	22	315	417,700
	6b	7b	24	1,069	12	270	288,700
	7b	8b	24	1,356	13	290	393,300
	8b	9b	24	501	14	290	145,300
	9b	10b	24	2,169	19	290	629,100
	10b	15b	24	2,740	19	290	794,600
Total Pipe Cost (Rounded)							**7,236,300**

In addition to the pipe costs for the project, the Interceptor will require 65 manholes as stated in the 2009 MSA Consultants, Inc. report. The total construction cost for the pipes, without contingency, construction management, or engineering and administration, is estimated to be $7,236,300. Ancillary costs are estimated at the end of this section.

Avenida Esmeralda Interceptor

The Avenida Esmeralda Interceptor will serve as a temporary relief to the Dr. Carreon Blvd. corridor, and will be able to add operational flexibility to the system. As this improvement only includes one new pipe, costs are relatively low compared to other improvements in the system**.** **Table 8-3** presents estimated costs associated with the Avenida Esmeralda Interceptor.

Table 8-3
Avenida Esmeralda Interceptor Costs

Start Node	Stop Node	Length (ft.)	Size (in)	Pipe Depth (ft.)	Unit Cost ($/lf)	Total Construction Cost ($)
11E-M160	New[1] Manhole	220	15	17	245	53,900
New Manhole	New Manhole	149	15	17	245	36,500
Total						**90,400**

Monroe Interceptor Operational Change

Because this improvement project is an operational change and all infrastructure is present, there is no cost estimate for this improvement. However, there is anticipated to be personnel and possibly some equipment costs associated with creating the bulkheading necessary to enact this change. It is recommended that VSD conduct an estimate of probable time and cost before embarking on this improvement. Estimated costs for this operational change are not included in this report.

Clinton Street Operational Change

Similar to the Monroe Interceptor, this recommended improvement does not require new or upgraded infrastructure. But, as before, there will likely be personnel and equipment costs associated with the bulkheading required for this operational change. It is recommended that VSD also conduct an estimate of probable time and cost for the Clinton St. operational change before moving forward. Estimated costs for this operational change are not included in this report.

Shields Interceptor

The Shields Interceptor was a project that was included in the 2009 MSA Consultants report on the Requa Interceptor alignment as the interceptor would allow the capacity to take Shields Pump Station offline and send flows to the east. For this Master Plan, the projects are evaluated separately. **Table 8-4** presents the costs associated with the Shields Interceptor.

Table 8-4
Shields Interceptor Costs

New Pipes						
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
9C-M145	New Manhole	1277	12	13	195	249,000
New Manhole	9D-M195	150	12	13	195	29,300
Total						**278,300**

Avenue 48 West Upgrades

The Avenue 48 West Upgrades will serve to relieve the operational issues beginning at Avenue 48 and Madison St. Costs in this table are estimated using new pipe costs as a conservative estimate, though actual method of upgrade will be decided on a case by case basis**. Table 8-5** presents estimated costs associated with the Avenue 48 West Upgrades.

Table 8-5
Avenue 48 West Upgrades Costs

Pipe to be upgraded	**Existing Size (in)**	**Proposed Size (in)**	**Length (ft.)**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
12C-M180_12C-M185	10	15	601	14	220	132,100
12C-M185_12C-M090	10	15	70	14	220	15,300
12C-M090_12C-M095	10	18	248	14	235	58,200
12C-M095_12C-M100	10	18	553	14	235	130,000
12C-M100_12C-M190	10	18	643	14	235	151,000
12C-M190_12C-M105	10	18	116	14	235	27,200
12C-M105_12C-M106	10	18	33	14	235	7,800
12C-M106_12D-M150	10	18	626	14	235	147,200
12D-M150_12D-M340	10	18	180	14	235	42,300
12D-M340_12D-M155	10	18	476	14	235	112,000
Total						**823,100**

8.2.2 Recommended Improvements for 5-Year Planning Scenario

Arabia Interceptor/Jackson Street Operational Change

The Arabia Interceptor/Jackson Street Operational Change consists of the bulkheading of manhole 10H-M220 and a new pipeline along Arabia St. Because of this location's proximity to Dr. Carreon Blvd., traffic may be an issue and lead to higher than anticipated costs. **Table 8-6** presents the estimated costs for the Arabia Interceptor. Costs associated with the operational change on Jackson St. are not estimated.

Table 8-6
Arabia Interceptor/Jackson Street Operational Change Costs

New Pipes						
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
10G-M195	9G-M215	850	8	8	115	101,200

Highway 111 Interceptor

The Highway 111 Interceptor is designed to send flows from Highway 111 north to the Requa Interceptor in order to free up capacity so the pipes west along Highway 111 can accept flows from the Jackson St. Interceptor and other improvements such as a possible jail expansion on Highway 111. The alignment of this interceptor would run along Highway 111, north along Arabia St. to Requa Ave. Traffic costs must be considered for this improvement due to impacts to Highway 111 during construction. **Table 8-7** presents estimated costs for the Highway 111 interceptor.

Table 8-7
Highway 111 Interceptor Costs

New Pipes						
Start Node	**Stop Node**	**Length (ft.)**	**Size (in)**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
9G-M100	MH-28 (Requa Interceptor Manhole)	1,229	12	17	220	270,400
Pipes to be upsized						
Pipe to be upgraded	**Existing Size (in)**	**Proposed Size (in)**	**Length (ft.)**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
9F-M047_9F-M050	8	12	231	12	175	40,400
9F-M050_9F-M055	8	12	52	12	175	9,100
9F-M055_9G-M100	8	12	340	12	175	59,500
9F-M035_9F-M305	8	12	296	12	175	51,800
9F-M045_9F-M047	8	12	218	12	175	38,200
9F-M040_9F-M045	8	12	454	12	175	79,500
9F-M305_9F-M040	8	12	160	12	175	28,000
Total						**576,900**

Avenue 49 Interceptor

The Avenue 49 Interceptor will transfer flow from the impacted 10-inch line running under Desert Grove Dr. in the south portion of VSD. The recommended pipe would run along Avenue 49, in a lightly developed portion of the system. Due to the length of pipe required and the occupancy in the area, there are not expected to be a large amount of ancillary costs associated with this project. **Table 8-8** presents estimated costs for Avenue 49 interceptor.

Table 8-8
Avenue 49 Interceptor Costs

Start Node	Stop Node	Length	Diameter	Pipe Depth (ft.)	Unit Cost ($/lf)	Total Construction Cost ($)
13E-M235	13E-M280	565	12	12	175	**98,900**

Industrial Pl./Market Interceptor

The Industrial Pl./Market Interceptor will span along Fred Waring Drive North of the 10 Freeway and south of Industrial Plaza. This area of the system is mostly industrial and is lightly developed. In addition Monroe St., which runs parallel to Fred Waring in this area, serves as the major thoroughfare. Therefore, traffic is not expected to be an issue with this improvement. **Table 8-9** presents estimated costs for the Industrial Pl./Market Interceptor.

Table 8-9
Industrial Pl./Market Interceptor Summary

Start Node	Stop Node	Length	Diameter	Pipe Depth (ft.)	Unit Cost ($/lf)	Total Construction Cost ($)
6F-M215	6F-M340	967	12	9	175	**169,300**

8.2.3 Recommended Improvements for Build-Out Scenario

Avenue 44/Palo Verde Interceptor and Upgrade

This interceptor and related upgrades will serve the north-central area of the VSD system. This upgrade and addition will directly serve residential and commercial properties along Jackson St. and Avenue 44. **Table 8-10** presents estimated costs for the Avenue 44/Palo Verde Interceptor and Upgrade.

Table 8-10
Avenue 44/Palo Verde Interceptor and Upgrade Costs

New Pipes						
Start Node	**Stop Node**	**Length**	**Diameter**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
7H-M185	7H-M305	25	12	9	175	4,400
Pipes to be upsized						
Pipe to be upgraded	**Existing Size (in)**	**Recom-mended Size (in)**	**Length (ft.)**	**Pipe Depth (ft.)**	**Unit Cost ($/lf)**	**Total Construction Cost ($)**
Reach 1						
7H-M310_7H-M315	15	18	222	10	215	47,800
7H-M305_7H-M307	15	18	258	9	215	55,500
7H-M315_7I-M035	15	18	315	10	215	67,800
7H-M307_7H-M310	15	18	383	10	215	82,400
7I-M050_7I-M055	15	18	504	13	235	118,500
7I-M035_7I-M040	15	18	111	11	215	23,900
7I-M045_7I-M050	15	18	372	9	215	80,000
7I-M055_7I-M060	15	18	489	20	260	127,200
7I-M060_8I-M105	15	18	475	20	260	123,500
7I-M040_7I-M045	15	18	273	11	215	58,700
8I-M105_8I-M110	15	18	239	20	260	62,200
8I-M110_8I-M115	15	18	598	14	235	140,600
8I-M115_8J-M055	15	18	703	14	235	165,300
Reach 2						
6H-M115_6H-M120	10	12	294	9	160	47,100
6H-M120_6H-M125	10	12	130	9	160	20,800
6H-M125_6H-M130	10	12	181	8	160	29,000
6H-M130_6H-M135	10	12	260	8	160	41,600
6H-M135_6H-M140	10	12	91	8	160	14,600
6H-M140_6H-M145	10	12	332	8	160	53,200
6H-M145_7H-M274	10	12	290	8	160	46,400
7H-M274_7H-M275	10	12	165	9	160	26,400
7H-M275_7H-M280	10	12	285	9	160	45,600
7H-M280_7H-M285	10	12	155	8	160	24,800
7H-M285_7H-M290	10	12	140	8	160	22,400
7H-M290_7H-M185	10	12	291	9	160	46,600
Total						**1,576,300**

Lago Vista Upgrade

The Lago Vista Upgrade will serve the far northwest portion of the VSD system. Lago Vista serves as the main thoroughfare for a large residential development in this area of the system. **Table 8-11** presents estimated costs for the Lago Vista Upgrade.

Table 8-11
Lago Vista Upgrade Costs

Pipe to be upgraded	Existing Size (in)	Proposed Size (in)	Length (ft.)	Pipe Depth (ft.)	Unit Cost ($/lf)	Total Construction Cost ($)
6K-M050_6K-M045	12	18	325	19	260	84,500
6K-M055_6K-M050	12	15	539	19	245	132,100
6K-M040_6K-M010	12	18	452	20	260	117,600
6K-M045_6K-M040	12	18	382	15	235	89,800
Total						**424,000**

8.3 SUMMARY

Based on the above estimates, **Table 8-12** presents a summary of all recommended projects and the associated total project costs. **Table 8-13** presents these project costs phased out for each planning phase, as well as gives a final cost estimate that includes a 30 percent contingency factor, a 15 percent engineering and administration estimate, and a 10 percent construction management factor. Based on these results, the total cost for all recommended improvements equals roughly $49,390,400, where $31,759,600 is the cost of replacement calculated in **Section 6**, and $17,630,800 is the cost calculated in this section. It is of note that these costs are a conservative estimate, and in the case of those costs associated with the replacement program outlined in **Section 6**, it has been assumed that full replacement will be necessary for all pipes, while in fact many of the pipes may be able to be rehabilitated at a lower cost. Costs for pipes that needed replacement based on both capacity concerns and conditions concerns were only counted in the **Section 8** costs above, and not counted again in the **Section 6** costs.

Table 8-12
Summary of CIP Estimated Costs

Project No.	Project Name	Total Construction (Const.) Cost ($)	30% Contingency ($)	15 % Eng. and Admin. ($)	10% Constr. Mgmt. ($)	Rounded Total Cost ($)
E-1	Requa Interceptor	7,236,300	2,170,900	1,085,400	723,600	11,216,300
E-2	Avenida Esmeralda Interceptor	90,400	27,100	13,600	9,000	140,100
E-3	Monroe Interceptor Operational Change	N/A	-	-	-	-
E-4	Clinton Street Operational Change	N/A	-	-	-	-
E-5	Shields Interceptor	278,300	83,500	41,700	27,800	431,400
E-6	Avenue 48 West Upgrade	823,100	246,900	123,500	82,300	1,275,800
P-1	Arabia Interceptor/ Jackson Street Operational Change	101,200	30,400	15,200	10,100	156,900
P-2	Highway 111 Interceptor	576,900	173,100	86,500	57,700	894,200
P-3	Avenue 49 Interceptor	98,900	29,700	14,800	9,900	153,300
P-4	Industrial Pl./Market Interceptor	169,300	50,800	25,400	16,900	262,400
B-1	Ave 44/Palo Verde Interceptor and Upgrade	1,576,300	472,900	236,400	157,600	2,443,300
B-2	Lago Vista Upgrade	424,000	127,200	63,600	42,400	657,200
Pipe Replacement Costs from Section 6		20,490,100	6,147,000	3,073,500	2,049,000	31,759,600
Total (Rounded)		**31,864,800**	**9,559,400**	**4,779,700**	**3,186,500**	**49,390,400**

Note: June 2013 dollars, costs rounded to nearest hundred.

Table 8-13
Phased CIP Costs

Scenario	Existing	5-Year	Build-Out
Estimated Construction Cost from Section 8 ($)	8,428,100	946,300	2,000,300
Estimated Construction Cost from Section 6 ($)	3,028,900	17,461,200	0
Subtotal	**11,457,000**	**18,407,500**	**2,000,300**
30% Contingency ($)	3,437,100	5,522,300	600,100
15% Engineering and Administration Costs ($)	1,718,600	2,761,100	300,000
10% Construction Management ($)	1,145,700	1,840,800	200,000
Rounded Total Cost ($)	**17,758,400**	**28,531,600**	**3,100,400**

Note: June 2013 dollars, costs rounded to nearest hundred.

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Appendix A
References

The following entities provided information that was cited or used for this Master Plan report for Valley Sanitary District (VSD). Specific documents and websites used in this report are also listed.

Boyer Engineering Company, Inc. *Sewer System Capacity Study: Avenue 42, between Madison Street and Monroe Street*. July, 2008.

Coachella Valley Association of Governments (CVAG). *www.cvag.org.* Accessed: October 2012

Coachella Valley Water District (CVWD). *www.cvwd.org.* Accessed: April 2013

Dudek and Associates, Inc. *Wastewater Collection System Master Plan.* May, 2003

Electronic Files, Valley Sanitary District, Received: May-June 2012

- GIS file of sewer maintenance holes
- GIS file of sewer mains
- GIS file of pump stations
- GIS file of 2- foot elevation contours
- GIS file for the VSD service area boundary
- GIS files for street centerlines and parcels
- GIS information for land use general plan
- Digital aerial photography coverage for VSD
- Topographical data for VSD
- Atlas Maps

Hunsaker & Associates Irvine, Inc. *Sewer System Capacity Study: Avenue 42, between Madison Street and Monroe Street.* May, 2008.

MSA Consultants, Inc. *ENGINEER'S REPORT: Requa Avenue Interceptor Alignment Review.* November, 2009.

National Oceanic and Atmospheric Administration Data Center. *www.ncdc.noaa.gov/data-access.* Accessed: November 2012

United States Census Bureau. *www.census.gov.* Accessed: October 2012

United Sates Historical Climatology Network. *cdiac.ornl.gov/epubs/ndp/ushcn/ushcn.html.* Accessed: November 2012

Utility Systems, Science, and Software, Inc. (US3). *www.uscubed.com*. Accessed: February-March, 2013.

Winzler and Kelly, Consulting Engineers. *Technical Memorandum: Sanitary Sewer Main Analysis.* August, 2008.

Appendix B
Known Developments

The following image was provided by VSD and shows known developments over the 5-year planning horizon. Areas marked as “build-out” were estimated in the model by changing the land use for that area. Developments with known Equivalent Dwelling Units (EDUs) were assigned point loads as described in **Section 4**. This document was provided to MWH by VSD on March 27, 2013.

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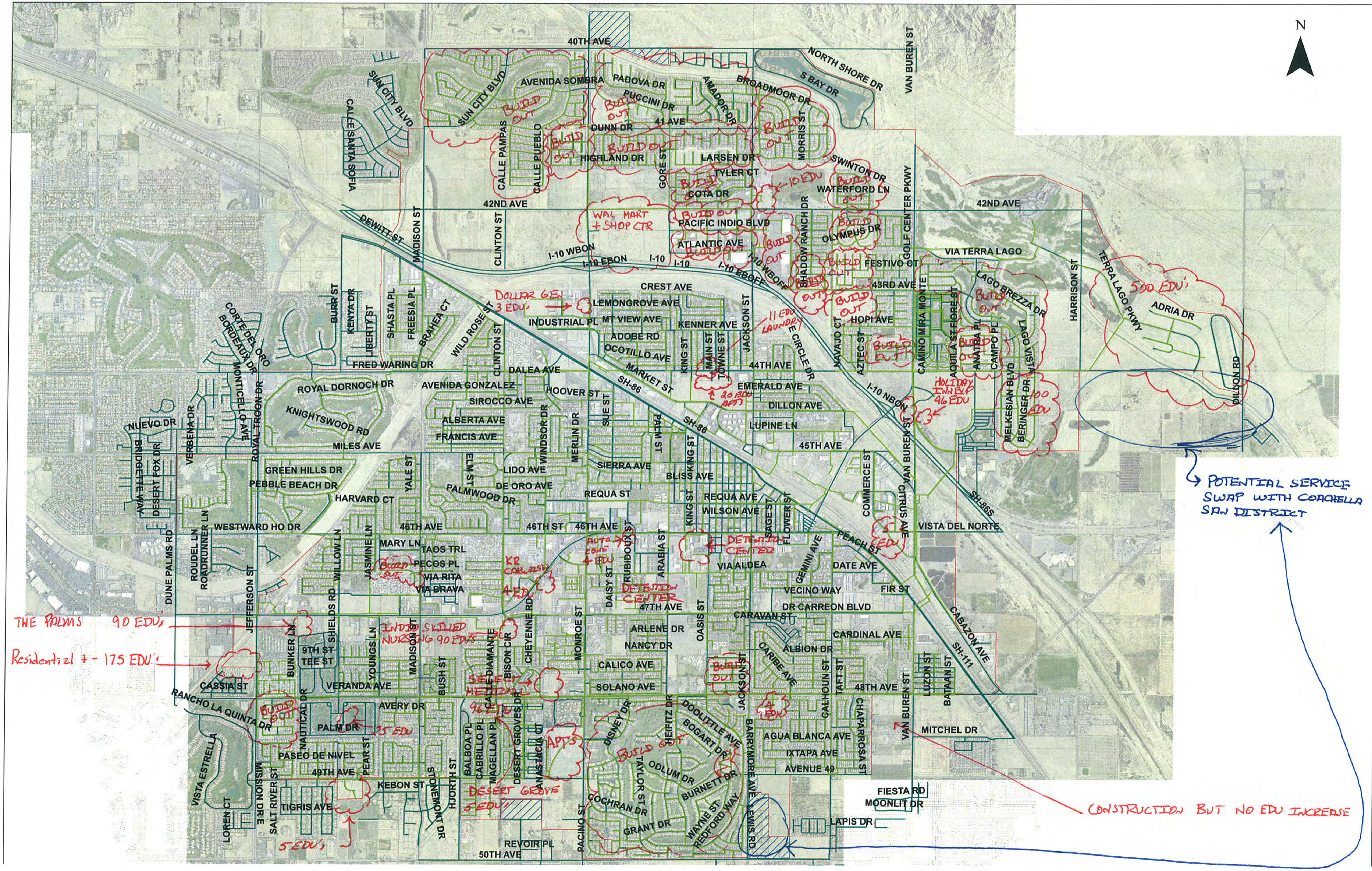
N
40TH AVE
NORTH SHORE DR
S BAY DR
VAN BUREN ST
SUN CITY BLVD
AVENIDA SOMBRA
PADOVA DR
PUCCINI DR
AMADOR DR
BROADMOOR DR
CALLE SANTA SOFIA
CALLE PAMPAS
CALLE PUEBLO
DUNN DR
41 AVE
HIGHLAND DR
GORE ST
LARSEN DR
TYLER CT
MORRIS ST
COTA DR
SWINTON DR
WATERFORD LN
42ND AVE
GOLF CENTER PKWY
DEWITT ST
MADISON ST
CLINTON ST
PACIFIC INDIO BLVD
ATLANTIC AVE
SHADOW RANCH DR
OLYMPUS DR
I-10 WBON
I-10 EBON
I-10
I-10 EBOFF
I-10 WBOFF
FESTIVO CT
VIA TERRA LAGO
43RD AVE
CREST AVE
LEMONGROVE AVE
MT VIEW AVE
INDUSTRIAL PL
ADOBE RD
OCOTILLO AVE
KENNER AVE
HOPI AVE
LAGO BREZZA DR
HARRISON ST
TERRA LAGO PKWY
ADRIA DR
BURR ST
KENYA DR
LIBERTY ST
SHASTA PL
FREESIA PL
BRAHEA CT
WILD ROSE ST
CORTE DEL ORO
BORDEAUX DR
MONTICELLO AVE
FRED WARING DR
DALEA AVE
MARKET ST
44TH AVE
EMERALD AVE
DILLON AVE
LUPINE LN
ROYAL DORNOCH DR
AVENIDA GONZALEZ
HOOVER ST
SH-86
SIROCCO AVE
ALBERTA AVE
FRANCIS AVE
KNIGHTSWOOD RD
MILES AVE
NUEVO DR
VERBENA DR
ROYAL TROON DR
BRIDGETTE WAY
DESERT FOX DR
45TH AVE
I-10 NBON
MELKESIAN BLVD
BERINGER DR
LAGO VISTA
DILLON RD
GREEN HILLS DR
PEBBLE BEACH DR
HARVARD CT
YALE ST
ELM ST
LIDO AVE
DE ORO AVE
WINDSOR DR
MERLIN DR
SUE ST
PALM ST
SIERRA AVE
BLISS AVE
PALMWOOD DR
REQUA ST
REQUA AVE
WILSON AVE
COMMERCE ST
CITRUS AVE
SH-86S
VISTA DEL NORTE
WESTWARD HO DR
46TH AVE
46TH ST
MARY LN
TAOS TRL
PECOS PL
VIA RITA
VIA BRAVA
VIA ALDEA
DATE AVE
PEACH ST
GEMINI AVE
VECINO WAY
FIR ST
DR CARREON BLVD
47TH AVE
CABAZON AVE
SH-111
DUNE PALMS RD
ROUDEL LN
ROADRUNNER LN
JEFFERSON ST
SHIELDS RD
WILLOW LN
JASMINE LN
CARAVAN ST
ARLENE DR
NANCY DR
CARDINAL AVE
ALBION DR
CARIBE AVE
9TH ST
TEE ST
BUNKER LN
YOUNGS LN
CALICO AVE
SOLANO AVE
CASSIA ST
VERANDA AVE
48TH AVE
RANCHO LA QUINTA DR
AVERY DR
PALM DR
NAUTICAL DR
MONROE ST
CHEYENNE RD
BISON CIR
CALLE DIAMANTE
DISNEY DR
HEIFITZ DR
DOOLITTLE AVE
BOGART DR
BARRYMORE AVE
AGUA BLANCA AVE
IXTAPA AVE
AVENUE 49
MITCHEL DR
CHAPARROSA ST
PASEO DE NIVEL
49TH AVE
KEBON ST
VISTA ESTRELLA
MISION DR E
SALT RIVER ST
TIGRIS AVE
LOREN CT
BALBOA PL
CABRILLO PL
MAGELLAN PL
DESERT GROVES DR
ANASTACIA CT
ODLUM DR
BURNETT DR
TAYLOR ST
COCHRAN DR
GRANT DR
WAYNE ST
REDFORD WAY
LEWIS RD
FIESTA RD
MOONLIT DR
LAPIS DR
REVOIR PL
50TH AVE
PACINO ST
BUILD OUT
WAL MART + SHOP CTR
DOLLAR GEN 3 EDU
11 EDU LAUNDRY
20 EDU APTS
HOLIDAY INN EXP 46 EDU
100 EDU
550 EDU'S
POTENTIAL SERVICE SWAP WITH COACHELLA SAN DISTRICT
AUTO ZONE 4 EDU
KR CARWASH 4 EDU
DETENTION CENTER
EDU
THE PALMS 90 EDU'S
Residential +- 175 EDU'S
INDIO SKILLED NURSING 90 EDU'S
SENIOR HEIGHTS 96 EDU
25 EDU
APTS
DESERT GROVE 5 EDU
5 EDU'S
CONSTRUCTION BUT NO EDU INCREASE

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Appendix C
Technical Memorandum - Flow Monitoring

Below is the Flow Monitoring Technical Memorandum (TM) prepared for Valley Sanitary District (VSD). The final version of this TM was delivered to VSD on December 3, 2012.

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TECHNICAL MEMORANDUM

To:	Joe Glowitz, VSD	**Date:**	December 3, 2012
From:	Jinny Huang, MWH	**Reference:**	10500972/6.2
Subject:	Flow Monitoring Plan		

Introduction

As part of the collection system hydraulic modeling effort, a flow monitoring program will be implemented in order to correlate the actual collection system sewer flows with the estimated flows in the hydraulic model. This flow monitoring plan focuses on the field work and data collection. In addition, the plan shows the proposed locations of the monitoring sites.

The objectives of the flow monitoring program are:

1. To develop flow generation rates for various land use categories;
2. To develop the diurnal curve for various land use categories;
3. To collect representative sewer flows in the collection system to calibrate the hydraulic model to the dry weather flow conditions.

The program has been developed in accordance with Task 4 of the Collection System Master Plan project. MWH will utilize Downstream Services, Inc. (DSI) as subconsultants to perform the flow monitoring in the field. MWH's engineer will supervise the DSI crew on the day of installation of the meters. DSI will be responsible for flow monitoring, data collection, data processing, and transmission of the data to MWH. DSI will also be responsible for preparing any required traffic control plans in accordance with Manual on Uniform Traffic Control Devices (MUTCD) standards.

Implementation of Flow Monitoring Plan

To achieve maximum benefit from the VSD flow monitoring plan, certain guidelines should be considered when selecting manholes for meter installation:

- Avoid manholes with junctions of large pipes or drops: turbulent "mixing" of flows will likely result in inaccurate level and velocity readings. These manholes can also experience high levels of hydrogen sulfide (H_2S) gas, which can damage electrical equipment over time and preclude personnel entry for maintenance, cleaning and periodic accuracy checks;

- Avoid manholes near curves or sharp alignment bends: velocity variations between the inside and outside walls of a pipeline around a curve or sharp alignment bend will likely result in inaccurate velocity readings. Most manufacturers recommend a straight, constantly sloped length of 5 to 10 times the pipe diameter upstream and downstream from the meter location;

Flow Monitoring Plan

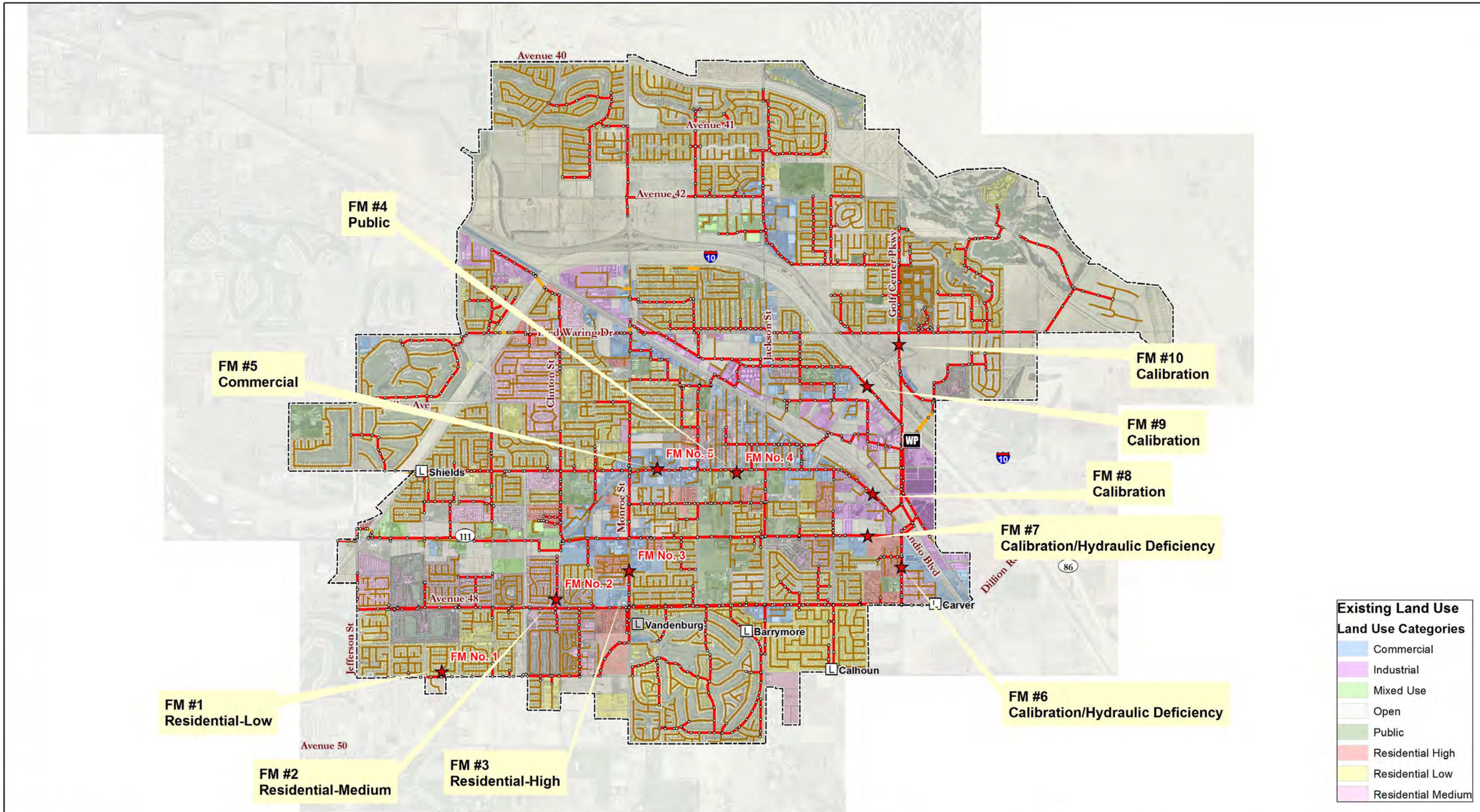
According to the scope of work between MWH and VSD, ten (10) temporary flow monitoring meters are to be installed.

In evaluating the VSD sewer system, MWH is recommending five (5) flow monitoring locations to be selected to obtain flows from a variety of land use types, and five (5) flow monitoring locations to obtain flows from a wide variety of spatial distributions. **Table 1** lists the flow monitoring locations and the reasoning for the location choice. **Figure 1** shows the locations of the proposed flow monitoring meters.

Table 1
Flow Monitoring Locations

Monitor No.	Purpose	Location	Manhole ID	Pipe Diameter
1	Residential – Low Density Land Use	Orchard Drive and 49th Avenue	13C-M085	8
2	Residential – Medium Density Land Use	Avenida Camelia and Calle Diamante	12E-M360	15
3	Residential – High[1] Density Land Use	Monroe Street, 500 ft north of Victoria Street	11F-M070	10
4	Public Land Use	South of Highway 111, 200 ft east of Oasis Avenue	9G-M020	8
5	Commercial Land Use	Highway 111, 500 ft west of Rubidoux Street	9F-M360	8
6	Calibration/ Hydraulic Deficiencies[2]	Van Buren Street, 150 ft north of Manila Avenue	11J-M095	30
7	Calibration/ Hydraulic Deficiencies[2]	Dr. Carreon Blvd, 1,300 ft east of Calhoun Street	10I-M140	18
8	Calibration	Highway 111, 300 ft south of Maple Avenue	10I-M110	18
9	Calibration	Northeast area of Golf Center Parkway and 45th Avenue intersection, and west of Whitewater River	7I-M060	15
10	Calibration	Golf Center Parkway, 400 ft south of 44th Avenue	7J-M055	36

1 Captures some commercial land use.
2 Hydraulically deficient based on 2002 Sewer Master Plan.



Key to Features

- FlowMeterLocations
- Lift Station
- Modeled Lift Station
- Wastewater Treatment Plant
- Manhole
- Valley Sanitary District Boundary
- Siphon
- Modeled Sewer Pipeline
- Sewer Pipeline

N

0 0.5 1 Miles

Document: \\Uspas1s01\muni\Clients\Valley San District\IDIQ As-Needed\Task 1 -Sewer System MP\14 Electronic Files - Modeling_MXDs\FlowMonitoringSitesv2.mxd

Date:November 30, 2012

Valley Sanitary District
Proposed Flow Monitoring Sites

MWH.

Figure 1

Flow Monitor No. 1

Flow Monitor No. 1 collects low density residential flow for a rough subcatchment area of 40 acres. The monitor will be installed along an 8-inch pipeline at manhole 13C-M085 at the intersection of Orchard Drive and Apricot Lane, as shown in **Figure 2**.

Figure 2 - Flow Monitor No. 1 Catchment Area

Flow Monitoring No. 2

Flow Monitor No. 2 collects medium density residential flow for a rough subcatchment area of 60 acres. The monitor will be installed along a 15-inch pipeline at manhole 12E-M360 at the intersection of Avenida Camelia and Calle Diamante, as shown in **Figure 3**.

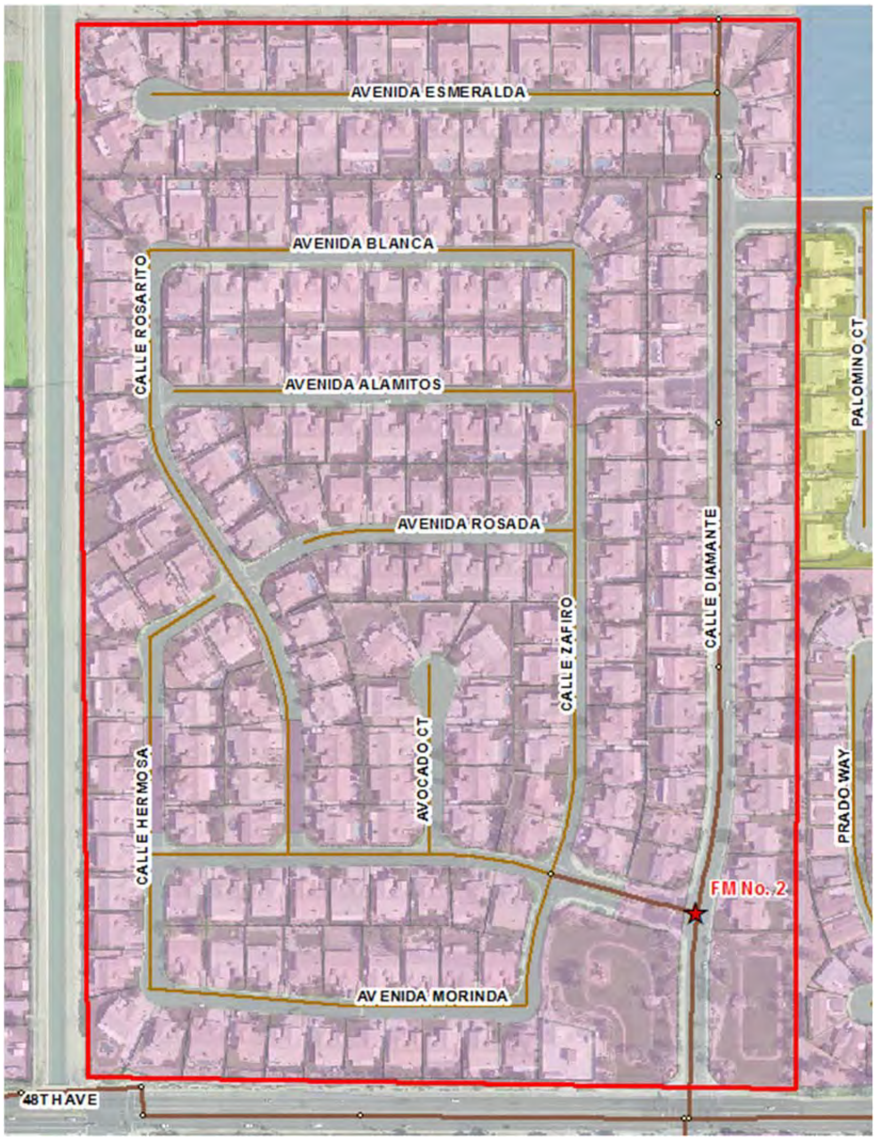


Figure 3 - Flow Monitor No. 2 Catchment Area

Flow Monitor No. 3

Flow Monitor No. 3 collects primarily high density residential flow of about 20 acres and with about 12 acres of commercial flow. The monitor will be installed a 10-inch pipeline at manhole 11F-M070 on Monroe Street (running north to south), about 500 feet north of Victoria Street, as shown in **Figure 4**.

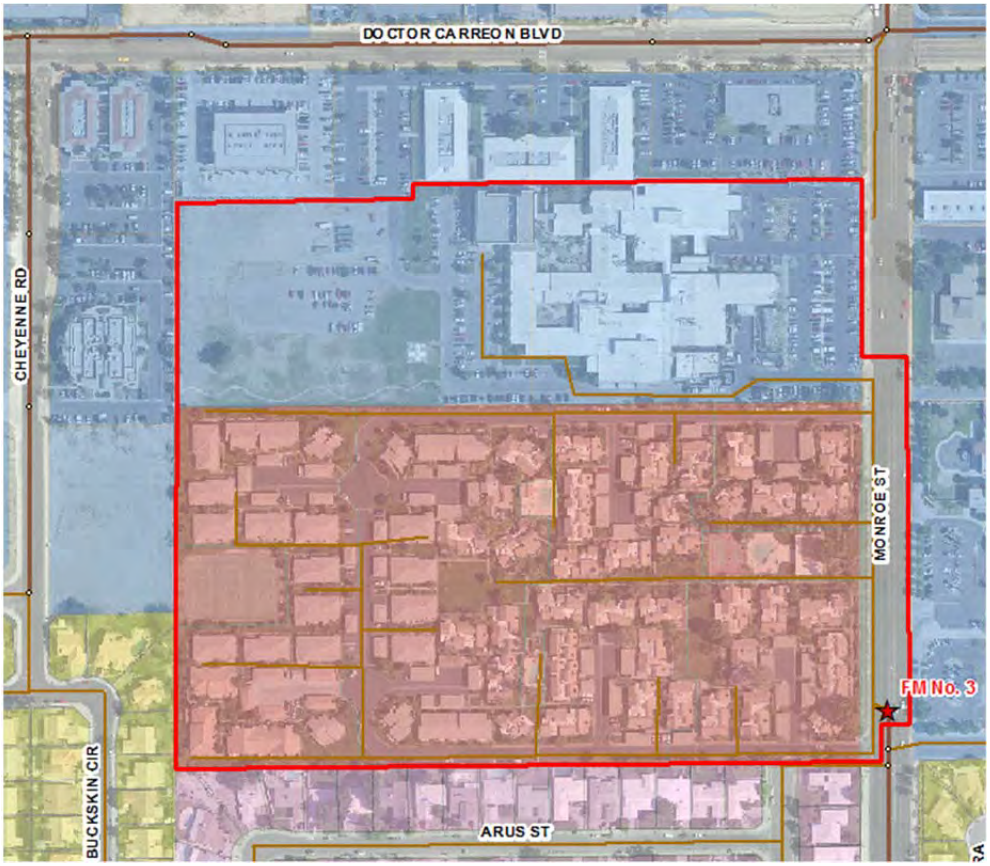


Figure 4 - Flow Monitor No. 3 Catchment Area

Flow Monitor No. 4

Flow Monitor No. 4 collects about 10 acres of public facility flow along an 8-inch pipeline at manhole 9G-M020 at the Larson Justice Center. The manhole is located south of Highway 111 and about 200 feet east of Oasis Avenue, as shown in **Figure 5**.

Figure 5 - Flow Monitors 4 Catchment Areas

Flow Monitor No. 5

Flow Monitor No. 5 collects commercial flow for about 10 acres. The monitor will be installed along an 8-inch pipeline at manholes 9F-M360 along a secondary street about 500 feet west of Rubidoux Street (running north to south), just north of Highway 111, as shown in **Figure 6**.

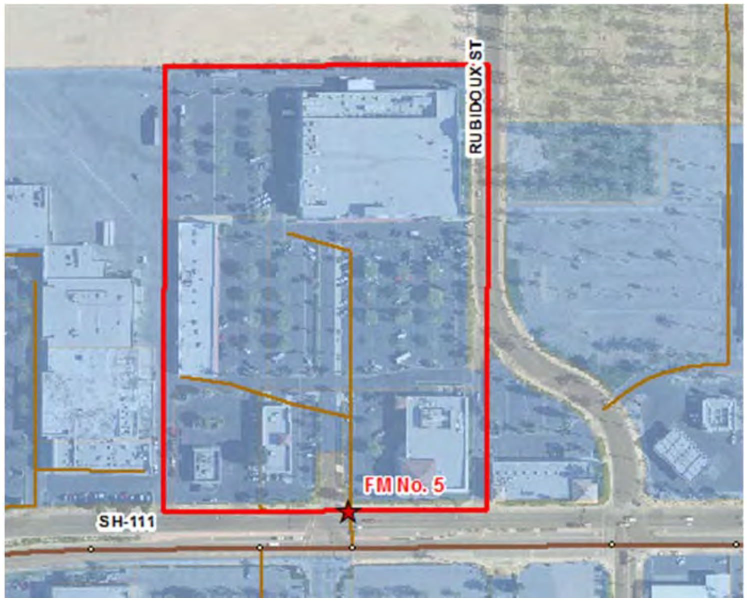


Figure 6 - Flow Monitor No. 5 Catchment Area

Flow Monitor No. 6

Flow Monitor No. 6 will collect flow from a mix of land use types for a large catchment area of the VSD collection system. This site is also chosen based on its hydraulic deficient designation in the 2002 Sewer Master Plan. The monitor will be located along a 30-inch pipeline at manhole 11J-M095 on Van Buren Street, approximately 150 feet north of Manila Avenue.

Flow Monitor No. 7

Flow Monitor No. 7 will collect flow from a mix of land use types for a large catchment area of the VSD collection system. This site is also chosen based on its hydraulic deficient designation in the 2002 Sewer Master Plan. The monitor will be located along an 18-inch pipeline at manhole 10I-M140 on Dr. Carreon Boulevard, about 1,300 feet east of Calhoun Street.

Flow Monitor No. 8

Flow Monitor No. 8 will collect flow from a mix of land use types for a large catchment area of the VSD collection system. The monitor will be located along an 18-inch pipeline at manhole 10I-M110 along Highway 111, approximately 300 feet south of Maple Avenue.

Flow Monitor No. 9

Flow Monitor No. 9 will collect flow from a mix of land use types for a large catchment area of the VSD collection system. The monitor will be located along a 15-inch pipeline at manhole 7I-M060 at a vacant field west of Whitewater River, and at the northeast area of the Golf Center Parkway and 45th Avenue intersection.

Flow Monitor No. 10

Flow Monitor No. 10 will collect flow from a mix of land use types for a large catchment area of the VSD collection system. The monitor will be located along a 36-inch pipeline at manhole 7J-M055 along Golf Center Parkway, about 400 feet south of 44th Avenue.

Flow Monitoring

Once the flow monitors are installed and confirmed, Downstream Service, Inc. (DSI) will monitor flows for a period of 7 days (“monitoring period”). This period may be extended if necessary. To record data over the longer term, pressure-sensitive taps will be used.

During the course of the project and as part of DSI quality control program, the field crews will visit each location and reconfirm that the monitor is in proper working condition. This includes cleaning depth and velocity sensors, confirmations as needed, and checking an installation to make sure that the ring is secure in the pipe. A DSI data analyst will also review the data on a regular basis throughout the monitoring period.

DSI will provide all necessary services for the flow monitors that involve troubleshooting the common faults that are repairable in the field. Common service problems are sensor scrubs, battery changes, and internal board replacements.

Once activated and confirmed to be working properly, DSI field crews will visit the monitored locations. Depth and velocity data will be collected and reviewed onsite to reduce the potential for data loss.

Once authorized, crews will remove the flow monitors and deliver final data to the data analyst.

Flow Data

During and upon completion of the monitoring period, DSI will analyze the data. The data analyst will directly calculate flow using the continuity equation from recorded depth and average velocity data. Flow quantities as determined by the continuity equation will be plotted. The analyst will also utilize scattergraphs (depth vs. velocity readings) to verify monitor accuracy. Once the data is transmitted to MWH, the data will be used for calibration of the hydraulic model.

Public Notification

VSD is responsible for notifying City of Indio, Riverside County, VSD operations crew, emergency services, and residential water groups that there will be a field crew working in the select areas.

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Appendix D
US3 Flow Monitoring Report

Flow monitoring activities for the VSD system were completed by Utility Systems, Science and Software, Inc. (US3) between January 4th and January 19th, 2013. This Appendix contains the site installation reports and statistics summaries provided by US3 to MWH for the ten flow monitoring locations chosen for the system. This data was used to calibrate the collection system model as described in **Section 4**.

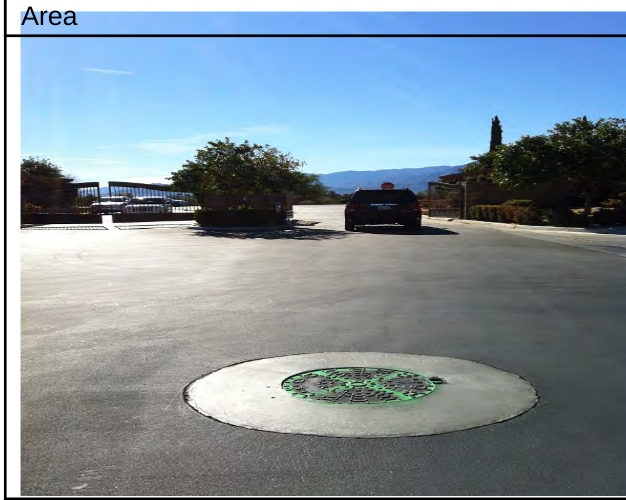
Site Installation Report

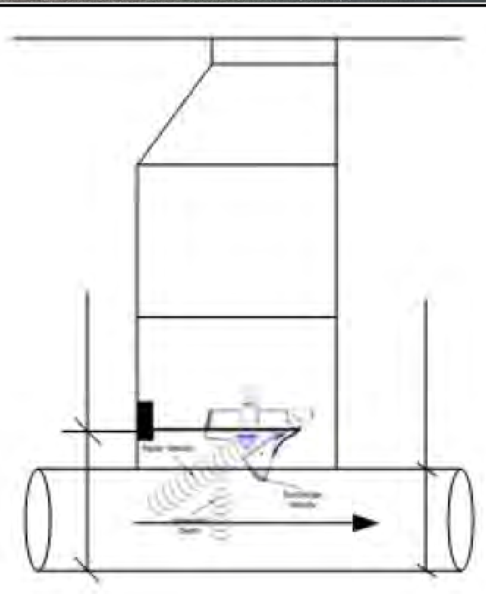
Customer:	MWH Americas, Inc.
Site Name:	13C-M085
Site Location	Orchard Drive and 49th Avenue

Access: Behind Gate in Private Residential Area

System Type: Sanitary X Storm ☐

Install Date: 1/5/2013





Manhole Depth (feet)	12.5
Pipe Size (inches)	8 Inch
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0

Hydraulics

Profile used “.2, .4, .8 of Depth Method ” Three point profile through

cross section of flow.

Avg Velocity	Avg Measured Level	Multiplier
1.25 FPS	3 Inches	1

Gas

O2	H2S	CO	LEL
20.1	.01	.0	.0

Notes

Traffic Safety

Little – Residential Area

Land Use

Residential	Commercial	Industrial	Trunk
X			

Meter Site Document

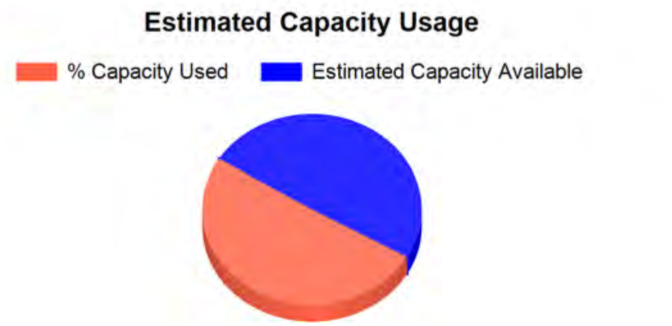
City	MWH Americas, Inc.
Site Name	13C-M085
Site Location	Orchard Drive and 49th Avenue
Access	Behind Gate in Private Residential Area

Temporary Flow Study

MWH Americas, Inc.

13C-M085

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	1.065	2.690	0.071
Maximum	2.210	4.358	0.193
Minimum	0.220	1.803	0.016
Pipe Size		8.000	
Estimated Capacity (mgd)		0.382	
Capacity Used		50.56 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 01/23/2013
Customer: MWH Americas, Inc.
Site: 13C-M085
Pipe size: 8"

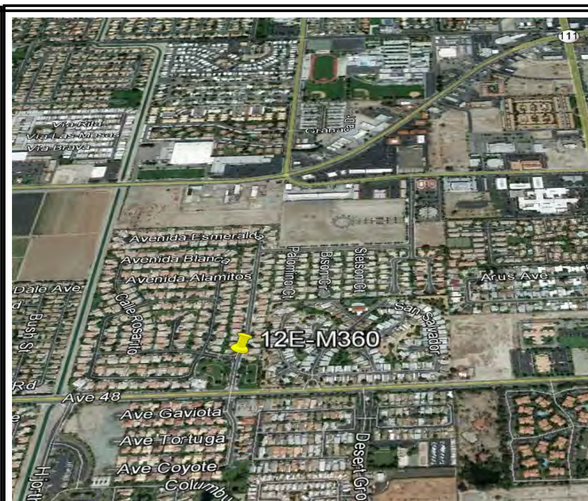
Weekly Flow Statistics for 13C-M085

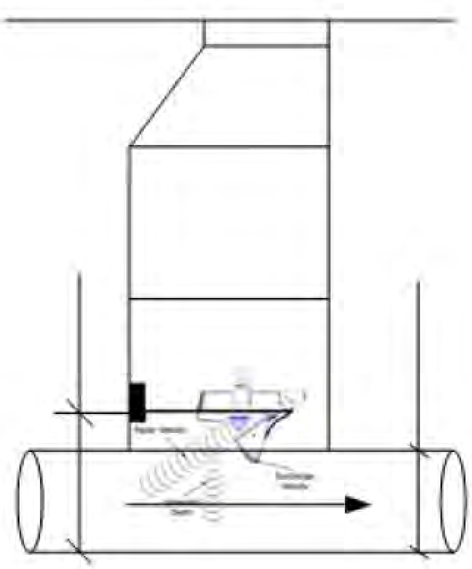
	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	44.48	82.63	24.14	0.06	0.12	0.03	0.89	1.35	0.55	2.82	3.32	2.34	64,050
1/5/2013	40.62	89.32	15.39	0.06	0.13	0.02	0.86	2.21	0.41	2.71	3.91	2.03	58,491
1/6/2013	44.70	118.00	11.40	0.06	0.17	0.02	0.93	1.82	0.35	2.76	4.36	1.93	64,369
Week:	**43.27**	**118.00**	**11.40**	**0.06**	**0.17**	**0.02**	**0.89**	**2.21**	**0.35**	**2.76**	**4.36**	**1.93**	**186,910**
1/7/2013	41.09	100.19	11.24	0.06	0.14	0.02	0.91	1.91	0.22	2.61	3.64	1.82	59,176
1/8/2013	41.90	95.62	15.21	0.06	0.14	0.02	0.91	1.83	0.47	2.68	3.76	1.80	60,339
1/9/2013	49.29	94.81	15.05	0.07	0.14	0.02	1.10	1.88	0.45	2.64	3.61	1.86	70,979
1/10/2013	52.36	102.03	22.19	0.08	0.15	0.03	1.13	1.92	0.68	2.68	3.86	1.93	75,399
1/11/2013	53.35	119.43	21.94	0.08	0.17	0.03	1.17	1.85	0.66	2.65	3.84	1.80	76,823
1/12/2013	54.71	134.07	20.49	0.08	0.19	0.03	1.15	2.00	0.57	2.73	3.68	1.84	78,781
1/13/2013	53.85	108.44	24.16	0.08	0.16	0.03	1.13	1.90	0.67	2.76	3.64	1.94	77,542
Week:	**49.51**	**134.07**	**11.24**	**0.07**	**0.19**	**0.02**	**1.07**	**2.00**	**0.22**	**2.68**	**3.86**	**1.80**	**499,039**
1/14/2013	50.55	101.24	20.91	0.07	0.15	0.03	1.11	2.09	0.66	2.66	3.87	1.89	72,785
1/15/2013	54.18	103.05	23.92	0.08	0.15	0.03	1.14	1.86	0.64	2.76	3.65	1.97	78,026
1/16/2013	53.33	111.84	24.17	0.08	0.16	0.03	1.18	2.02	0.58	2.66	3.65	1.89	76,794
1/17/2013	50.37	98.92	21.12	0.07	0.14	0.03	1.10	1.83	0.70	2.67	3.58	1.90	72,537
1/18/2013	53.19	121.43	28.03	0.08	0.17	0.04	1.12	1.93	0.63	2.72	3.84	2.16	76,587
1/19/2013	47.19	93.13	20.51	0.07	0.13	0.03	1.09	1.72	0.50	2.57	3.54	1.86	67,951
Week:	**51.47**	**121.43**	**20.51**	**0.07**	**0.17**	**0.03**	**1.12**	**2.09**	**0.50**	**2.67**	**3.87**	**1.86**	**444,680**

Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	12E-M360
Site Location	Avenida Camelia & Calle Diamante

Access:	System Type:	
Street Access	Sanitary [X] Storm [ ]	Install Date: 1/5/2013





Manhole Depth (feet)	10 Feet
Pipe Size (inches)	15 Inches
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0

Hydraulics

Profile used ".2, .4, .8 of Depth Method " Three point profile through

cross section of flow.

Avg Velocity	Avg Measured Level	Multiplier
1.67 FPS	1.5 Inches	1

Gas

O2	H2S	CO	LEL
20.1	.0	.0	.0

Notes

Traffic Safety

Little Traffic

Land Use

Residential	Commercial	Industrial	Trunk
X			

Meter Site Document

City	MWH Americas, Inc.
Site Name	12E-M360
Site Location	Avenida Camelia & Calle Diamante
Access	Street Access

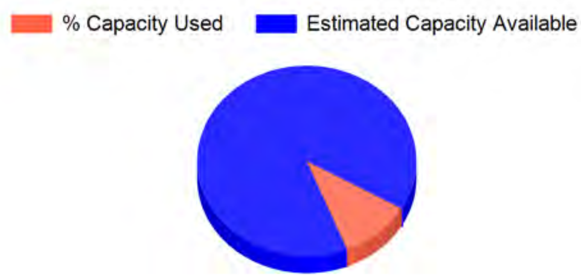
Temporary Flow Study

MWH Americas, Inc.

12E-M360

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	1.443	1.875	0.085
Maximum	2.260	3.580	0.197
Minimum	0.560	1.050	0.020
Pipe Size		15.000	
Estimated Capacity (mgd)		1.847	
Capacity Used		10.66 %	
Sensor Type		Hach - Flodar	

Estimated Capacity Usage



Utility Systems, Science and Software

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Utility Systems Science and Software

Report Date: 06/13/2013
Customer: MWH Americas, Inc.
Site: 12E-M360
Pipe size: 15"

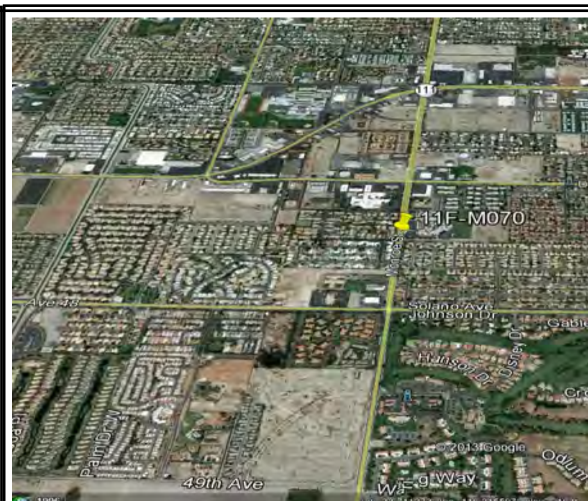
Weekly Flow Statistics for 12E-M360

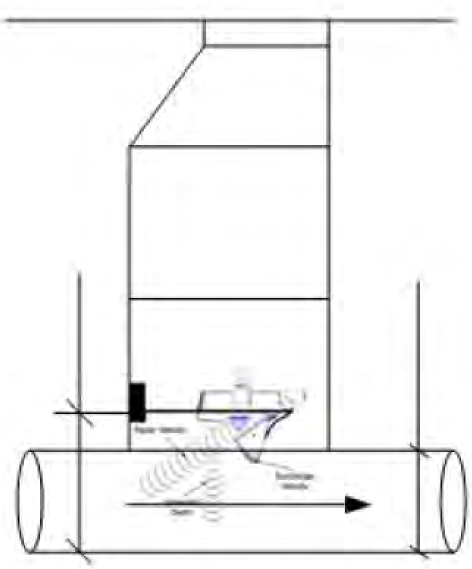
	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Total
1/4/2013	54.21	108.23	0.00	0.08	0.16	0.00	1.08	2.02	0.00	2.79	3.58	1.79	78,059
1/5/2013	75.41	128.30	15.91	0.11	0.18	0.02	1.62	2.26	0.89	1.97	2.48	1.08	108,592
1/6/2013	69.25	121.65	29.63	0.10	0.18	0.04	1.49	2.14	0.68	2.08	2.51	1.46	99,724
Week:	**66.29**	**128.30**	**0.00**	**0.10**	**0.18**	**0.00**	**1.39**	**2.26**	**0.00**	**2.28**	**3.58**	**1.08**	**286,375**
1/7/2013	48.27	72.13	14.51	0.07	0.10	0.02	1.23	1.57	0.76	1.80	2.29	1.11	69,516
1/8/2013	53.20	91.18	15.87	0.08	0.13	0.02	1.38	1.81	0.78	1.78	2.28	1.19	76,609
1/9/2013	59.23	136.70	13.82	0.09	0.20	0.02	1.34	1.83	0.61	1.91	3.22	1.28	85,291
1/10/2013	58.84	92.79	19.11	0.08	0.13	0.03	1.56	1.87	1.11	1.75	2.22	1.05	84,734
1/11/2013	59.93	89.20	26.40	0.09	0.13	0.04	1.35	1.64	0.99	1.99	2.33	1.40	86,304
1/12/2013	62.07	97.20	29.75	0.09	0.14	0.04	1.53	1.88	1.04	1.87	2.25	1.50	89,376
1/13/2013	62.35	103.30	24.24	0.09	0.15	0.03	1.53	2.03	1.07	1.84	2.28	1.28	89,784
Week:	**57.70**	**136.70**	**13.82**	**0.08**	**0.20**	**0.02**	**1.42**	**2.03**	**0.61**	**1.85**	**3.22**	**1.05**	**581,614**
1/14/2013	52.91	79.62	28.39	0.08	0.11	0.04	1.35	1.63	1.07	1.84	2.23	1.39	76,187
1/15/2013	52.41	80.77	22.63	0.08	0.12	0.03	1.27	1.70	0.84	1.90	2.39	1.43	75,465
1/16/2013	59.60	83.96	31.80	0.09	0.12	0.05	1.56	1.81	1.27	1.80	2.18	1.37	85,820
1/17/2013	58.29	82.42	14.70	0.08	0.12	0.02	1.54	1.77	0.79	1.76	2.11	1.12	83,933
1/18/2013	57.73	80.82	22.44	0.08	0.12	0.03	1.58	1.82	1.16	1.73	2.09	1.15	83,128
1/19/2013	21.76	101.14	0.00	0.03	0.15	0.00	0.61	1.75	0.00	0.79	2.43	0.00	31,331
1/20/2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Week:	**43.24**	**101.14**	**0.00**	**0.06**	**0.15**	**0.00**	**1.13**	**1.82**	**0.00**	**1.40**	**2.43**	**0.00**	**435,864**

Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	11F-M070
Site Location	Monroe Street

Access:	System Type:	
Street Access	Sanitary [X] Storm [ ]	Install Date: 1/5/2013





Manhole Depth (feet)	13
Pipe Size (inches)	10
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0.25

Hydraulics

Profile used ".2, .4, .8 of Depth Method " Three point profile through

cross section of flow.

Avg Velocity	Avg Measured Level	Multiplier
.90	2.25	1

Gas

O2	H2S	CO	LEL
20.4	.0	.0	.0

Notes

Traffic Safety

Medium Traffic

Land Use

Residential	Commercial	Industrial	Trunk
X			

Meter Site Document

City	MWH Americas, Inc.
Site Name	11F-M070
Site Location	Monroe Street
Access	Street Access

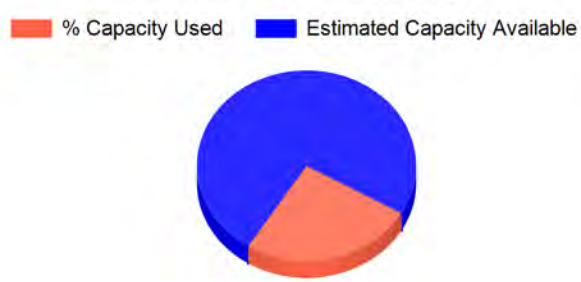
Temporary Flow Study

MWH Americas, Inc.

11F-M070

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	1.405	1.956	0.070
Maximum	2.269	3.164	0.171
Minimum	0.519	1.081	0.012
Pipe Size		10.000	
Estimated Capacity (mgd)		0.667	
Capacity Used		25.59 %	
Sensor Type		Hach - Flodar	

Estimated Capacity Usage



Utility Systems, Science and Software

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San Diego, CA 92021

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Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 01/23/2013
Customer: MWH Americas, Inc.
Site: 11F-M070
Pipe size: 10"

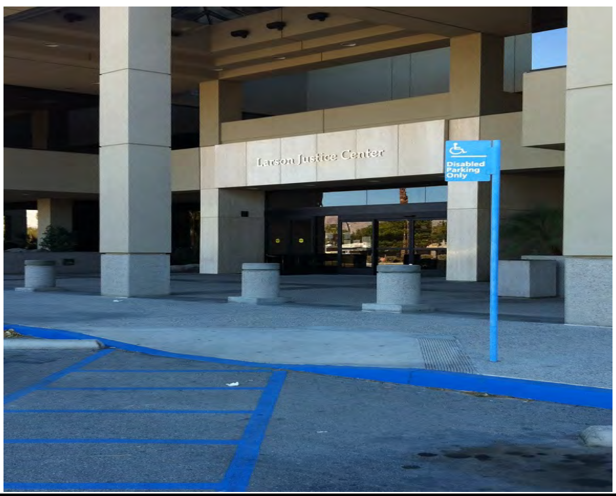
Weekly Flow Statistics for 11F-M070

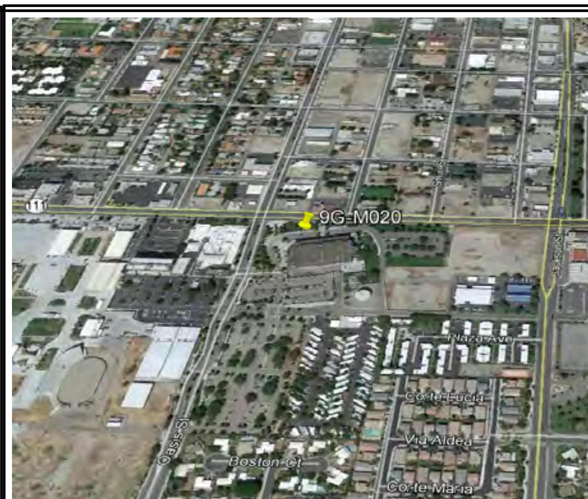
	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Total
1/4/2013	54.16	73.90	32.95	0.08	0.11	0.05	1.51	1.84	0.95	2.04	2.36	1.72	77,990
1/5/2013	46.32	79.79	14.94	0.07	0.11	0.02	1.47	2.05	0.68	1.83	2.41	1.30	66,702
1/6/2013	48.94	89.55	10.17	0.07	0.13	0.01	1.46	1.97	0.52	1.89	2.62	1.18	70,480
Week:	**49.81**	**89.55**	**10.17**	**0.07**	**0.13**	**0.01**	**1.48**	**2.05**	**0.52**	**1.92**	**2.62**	**1.18**	**215,173**
1/7/2013	46.58	83.20	11.78	0.07	0.12	0.02	1.48	1.80	0.56	1.85	2.57	1.08	67,078
1/8/2013	48.20	91.75	10.56	0.07	0.13	0.02	1.43	1.97	0.54	1.91	2.61	1.21	69,413
1/9/2013	47.91	104.45	12.54	0.07	0.15	0.02	1.41	2.06	0.66	1.93	2.65	1.22	68,997
1/10/2013	45.88	105.75	11.77	0.07	0.15	0.02	1.31	1.94	0.67	1.95	2.75	1.16	66,061
1/11/2013	45.85	85.57	14.42	0.07	0.12	0.02	1.39	1.75	0.94	1.91	2.66	1.14	66,019
1/12/2013	52.30	101.55	16.25	0.08	0.15	0.02	1.46	1.95	0.79	1.99	2.73	1.34	75,317
1/13/2013	50.69	93.18	15.52	0.07	0.13	0.02	1.44	1.92	0.69	1.97	2.64	1.30	72,992
Week:	**48.20**	**105.75**	**10.56**	**0.07**	**0.15**	**0.02**	**1.42**	**2.06**	**0.54**	**1.93**	**2.75**	**1.08**	**485,877**
1/14/2013	48.30	106.81	8.12	0.07	0.15	0.01	1.26	1.82	0.53	2.10	3.16	1.14	69,550
1/15/2013	47.85	96.87	13.87	0.07	0.14	0.02	1.28	1.99	0.70	2.05	2.82	1.21	68,905
1/16/2013	50.63	83.32	13.49	0.07	0.12	0.02	1.42	1.96	0.64	1.99	2.57	1.34	72,902
1/17/2013	55.34	118.57	16.40	0.08	0.17	0.02	1.48	2.27	0.67	2.04	2.76	1.37	79,686
1/18/2013	49.41	89.65	14.85	0.07	0.13	0.02	1.40	1.92	0.64	1.98	2.50	1.37	71,157
1/19/2013	46.24	87.51	13.91	0.07	0.13	0.02	1.40	2.06	0.66	1.87	2.58	1.41	66,587
Week:	**49.63**	**118.57**	**8.12**	**0.07**	**0.17**	**0.01**	**1.37**	**2.27**	**0.53**	**2.01**	**3.16**	**1.14**	**428,787**

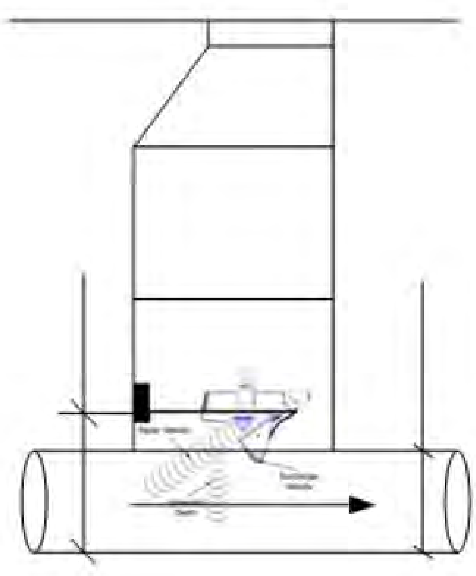
Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	9G-M020
Site Location	South of Hwy 111 & Oasis

Access:	System Type:	
Parking Lot Access	Sanitary [X] Storm [ ]	Install Date: 1/5/2013







Manhole Depth (feet)	7 Feet
Pipe Size (inches)	8 Inches
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0

Hydraulics

Profile used “.2, .4, .8 of Depth Method ” Three point profile through

cross section of flow.

Avg Velocity	Avg Measured Level	Multiplier
1.03 FPS	.6 Inches	1

Gas

O2	H2S	CO	LEL
20.9	.0	.0	.0

Notes

Traffic Safety

Parking Lot Little traffic

Land Use

Residential	Commercial	Industrial	Trunk
	X		

Meter Site Document

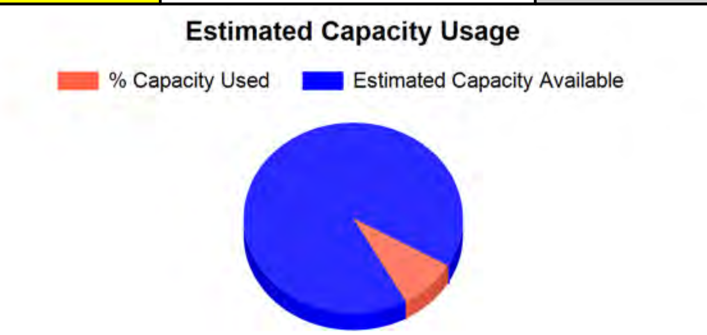
City	MWH Americas, Inc.
Site Name	9G-M020
Site Location	South of Hwy 111 & Oasis
Access	Parking Lot Access

Temporary Flow Study

MWH Americas, Inc.

9G-M020

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	1.092	0.675	0.011
Maximum	2.170	1.170	0.033
Minimum	0.680	0.480	0.006
Pipe Size		8.000	
Estimated Capacity (mgd)		0.382	
Capacity Used		8.70 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

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San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 01/23/2013
Customer: MWH Americas, Inc.
Site: 9G-M020
Pipe size: 8"

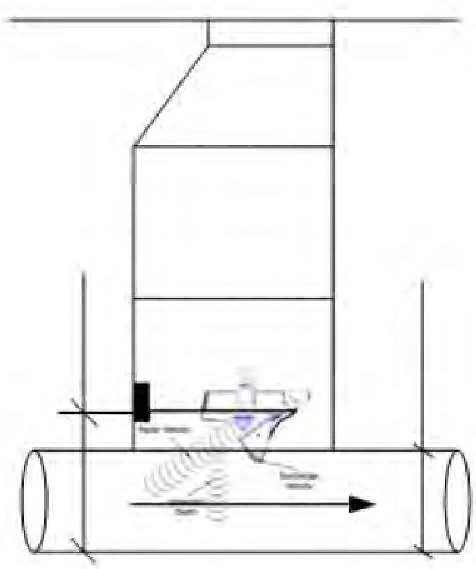
Weekly Flow Statistics for 9G-M020

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	6.64	12.69	4.48	0.01	0.02	0.01	1.33	1.82	1.10	0.56	0.72	0.50	9,556
1/5/2013	4.81	5.34	4.19	0.01	0.01	0.01	1.08	1.19	0.96	0.53	0.58	0.48	6,922
1/6/2013	4.88	6.35	3.90	0.01	0.01	0.01	0.88	1.01	0.77	0.61	0.71	0.58	7,026
Week:	**5.44**	**12.69**	**3.90**	**0.01**	**0.02**	**0.01**	**1.10**	**1.82**	**0.77**	**0.57**	**0.72**	**0.48**	**23,504**
1/7/2013	8.64	19.82	4.31	0.01	0.03	0.01	1.20	1.81	0.79	0.70	0.98	0.51	12,444
1/8/2013	7.31	14.81	4.23	0.01	0.02	0.01	1.30	1.82	1.03	0.60	0.80	0.50	10,529
1/9/2013	9.04	23.06	4.36	0.01	0.03	0.01	1.35	2.17	1.04	0.66	0.96	0.51	13,016
1/10/2013	7.44	13.99	4.07	0.01	0.02	0.01	1.21	1.60	0.99	0.64	0.84	0.50	10,719
1/11/2013	7.97	20.76	4.10	0.01	0.03	0.01	1.17	1.84	0.90	0.67	1.00	0.54	11,479
1/12/2013	4.80	5.24	4.15	0.01	0.01	0.01	0.91	1.01	0.82	0.60	0.67	0.54	6,911
1/13/2013	5.47	6.99	4.26	0.01	0.01	0.01	0.77	0.84	0.68	0.73	0.84	0.67	7,873
Week:	**7.24**	**23.06**	**4.07**	**0.01**	**0.03**	**0.01**	**1.13**	**2.17**	**0.68**	**0.65**	**1.00**	**0.50**	**72,971**
1/14/2013	9.25	21.02	4.35	0.01	0.03	0.01	1.03	1.54	0.70	0.82	1.14	0.57	13,322
1/15/2013	7.71	15.73	4.14	0.01	0.02	0.01	1.10	1.55	0.85	0.69	0.93	0.56	11,096
1/16/2013	8.63	17.67	4.25	0.01	0.03	0.01	1.11	1.59	0.86	0.73	1.02	0.57	12,431
1/17/2013	7.89	14.67	4.20	0.01	0.02	0.01	1.03	1.36	0.83	0.74	0.97	0.57	11,355
1/18/2013	9.27	22.26	4.32	0.01	0.03	0.01	1.03	1.57	0.79	0.80	1.17	0.60	13,344
1/19/2013	5.45	6.01	0.00	0.01	0.01	0.00	0.87	0.95	0.00	0.66	0.71	0.00	7,851
Week:	**8.03**	**22.26**	**0.00**	**0.01**	**0.03**	**0.00**	**1.03**	**1.59**	**0.00**	**0.74**	**1.17**	**0.00**	**69,398**

Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	9F-M360
Site Location	Hwy 111 & Rubidoux / CVS

Access:	System Type:	
Street Acess	Sanitary [X] Storm [ ]	Install Date: 1/5/2013



Manhole Depth (feet)	9.5 Feet
Pipe Size (inches)	8 Inch
Pipe Condition	Old but Good
Manhole Material	Concrete
Silt (inches)	0.5

Hydraulics

Profile used ".2, .4, .8 of Depth Method " Three point profile through

cross section of flow.

Avg Velocity	Avg Measured Level	Multiplier
.66 FPS	3 Inches	1

Gas

O2	H2S	CO	LEL
20.1	.01	.0	.0

Notes

Low Velocity Site

Traffic Safety

Commercial Medium

Land Use

Residential	Commercial	Industrial	Trunk
	X		

Meter Site Document

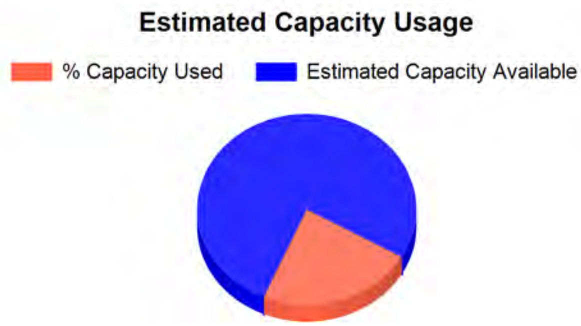
City	MWH Americas, Inc.
Site Name	9F-M360
Site Location	Hwy 111 & Rubidoux / CVS
Access	Street Acess

Temporary Flow Study

MWH Americas, Inc.

9F-M360

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	0.643	3.270	0.055
Maximum	1.190	3.860	0.088
Minimum	0.410	2.640	0.033
Pipe Size		8.000	
Estimated Capacity (mgd)		0.382	
Capacity Used		23.07 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 06/13/2013
Customer: MWH Americas, Inc.
Site: 9F-M360
Pipe size: 8"

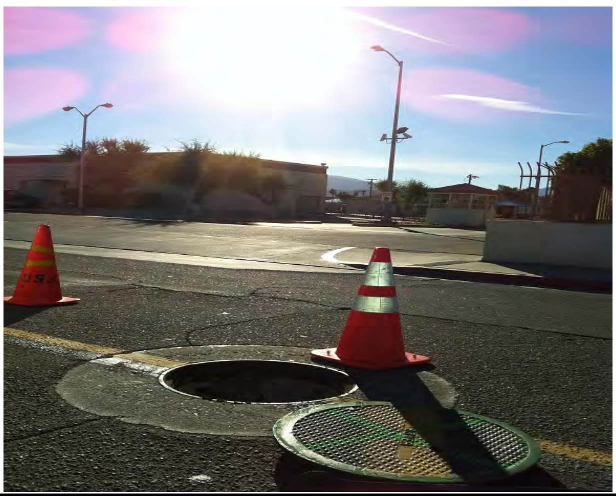
Weekly Flow Statistics for 9F-M360

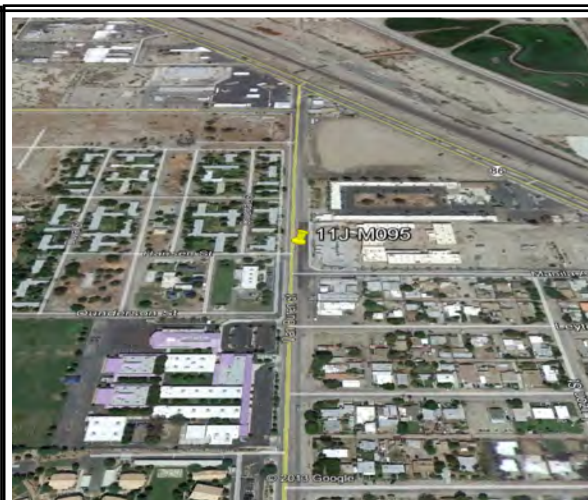
	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	44.71	59.40	0.00	0.06	0.09	0.00	0.71	0.88	0.00	3.38	3.58	3.15	64,377
1/5/2013	45.70	58.28	30.43	0.07	0.08	0.04	0.76	1.19	0.54	3.30	3.82	2.72	65,814
1/6/2013	43.76	61.16	32.28	0.06	0.09	0.05	0.74	0.93	0.51	3.23	3.62	2.82	63,009
Week:	**44.72**	**61.16**	**0.00**	**0.06**	**0.09**	**0.00**	**0.74**	**1.19**	**0.00**	**3.30**	**3.82**	**2.72**	**193,199**
1/7/2013	39.17	52.80	29.55	0.06	0.08	0.04	0.66	0.78	0.50	3.26	3.77	2.79	56,398
1/8/2013	40.18	53.47	29.29	0.06	0.08	0.04	0.64	0.82	0.49	3.38	3.76	3.07	57,865
1/9/2013	39.73	57.46	30.32	0.06	0.08	0.04	0.65	0.83	0.54	3.33	3.82	2.82	57,213
1/10/2013	36.68	50.17	26.85	0.05	0.07	0.04	0.61	0.76	0.47	3.29	3.86	2.79	52,822
1/11/2013	36.03	51.59	24.43	0.05	0.07	0.04	0.60	0.77	0.42	3.24	3.75	2.69	51,883
1/12/2013	35.36	51.27	24.09	0.05	0.07	0.03	0.61	0.76	0.44	3.19	3.72	2.69	50,911
1/13/2013	34.63	55.41	24.27	0.05	0.08	0.03	0.59	0.83	0.42	3.21	3.54	2.73	49,873
Week:	**37.40**	**57.46**	**24.09**	**0.05**	**0.08**	**0.03**	**0.62**	**0.83**	**0.42**	**3.27**	**3.86**	**2.69**	**376,965**
1/14/2013	40.84	52.80	29.83	0.06	0.08	0.04	0.65	0.94	0.50	3.38	3.77	3.01	58,805
1/15/2013	37.56	55.55	28.11	0.05	0.08	0.04	0.64	0.82	0.48	3.24	3.69	2.77	54,088
1/16/2013	36.57	49.09	24.62	0.05	0.07	0.04	0.62	0.73	0.51	3.24	3.75	2.73	52,656
1/17/2013	33.39	48.40	22.75	0.05	0.07	0.03	0.57	0.75	0.41	3.20	3.79	2.64	48,079
1/18/2013	35.80	49.79	23.03	0.05	0.07	0.03	0.62	0.76	0.43	3.18	3.69	2.64	51,549
1/19/2013	40.24	53.71	32.66	0.06	0.08	0.05	0.69	0.83	0.52	3.20	3.75	2.72	57,947
1/20/2013	44.20	46.37	40.47	0.06	0.07	0.06	0.73	0.75	0.69	3.30	3.34	3.21	63,643
Week:	**38.37**	**55.55**	**22.75**	**0.06**	**0.08**	**0.03**	**0.65**	**0.94**	**0.41**	**3.25**	**3.79**	**2.64**	**386,766**

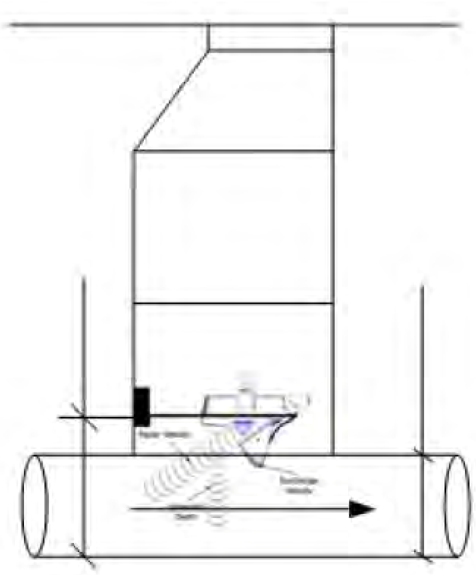
Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	11J-M095
Site Location	Van Buren & Manila

Access: Street Access	System Type: Sanitary [X] Storm [ ]	Install Date: 1/5/2013







Manhole Depth (feet)	13
Pipe Size (inches)	30
Pipe Condition	Good
Manhole Material	000
Silt (inches)	0

Hydraulics

Avg Velocity	Avg Measured Level	Multiplier
1.06 FPS	16 Inches	1

Gas

O2	H2S	CO	LEL
20.1	.0	.0	.0

Notes

Traffic Safety

Medium to Heavy

Land Use

Residential	Commercial	Industrial	Trunk
X	X	X	X

Meter Site Document

City	MWH Americas, Inc.
Site Name	11J-M095
Site Location	Van Buren & Manila
Access	Street Access

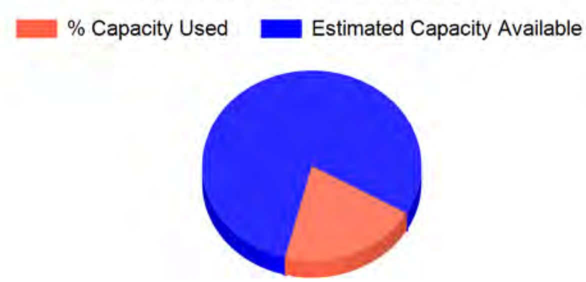
Temporary Flow Study

MWH Americas, Inc.

11J-M095

Meter Start Date	From	1/5/2013 12:00:00 AM
Meter Stop Date	To	1/19/2013 12:00:00 AM
Velocity (fps)	Level (in)	Flow (mgd)
Average 1.066	15.504	1.811
Maximum 1.548	19.869	3.036
Minimum 0.540	10.607	0.550
Pipe Size	30.000	
Estimated Capacity (mgd)	14.731	
Capacity Used	20.61 %	
Sensor Type	Hach - Flodar	

Estimated Capacity Usage



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 01/23/2013
Customer: MWH Americas, Inc.
Site: 11J-M095
Pipe size: 30"

Weekly Flow Statistics for 11J-M095

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	1453.72	1617.44	1240.72	2.09	2.33	1.79	1.14	1.21	1.06	16.88	17.51	15.65	2,093,361
1/5/2013	1277.76	1891.92	408.68	1.84	2.72	0.59	1.07	1.30	0.58	15.59	19.17	10.77	1,839,977
1/6/2013	1290.03	1865.97	451.96	1.86	2.69	0.65	1.07	1.29	0.64	15.70	19.15	10.68	1,857,643
Week:	**1340.50**	**1891.92**	**408.68**	**1.93**	**2.72**	**0.59**	**1.09**	**1.30**	**0.58**	**16.06**	**19.17**	**10.68**	**5,790,981**
1/7/2013	1263.24	1887.59	445.50	1.82	2.72	0.64	1.08	1.47	0.62	15.43	18.22	10.86	1,819,060
1/8/2013	1211.96	1693.11	428.19	1.75	2.44	0.62	1.03	1.24	0.60	15.38	18.33	10.61	1,745,222
1/9/2013	1218.33	1669.73	408.01	1.75	2.40	0.59	1.04	1.22	0.58	15.37	18.31	10.65	1,754,402
1/10/2013	1228.62	1759.66	421.45	1.77	2.53	0.61	1.04	1.31	0.60	15.45	18.51	10.65	1,769,210
1/11/2013	1236.05	1685.28	454.58	1.78	2.43	0.65	1.06	1.30	0.65	15.37	17.67	10.69	1,779,908
1/12/2013	1247.69	2108.41	448.60	1.80	3.04	0.65	1.04	1.53	0.62	15.68	19.38	10.91	1,796,669
1/13/2013	1261.40	2049.04	396.68	1.82	2.95	0.57	1.02	1.36	0.55	15.88	19.87	10.83	1,816,416
Week:	**1238.18**	**2108.41**	**396.68**	**1.78**	**3.04**	**0.57**	**1.05**	**1.53**	**0.55**	**15.51**	**19.87**	**10.61**	**12,480,888**
1/14/2013	1247.01	1893.58	434.67	1.80	2.73	0.63	1.06	1.44	0.59	15.59	18.84	10.79	1,795,689
1/15/2013	1271.61	2013.63	447.50	1.83	2.90	0.64	1.10	1.49	0.63	15.45	18.92	10.70	1,831,112
1/16/2013	1267.12	2088.71	381.69	1.82	3.01	0.55	1.08	1.51	0.54	15.43	18.63	10.62	1,824,647
1/17/2013	1300.11	2099.56	459.45	1.87	3.02	0.66	1.12	1.55	0.62	15.40	18.49	10.70	1,872,163
1/18/2013	1300.55	2025.64	419.96	1.87	2.92	0.60	1.14	1.54	0.60	15.25	17.56	10.62	1,872,786
1/19/2013	1293.52	2256.04	502.47	1.86	3.25	0.72	1.15	1.64	0.67	15.04	19.59	10.97	1,862,675
Week:	**1279.99**	**2256.04**	**381.69**	**1.84**	**3.25**	**0.55**	**1.11**	**1.64**	**0.54**	**15.36**	**19.59**	**10.62**	**11,059,072**

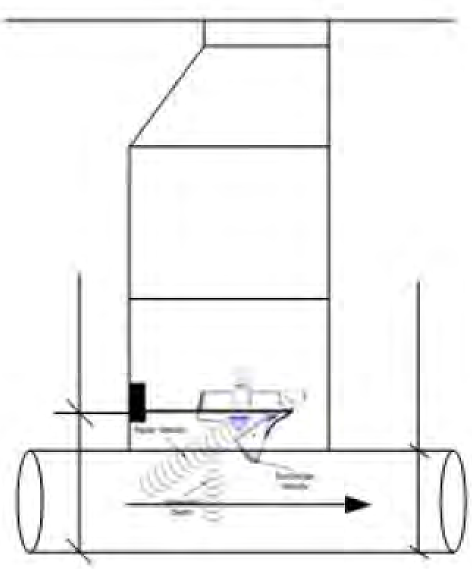
Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	10I-M140
Site Location	Hwy 111-Maple

Access:
Sidewalk Access – CAT Rentals

System Type:
Sanitary [X] Storm [ ]

Install Date: 1/5/2013



Manhole Depth (feet)	8.5 Feet
Pipe Size (inches)	18
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0

Hydraulics

Profile used “.2, .4, .8 of Depth Method ” Three point profile through

cross section of flow.
Depth at time of Measure - Fast Velocity

Avg Velocity	Avg Measured Level	Multiplier
3.14	12.5	.90

Gas

O2	H2S	CO	LEL
20.1	0	0	0

Notes

Traffic Safety

Fast Traffic

Land Use

Residential	Commercial	Industrial	Trunk
X	X	X	

Meter Site Document

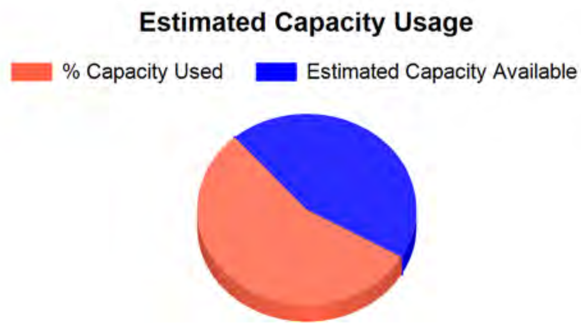
City	MWH Americas, Inc.
Site Name	10I-M140
Site Location	Hwy 111-Maple
Access	Sidewalk Access – CAT Rentals

Temporary Flow Study

MWH Americas, Inc.

10I-M140

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	3.052	10.969	2.243
Maximum	3.720	12.880	3.220
Minimum	1.990	7.950	0.980
Pipe Size		18.000	
Estimated Capacity (mgd)		5.829	
Capacity Used		55.25 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 06/13/2013
Customer: MWH Americas, Inc.
Site: 10I-M140
Pipe size: 18"

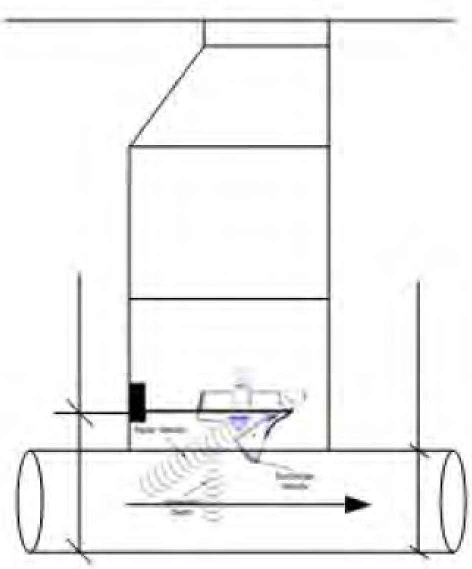
Weekly Flow Statistics for 10I-M140

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	1899.56	1933.09	1849.32	2.74	2.78	2.66	3.39	3.42	3.34	11.99	12.12	11.87	2,735,373
1/5/2013	1647.53	2188.51	752.47	2.37	3.15	1.08	3.18	3.66	2.12	11.08	12.72	8.02	2,372,437
1/6/2013	1690.21	2224.08	940.77	2.43	3.20	1.35	3.22	3.72	2.43	11.22	12.76	8.07	2,433,904
Week:	**1745.77**	**2224.08**	**752.47**	**2.51**	**3.20**	**1.08**	**3.26**	**3.72**	**2.12**	**11.43**	**12.76**	**8.02**	**7,541,714**
1/7/2013	1598.28	2167.81	730.03	2.30	3.12	1.05	3.08	3.61	2.06	11.11	12.77	8.02	2,301,521
1/8/2013	1587.85	2236.42	694.50	2.29	3.22	1.00	3.08	3.69	2.05	11.02	12.88	7.95	2,286,497
1/9/2013	1457.45	2123.76	680.82	2.10	3.06	0.98	2.87	3.57	1.99	10.88	12.66	8.00	2,098,724
1/10/2013	1521.47	2059.22	896.39	2.19	2.97	1.29	2.99	3.51	2.39	10.97	12.56	8.12	2,190,922
1/11/2013	1511.00	2017.37	724.30	2.18	2.91	1.04	2.98	3.46	2.10	10.92	12.43	8.09	2,175,847
1/12/2013	1593.50	2154.93	710.48	2.29	3.10	1.02	3.10	3.61	2.05	11.01	12.72	8.11	2,294,637
1/13/2013	1581.15	2214.54	934.38	2.28	3.19	1.35	3.09	3.66	2.42	10.98	12.88	8.15	2,276,858
Week:	**1550.10**	**2236.42**	**680.82**	**2.23**	**3.22**	**0.98**	**3.03**	**3.69**	**1.99**	**10.98**	**12.88**	**7.95**	**15,625,005**
1/14/2013	1512.01	2092.73	998.86	2.18	3.01	1.44	2.99	3.53	2.51	10.92	12.62	8.19	2,177,297
1/15/2013	1519.27	2086.81	935.11	2.19	3.01	1.35	3.02	3.52	2.56	10.89	12.65	8.00	2,187,743
1/16/2013	1528.93	2137.78	943.17	2.20	3.08	1.36	3.02	3.56	2.56	10.92	12.77	8.12	2,201,655
1/17/2013	1568.20	2127.41	979.23	2.26	3.06	1.41	3.09	3.57	2.64	10.95	12.72	8.11	2,258,208
1/18/2013	1538.90	2072.77	954.61	2.22	2.98	1.37	3.05	3.53	2.58	10.88	12.51	8.13	2,216,013
1/19/2013	1406.58	2117.81	922.16	2.03	3.05	1.33	2.99	3.56	2.51	10.24	12.66	7.94	2,025,473
Week:	**1512.31**	**2137.78**	**922.16**	**2.18**	**3.08**	**1.33**	**3.03**	**3.57**	**2.51**	**10.80**	**12.77**	**7.94**	**13,066,388**

Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	10I-M110
Site Location	Hwy 111-Maple

Access:	System Type:	
Sidewalk Access – CAT Rentals	Sanitary X Storm ☐	Install Date: 1/5/2013



Manhole Depth (feet)	10.5
Pipe Size (inches)	18
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0

Hydraulics

Profile used ".2, .4, .8 of Depth Method " Three point profile through

cross section of flow.
Depth at time of Measure - Fast Velocity

Avg Velocity	Avg Measured Level	Multiplier
1.88 FPS	8 Inches	.99

Gas

O2	H2S	CO	LEL
20.9	0	0	0

Notes

Traffic Safety

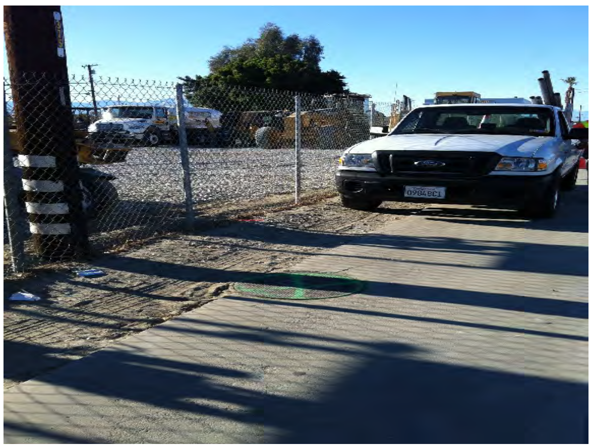
Low Traffic

Land Use

Residential	Commercial	Industrial	Trunk
X			

Meter Site Document

City	MWH Americas, Inc.
Site Name	10I-M110
Site Location	Hwy 111-Maple
Access	Sidewalk Access – CAT Rentals



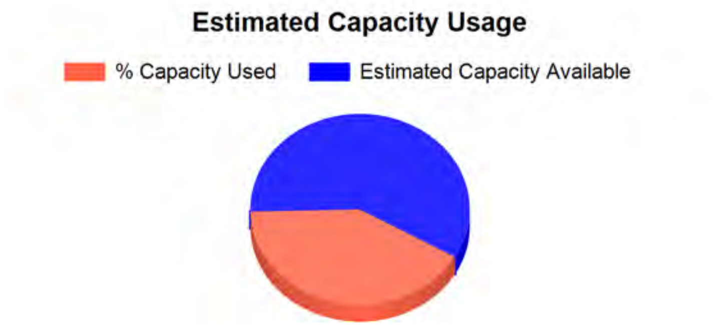
Temporary Flow Study

MWH Americas, Inc.

10I-M110

Meter Start Date	From	1/5/2013 12:00:00 AM
Meter Stop Date	To	1/19/2013 12:00:00 AM

Velocity (fps)		Level (in)	Flow (mgd)
Average	1.771	6.761	0.722
Maximum	2.216	8.954	1.204
Minimum	1.138	4.136	0.235
Pipe Size		18.000	
Estimated Capacity (mgd)		2.914	
Capacity Used		41.34 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 01/23/2013
Customer: MWH Americas, Inc.
Site: 10I-M110
Pipe size: 18"

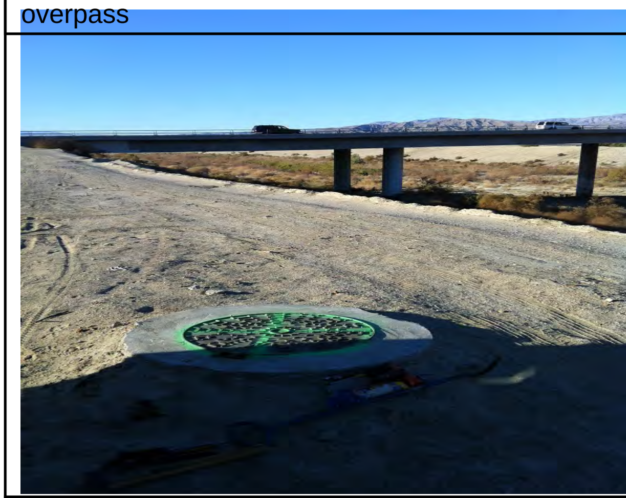
Weekly Flow Statistics for 10I-M110

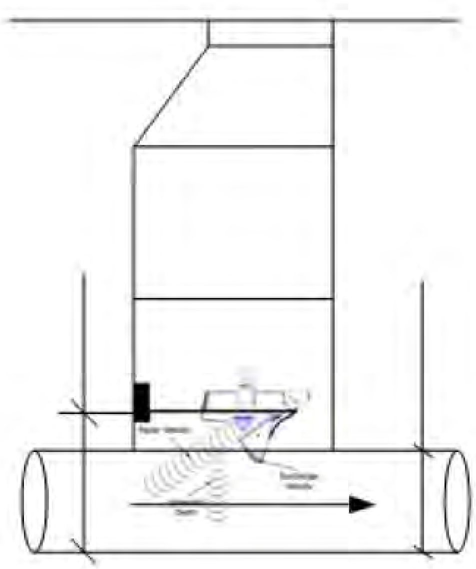
	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	606.37	728.66	449.41	0.87	1.05	0.65	1.89	2.07	1.68	7.64	8.54	6.48	873,176
1/5/2013	500.54	771.27	191.29	0.72	1.11	0.28	1.75	2.11	1.23	6.81	8.63	4.52	720,782
1/6/2013	519.10	774.60	191.27	0.75	1.12	0.28	1.79	2.11	1.24	6.88	8.63	4.50	747,508
Week:	**542.01**	**774.60**	**191.27**	**0.78**	**1.12**	**0.28**	**1.81**	**2.11**	**1.23**	**7.11**	**8.63**	**4.50**	**2,341,467**
1/7/2013	510.66	748.18	171.28	0.74	1.08	0.25	1.78	2.19	1.14	6.81	8.45	4.37	735,353
1/8/2013	514.63	759.18	186.60	0.74	1.09	0.27	1.80	2.19	1.22	6.82	8.37	4.46	741,073
1/9/2013	505.14	745.65	176.42	0.73	1.07	0.25	1.81	2.21	1.24	6.69	8.40	4.25	727,407
1/10/2013	491.82	745.64	179.08	0.71	1.07	0.26	1.80	2.14	1.27	6.61	8.22	4.18	708,218
1/11/2013	491.09	773.35	165.77	0.71	1.11	0.24	1.77	2.22	1.21	6.65	8.50	4.14	707,176
1/12/2013	492.37	816.05	176.91	0.71	1.18	0.25	1.74	2.16	1.21	6.74	8.91	4.33	709,006
1/13/2013	517.08	836.36	183.87	0.74	1.20	0.26	1.78	2.17	1.27	6.83	8.95	4.30	744,592
Week:	**503.26**	**836.36**	**165.77**	**0.72**	**1.20**	**0.24**	**1.78**	**2.22**	**1.14**	**6.74**	**8.95**	**4.14**	**5,072,825**
1/14/2013	496.39	762.44	163.44	0.71	1.10	0.24	1.77	2.09	1.17	6.71	8.48	4.19	714,803
1/15/2013	498.22	776.02	176.40	0.72	1.12	0.25	1.76	2.07	1.19	6.79	8.66	4.37	717,441
1/16/2013	487.88	720.46	163.48	0.70	1.04	0.24	1.74	2.09	1.16	6.72	8.23	4.22	702,552
1/17/2013	509.44	729.69	187.42	0.73	1.05	0.27	1.77	2.07	1.22	6.86	8.23	4.48	733,596
1/18/2013	482.63	732.13	164.46	0.69	1.05	0.24	1.73	2.11	1.14	6.69	8.19	4.27	694,985
1/19/2013	452.84	809.98	176.84	0.65	1.17	0.25	1.68	2.11	1.22	6.40	8.93	4.30	652,088
Week:	**487.90**	**809.98**	**163.44**	**0.70**	**1.17**	**0.24**	**1.74**	**2.11**	**1.14**	**6.69**	**8.93**	**4.19**	**4,215,466**

Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	MH-71-M060
Site Location	Golf Cntr Pkwy & 45th Ave

Access:	System Type:	Install Date: 1/5/2013
Dirt Road-next to concrete canal and overpass	Sanitary [X] Storm [ ]	





Manhole Depth (feet)	19 Feet
Pipe Size (inches)	15 Inches
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0

Hydraulics

Profile used ".2, .4, .8 of Depth Method " Three point profile through

cross section of flow.

Avg Velocity	Avg Measured Level	Multiplier
4.05	4 Inches	.9

Gas

O2	H2S	CO	LEL
20.9	.0	.0	.0

Notes

Traffic Safety

No Traffic. On dirt road. Key access

Land Use

Residential	Commercial	Industrial	Trunk
	X	X	

Meter Site Document

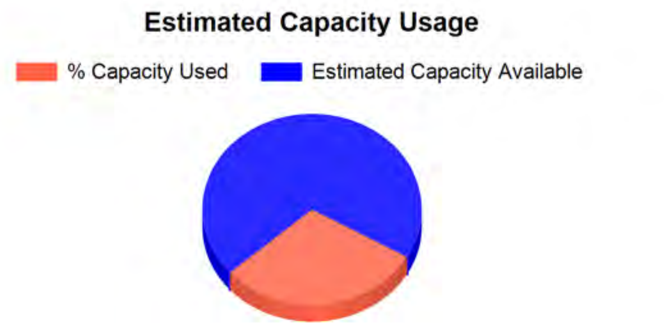
City	MWH Americas, Inc.
Site Name	MH-71-M060
Site Location	Golf Cntr Pkwy & 45th Ave
Access	Dirt Road-next to concrete canal and overpass

Temporary Flow Study

MWH Americas, Inc.

MH-71-M060

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	3.063	4.293	0.587
Maximum	5.077	5.872	1.069
Minimum	1.082	2.011	0.108
Pipe Size		15.000	
Estimated Capacity (mgd)		3.550	
Capacity Used		30.10 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 01/23/2013
Customer: MWH Americas, Inc.
Site: MH-71-M060
Pipe size: 15"

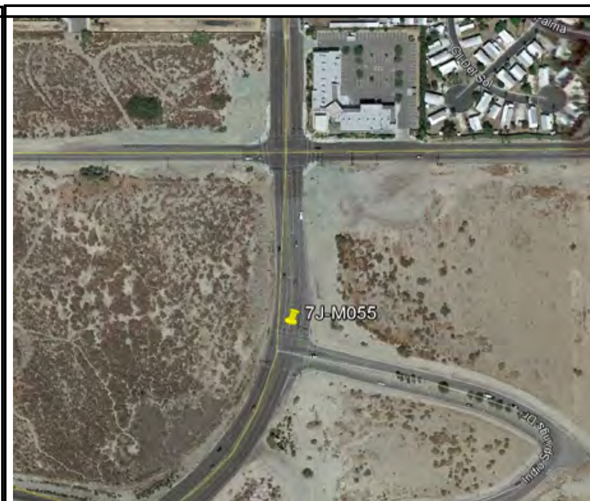
Weekly Flow Statistics for MH-71-M060

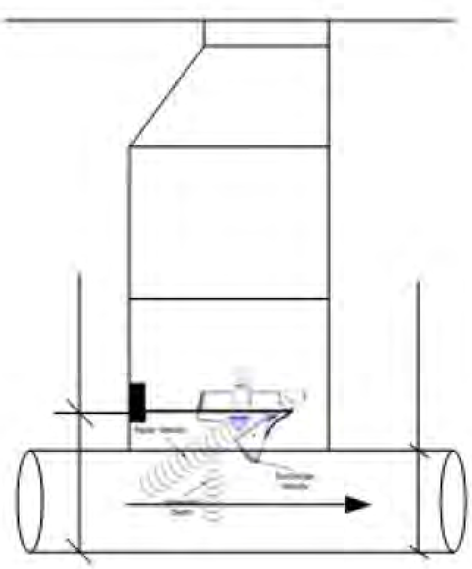
	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	501.21	640.82	338.25	0.72	0.92	0.49	4.35	4.89	3.80	3.93	4.40	3.15	721,746
1/5/2013	445.47	700.38	127.25	0.64	1.01	0.18	4.31	4.99	2.78	3.54	4.77	2.01	641,483
1/6/2013	459.60	678.63	148.66	0.66	0.98	0.21	4.40	5.08	3.38	3.58	4.69	2.01	661,827
Week:	**468.76**	**700.38**	**127.25**	**0.68**	**1.01**	**0.18**	**4.35**	**5.08**	**2.78**	**3.69**	**4.77**	**2.01**	**2,025,056**
1/7/2013	422.97	649.56	144.55	0.61	0.94	0.21	3.57	4.95	2.74	4.11	5.65	2.01	609,080
1/8/2013	367.77	522.29	118.31	0.53	0.75	0.17	2.40	3.04	1.44	4.66	5.73	2.98	529,582
1/9/2013	345.22	491.37	77.52	0.50	0.71	0.11	2.28	2.71	1.10	4.61	5.68	2.79	497,123
1/10/2013	367.98	674.65	81.20	0.53	0.97	0.12	2.41	3.48	1.08	4.60	5.79	2.89	529,884
1/11/2013	404.63	636.43	101.60	0.58	0.92	0.15	2.85	3.71	1.40	4.40	5.43	2.84	582,660
1/12/2013	435.26	706.07	132.05	0.63	1.02	0.19	3.11	3.83	2.00	4.34	5.54	2.62	626,768
1/13/2013	452.19	742.09	117.23	0.65	1.07	0.17	3.18	3.94	2.06	4.36	5.70	2.36	651,156
Week:	**399.43**	**742.09**	**77.52**	**0.58**	**1.07**	**0.11**	**2.83**	**4.95**	**1.08**	**4.44**	**5.79**	**2.01**	**4,026,253**
1/14/2013	426.24	619.85	127.03	0.61	0.89	0.18	3.02	3.77	2.16	4.41	5.58	2.46	613,788
1/15/2013	361.56	666.12	104.37	0.52	0.96	0.15	2.39	3.43	1.49	4.60	5.87	2.75	520,648
1/16/2013	435.12	652.35	107.92	0.63	0.94	0.16	2.94	3.63	1.51	4.50	5.47	2.69	626,570
1/17/2013	402.61	599.10	129.23	0.58	0.86	0.19	3.00	3.77	2.22	4.29	5.51	2.44	579,752
1/18/2013	384.16	594.36	75.31	0.55	0.86	0.11	2.68	3.49	1.10	4.39	5.55	2.72	553,184
1/19/2013	365.12	644.62	139.46	0.53	0.93	0.20	2.69	3.15	2.28	4.31	6.19	2.53	525,773
Week:	**395.80**	**666.12**	**75.31**	**0.57**	**0.96**	**0.11**	**2.79**	**3.77**	**1.10**	**4.42**	**6.19**	**2.44**	**3,419,716**

Site Installation Report

Customer:	MWH Americas, Inc.
Site Name:	7J-M055
Site Location	Golf Center Pky & 44th Avenue

Access:	System Type:	
Street Access – near casino	Sanitary X Storm ☐	Install Date: 1/5/2013





Manhole Depth (feet)	21
Pipe Size (inches)	36 Inches
Pipe Condition	Good
Manhole Material	Concrete
Silt (inches)	0.5

Hydraulics

Profile used “.2, .4, .8 of Depth Method ” Three point profile through cr

cross section of flow. Good even Flow

Avg Velocity	Avg Measured Level	Multiplier
2.16 FPS	7 inches	.9

Gas

O2	H2S	CO	LEL
21.9	19	.0	.0

Notes

High H2s

Traffic Safety

Very High Traffic Site

Land Use

Residential	Commercial	Industrial	Trunk
X	X		X

Meter Site Document

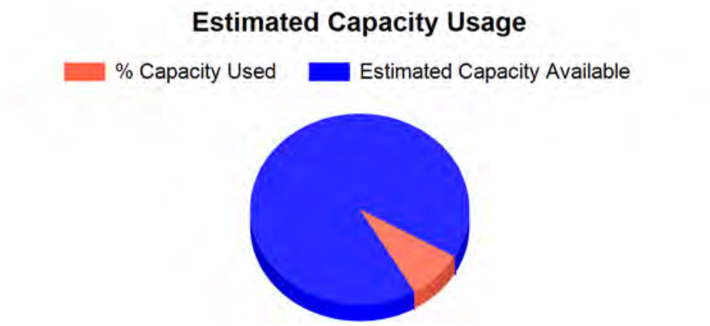
City	MWH Americas, Inc.
Site Name	7J-M055
Site Location	Golf Center Pky & 44th Avenue
Access	Street Access – near casino

Temporary Flow Study

MWH Americas, Inc.

7J-M055

Meter Start Date		From	1/5/2013 12:00:00 AM
Meter Stop Date		To	1/19/2013 12:00:00 AM
Velocity (fps)		Level (in)	Flow (mgd)
Average	1.868	6.996	1.212
Maximum	2.370	8.760	2.033
Minimum	1.160	4.660	0.402
Pipe Size		36.000	
Estimated Capacity (mgd)		24.231	
Capacity Used		8.39 %	
Sensor Type		Hach - Flodar	



Utility Systems, Science and Software

6190 Fairmount Ave. Suite E
San Diego, CA 92021

601 N. Parkcenter Drive Suite 209
Santa Ana, CA 92705

Utility Systems Science and Software

Report Date: 06/13/2013
Customer: MWH Americas, Inc.
Site: 7J-M055
Pipe size: 36"

Weekly Flow Statistics for 7J-M055

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)			
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total**
1/4/2013	1046.07	1151.01	884.98	1.51	1.66	1.27	2.08	2.17	1.94	7.76	8.07	7.26	1,506,338
1/5/2013	902.42	1384.37	385.49	1.30	1.99	0.56	1.92	2.35	1.33	7.19	8.69	5.30	1,299,478
1/6/2013	952.82	1412.08	371.65	1.37	2.03	0.54	1.96	2.37	1.30	7.35	8.76	5.25	1,372,056
Week:	**967.10**	**1412.08**	**371.65**	**1.39**	**2.03**	**0.54**	**1.99**	**2.37**	**1.30**	**7.43**	**8.76**	**5.25**	**4,177,873**
1/7/2013	949.02	1271.82	378.41	1.37	1.83	0.54	1.97	2.25	1.32	7.37	8.44	5.26	1,366,590
1/8/2013	875.41	1225.95	375.76	1.26	1.77	0.54	1.90	2.24	1.30	7.14	8.25	5.29	1,260,584
1/9/2013	855.66	1172.23	375.54	1.23	1.69	0.54	1.89	2.21	1.31	7.07	8.07	5.26	1,232,153
1/10/2013	858.85	1181.68	394.78	1.24	1.70	0.57	1.89	2.22	1.34	7.08	8.09	5.36	1,236,740
1/11/2013	844.89	1152.25	382.81	1.22	1.66	0.55	1.88	2.18	1.31	7.03	8.05	5.33	1,216,636
1/12/2013	897.66	1399.32	378.65	1.29	2.02	0.55	1.92	2.36	1.31	7.18	8.73	5.29	1,292,634
1/13/2013	930.59	1387.46	397.99	1.34	2.00	0.57	1.94	2.34	1.34	7.27	8.73	5.39	1,340,050
Week:	**887.44**	**1399.32**	**375.54**	**1.28**	**2.02**	**0.54**	**1.91**	**2.36**	**1.30**	**7.16**	**8.73**	**5.26**	**8,945,387**
1/14/2013	803.75	1140.89	373.70	1.16	1.64	0.54	1.85	2.17	1.30	6.89	8.04	5.27	1,157,395
1/15/2013	747.22	1114.38	278.83	1.08	1.60	0.40	1.77	2.15	1.16	6.64	7.94	4.66	1,075,998
1/16/2013	747.74	997.88	295.93	1.08	1.44	0.43	1.78	2.03	1.19	6.68	7.65	4.77	1,076,741
1/17/2013	689.59	961.63	295.23	0.99	1.38	0.43	1.73	2.03	1.18	6.47	7.48	4.79	993,003
1/18/2013	673.79	925.95	293.44	0.97	1.33	0.42	1.71	2.01	1.18	6.41	7.31	4.77	970,251
1/19/2013	612.98	983.35	309.20	0.88	1.42	0.45	1.64	2.23	1.21	6.13	7.26	4.86	882,690
Week:	**712.51**	**1140.89**	**278.83**	**1.03**	**1.64**	**0.40**	**1.75**	**2.23**	**1.16**	**6.54**	**8.04**	**4.66**	**6,156,078**

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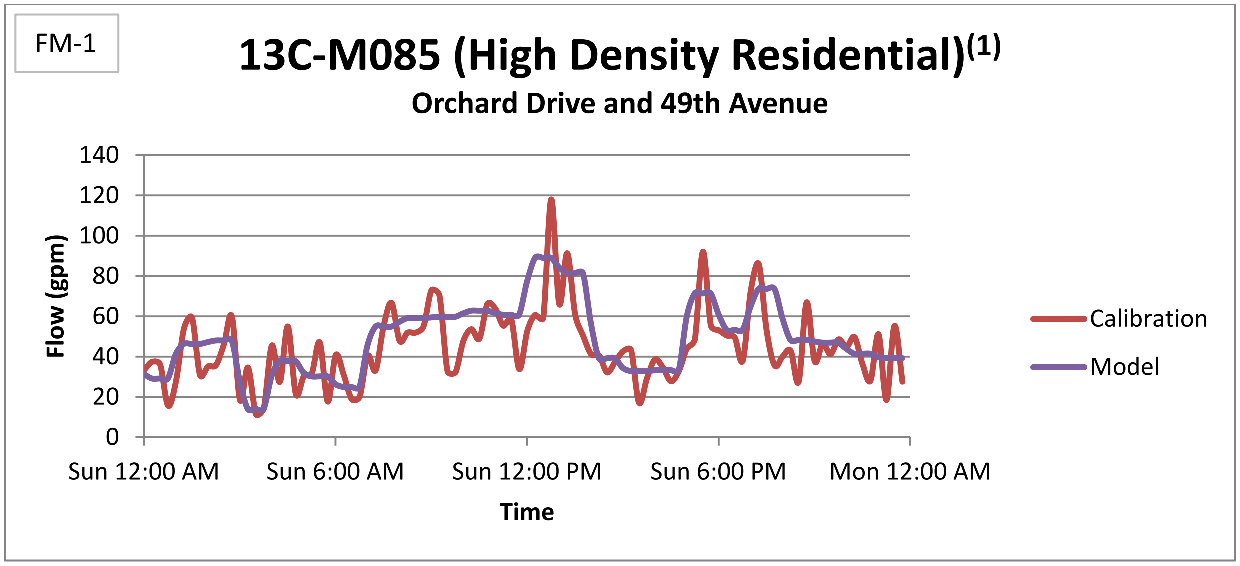
Appendix E
Final Land Uses and Calibration Results

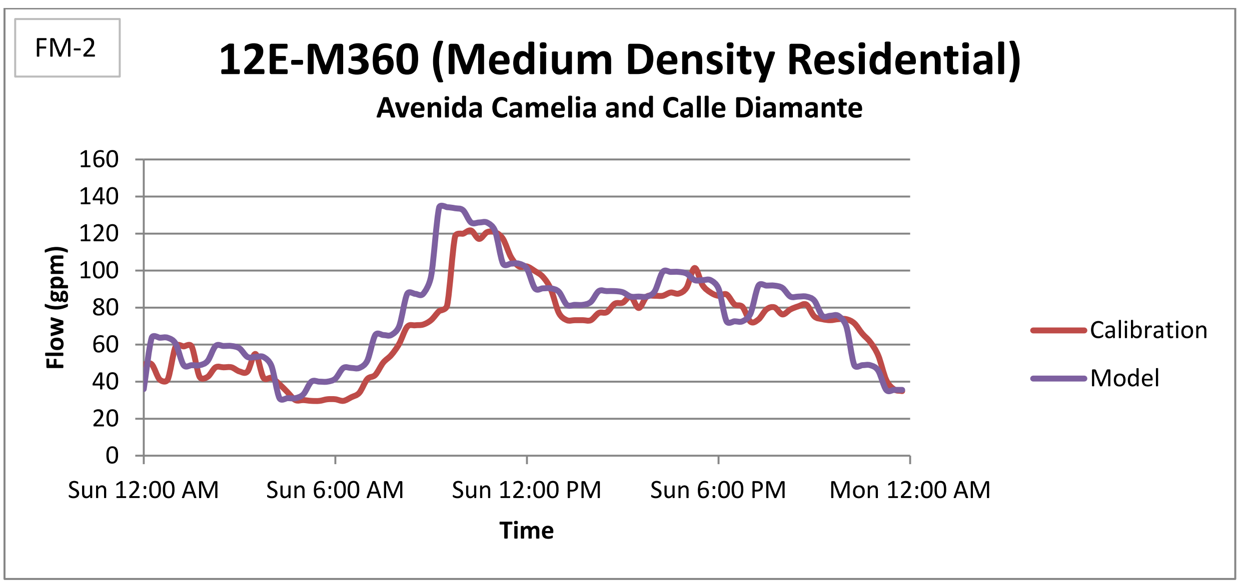
FINAL LAND USES AND DIURNAL MULTIPLES FOR EXISTING SYSTEM

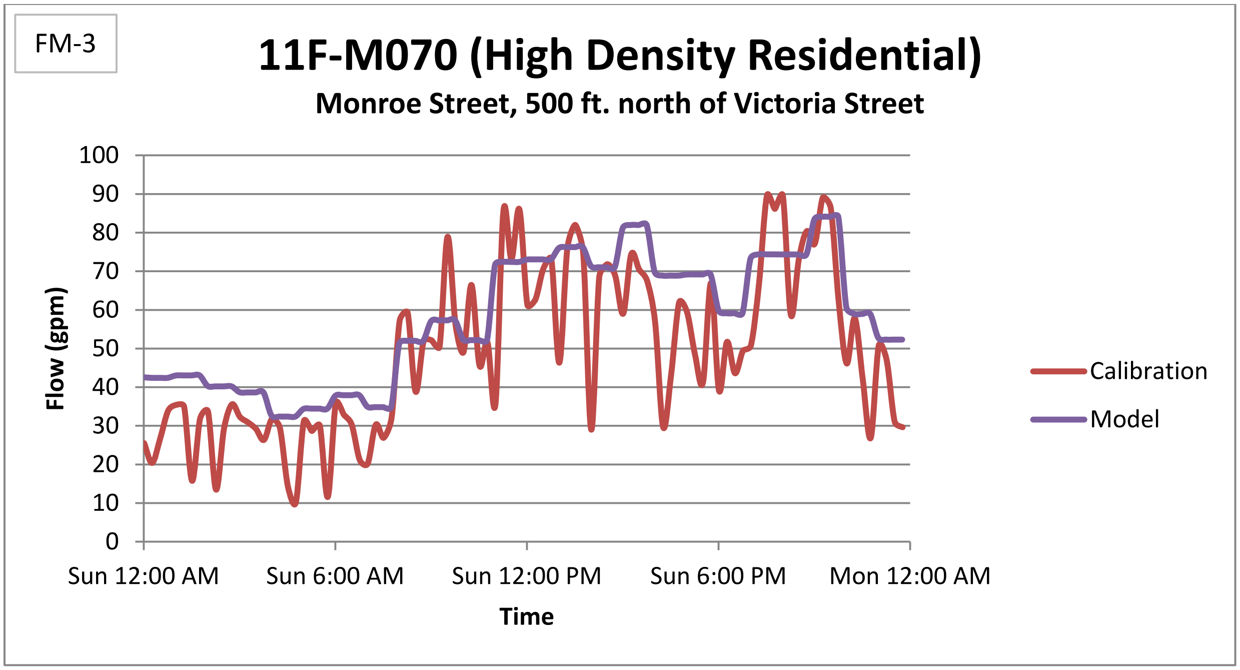
Pattern	Description	Diurnal Multiple (Weekend/ Weekday)
Commercial Central	Commercial flow in the central portion of the system	1.06/1.01
Commercial High_FM	Used only for area tributary to manhole 9F-M360 (Flow Monitor No. 5) which showed unusually high flows for flow monitoring period and was assigned its own duty factor separate from other commercial property in the system	1.10/1.00
Commercial North	Commercial flow in the northern portion of the system	1.10/1.00
Commercial North Central	Commercial flow in the north-central portion of the system	1.48/0.91
Commercial North Central High	Higher commercial flow in the north-central portion of the system	1.48/0.91
Commercial South	Commercial flow in the southern portion of the system	1.26/1.19
Commercial South Central	Commercial flow in the south-central portion of the system	1.52/1.36
Existing Jail	Flows from the existing detention center on Highway 111	1.00/1.00
Industrial North Central	Industrial flows in the north-central portion of the system	1.48/0.91
Industrial South Central	Industrial flows in the south-central portion of the system	1.52/1.36
Mixed Use	Mixed-use flows throughout the system	0.69/0.69
Open	Open areas throughout the system	1.00/1.00
Public	Public flows throughout the system	0.64/1.00
Residential Central	Residential flow in the central portion of the system	1.11/1.08
Residential High	High residential flow throughout the system	1.00/1.00
Residential North	Residential flow in the northern portion of the system	0.96/0.87
Residential North Central	Residential flow in the north-central portion of the system	1.49/0.91
Residential South	Residential flow in the southern portion of the system	1.00/0.75
Residential South Central	Residential flow in the south-central portion of the system	1.50/1.32
Residential South Low	Lower residential flow in the southern portion of the system	1.06/1.06
Septic	Septic areas in the system (no flow, given same duty factor and diurnal pattern as open areas)	1.00/1.00
Vacant	Vacant areas in the system (no flow, given same duty factor and diurnal pattern as open areas)	1.00/1.00

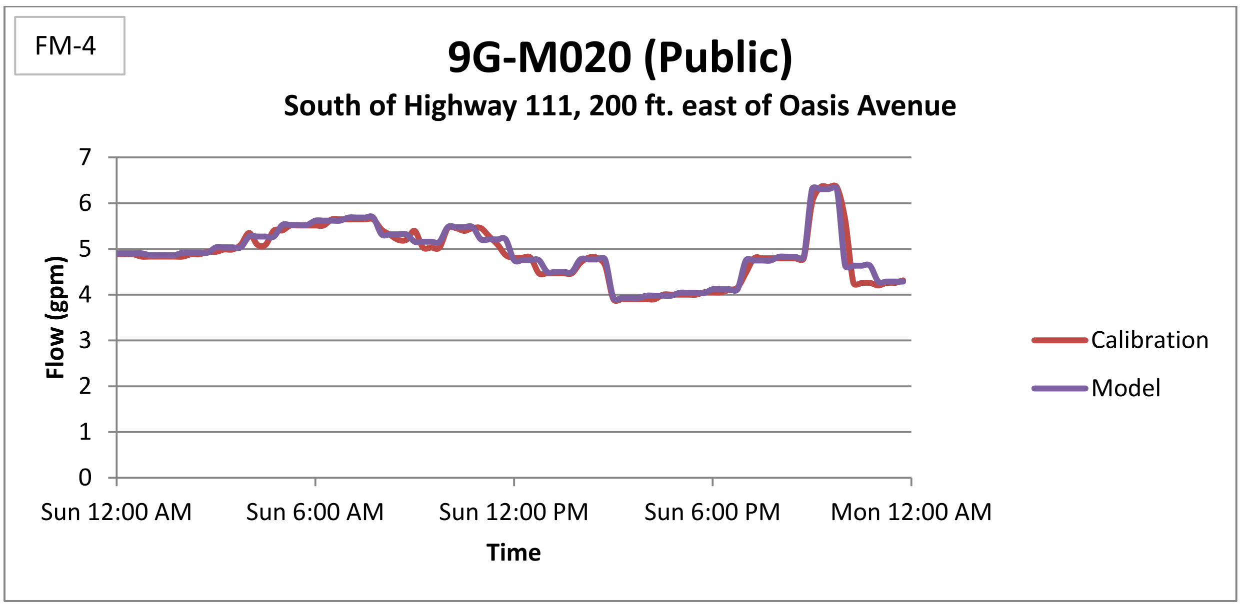
CALIBRATION RESULTS

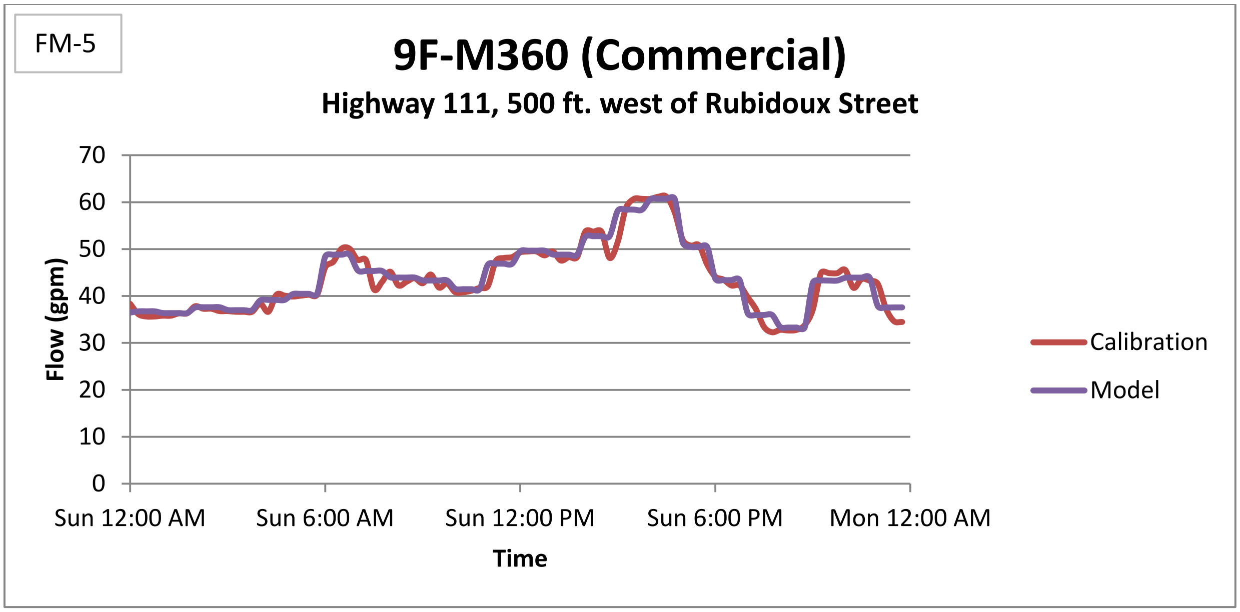
Weekend Calibration Day – Sunday, January 6th, 2013

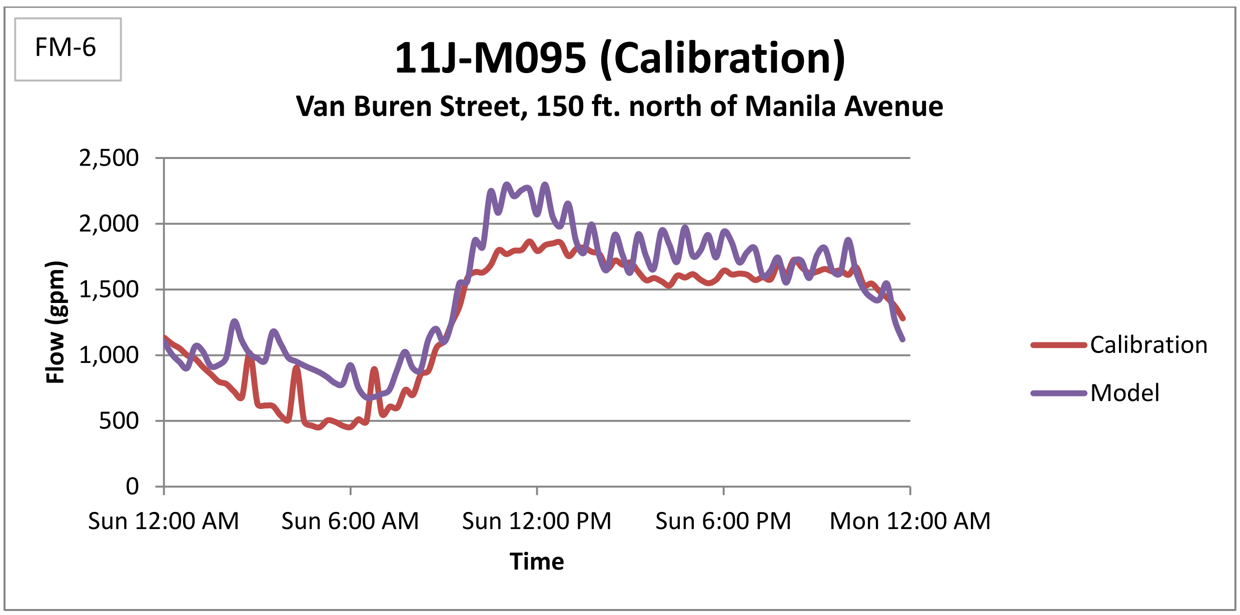


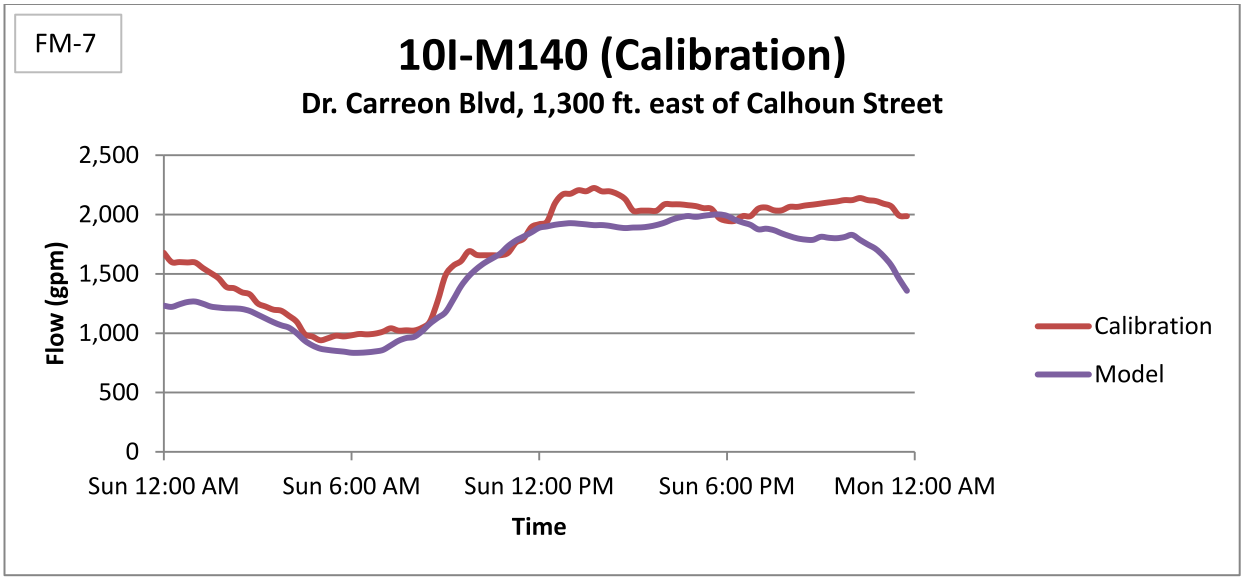


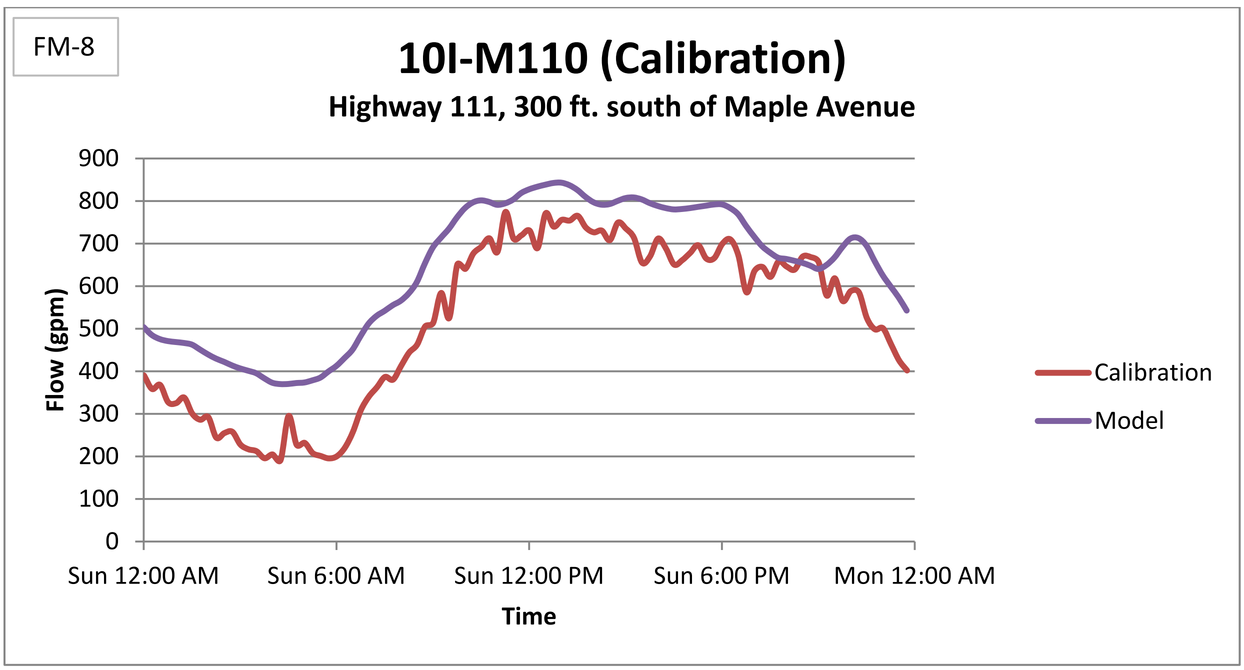

FM-3
11F-M070 (High Density Residential)
Monroe Street, 500 ft. north of Victoria Street
Flow (gpm)
100
90
80
70
60
50
40
30
20
10
0
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

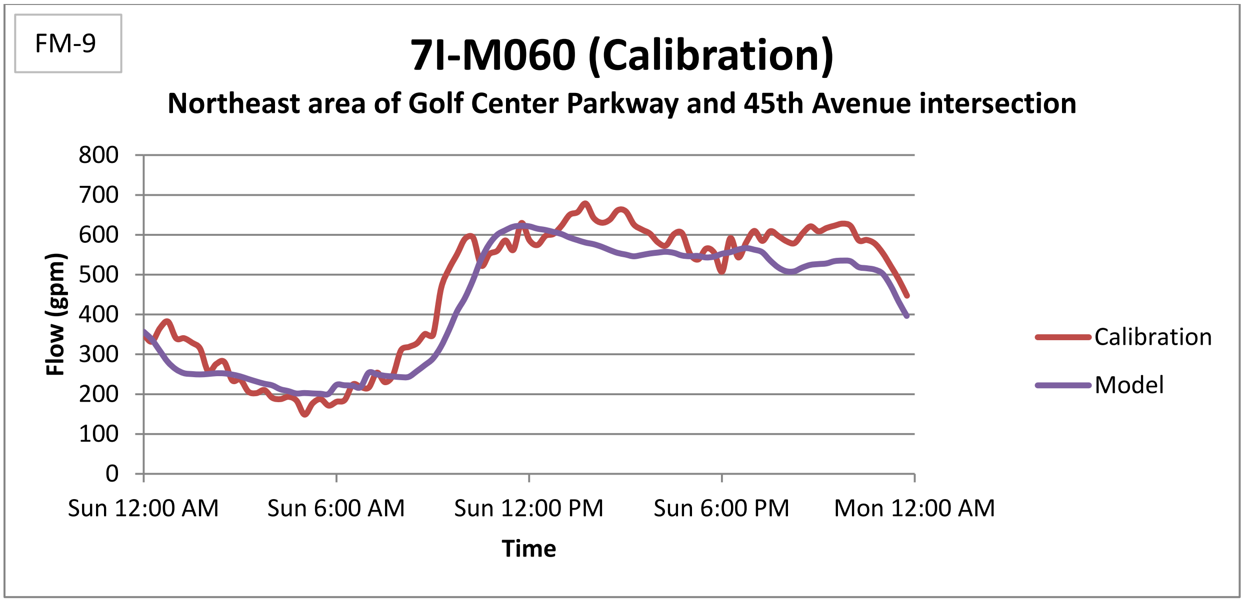

FM-4
9G-M020 (Public)
South of Highway 111, 200 ft. east of Oasis Avenue
Flow (gpm)
7
6
5
4
3
2
1
0
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

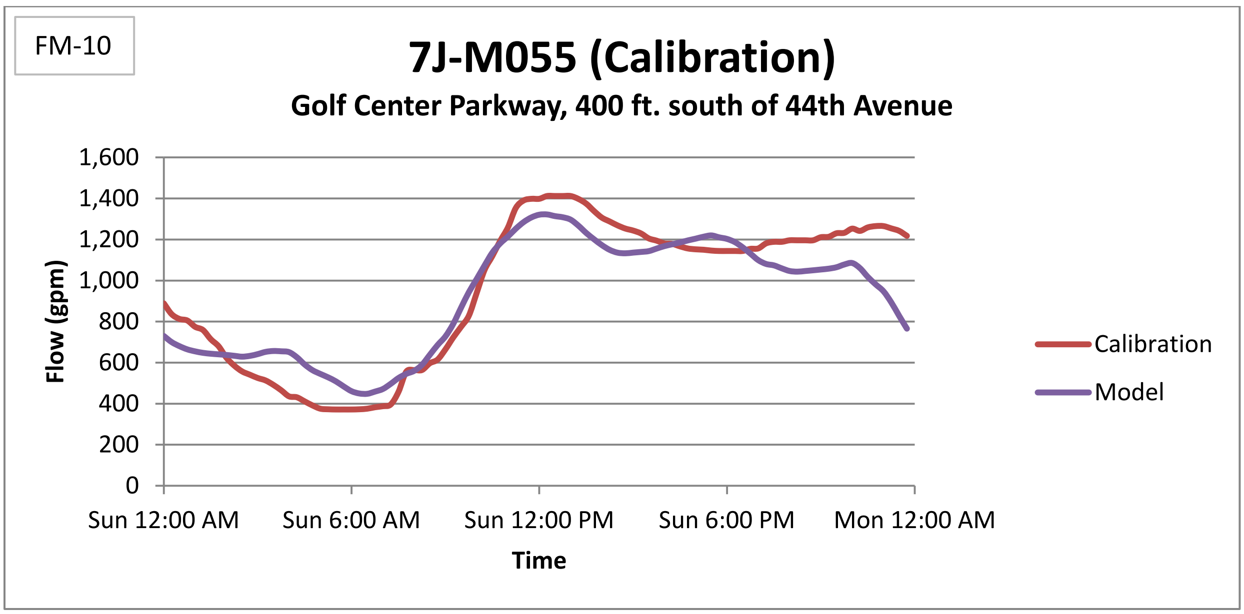

FM-5
9F-M360 (Commercial)
Highway 111, 500 ft. west of Rubidoux Street
70
60
50
40
30
20
10
0
Flow (gpm)
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

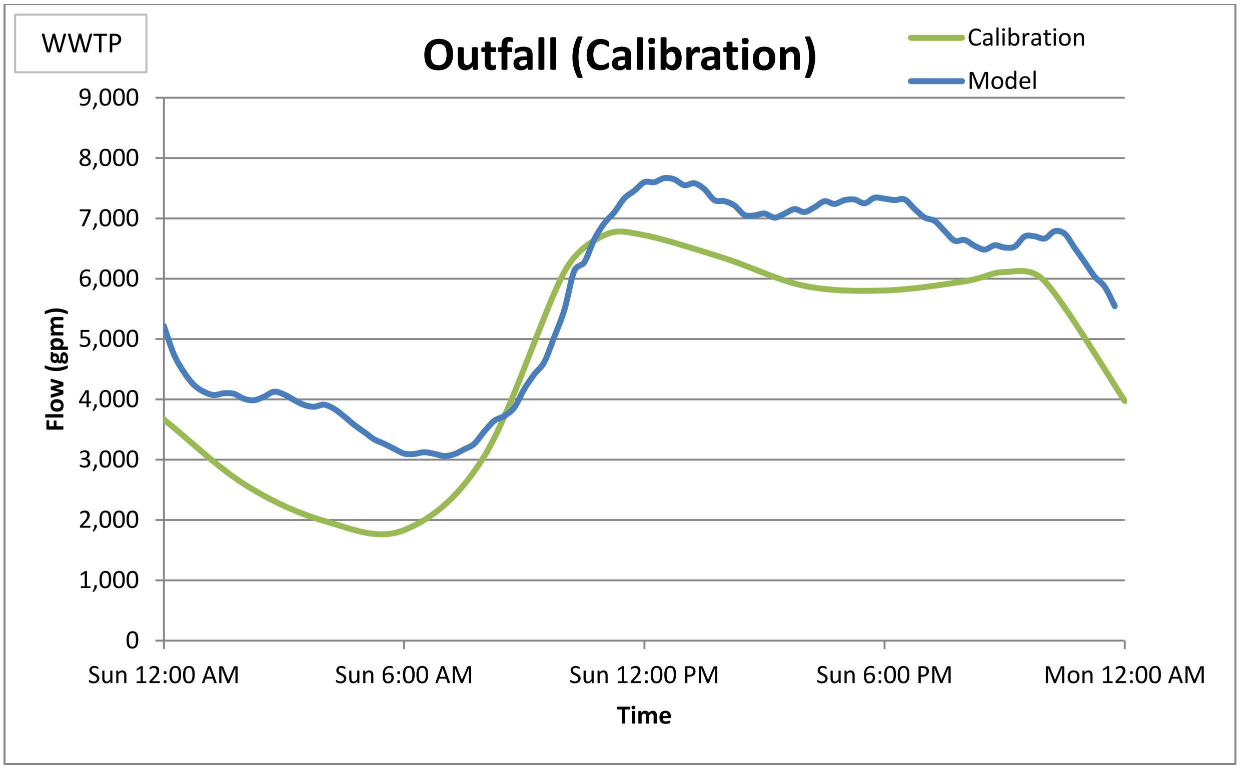

FM-6
11J-M095 (Calibration)
Van Buren Street, 150 ft. north of Manila Avenue
2,500
2,000
1,500
1,000
500
0
Flow (gpm)
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model


FM-7
10I-M140 (Calibration)
Dr. Carreon Blvd, 1,300 ft. east of Calhoun Street
Flow (gpm)
2,500
2,000
1,500
1,000
500
0
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

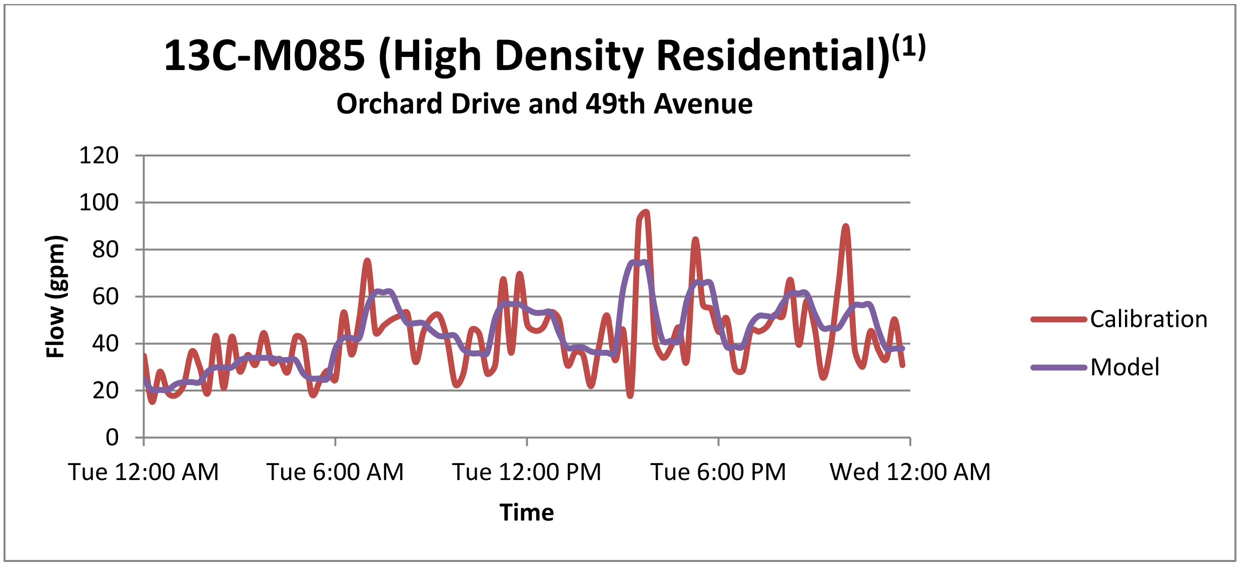

FM-8
10I-M110 (Calibration)
Highway 111, 300 ft. south of Maple Avenue
Flow (gpm)
900
800
700
600
500
400
300
200
100
0
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

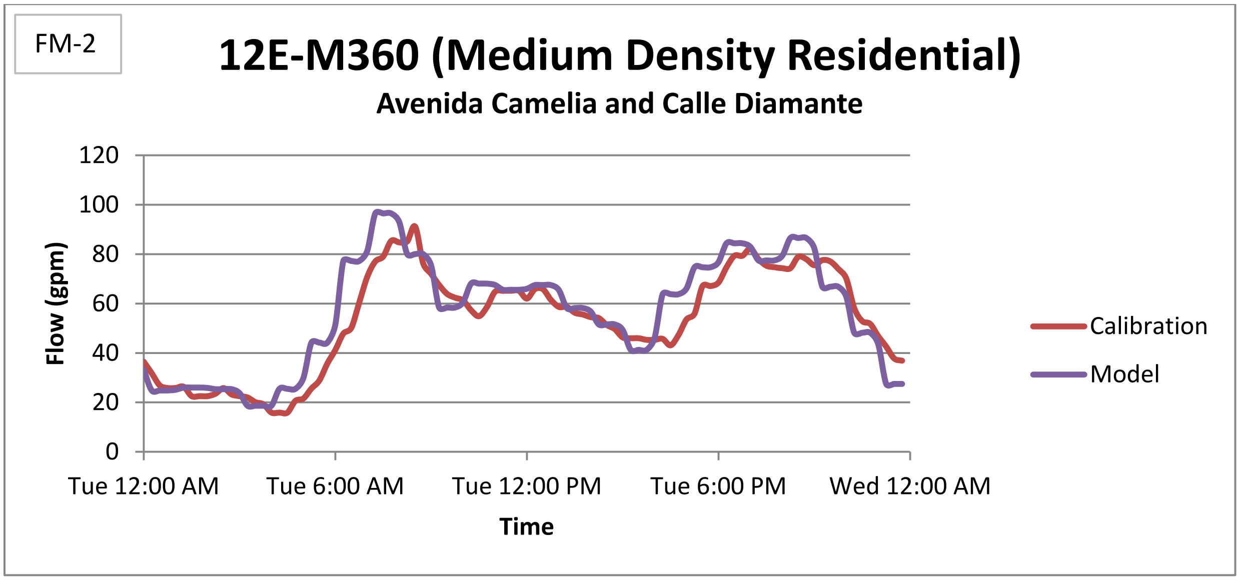

FM-9
7I-M060 (Calibration)
Northeast area of Golf Center Parkway and 45th Avenue intersection
800
700
600
500
400
300
200
100
0
Flow (gpm)
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

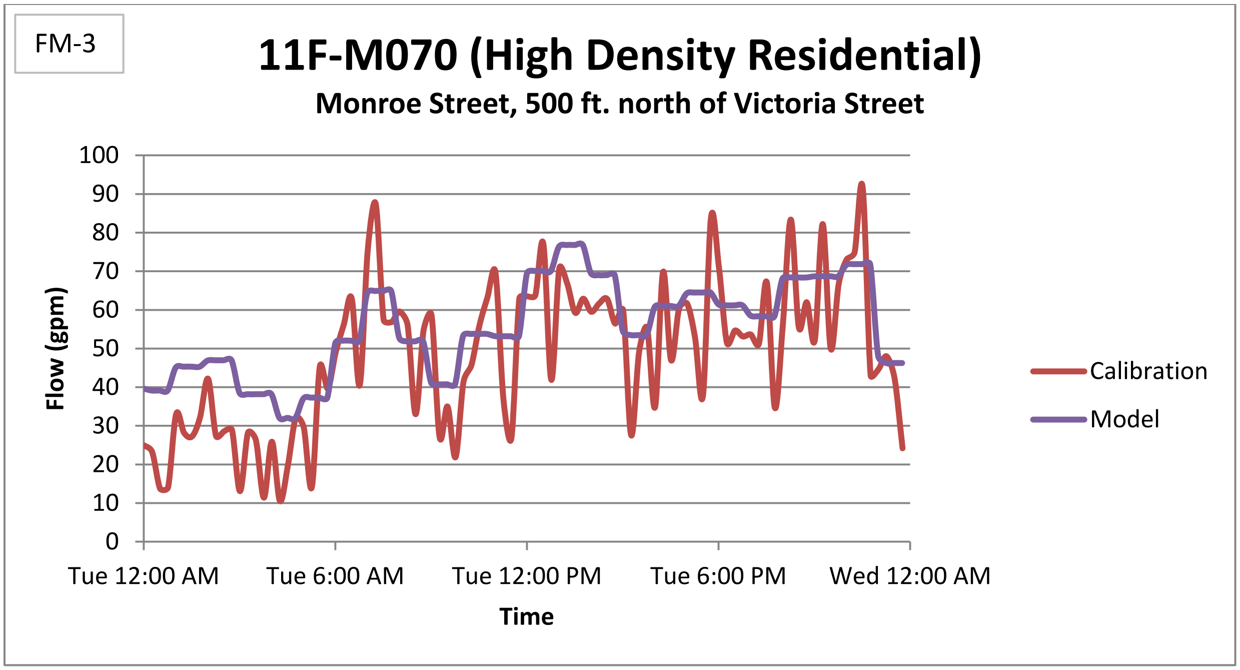

FM-10
7J-M055 (Calibration)
Golf Center Parkway, 400 ft. south of 44th Avenue
1,600
1,400
1,200
1,000
800
600
400
200
0
Flow (gpm)
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time
Calibration
Model

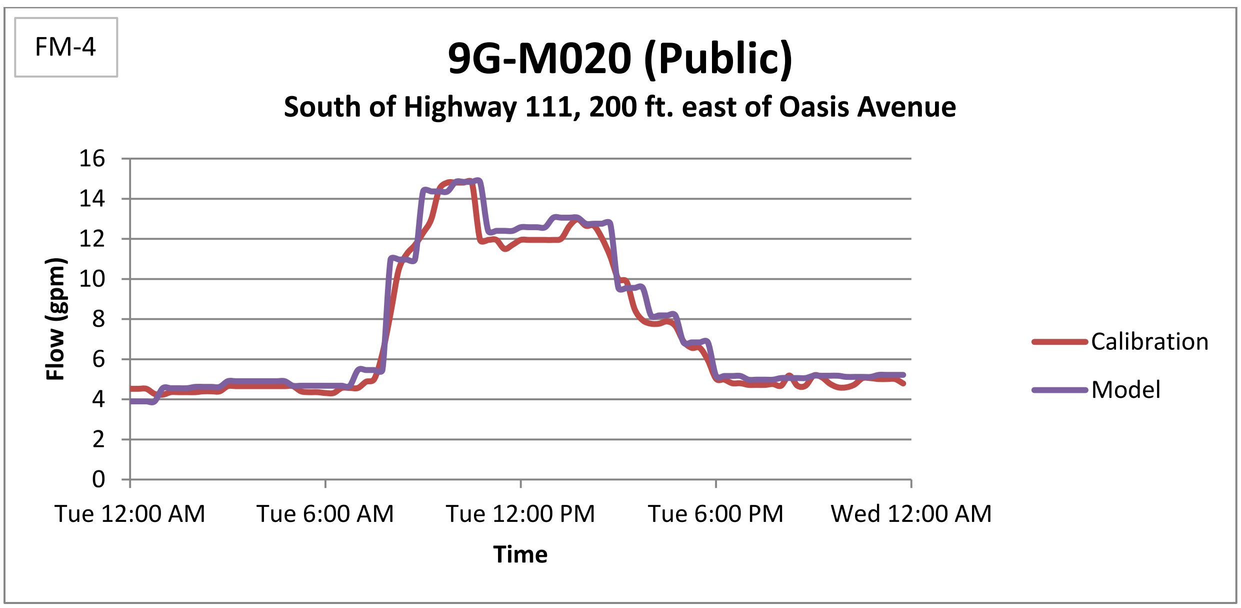

WWTP
Outfall (Calibration)
Calibration
Model
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Flow (gpm)
Sun 12:00 AM
Sun 6:00 AM
Sun 12:00 PM
Sun 6:00 PM
Mon 12:00 AM
Time

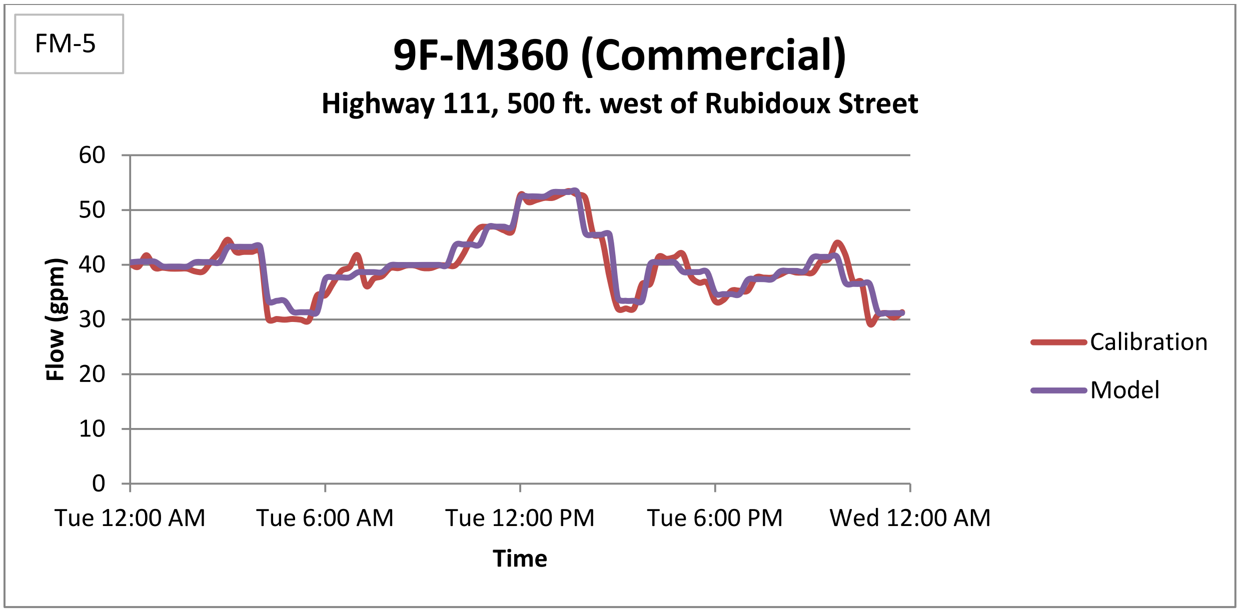
Weekday Calibration Day – Tuesday January 8th, 2013






FM-3
11F-M070 (High Density Residential)
Monroe Street, 500 ft. north of Victoria Street
Flow (gpm)
100
90
80
70
60
50
40
30
20
10
0
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model


FM-4
9G-M020 (Public)
South of Highway 111, 200 ft. east of Oasis Avenue
Flow (gpm)
16
14
12
10
8
6
4
2
0
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model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9F-M360 (Commercial)
Highway 111, 500 ft. west of Rubidoux Street
60
50
40
30
20
10
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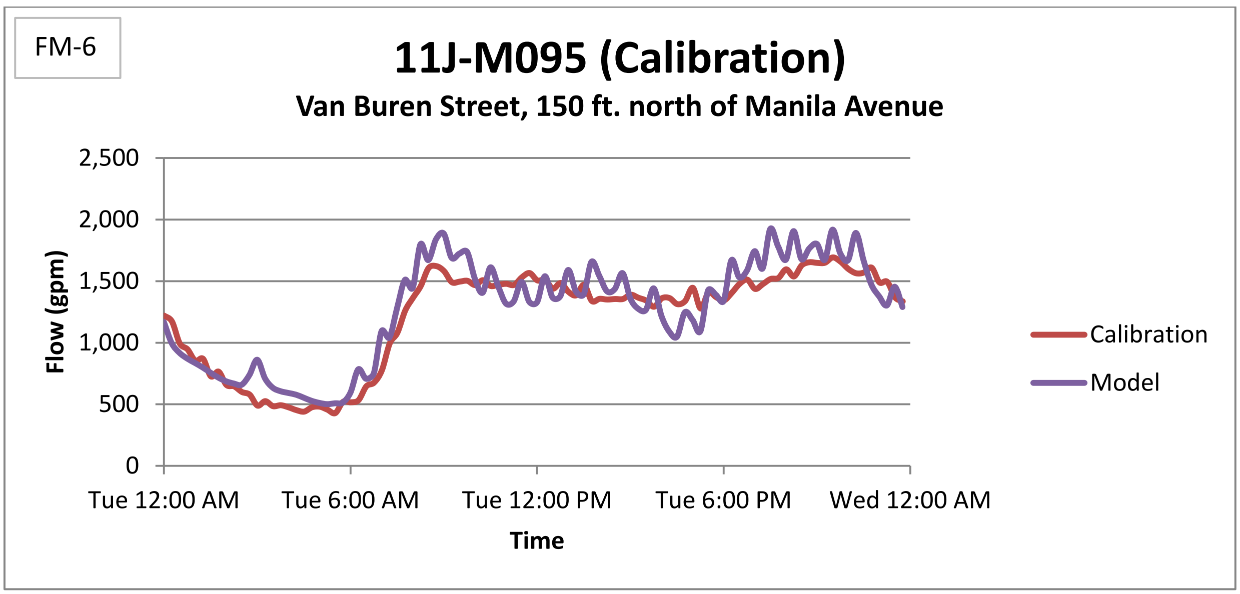
Flow (gpm)
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model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2,500
2,000
1,500
1,000
500
0
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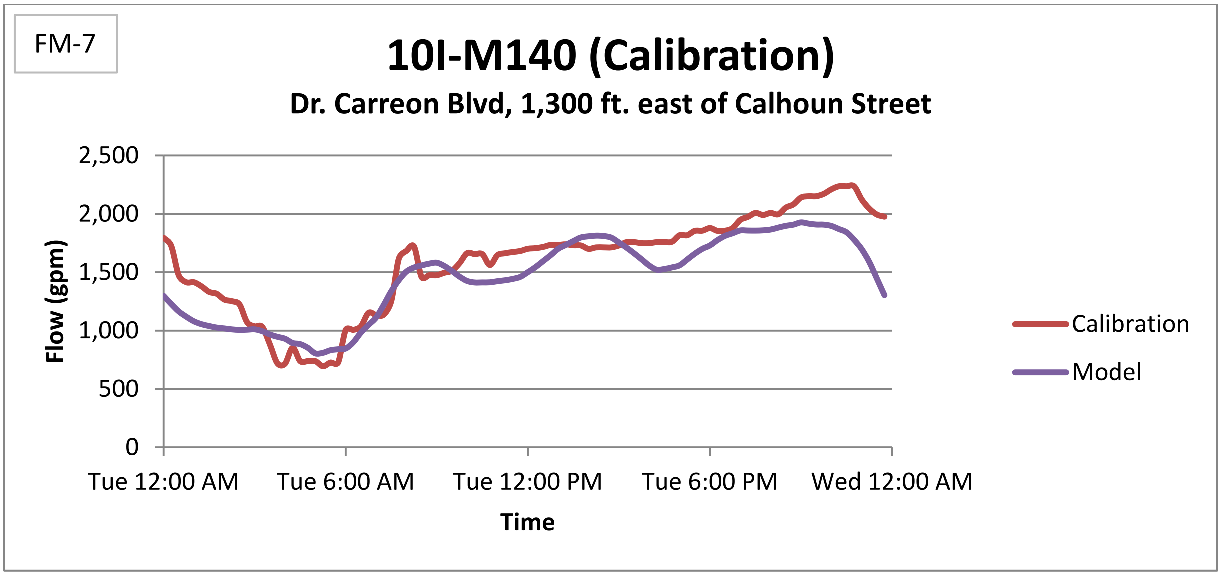
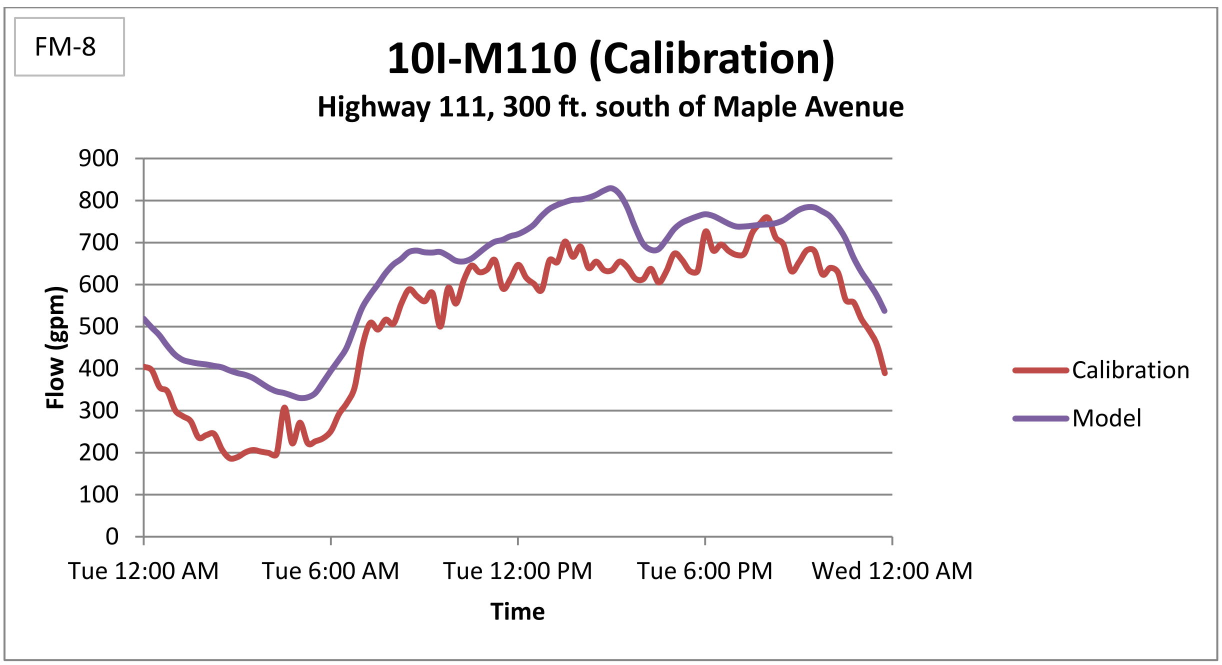
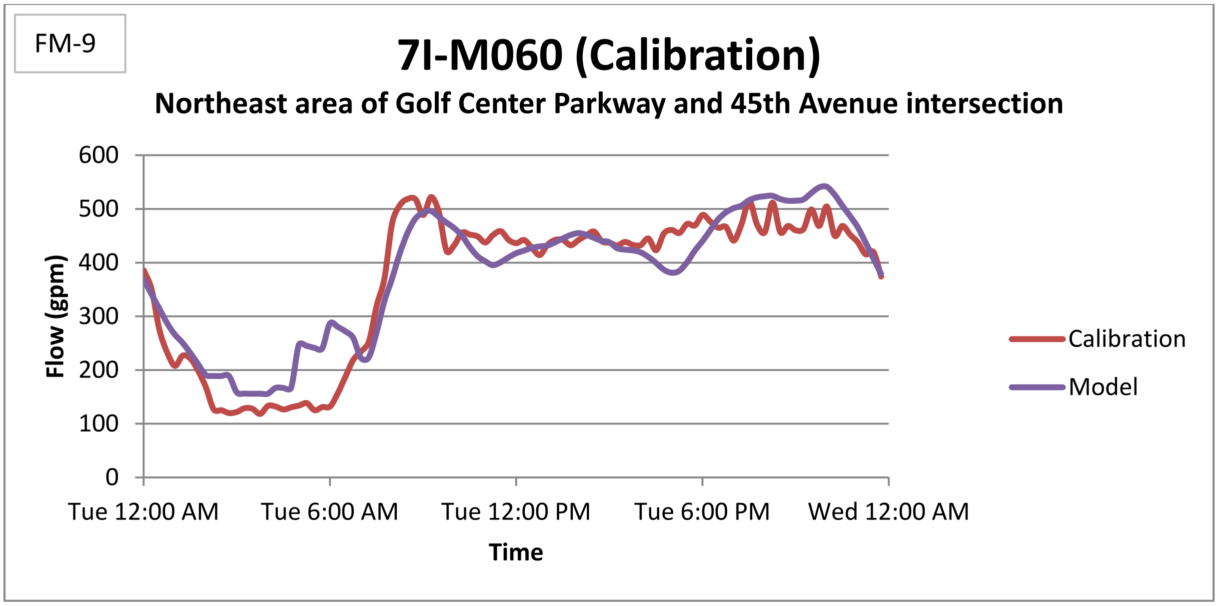
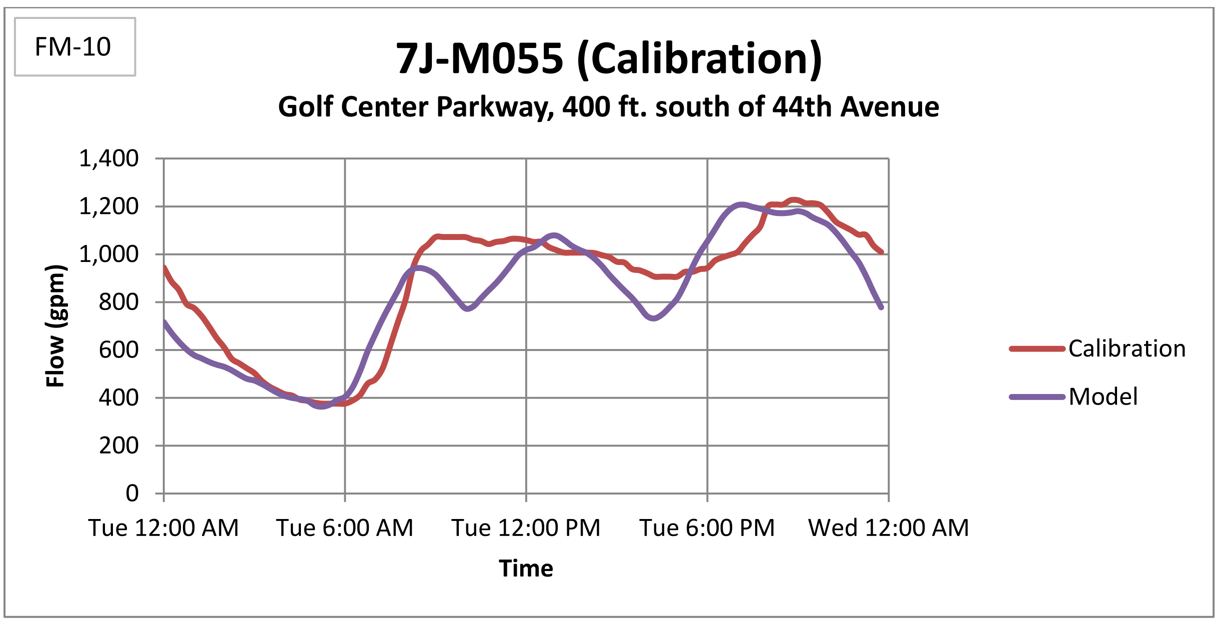
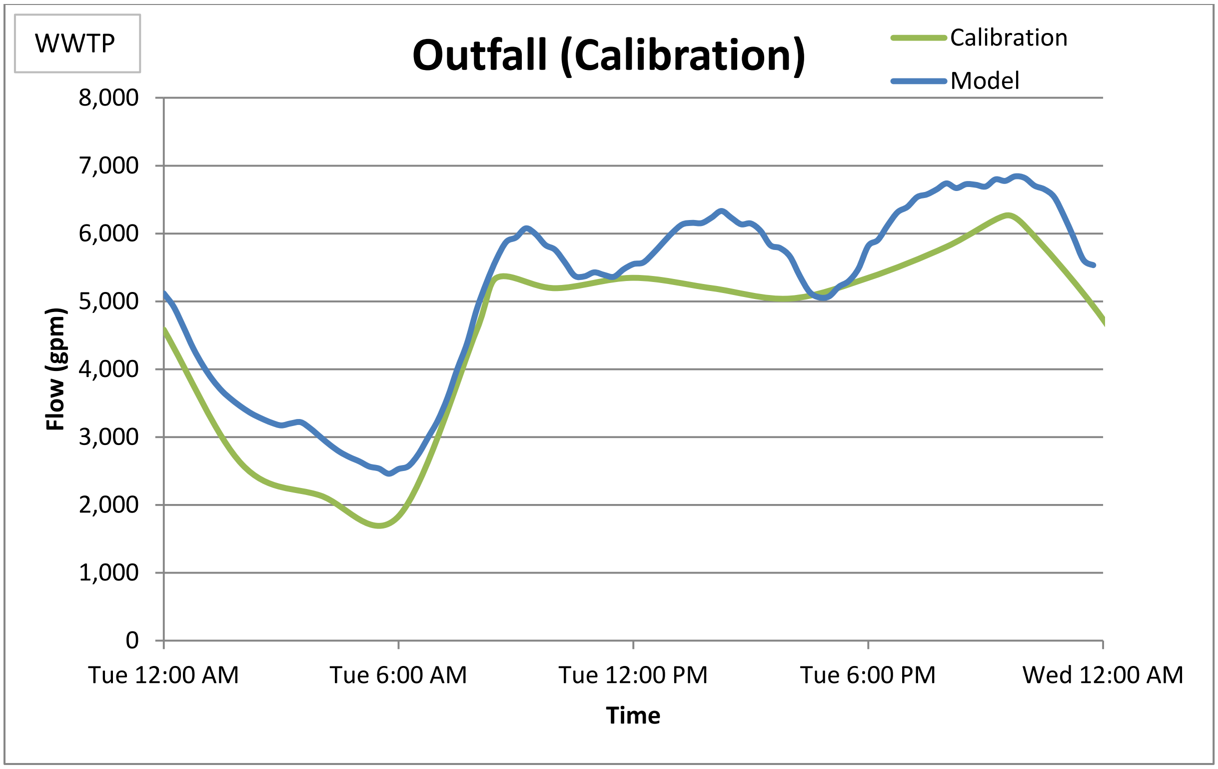
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model


FM-7
10I-M140 (Calibration)
Dr. Carreon Blvd, 1,300 ft. east of Calhoun Street
Flow (gpm)
2,500
2,000
1,500
1,000
500
0
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model


FM-8
10I-M110 (Calibration)
Highway 111, 300 ft. south of Maple Avenue
Flow (gpm)
900
800
700
600
500
400
300
200
100
0
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model


FM-9
7I-M060 (Calibration)
Northeast area of Golf Center Parkway and 45th Avenue intersection
Flow (gpm)
600
500
400
300
200
100
0
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model


FM-10
7J-M055 (Calibration)
Golf Center Parkway, 400 ft. south of 44th Avenue
Flow (gpm)
1,400
1,200
1,000
800
600
400
200
0
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time
Calibration
Model


WWTP
Outfall (Calibration)
Calibration
Model
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Flow (gpm)
Tue 12:00 AM
Tue 6:00 AM
Tue 12:00 PM
Tue 6:00 PM
Wed 12:00 AM
Time

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Appendix F
Technical Memorandum – Sewer System Planning and Design Criteria

Below is the Sewer System Planning and Design Criteria Technical Memorandum (TM) prepared for Valley Sanitary District (VSD). This TM was delivered to VSD on October 1, 2012.

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TECHNICAL MEMORANDUM

To:	Joe Glowitz, VSD	**Date:**	October 1, 2012
From:	Alok Pandya, MWH Jinny Huang, MWH	**Reference:**	10500972/6.2

Subject: Sewer System Planning and Design Criteria

Introduction

This Technical Memorandum (TM) summarizes Valley Sanitary District's (VSD) planning and sewer system design criteria for the Collection System Master Plan. System characteristics such as per capita flow and peaking factors are discussed, in addition to wastewater flow criteria of flow allocation of the sewer model. These criteria are based on industry guidelines and literature and MWH experience of similar systems. These criteria will serve as the starting point for establishing the size and slope of future sewers, including gravity trunk sewers and force mains, the design and layout of various system features, and as a guide to develop the proposed improvement project costs.

Deviations from the recommended guidelines may be necessary in defining specific improvement projects for an existing sewer collection system due to the restrictions posed by existing upstream and downstream conditions. In these special circumstances, design criteria will need to be determined on a case-by-case basis.

Wastewater Flow Criteria

Flow generation for existing conditions is based on a flow pattern for different land uses and the per capita flow generation by land use. Projected wastewater flows is based on future population information and changes in land use. Flows generated for each land use will be determined by flow monitoring results to be conducted during the month of November to capture typical dry weather flow data. Existing zoning, future land use, and population for the VSD service area is discussed in the following section.

Land Use

The VSD service area is approximately 12,800 acres of land which includes mostly of areas in the City of Indio and unincorporated areas of Riverside County. Existing zoning information for the service area is provided in a GIS shapefile from the 2010 City of Indio General Plan, which contains over 30 land use categories. Existing zoning information for the unincorporated areas is based from the Riverside County General Plan GIS shapefile or determined by visual inspection using aerial images.

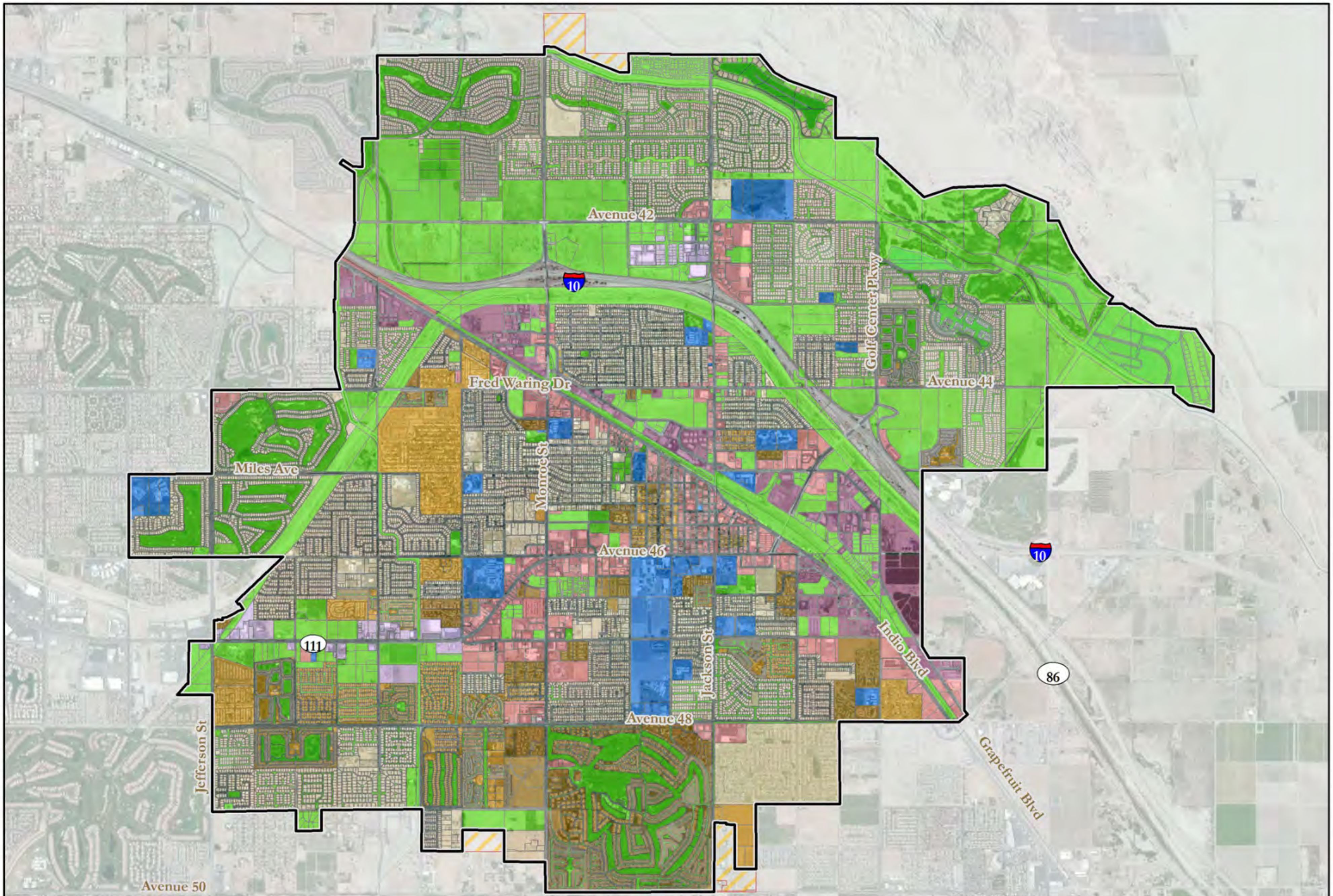
MWH grouped specific land use types into eight general categories. These land use categories used for the VSD sewer model include residential high, residential medium, residential low, commercial, mixed use, open space, industrial, and public. A list of land use categories and percentage of total VSD service area by land use is provided in Table 1.

MWH reviewed existing land use information and observed inconsistencies between the land uses designated in the general plan and aerial images. Existing land use for the VSD area was refined to appropriately match one of the eight general categories and shown in Figure 1.

Future zoning information is also based on the City of Indio and Riverside County general plans, and grouped into the same eight categories. In reviewing the future zones, oddities in select areas of the system were observed, where land use in the general plan was modified from a high density type land use to lower density type land use (e.g., residential to open space or residential to commercial). In this case, MWH would select the land use with the higher density land use type as the modified future zone. Selecting a higher density land use for the future would provide for a more conservative estimation of flow for that area. A major difference between existing land use and future zoning includes the conversion of open land to residential high, which increases residential high from about 6 to 22 percent. There are also areas of existing residential low land use that is zoned for residential high in the future, which decreases residential low from about 26 to 22 percent. The VSD area will also be expanded in the future to include annexed areas as shown in Figure 2.

Table 1
VSD Existing Land Use and Future Zoning Categories by Area

VSD Zone	Existing Land Use		Future Zoning	
	Area (acre)	Percent Total Area (%)	Area (acre)	Percent Total Area (%)
Residential High	723	5.7%	2,860	22.2%
Residential Medium	966	7.6%	739	5.7%
Residential Low	3,328	26.1%	2,852	22.3%
Commercial	735	5.8%	1,063	8.2%
Mixed Use	137	1.1%	777	6.0%
Open Space	5,989	46.9%	3,574	27.7%
Industrial	437	3.4%	542	4.2%
Public	452	3.5%	457	3.5%
Total	**12,768**	**100%**	**12,882**	**100%**



Key to Features

- Valley Sanitary District Boundary
- Commercial
- Industrial
- Mixed Use
- Open Space
- Public
- Residential High
- Residential Medium
- Residential Low
- Future Annexation

0 0.25 0.5 Miles

N

Document: \\Uspas1s01\muni\Clients\Valley San District\IDIQ As-Needed\Task 1 -Sewer System MP\14 Electronic Files - Modeling_MXDs\GenLandUse.mxd

Date: **September 27, 2012**

Generalized Existing Land Use

Figure 1

MWH

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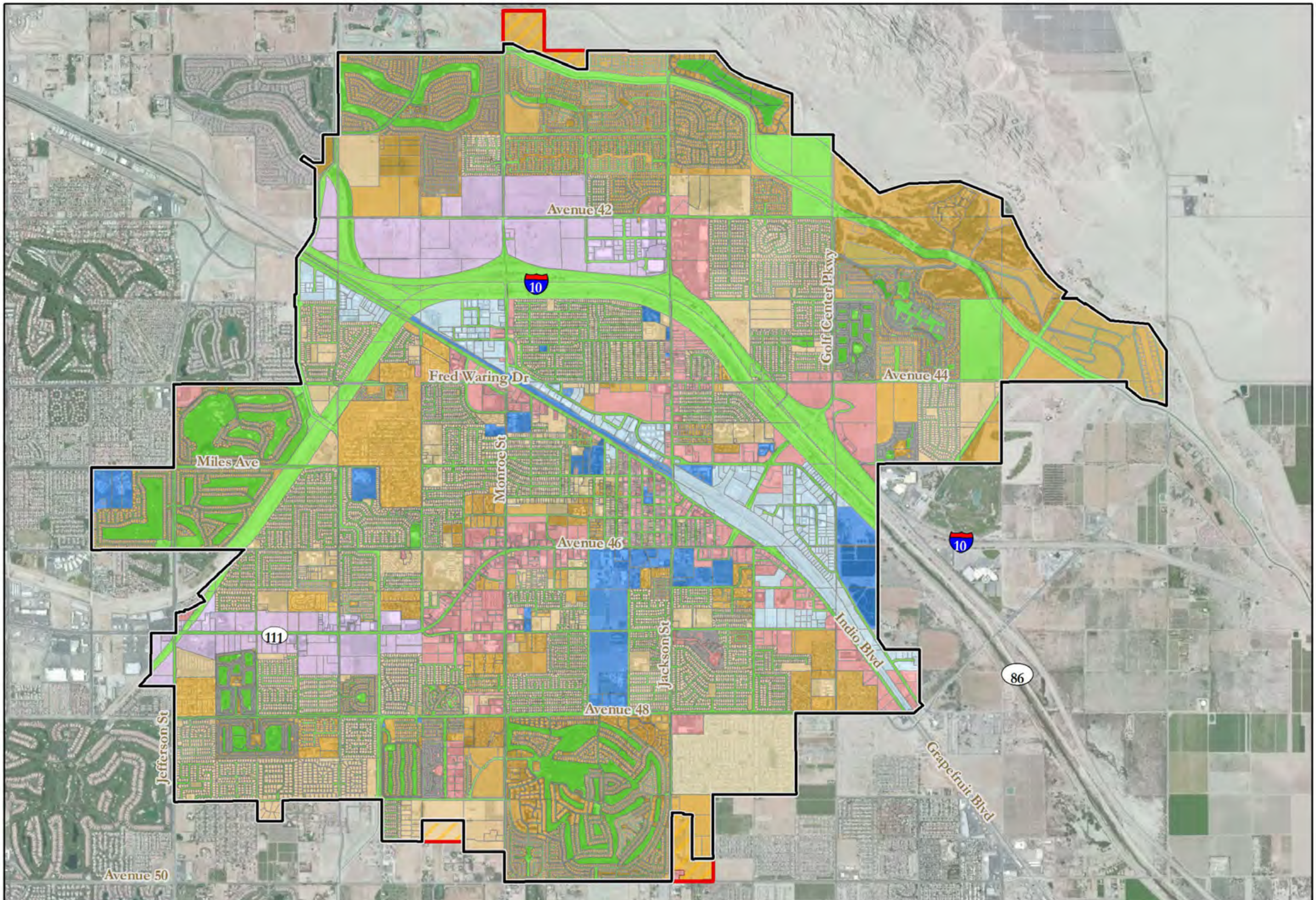

Key to Features

- Valley Sanitary District Boundary
- Future Valley Sanitary District Boundary
- Future Annexation
- Commercial
- Industrial
- Mixed Use
- Open
- Public
- Residential High
- Residential Medium
- Residential Low

N

0 0.25 0.5 Miles

Document: \\Uspas1s01\muni\Clients\Valley San District\IDIQ As-Needed\Task 1 -Sewer System MP\14 Electronic Files - Modeling_MXDs\ZoningGeneral.mxd

Date: September 24, 2012

Generalized Future Zoning

Figure 2

MWH

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Residential

Residential land use consists of about 40 percent of the total service area. Approximately 66 percent is low-density residential homes (single-family homes), 20 percent is medium-density residential homes (multi-family home, condominiums, mobile homes), and the other 14 percent of residential land is high-density residential homes (apartment buildings).

Based on the City of Indio Code of Ordinances, residential densities for low-, medium, and high-density residential typically range 3.5 to 4.0, 6.0 to 8.0, and 12.0 to 15.0 dwelling units per acre (du/acre), respectively. According to the 2010 Census Bureau, there is about 2.89 person per dwelling unit in California. Using the population in 2010 of 76,036 and an average daily wastewater flow generation from the treatment plant of approximately 6.107 million gallons per day as depicted in Figure 3, the wastewater generation for residential land use would be 80.3 gallons per person per day.

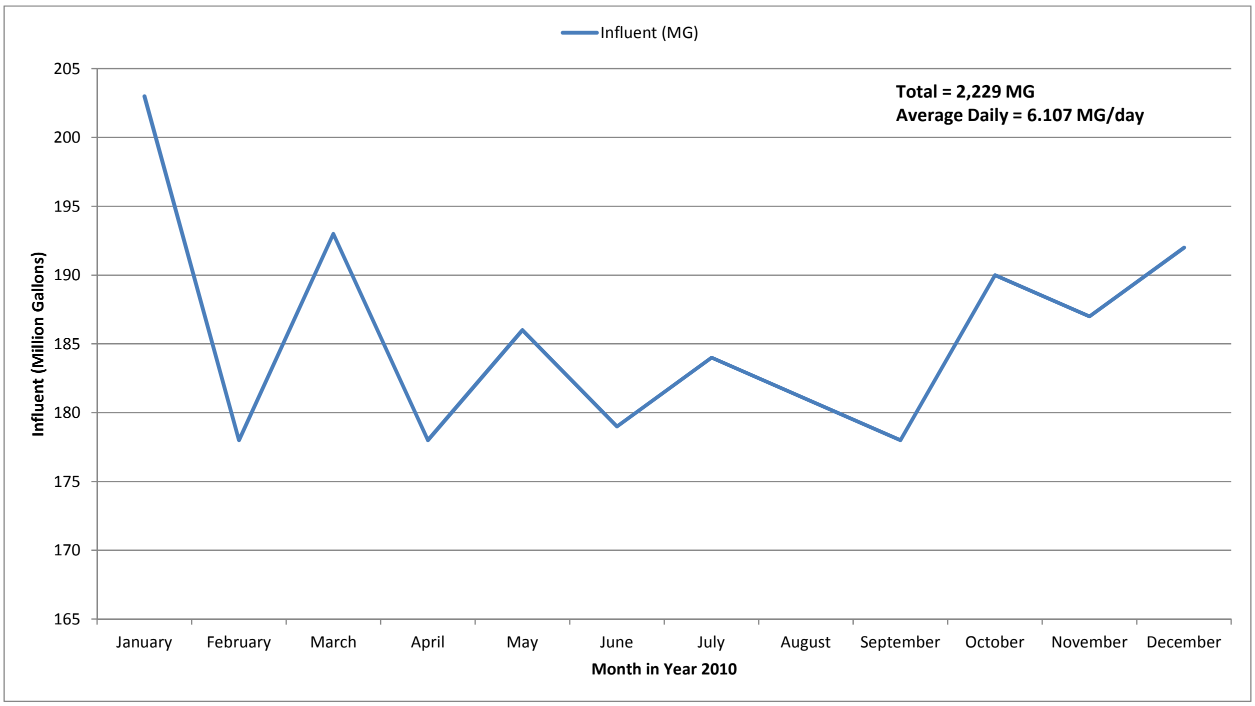

Figure 3
2010 Treatment Plant Average Inflow

A flow pattern for the different type of residential land use will be developed based on flow monitoring data. Typical weekday residential profile characteristics include a low and steady flow between late night to early morning hours (e.g., 12:00 AM to 4:00 AM), and morning (e.g., 6:00 AM to 9:00 AM) and evening peaks (e.g., 5:00 PM to 8:00 PM).

Commercial

Commercial flows are defined as wastewater flows that are generated by commercial businesses such as restaurants, retail offices, hotels, theatres, car washes, laundry facilities, etc. Commercial flows consist of approximately 6 percent of the total service area. These flows are estimated by an assumed wastewater duty factor for the land use and adjusted after flow monitoring.

Mixed Use

A mixed use area contains a combination of land uses such as residential and commercial within one area, and consists approximately one percent of the total service area. An example of mixed use would be retail stores on the ground floor of a building and office and/or residential area on the upper levels. Mixed land use may also include hotels, lofts, and medium-family residential and commercial facilities with the same area.

Open Space

Open space are open area such as parks, fields, streets, roadways, highways, and undeveloped areas, and consists of approximately 47 percent of the total service area. Open space also consists of existing vacant land. For example, land zoned for residential medium that is currently undeveloped based on aerial images is considered open space under the existing land use. Open spaces may also include central plazas and event courts with sitting areas, water features, gateway elements, festival and special event pedestrian way, neighborhood parks, or landscape parkway. Flow generation for open space is also expected to have no flow contribution to the collection system.

Industrial

Industrial wastewater flows vary significantly based on factors such as the type, size, operational techniques, and presence of on-site treatment facilities for wastewater. Variations in industrial peak flows are significant because of the method of operation and work shifts. Industrial land use consists of about 4 percent of the total land, and there are no large industrial customers are known to contribute significant wastewater flow to the system. Typical industrial diurnal pattern is consistent (i.e., flat) throughout the hours of operation (e.g., 8:00 AM to 8:00 PM).

Public

Public areas include public facilities such as schools, libraries, hospitals, recreational areas, institutions and consist of approximately 4 percent of the total service area. Similar to open space, flow generation to the collection system is expected to be little to none.

Population

Population information is used to verify flow data for the VSD system, and to determine the increase in flow generation within the area based on growth rate of the population. Population information is provided by 2010 U.S. Bureau of Census data and population projections are based 2012 Coachella Valley Association of Governments (CVAG) data for the City of Indio. Since projections are not available for unincorporated areas within the VSD service area, this area is assumed to have a similar growth rate as the City of Indio. Population projection data is provided for each Census tract and evaluated from year 2010 through 2035 in five year increments, as shown in Table 2. Population within the VSD service areas is expected to increase almost 60 percent from year 2010 to 2035.

Table 2
Existing and Projected Population within VSD Service Area

Year	VSD Population	Growth Rate (%)
2010	76,036	
2015	87,486	15.1%
2020	100,387	14.7%
2025	106,923	6.5%
2030	113,681	6.3%
2035	120,676	6.2%

Flow Allocation

Wastewater flows are allocated in the hydraulic model using subcatchment areas. Subcatchments are hydraulic units of land whose drainage system elements direct flow to a single discharge point. These subcatchments are manually delineated to define a sewershed area encapsulating a network of pipelines and are sized roughly 25 to 50 acres to provide sufficient resolution to uniformly apply the wastewater flow components (e.g., flow pattern, land use type). The downstream node of each subcatchment, known as the receiving node, is selected to receive the flows collected within the basin. Within the model, flow is allocated for each subcatchment using the SewerGems LoadBuilder application. Flow loading will be based on land use areas (i.e., polygons), flow rate per land use, and a diurnal pattern associated with land use. The following section describes projections for existing and future wastewater flows.

Existing Flow Projections

Existing flow projections are based on the existing land use information and expected flow generation for each land use. Flow rate per capita of 80.3 gallons per day is based on 2010 U.S. Census Bureau population and flow generation from the treatment plant in 2010 within the VSD service area. Using the calculated water duty factor, dwelling unit threshold for each residential type based on the City of Indio Municipal Code of Ordinances, and the U.S. Census Bureau typical population per dwelling unit discussed previously, the wastewater duty factor can be calculated for low, medium, and high residential land use types as shown in Table 3. Other wastewater duty factors for commercial, mixed used, and industrial land use types are based on information from systems of similar geography and included in Table 3. Wastewater duty factors presented in Table 3 may be adjusted at a later time during model calibration based on updated information gathered from the flow monitoring data.

As discussed previously, flow monitoring will be conducted for one-week during a typical dry weather in year 2012. Flow monitors will be recommended for each land use as well as for select subcatchment area. Flow data is collected to determine typical flow rate from each land use, calibrate the sewer system, and develop flow patterns. A flow pattern will be created for a land use and input into the model to simulate flow generation variations over a 24-hour period.

Table 3
Typical Wastewater Flow Rate per Land Use Category

Land Use Category	Wastewater Duty Factor (gpd/acre)
Residential High	3,500
Residential Medium	1,900
Residential Low	1,000
Commercial	800
Mixed Use	2,700
Open Space	0
Industrial	700
Public	600

Future Flow Projections

Future zoning land use is used to predict future flows and asses the need of system improvements to meet growth-related increases in flows to the year 2035. The same wastewater duty factors used to project existing flows will also be used to project future flows using future zoning information. There are several locations within the VSD service area where future zoning land use from the City of Indio and Riverside County general plan is less dense than the existing land use. During these cases, the land use designation with the most dense or great wastewater duty factor is used to obtain the most conservative estimate for that area. Population projection using SCAG and Census Data used to evaluate future population will be used to verify the flow projections.

Known Developments

Based on discussion with VSD staff, several existing major facilities may be contributing a significant amount of wastewater flow to the collection system. In addition, there are future developments and annexation areas that will also be included in the future VSD system. Wastewater flows for the existing facilities and future developments will be individually assessed and are listed below:

- County of Riverside Indio Jail Facility Expansion
- Fantasy Springs Casino
- John F. Kennedy Memorial Hospital
- Indian Palms Country Club
- Indio County Date Festival
- Annexation: north of 50th Avenue and east of Jackson Street
- Annexation: 40th Avenue and east of Monroe Street
- Annexation: south of 49th Street and west of Monroe Street

Infiltration/Inflow

VSD typically experiences insignificant infiltration and inflows (I/I) through the year due to its dry climate. For systems similar to VSD, I/I is accounted for using conservative per capita flows. Based on discussion with VSD, areas within the system may receive more inflow during winter storm events. Flow monitoring is planned to capture at least one rainfall event to compare flows to a typical dry weather day. The significance of inflow to the VSD system will be determined from the flow monitoring data. Sources of inflow can include uncapped cleanouts, misconnections to stormwater collection laterals (e.g., rain gutter downspout, outdoor drains, storm drain) and uncovered manholes. Studies have also shown that for newly-constructed sewers, the infiltration component is insignificant. Manholes located in low-lying areas should be watertight in their design to avoid inflow problems caused by flash-floods.

Hydraulic Design Criteria

Peak Design Flow

Taking into account the limited precipitation and the dry weather, the VSD sewer system shall be sized to accommodate the peak dry weather flow (PDWF) observed within the service area. Additional wet weather flow and insignificant inflows can be accommodated by the additional capacity available when the d/D (flow depth/sewer diameter) ratio is greater than 0.5. The recommended peak flow criteria for facility design and sizing is listed below.

- For collector sewers up to 18-inch in diameter, the design peak flow should be equal to 3 times the average day flow.
- For trunk sewers greater than or equal to 18-inch in diameter, the design peak flow should be equal to 2.5 times the average day flow.

Peaking Factors

Typical flow patterns (from field monitoring data for similar agencies in southern California) for different land use classifications are presented on Figure 4. These curves represent the variation in sewer flows for each land use type during a 24-hour period. Flow patterns for general land types used for the VSD sewer system will be generated from the flow monitoring data.

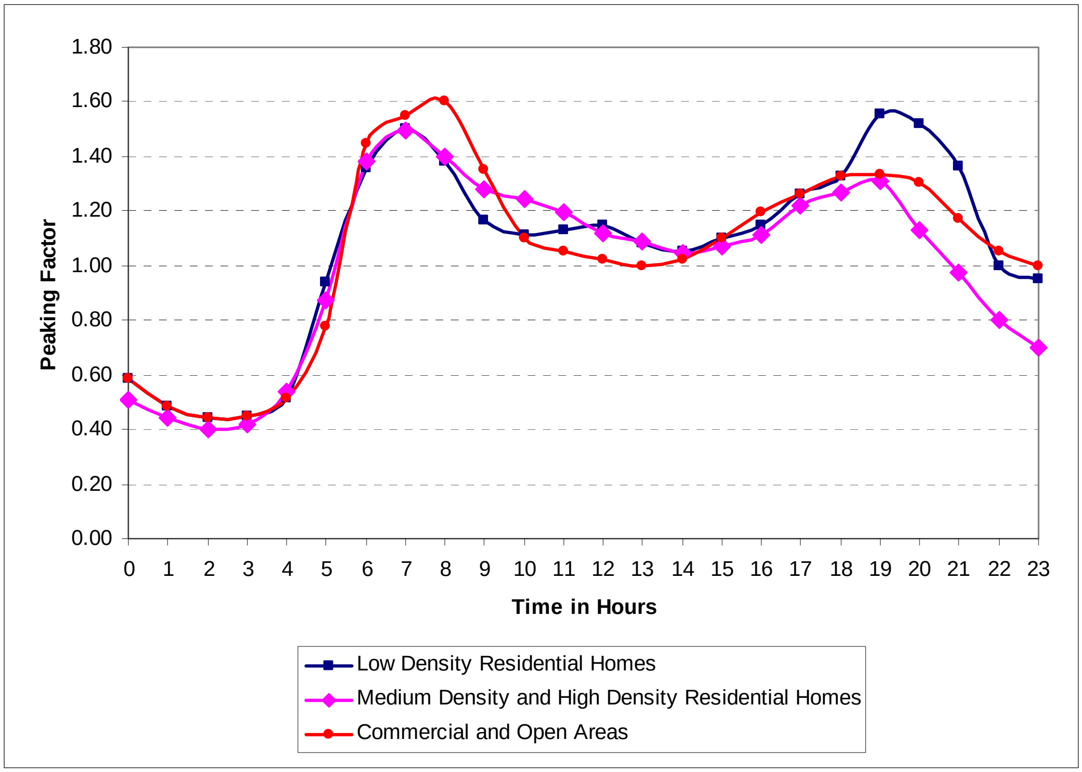

Figure 4
Typical Flow Pattern

Minimum Collection Sewer Size

No sewer shall be less than 8-inches in diameter except at locations authorized by VSD.

d/D Ratio

Typically, sewer systems are designed to account for extraneous flows by designing pipes to have a d/D ratio of 0.5 for PDWFs. The additional wet weather flow can be conveyed by the additional sewer capacity available (in excess of d/D equal to 0.5). Recommended d/D for the VSD sewer system is:

- Maximum d/D ratio for all sewers that are less than 18-inch in diameter shall be 0.50; and
- Maximum d/D ratio for all sewers that are greater than or equal to 18-inch in diameter shall be 0.75.

Slopes and Velocity

All trunk and collector sewers shall be designed with hydraulic slopes sufficient to result in mean velocities at the average day rate of flow of not less than 2 feet per second (fps). The mains shall be designed to meet the minimum slope criteria of 0.4 percent. The maximum allowable velocity in the sewer shall not be greater than 10 fps.

Manholes

Manholes shall be installed on sewers at all changes in slope, size of pipe, or alignment and at all intersections of main line sewers. The maximum spacing allowable between manholes is

500 feet unless otherwise approved. The recommended design criteria for gravity sewer improvement projects discussed above and summarized in the table below. The system planning criteria are summarized in Table 4.

Table 4
System Planning Criteria

Design Criteria	Value
Per Capita Flow	
Flow Generation Rate	Based on Population and Land Use
Velocity	
Minimum Velocity	2 fps
Maximum Velocity	10 fps
d/D Ratio	
For all sewers that are less than 18-inch in diameter	0.5
For all sewers that are greater than or equal to 18-inch in diameter	0.75
Manning's n (gravity mains)	0.013
Hazen-Williams C-factor (force mains)	120
Average Manhole Losses	0.1 feet
Peak Manhole Losses	0.5 feet

Recommended Master Planning Design Criteria for Special Projects

In addition to the recommended design criteria for gravity sewers, the recommended design criteria for non-gravity sewer improvement projects are summarized in Table 5.

Table 5
Design Criteria for Special Projects

Item		Recommended Values
Special Projects	Pump Stations and Force Mains	▪ Pump Stations and force mains will be avoided whenever possible. ▪ Maximum velocity at firm pumping capacity: 8 fps during PDWF at buildout. ▪ Average Dry Weather Flow (ADWF) (existing conditions) velocity = 3.0 fps minimum. ▪ Uses Manning's 'n' to calculate headloss in force mains in the model. For this Master Plan Update, a Manning's 'n' of 0.013 will be assigned to all force mains
	Diversion Structures	▪ New diversion structures will be avoided whenever possible ▪ Maintain existing diversion structures open with no control setting whenever possible ▪ If a gate/stop-log setting is required for a diversion structure, maintain a fixed setting for all flow conditions whenever possible

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Appendix G
MSA Consultants, Inc. Engineer's Report – Requa Avenue Interceptor

This Appendix contains the MSA Consultants, Inc. Requa Avenue Interceptor Alignment Review. This document was submitted in November, 2009, and serves as the basis for Requa Avenue Interceptor discussed in **Section 5**.

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ENGINEER'S REPORT
Requa Avenue Interceptor Alignment Review

Located within City of Indio,
County of Riverside, California

Requa Avenue Interceptor

November 2, 2009

REGISTERED PROFESSIONAL ENGINEER
JULIAN A. DE LA TORRE
C43880
Exp. 6-30-11
CIVIL
STATE OF CALIFORNIA

Prepared for:

Valley Sanitary District

JN: 1868

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34200 BOB HOPE DRIVE ■ RANCHO MIRAGE ■ CA 92270
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Engineer's Report
Requa Avenue Interceptor Alignment Review

Prepared for: Valley Sanitary District

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1.0 GENERAL

1.1 Purpose and Intent of the Report

This Engineer's Report provides a basis for the design of a new gravity sewer pipeline to convey flows from the Shields Road Lift Station to the Valley Sanitary District (VSD) Treatment Plant. The report calculates tributary flows and defines the sewer size of the proposed sewer based on VSD requirements. The proposed sewer alignment has been divided into two (2) separate phases. Phase 1A depicts sewer alignments and alternatives from the intersection of Requa Avenue and Flower Street to the VSD Treatment Plant, while Phase 1B represents the proposed sewer alignment from the Shields Lift Station to the intersection of Requa Avenue and Flower Street.

The purposed of the report is to define the Phase 1A Alignment by conducting a detailed review of the Phase 1A portion and to only confirm pipe size and tie-in elevations for the Phase 1B remainder.

1.2 Background & Objectives

VSD completed the Sewer Collection System Master Plan in 2003 (2003 SCSMP). As part of the master plan preparation process, the collection system was evaluated using a computerized hydraulic modeling program (HYDRA). Based on existing flows, there were a number of pipeline segments experiencing peak flows above design capacity, and some areas surcharging. As part of the planning process, a number of capital improvement projects were identified to both reduce existing capacity issues and provide adequate capacity for expected future flows.

In addition to the 2003 SCSMP, Dudek and Associates prepared two Preliminary Design Reports entitled *Requa Avenue Interceptor PDR* and *Avenue 46 / Shields Road Lift Station Interceptor PDR*. These reports explored alternatives to provide a preliminary basis for the design of a new gravity sewer pipeline to convey flows through central Indio to the VSD Treatment Plant.

VSD requested:

1. Verification of existing and expected flows along the proposed alignment
2. Verification of the feasibility of intercepting flows at the Shields Road Lift Station to the existing 10" sewer main
3. Verification of the feasibility of constructing a new sewer interceptor at the intersection of Highway 111 and Madison Street.
4. Verification of sewer main hydraulics based on District requirements.

This report, independently of the prior reports, completes a detailed study of items 1 through 4 above. A comparison is made to the prior PDR's to confirm the design concepts and parameters. Results of these comparisons are discussed further in the report.

1.3 Organization of the Report

The report is organized into eight (8) sections as follows:

Section 1 – General:

This section describes the purpose and intent of the report and general back-ground information

Section 2 – Key Project Stakeholders

Section 2 defines the interceptor owner, permitting agencies, and those property owners providing sewer access easements.

Section 3 – Land Use and Units of Service

This section classifies the land use per City of Indio Land Use Diagram (revised May, 2007) and the associated units of service (UOS) as described per Table 6-2 of the 2003 SCSMD. Unit flows were assigned a rate of 300 gallons per day per UOS.

Section 4 – Existing Utilities

Section 4 identifies the existing utilities located within the Phase 1A segment of the alignment, and provides a list of the respective agencies contact information.

Section 5 – Survey

Survey crews from MSA Consulting, Inc. set control points and field verified top of manhole and invert elevations at key locations along the Phase 1A and Phase 1B alignments.

Section 6 – Hydraulic Criteria

In this section the hydraulic design parameters utilized in the modeling of the proposed alignments is identified.

Section 7 – Verification of Anticipated Sewer Flows

Section 7 summarized the anticipated sewer flows tributary to the proposed alignments. Sewer flows were assigned a rate of 300 gallons per day per unit of service.

Section 8 – Proposed Interceptor Alignments

This section describes the two phases of the proposed Requa Street Interceptor as well as the proposed Madison Street Interceptor. It also provides a narrative of the nine (9) alternatives for the Phase 1A portion of the alignment. Comparisons of alignment lengths are provided as well as respective sewer easement acquisitions required for each alternative. Depths of installation at key locations are tabulated for both phases of the interceptor.

Section 9 – Estimate of Probable Construction Costs

Section 9 summarizes the estimate of probable construction costs for each of the alternatives for the Phase 1A portion of the interceptor alignments as well as a total cost for the Phase 1B (Fixed Portion). Detailed itemizations of the costs are included in the appendix.

Section 10 – Preferred Alignment

This section presents the preferred alignment alternative for the Phase 1A portion based on ease of construction, estimate of probable construction costs and directness of alignment to the VSD treatment plant.

2.0 KEY PROJECT STAKEHOLDERS

This section identifies key stakeholders for the Requa Avenue Interceptor project and provides contact information for each agency/company and private property owners where sewer access easements will be required.

Valley Sanitary District (VSD)

Contact: Rex Sharp, General Manager
45-500 Van Buren Street
Indio, CA 92201
Phone (760) 347-2356
Fax (760) 347-9979

City of Indio

Contact: Grant Eklund, City Engineer
City of Indio Department of Engineering/Public Works
100 Civic Center Mall
Indio, CA 92201
Phone (760) 391-4018
Fax (760) 342-6590

Union Pacific Railroad

Contact: John Preble, Manager Contracts
Union Pacific Railroad
1400 Douglas Street MS 1690
Omaha, NE 68179-1690
Phone (501) 544-8536
Fax (501) 544-0340

Private Property Owners

Contact: (To Be Determined)

3.0 LAND USE AND UNITS OF SERVICE

All parcel information and geometry shown on the exhibits was obtained from the Riverside County Transportation and Land Use Management Agency (TLMA). Land use was identified utilizing City of Indio Land Use Diagram (revised May, 2007). Units of Service (UOS) were applied utilizing Table 6-2 from the 2003 SCSMD and are summarized below:

Table 1: Land Use and Units of Service

Land Use Type	UOS/Acre	Unit Flow
Country Estates	3.5	300 gpd/UOS
Residential – Low	5	
Residential – Medium	10	
Residential – High	20	
Commercial Office	8	
Neighborhood Commercial	8	
Regional Commercial	8	
Community Commercial	8	
Downtown Commerce	8	
Business Park	3	
Industrial Park	3	
Manufacturing	3	
Mixed Use	8	
Public	8	

4.0 EXISTING UTILITIES

Existing utilities, within the Phase 1A portion, were determined utilizing available as-built drawings, aerial photography and site visits. Preliminary existing sewer alignments were obtained from Valley Sanitary District and refined via survey information. Existing utility vaults, power poles, were identified and used in assessing the viability of the proposed sewer alignment. It was assumed that a parallel sewer installed within an existing sewer easement at a lower elevation is feasible in terms of avoiding existing utilities.

The final design, which is not a part of this scope of work, will further delineate horizontal and vertical locations of existing utilities crossing the approved interceptor alignment. The final design will use information obtained by potholing and utility information provided by the agencies/companies serving the area along the Phase 1A alignment.

The following list contains contact information for the agencies/companies affected:

City of Indio
Engineering Department
Roldan Lopez
100 Civic Center Mall
Indio, CA 92201
(760) 391-4017
rlopez@indio.org

Coachella Valley Water District
Irrigation Department
Mike Schaefer
85-995 Avenue 52
Coachella, CA 92236
(760) 398-2651
mschaefer@cvwd.org

The Gas Company
Engineering Division
Art Escobedo
75-097 Mayfair
Palm Desert, CA 92211
(760) 346-5927

Imperial Irrigation District
Travis Maston
333 East Barion Blvd
Imperial, CA 92251
(760) 398-5871

Level 3 Communications, LLC
Megan Sturdevant
1025 El Dorado Blvd., 33A-516
Bloomfield, CO 80021
(720) 888-3860
Megan.Sturdevant@Level3.com

Kinder Morgan Petroleum Pipelines
Don Quinn
1100 Town & Country Road
Orange, CA 92868
(714) 560-4940

MCI WorldCom
Investigations Group
2400 Glenville
Richardson, TX 75082
(972) 729-6016

Time Warner Cable
Construction Department
Bob Loots
83-473 Avenue 45
Indio, CA 92201
(760) 674-5540
bob.loots@twcable.com

Valley Sanitary District
Mike Butvidas
45-500 Van Buren Street
Indio, CA 92201
(760) 347-2356
mbutvidas@valley-sanitary.org

Verizon
Network Engineering Office
Larry Moore
295 North Sunrise Way
Palm Springs, CA 92262
(760) 778-3603
larry.moore@verizon.com

5.0 Survey

A field survey was conducted to verify existing top of manhole and invert elevations at key locations within the Phase 1A and 1B areas.

The basis of bearings for this survey is the California Coordinate System, Zone 6, NAD 83 (epoch 2007) between continuous global positioning stations (CGPS) and or continuous operating reference stations (CORS) COTD AND PSAP. Identified locally along the south line of Section 24 and taken as N89°38'26"E.

Benchmark vertical datum for all survey work used is referenced to a 2" Brass Disk stamped REPL C-NAIL 1998 (DN. 0.7' IN WELL) located at the intersection of Smurr Street and 46th Avenue, with an elevation equal to 485.90'. All elevations shown on the exhibits are NAVD88 + 500'.

In addition, control points were identified and set along the Phase 1A alignment (see Survey Monument & Control Points Exhibit in the appendix).

6.0 HYDRAULIC CRITERIA

The proposed interceptor alignment was evaluated based on the design criteria established by VSD. This section defines the criteria and methodology used in evaluating the proposed alignment.

6.1 District Criteria

Each proposed section of the alignment was assigned flows as determined based on the assigned land use and corresponding Units of Service and modeled using the Manning's Equation for circular pipes to verify District standards were maintained. District criteria used is listed below:

1. Minimum velocity at design flow will be 2 feet per second (fps).
2. Maximum d/D for pipe sizes 15-inches and smaller is 0.50 or less.
3. Maximum d/D for pipe sizes 18-inches and larger is 0.75 or less.
4. The Manning's coefficient for pipe roughness (n-value) equals 0.013.
5. Intersecting pipes of differing diameters will be matched at the design spring-lines.
6. Minimum slope for pipes 10-inches and larger is 0.0020 ft/ft.
7. A peaking factor of 2.5 was used in the analysis of the proposed sewer size.
8. Conversion factor – MGD to CFS = 1.547129271
9. Conversion factor – CFS to MGD = 0.6463584

7.0 *VERIFICATION OF ANTICIPATED SEWER FLOWS*

A review was performed on the existing and anticipated flows tributary to the proposed interceptors based on the Land Uses as shown per the Indio Land Use Diagram (revised May, 2007) and the associated Units of Service as shown above.

7.1 Overflow Manholes

VSD currently has a number of overflow manholes which will divert surge flows from the primary trunk sewer towards a different line. Some of the overflow manholes which are tributary to the Requa Street Interceptor are:

1. Highway 111 and Madison Street
2. Clinton and 46th Avenue
3. Monroe Street and Requa Avenue
4. Arabia Street and Requa Avenue
5. Fred Waring Drive and Monroe Street
6. Arabia Street and Leroy Way

For the purposes of this report none of the benefits of the overflow manholes were taken into account and all sewer flows were considered tributary to the proposed interceptor line.

7.2 Tributary Areas and Anticipated Sewer Flows

The tributary area was subdivided into 8 smaller areas: A through H (See Existing Sewer Exhibits Sheets 1-9). It should be noted that for the purposes of this review, all of Area 'H' was considered tributary. Based on District requests the tributary areas were grouped based on the representative section of the proposed improvements:

Madison Street Interceptor – Consists of Area 'A'
Shields Lift Station to Madison Street – Area 'B'
Madison Street to Flower Street – Areas 'A' through 'G'
Flower Street to Treatment Plant – Areas 'A' through 'H' (Note: all of Area 'H' was considered tributary to the proposed sewer). See Worksheet 2.

Table 2 shown below presents the anticipated sewer flow at key locations along the interceptor:

Table 2: Anticipated Sewer Flows

NODE	UOS ADDED	LINE TOTAL UOS	TOTAL UOS	FLOW		PEAK FLOW	
				(MGD)	(CFS)	(MGD)	(CFS)
A1	272	272		0.08	0.13	0.20	0.32
A2	504	776		0.23	0.36	0.58	0.90
A3	280	1,056		0.32	0.49	0.79	1.23
A4	444	1,500		0.45	0.70	1.13	1.74
A5	140	1,640		0.49	0.76	1.23	1.90
A6	299	1,939		0.58	0.90	1.45	2.25
A7	14	1,953		0.59	0.91	1.46	2.27
A8	141	2,094		0.72	1.11	1.80	2.79
A9	122	2,216		0.66	1.03	1.66	2.57
A10	22	2,238		0.67	1.04	1.68	2.60
A11	163	2,401		0.72	1.11	1.80	2.79
A12	262	2,663		0.80	1.24	2.00	3.09
A13	70	2,733		0.82	1.27	2.05	3.17
A14	22	2,755	**2,755**	0.83	1.28	2.07	3.20
B3	753	753		0.23	0.35	0.56	0.87
B4	250	1,003		0.30	0.47	0.75	1.16
B6	530	1,533	**4,288**	0.46	0.71	1.15	1.78
C1	-0-	4,288		1.29	1.99	3.22	4.98
C3	392	4,680		1.40	2.17	3.51	5.43
C7	679	6,927		2.08	3.22	5.20	8.04
C10	174	7,101		2.13	3.30	5.33	8.24
F13	4,147	11,248	**11,248**	3.37	5.22	8.44	13.05
G1	-0-	11,248		3.37	5.22	8.44	13.05
G4	892	12,140		3.64	5.63	9.11	14.09
G14	1,140	13,280	**13,280**	3.98	6.16	9.95	15.41
H	4,366	17,646	**17,646**	5.29	8.19	13.22	20.48

8.0 PROPOSED INTECEPTOR ALIGNMENTS

The proposed alignment was sub-divided into two (2) distinct phases. Phase 1A represents the area east of the Requa Avenue and Flower Street intersection, while Phase 1B, the fixed portion, is that area west of the intersection. Each of the primary phases was then further divided into specific segments or alternatives.

8.1 Phase 1A Alignment

Phase 1A begins at the Valley Sanitary District's Treatment Plant and ends at the intersection of Flower Street and Requa Avenue. As this portion of the improvements relies heavily on the acquisition of sewer easements, several alternative alignments have been explored. All of the alternatives cross the Union Pacific Railroad (UPRR) right-of-way in an identical manner.

In addition to the 5 primary alternatives (Alternative 'A'), an additional alternative (Alternative 'B') was considered for alternatives 2 through 5. Alternative 'A' alignments proceed north along the Golf Center Parkway right-of-way to APN 611-340-041 (City of Indio Redevelopment Agency) where the alignment heads in an easterly direction along Citrus Avenue. Alternative 'B' alignments proceed east within the UPRR right-of-way and cross APN 611-410-054 (privately owned) in a northeasterly direction to the cul-de-sac bulb of Citrus Avenue. When compared to the Alternative 'A' alignments, the Alternative 'B' alignments are approximately 200 linear feet (lf) longer and increase the length of installation under paving by approximately 720 lf; however, Alternative 'B' alignments require approximately 310 lf less in easements than the Alternative 'A' alignments.

As stated above each of the alternatives presented are required to cross the UPRR right-of-way. Engineering requirements were obtained from the Union Pacific Railway and copies of the requirements and exhibits are included in the appendix as part of this report.

Table 3 below summarizes the total length of sewer and the approximate length under paving for each of the alternatives:

Table 3: Phase 1A - Alternatives Comparison (Length)

ALT #	SEWER LENGTH (ft)	LENGTH UNDER PAVING (ft)	
		(ft)	Percent
1A	5,029	2,255	45%
2A	4,759	2,508	53%
2B	4,958	3,228	65%
3A	5,608	3,090	55%
3B	5,807	3,810	66%
4A	6,148	3,359	55%
4B	6,347	4,079	64%
5A	6,949	4,710	68%
5B	7,148	5,430	76%

Table 4 below identifies the Assessor's Parcel Numbers (APN) and approximate lengths of easements required for each of the alternatives:

Table 4: Phase 1A - Alternatives Comparison (Easements Required)

ALT #	APN	OWNER (If Known)	Length (ft)
1A	611-340-043	UPRR	851
	611-340-041	COI RDA	795
	611-410-059	HARTSHORN	11
	611-390-045	DELANOY	163
	611-391-014	COI	324
		TOTAL LENGTH	**2,144**
2A	611-340-043	UPRR	851
	611-340-041	COI RDA	795
	611-410-059	HARTSHORN	387
	611-410-081	SEECON XIX PTNRS	230
		TOTAL LENGTH	**2,263**
2B	611-340-043	UPRR	1,130
	611-340-054	HATHAWAY	206
	611-410-059	HARTSHORN	387
	611-410-081	SEECON XIX PTNRS	230
		TOTAL LENGTH	**1,953**
3A	611-340-043	UPRR	851
	611-340-041	COI RDA	795
	611-410-045	SCHULTZ	293
	611-410-051	IRELAND	268
		TOTAL LENGTH	**2,207**
3B	611-340-043	UPRR	1,130
	611-340-054	HATHAWAY	206
	611-410-045	SCHULTZ	293
	611-410-051	IRELAND	268
		TOTAL LENGTH	**1,897**
4A	611-340-043	UPRR	851
	611-340-041	COI RDA	795
	611-410-074	QUIRK	280
	611-410-071	DSAF	262
		TOTAL LENGTH	**2,188**
4B	611-340-043	UPRR	1,130
	611-340-054	HATHAWAY	206
	611-410-074	QUIRK	280
	611-410-071	DSAF	262
		TOTAL LENGTH	**1,878**
5A	611-340-043	UPRR	851
	611-340-041	COI RDA	795
		TOTAL LENGTH	**1,646**
5B	611-340-043	UPRR	1,130
	611-340-054	HATHAWAY	206
		TOTAL LENGTH	**1,336**

Phase 1A – Alternative 1A
This is the preferred alignment as it is the most direct and most cost effective route. It follows Alternative 'A' to the knuckle in Citrus Avenue where it continues to the east to APN 611-391-045. There is an existing VSD easement that will allow for the proposed sewer to continue in a northeasterly direction to the Animal Shelter (APN 611-391-014) and ultimately to Avenue 45. The proposed sewer will then continue along Avenue 45 in a southeasterly direction to the Valley Sanitary District's Treatment Plant. While not the shortest of the alternatives, at approximately 5,029 lf, this alignment has the least number of utility crossings and a significant portion of the alignment can be constructed in vacant or open space areas.

Some advantages and disadvantages of the remaining alternatives are itemized below:

Phase 1A – Alternatives 2A and 2B

- Shortest of all of the alternatives presented: 2A – 4,747 lf and 2B – 4,946 lf.
- The alignment will require boring through parcels 611-410-059 and 611-410-081
- In addition to the jack and bore, the City of Indio has planned to replace an existing 18" irrigation drain line with a 48" storm drain within the same area as the proposed sewer alignment (between the northerly building face and the property line). This corridor is approximately 20' feet wide.

Phase 1A – Alternatives 3A and 3B

- These alternatives are approximately 800 lf longer than Alternative 2 alignments: 3A – 5,608 lf and 3B – 5,807 lf.
- Alignment follows the existing sewer main through parcels 611-410-057 and 611-410-050, and while boring should not be required a significant portion of the easement is under existing concrete and/or asphalt.
- Considerable number of existing utility crossings especially at Van Buren Street where there are two (2) sewer mains located within the street.

Phase 1A – Alternatives 4A and 4B

- Alternative 4 alignments are approximately 1,390 lf longer than Alternative 2: 4A 6,148 lf and 4B – 6,347 lf.
- Easement required along parcels 611-410-073 and 611-410-074 and 611-410-072 and 611-410-071.
- As with Alternative 3 alignments, there will be a considerable amount of existing utility crossings associated with this alternative.
- In order to maintain District hydraulic requirements, Alternative 4B will require approximately 4,413 linear feet of 36-inch diameter sewer.

Phase 1A – Alternatives 5A and 5B

- The longest of the alternatives presented, being approximately 2,190 lf longer than Alternative 2: 5A – 6,949 lf and 5B – 7,148 lf.
- The majority of the alignment is within public right-of-way with only 1,646 and 1,336, linear feet respectively, of required easements.
- In order to maintain District hydraulic requirements Alternative 5A will require approximately 3,702 lf of 36-inch diameter sewer and Alternative 5B will require approximately 5,213 lf of 36-inch diameter sewer.
- Significant number of existing utility crossings.

Table 5 on the following page summarizes the hydraulic characteristics of the preferred alignment (Alternative 1A). A 0.2-foot drop was assigned to manholes reflecting a change in alignment. Once an alternative has been approved and easements secured by the District, the vertical component will be refined to reflect the final design. Exhibits for each of the alternatives are included in the appendix.

Table 5: Phase 1A – Alternative 1A (Preferred Alignment)

Down MH	Up MH	Pipe Diam. (in)	Length (ft)	Slope (ft/ft)	Q (mgd)	V (fps)	% Full	Peak Q (mgd)	Peak V (fps)	% Full	$Q_{50/75}$ (mgd)	Surplus Peak Q (mgd)	Surplus UOS
1	4	30	2,062	0.0046	5.29	4.92	37.2	13.23	6.19	63.7	16.40	3.16	4,216
4	5	30	1,342	0.0036	5.29	4.51	39.7	13.23	5.61	69.7	14.51	1.27	1,694
5	1 Ph1B	30	1,626	0.0020	3.98	3.37	39.9	9.96	4.19	70.2	10.81	0.85	1,135

Notes:

1. All of Area 'H' was considered tributary to the proposed sewer (See Worksheet 2).
2. A 0.2-foot drop was accounted for at manholes with alignment bends.
3. Surplus UOS represents the extra capacity the pipe is anticipated to possess.

8.2 Phase 1B Alignment

Phase 1B, is the fixed portion of the proposed alignment begins at the intersection of Requa Street and Flower Street and ends at the Shields Lift Station. This portion of the proposed improvements has been divided into three (3) distinct areas to identify and assess the requirements of VSD (see exhibits in the appendix).

Area 1: Flower Street to Madison Street

This portion of the alignment is consistent with the original alignment as described in the *Requa Avenue Interceptor PDR*, prepared by Dudek and Associates. However, the pipelines in this portion have been upsized to accommodate an anticipated increase of flows from the Madison Street Interceptor. Also, the existing 18" sewer stubs at the intersection of Monroe Street and Requa Avenue will need to be removed and replaced with larger diameter pipe (24" – West and 30" – East).

Area 2: Madison Street to Shields Lift Station

The District would prefer to continue to use the existing 10-inch sewer main along Avenue 46, between Duquesne Street and Madison Street. A proposed 10-inch sewer main would intercept flows from west of the White Water Channel and Shields Road and convey those flows to the existing 10-inch main, thus eliminating the need for a third sewer in Avenue 46.

Area 3: Madison Street Interceptor

Originally, as stated in the Avenue 46/Shields Road Lift Station Interceptor PDR, prepared by Dudek and Associates, a new pipeline was proposed to intercept flows along Highway 111 at the intersection of Shields Road and conveyed north to Avenue 46. Currently, the District would prefer to intercept the Highway 111 flows at the intersection of Highway 111 and Madison Street. A proposed 18-inch sewer main north along Madison Street to carry sewer flows from the Highway 111 corridor to the Requa Avenue Interceptor. This Madison Street sewer main would replace an older main and address the concerns regarding the potential density increase along the Highway 111 corridor and the existing land use as identified on the City of Indio Zoning Exhibit. Utilizing TLMA GIS information it was determined approximately 170.7 acres, representing 1,323 UOS, along the corridor are currently vacant. The Q_{75} for the proposed 18-inch main, at a slope of 0.0021 ft/ft, is 2.84 MGD. Therefore approximately 82.0 of the 170.7 acres currently vacant could be re-classified as Residential – High (20 UOS/acre) as opposed to the current classification of Mixed Use (8 UOS/acre) with the remaining 88.7 acres classified as Mixed Use (8 UOS/acre). However, the limiting factor is the existing 12" sewer main, along Highway 111, which has the following capacities:

Q_{50} = 0.84 MGD
Q_{75} = 1.53 MGD
Q_{Full} = 1.68 MGD

These capacities were obtained using the minimum slope (per VSD GIS Information) of 0.0053 ft/ft. The existing manholes and inverts along Highway 111 have not been field verified.

Tables 6 through 8 on the following pages summarize the hydraulic calculations for the proposed sewer mains along the Phase 1B (Fixed) portion of the project.

Table 6: Flower Street to Madison Street Hydraulic Summary

Down MH	Up MH	Pipe Diam. (in)	Length (ft)	Slope (ft/ft)	Q (mgd)	V (fps)	% Full	Peak Q (mgd)	Peak V (fps)	% Full	$Q_{50/75}$ (mgd)	Surplus Peak Q (mgd)	Surplus UOS
1	2	30	1,373	0.0020	3.98	3.37	39.9	9.96	4.19	70.2	10.81	0.85	1,135
2	3	30	2,663	0.0020	3.81	3.33	39.0	9.52	4.16	67.9	10.81	1.29	1,715
3	4	30	932	0.0024	3.49	3.48	35.4	8.72	4.39	60.0	11.84	3.12	4,157
4	5	30	1,747	0.0024	3.41	3.45	35.0	8.52	4.36	59.1	11.84	3.32	4,424
5	6	24	1,326	0.0096	2.13	5.06	26.1	5.32	6.53	42.2	13.06	7.74	10,318
6	7	24	1,069	0.0020	2.10	2.86	39.0	5.25	3.58	67.8	5.96	0.71	951
7	8	24	1,356	0.0021	1.98	2.88	37.3	4.95	3.61	63.9	6.11	1.16	1,547
8	9	24	501	0.0020	1.40	2.57	31.5	3.51	3.28	52.2	5.96	2.45	3,271
9	10	24	2,169	0.0020	1.34	2.53	30.7	3.35	3.24	50.8	5.96	2.61	3,484

Notes:

1. Based on the increased flows from the Madison Street Interceptor line, the existing 18” sewer stubs at MH 10 (Monroe Street and Requa Avenue) will need to be removed and replaced with the appropriate diameter pipe.

Table 7: Madison Street to Shields Lift Station

Down MH	Up MH	Pipe Diam. (in)	Length (ft)	Slope (ft/ft)	Q (mgd)	V (fps)	% Full	Peak Q (mgd)	Peak V (fps)	% Full	$Q_{50/75}$ (mgd)	Surplus Peak Q (mgd)	Surplus UOS
10	11	Existing 8-inch and 10-inch sewer mains											
11	12	10	528	0.0030	0.30	2.08	43.2	0.75	2.49	79.4	0.39	See Notes	See Notes
12	13	10	1,274	0.0043	0.22	2.17	33.6	0.56	2.79	56.3	0.46	See Notes	See Notes

Notes:

1. Approximately 374 lf and 1 Manhole will need to be removed and replaced between MH 11 and MH 12 to provide sufficient slope.
2. Tributary flows were assumed to be conveyed entirely by the 10-inch main, the existing 8-inch line will provide additional capacity for overflow.

Table 8: Madison Street Interceptor

Down MH	Up MH	Pipe Diam. (in)	Length (ft)	Slope (ft/ft)	Q (mgd)	V (fps)	% Full	Peak Q (mgd)	Peak V (fps)	% Full	$Q_{50/75}$ (mgd)	Surplus Peak Q (mgd)	Surplus UOS
10	14	18	1,337	0.0021	0.83	2.31	35.2	2.07	2.91	59.6	2.84	0.77	1,028
14	15	18	1,403	0.0021	0.67	2.18	31.6	1.68	2.78	52.4	2.84	1.16	1,545

Notes:

1. Surplus Units of Service shown are representative of existing flows along the Highway 111 Corridor based on City of Indio Land Use Diagram (revised May, 2007).

8.3 Depth of Installation

Depth of installation is a significant factor in assessing installation costs. Rim elevations for existing manholes along each alignment were used to approximate depths from ground surface to pipeline invert along each stretch of the proposed alignment. Installation depths ranged from approximately 8.5 to 22.0 feet below ground surface (bgs). Tables 9 and 10, below are summaries of the approximate depths at the key manhole locations identified for each phase of the project. The summary for Phase 1A represents the preferred alignment (Alternative 1A). Note: inverts shown are representative of centerline of the manhole.

Table 9: Phase 1A - Approximate Depth of Installation Summary

MH	Ground (ft)	Invert (ft)	Depth (ft)
1	470.3	451.12	19.2
2	471.2	453.24	18.0
3	470.3	458.75	11.6
4	470.9	461.62	9.3
5	477.0	466.44	10.6
6	476.9	467.72	9.2
7	480.3	469.50	10.8
MH1-P1B	481.9	470.85	11.1

Table 10: Phase 1B - Approximate Depth of Installation Summary

MH	Ground (ft)	Invert (ft)	Depth (ft)
1	481.9	470.85	11.1
2	486.0	473.60	12.4
3	495.4	478.90	16.5
4	498.3	481.15	17.2
5	507.4	485.66	21.7
6	510.9	498.76	12.1
7	511.6	501.1	10.5
8	517.5	504.07	13.4
9	519.7	505.07	14.6
10	528.3	509.41	18.9
11	531.8	518.55	13.3
12	533.1	520.15	13.0
13	538.9	525.60	13.3
14	529.5	512.64	16.9
15	528.4	515.64	12.8

9.0 ESTIMATE OF PROBABLE CONSTRUCTION COSTS

The primary factors used within the estimates include:

- Manholes – Number and Depth
- Length of Sewer Main
- Number of Utility Crossings
- Asphalt Restoration
- Concrete Restoration
- Handling of Existing Sewer Flows
- Easement Acquisition and Related Costs
- Traffic Control

A more detailed list for each alternative is included in the appendix.

A summary of the estimates of probable construction costs for each alternative is shown below, with detailed itemized breakdowns included in the appendix. Also included in the appendix are worksheets prepared by Overland Pacific itemizing the associated costs of acquisition of the sewer easements.

Table 11: Phase 1A – Comparison Summary of Probable Construction Costs

Alternative	Total Cost
1A	$3,005,094
2A	$3,597,727
2B	$3,713,595
3A	$3,224,698
3B	$3,340,566
4A	$3,450,718
4B	$3,974,169
5A	$4,108,622
5B	$4,363,336

As shown on the above summary Alternative 1A is the least costly while Alternative 5B is the most costly to install.

For the Phase 1B portion of the alignment, it is estimated the probable construction costs should be approximately $9,087,636. A 20% contingency was applied to the estimate and no provisions were accounted for potholing services. A detailed itemization of the estimate is included in the appendix.

10.0 PREFERRED ALIGNMENT

The preferred alignment for the Requa Avenue Interceptor for the Phase 1 portion would be Alternative 1A. This recommendation was founded on overall "ease of construction" and the lowest estimate of probable construction costs. The preferred alignment is the most direct route from the up-stream tie-in point at the intersection of Requa Street and Flower Street to the headworks of the treatment plant. It also fulfills project goals established by relieving flows south of Highway 111 and Doctor Carreon Boulevard.

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