Sewer Master Plan

February 2018

PREPARED FOR

City of Whittier
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Whittier, CA 90602

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P:Projects/48595/135-48595-16001/Docs/Reports/SewerMasterPlan

CONTENTS

Appendices

Tables

Figures

EXECUTIVE SUMMARY

Purposes of the Sewer Master Plan

There are several purposes to this Sewer Master Plan, as follows:

1. This report establishes the existing conditions and deficiencies in the City's sewer system in order to create a management aid in planning and budgeting system improvements through year 2035. As a management tool this report prioritizes and establishes conceptual level budgets for sewer system improvements required to remedy current deficiencies and those forecasted from changes in growth, development, and population densities.

2. This report documents the existing system, identifies pipes (sizes, ages, materials), and connection points to the County sewer system.

3. This report provides a summary of how the sewer collection works for those seeking to modify or understand its capabilities and limitations.

This report is a living document and will be updated by the City on a periodic basis in order to be revised to account for changes in forecasted sewer system requirements and conditions. The City should revisit the master plan in 10 years and provide revisions as necessary. The City should continue to follow the recommendations of the sewer system management plan.

Sewage Generation

The City of Whittier is near complete development with approximately 3% of the developable lots remaining undeveloped. Future redevelopment in the Uptown area, Whittier Blvd, and Whittwood Town Center will alter the current sewer system loadings on developed lots.

Although close to being fully developed, the population in Whittier is projected to increase by 7% from 87,500 to 93,700 in the year 2035.

The existing sewer system was modeled with an average day flow of 6,118 gallons per minute (gpm) 8.8 million gallons per day (mgd). Modeling of future sewer system flows were adjusted up to 6,863 gpm (9.9 mgd) to reflect increases in population and future development / re-development. The future loads represent a 12% increase in sewer flows by year 2035.

The total sewage flows of the entire system for the various scenarios are summarized in the following table:

Table E-1 Summary of Sewage Generation

Condition	Total Flow (gpm)
Existing Average Day	6,118
Existing Peak	11,779
Future Average Day	6,863
Future Peak	13,000

The above are the dry weather sewage flows. Wet weather flows are calculated at an approximate 10% increase of the average dry weather flows. The total existing wet weather flow is calculated as 6,730 gpm and the total future wet weather flow is calculated as 7,550 gpm. Peak dry weather flows, and not wet weather flows, have

been determined to be the critical scenario, and the flow quantities throughout this report refer to dry weather flows unless otherwise stated.

Hydraulic Computer Model

A computer model of the existing sewer system was developed using record information, geographical information system (GIS) data, and City maintenance logs. The computer model represents a tool to analyze the existing system, aid in forecasting the future requirements, and to evaluate proposed modifications. Computer modeling scenarios were developed for both the present and year 2035 sewer flow conditions. Additional modeling scenarios were developed to analyze bypass piping improvements for effectiveness. Deficiencies in the existing sewer system were identified in the model by insufficient piping diameters, insufficient piping slope, and through historical maintenance issues documented by City staff.

Existing and Future Sewer System

Because a large portion (47%) of the system was constructed in a short period of time (1950s) an increase in the rate of maintenance and piping replacement requirements is anticipated around the year 2030. The elevated maintenance requirements may peak around year 2040 as the older piping is required to be replaced.

The sewer piping system is composed primarily of vitrified clay pipe (VCP) with some reinforced concrete pipe (RCP) and polyvinyl chloride (PVC) piping. Future replacement piping is recommended to be PVC.

The model identified pipeline segments for replacement due to deficiencies and known maintenance issues. The pipeline segments were further categorized by priority, with the Priority 1 category listing the existing deficiencies in immediate concern.

Reducing Overall Replacement Costs

This report sought to reduce the overall CIP costs through the development of four bypass flow projects. The purpose of the bypass projects is to redirect sewer flow from pipeline segments exceeding capacity to pipelines with spare capacity. The four projects propose to utilize short segments of bypass piping in an effort to avoid replacing much longer segments of piping or piping in congested areas where construction would be costly. The four bypass projects proposed are estimated to reduce the overall piping replacement costs by up to 7% or $0.6M.

Uptown Area Development

Capacity issues with the Los Angeles County sewer piping in the street of La Cuarta is currently restricting development in the Uptown area. On May 11, 2017, the City of Whittier staff met with the County Sanitation District of Los Angeles (LACSD) to provide projected flows from Uptown Whittier. The City requested that LACSD make improvements to their existing Worsham Creek Trunk Sewer within La Cuarta St. to accommodate future flows that will be generated by future development to the year 2035. The County has agreed to include improvements to their Worsham Creek Trunk Sewer in their capital improvement plan. A copy of the letter from LACSD is included in the Appendix.

Capital Improvement Program (CIP)

This report estimated costs of the CIP for the sewer system improvements by piping diameter and lengths. A summary listing of the CIP cost estimates is shown in Table E-2. The table includes CIP projects organized by recommended priority to be constructed, where priority 1 improvements are the highest priority. Criteria used for prioritization is defined in Chapter 6, and are based on model results of pipeline flow depth as well as known maintenance issues.

Table E-2: Summary of CIP Costs

Project	Linear Feet of Piping	Estimated Cost
Priority 1 Improvements	35,432	$10.0M
Priority 2 Improvements (2035)	20,382	$5.8M
Priority 3 Improvements (2035)	2,833	$0.8M
Total:	58,647	$16.6M

Small Diameter Pipe Replacement Program

The City is in the process of replacing the 6" and smaller sewers with 8" sewers. These 6" sewers are generally older sewers that experience maintenance issues due to both their small size and their age. The cost to replace all 6-inch and 4-inch pipes in the system is approximately $105M and would be in addition to the CIP summary costs listed above.

Recommendations

- It is anticipated sewer pipeline maintenance issues will begin to increase around year 2030 (in comparison to current day maintenance issues) and peak around a decade later corresponding to the construction boom of the 1950s. It is recommended the City prepare to respond to expected increased annual sewer system maintenance costs from aging pipelines.
- A CIP of approximately $10.0M is recommended to correct the existing (Priority 1) sewer system deficiencies.
- A CIP of approximately $6.6M is recommended for future sewer system improvements through year 2035 (Priority 2 and Priority 3).
- The City currently has a proactive program of inspecting the sewer pipeline system annually and documenting defects. It is recommended to continue the annual inspections as means to be cognizant of the existing conditions and to further refine the hydraulic computer model during the subsequent updates of this report.
- Piping replacements are recommended to be PVC. PVC is the City's preferred pipe material due to ease of installation and connection, longer life, tighter joints to prevent root intrusion, and also for its cost.

CHAPTER 1. - INTRODUCTION

1.1 Background

Incorporated in 1898, the City of Whittier (City) is a mostly residential community located in Los Angeles County that constitutes part of the Gateway Cities. The City is situated just east of the San Gabriel River Freeway (605) and is bounded to the north by the hills of Hacienda Heights and encompasses an area of approximately 9,400 acres. The City is one of over 3,000 cities in the United States designated as a "Tree City USA" community, and is characterized by the tens of thousands of sycamores and magnolias trees that line the City's streets, yards, and parks.

On October 1, 1987, the Whittier Narrows Earthquake struck, with its epicenter located six miles from the City. The earthquake caused severe damage to uptown Whittier's historic buildings and infrastructure. As a result, damaged areas were re-developed, and in some cases re-zoned for higher land-use, while the sewer pipelines in these areas were not increased to handle the new higher capacity. The Master Plan will determine areas where sewer pipeline may be undersized for the land use areas they serve.

The predominant land use in the City is residential, which accounts for 56% of the City's total land use, and is primarily low-density, i.e. from 2 to 35 dwelling units per acre. However, the City also has a significant allocation of commercial land use and Industrial land use. Although the City is almost fully developed, development and re-development projects are ongoing and planned as part of City Specific Plans.

Through its Public Works Department the City owns, operates, and maintains a sanitary sewer collection system that includes approximately 190 miles of piping that ranges in size from 4 inches up to 15 inches in diameter, with over half of the pipe being 8". Within the City limits there are also approximately 7 miles of private sewers and 14 miles of Los Angeles County Sanitation District (LACSD) trunk sewers that the City does not own or maintain. The operating sewers date back to 1917 with the majority of the City's sewers constructed in the 1950's. Through the years, the City has continued to construct new sewers to meet new City development needs and to replace aging sewers as required.

1.2 Purpose of the Sewer Master Plan

The purpose of this report is to establish the existing conditions and deficiencies in the City's sewer system in order to create a management aid in planning and budgeting system improvements through year 2035. As a management tool this report provides a means to prioritize a schedule and establish preliminary budgets for sewer system improvements required to remedy current system deficiencies and those forecasted from changes in growth, development, and population densities.

1.3 Authorization and Work Scope

On March 8, 2016 the City of Whittier authorized Tetra Tech to prepare this Sewer System Master Plan. The scope of services includes the following five areas of work:

1.3.1 Sewer System Inventory

A project Technical Memorandum on GIS data verification was developed to handle missing data or data with discrepancies from the existing City GIS data set. Typically the missing data consisted of manhole

inverts, which were inferred based on record information of the piping slope. The hydraulic model developed for this study notes these inferred data in the attributes for tracking purposes. Special selection sets of pipes and manholes with missing information have been saved in the model. A copy of the June 15th, 2016 Technical Memorandum is included in the Appendix of this report.

1.3.2 Hydraulic Analysis

Development of a computer model of the existing system based on the updated GIS data files of the sewer system is initially performed. Calibration of the computer model is made based on field investigations, such as sewer system flow monitoring. Various computer modeling scenarios are then developed to analyze potential sewer system improvements and to evaluate the most effective solutions. Similarly, the computer model is used to determine the requirements of future sewer system improvements based on the forecasted development within the city.

1.3.3 Effective Life Expectancy of Existing Sewer System Components

Factors such as pipe age and type, soil conditions, and maintenance histories are used to evaluate the effective life expectancy of the existing sewer system components. This evaluation aids in prioritizing, budgeting, and planning the sewer system improvements.

1.3.4 Capital Improvement Planning

Based on the results from the sewer system computer modeling and system evaluations, a listing of short term and long term system improvements is identified. With this tool the City is able to move forward to plan and budget sewer replacement projects in an organized manner.

1.3.5 Master Plan Report

All documentation from this work is summarized and presented in this Sewer System Master Plan report to be available for immediate planning and preliminary budgeting of sewer system improvements. This report also serves as a central source of information for the existing sewer system including sewage generation, size and layout of the sewer piping system, and the relationship to LA County's trunk and treatment system.

CHAPTER 2. – LAND USE AND SEWAGE FLOW QUANTITIES

2.1 General

The City of Whittier is located in the southeasterly portion of Los Angeles County. The City is generally bound to the north by Hacienda Heights, to the east and southeast by La Habra, to the south by Santa Fe Springs, and to the west by the I-605 Freeway. The main arterial that runs through the City is Whittier Blvd, which serves as the City's main thoroughfare.

The topography varies throughout the City. The northern boundaries of the City are generally hilled areas, while the terrain in the remainder of the City is generally flat. The hilled areas to the north consist of primarily low density residential land use, and to a lesser degree medium density residential and parks. Elevation changes vary from approximately 800 feet to under 200 feet.

The population of the City based on 2010 census data is 85,331 persons. The City covers an area of 14.7 miles and the population density based on the 2010 census data is 5,819 persons per square mile. The estimated population in the year 2015 was 87,438 persons. This growth represents approximately a 0.5% increase per year.

2.2 General Plan Land Use Categories

The majority of the City's land use area consists of low density residential neighborhoods (comprising of 60% of the City's total area). Medium density residential (4%), medium high density residential (1%) and high density residential (3%) are generally located near the commercial and business areas and are dispersed. The City has a specific plan central area of retail commercial and mixed use residential known as Uptown Whittier that is located on 33 square city blocks centered on Greenleaf Ave and makes up 3.5% of the City's area.

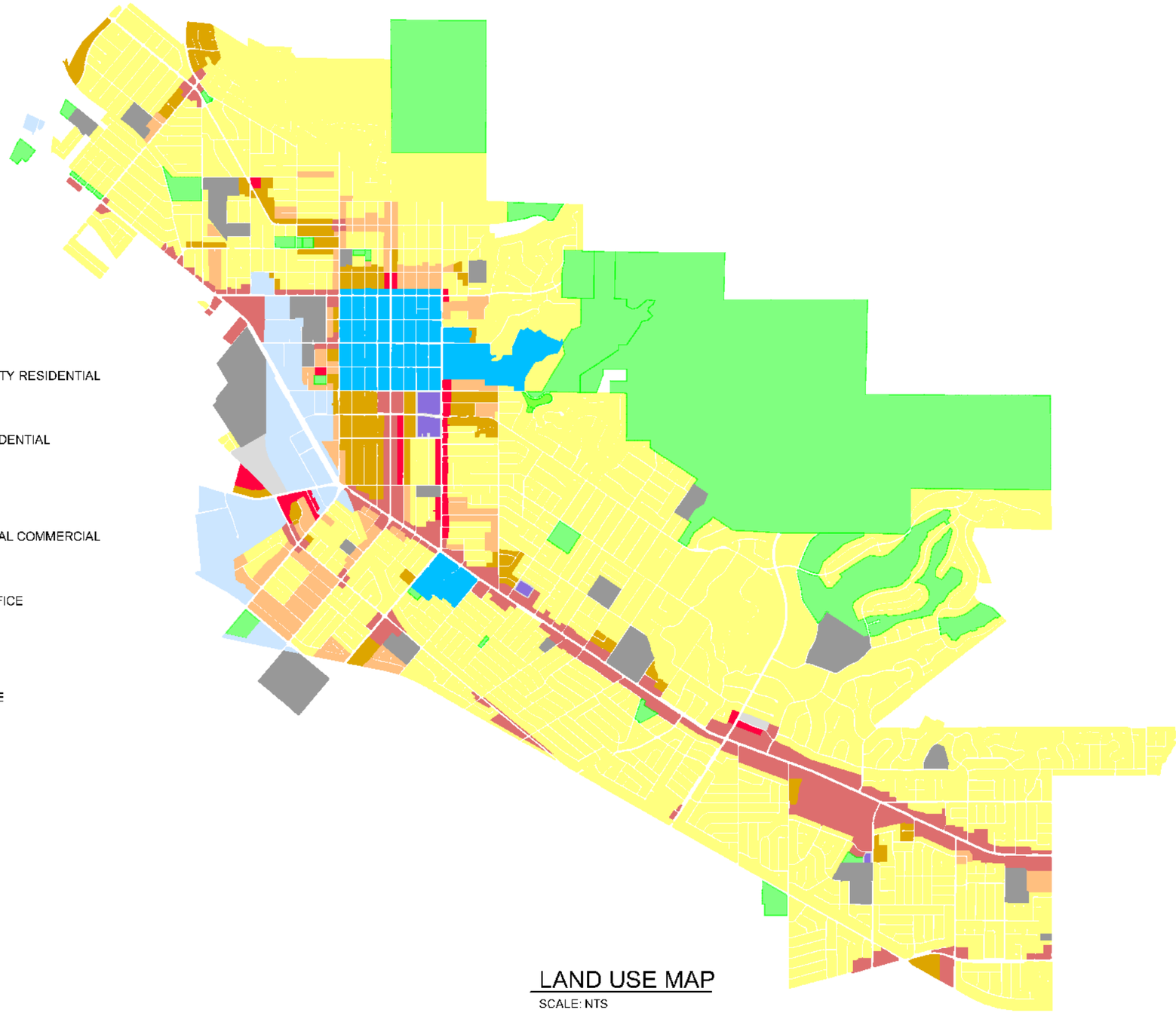
Commercial businesses and administrative offices which line the entire span of Whittier Blvd General Commercial business make up approximately 6.5% of the City's total area and Administrative and Professional Commercial make up approximately 1%. Industrial businesses (4%) are grouped at the southwestern area of the City. Schools (private, junior high, high school, and elementary) are spread out through the City and make up a combined 5.5% of the total area. Hospitals and public facilities (i.e. civic center, library, and post office) make up a combined 1% of the total area. Parks, golf courses, and open space combined make up the remaining 10.5% of the total area. A map of the City's land use is shown on Figure 2-1.

The City has defined land use categories per Section 2 of the Whittier General Plan included in the Appendix of this report and as shown on Table 2-1. For the purpose of allocating sewer loads to manholes for later use in the computer model (as discussed in greater detail in Chapter 4 of this report), General Plan land use categories of similar densities have been combined to the sewer land use categories as shown on Table 2-2. The combined sewer land use categories were developed in order to better adapt them to computer modeling constraints of the software.

Densities of each land use designation are defined, and expressed in either dwelling units per acre or floor area ratio (FAR). The dwelling units per acre measurement is used for residential development, while FAR is used for nonresidential development. Dwelling units per acre is defined as the number of residential housing units per acre of land. FAR is the ratio of a building's floor area to the total lot area.

Table 2-1
Whittier General Plan Land Use Categories

Land Use Designation	Density
Hillside Residential	2 units / acre
Low Density Residential	6 to 7 units / acre
Medium Density Residential	15 units / acre
Medium High Density Residential	25 units / acre
High Density Residential	35 units / acre
General Commercial	FAR 0.25 to 2.0
Administrative and Professional Commercial	FAR 0.5 to 2.0
General Industrial	FAR 0.6 to 1.0
Specific Plan	--
Elementary School	FAR 0.5
Junior High School	FAR 0.5
High School	FAR 0.5
Private School	FAR 0.5
Park	FAR 0.01
Civic Center	FAR 0.70
Hospital	FAR 1.0 to 2.0
Post Office	FAR 0.5
Golf Course	FAR 0.01
Library	FAR 0.5



LEGEND

- HILLSIDE RESIDENTIAL / LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- MEDIUM HIGH / HIGH DENSITY RESIDENTIAL
- GENERAL INDUSTRIAL
- GENERAL COMMERCIAL
- ADMINISTRATIVE AND PROFESSIONAL COMMERCIAL
- SPECIFIC PLAN
- CIVIC CENTER / LIBRARY / POST OFFICE
- HOSPITAL
- SCHOOLS
- GOLF COURSE / PARK / OPEN SPACE

N

LAND USE MAP

SCALE: NTS

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CITY OF WHITTIER

SEWER MASTER PLAN

LAND USE MAP

Project No.: 135-48595-16001

Date: 7/2016

Designed By: AL

Figure 2-1

Bar Measures 1 inch

2.3 Sewer Land Use Categories

The General Plan land use categories in Table 2-1 were used to calculate densities for the condensed sewer land use categories in Table 2-2. Table 2-1 lists the ranges of densities for certain categories, and the density ranges were combined into a single density as shown in Table 2-2. For each land use category, a single density value was calculated as the average value within that range. Additionally, each category was validated with select samples from satellite images by calculating the ratio of the building foot print to lot area. Density for the categories of hospitals and for schools were determined by calculating the FAR (including multi-story floor area) for each hospital and each school in the City from satellite images.

Once average densities of each general plan land use category in Table 2-1 were determined, densities were then combined for the sewer land use categories in Table 2-2 by taking the weighted averages of the combined categories based on contributing area.

Table 2-2
Sewer Land Use Categories

Land Use Designation	Density
Hillside / Low Density Residential	6 units / acre
Medium Density Residential	15 units / acre
Medium High / High Density Residential	32.2 units / acre
General Industrial	0.8 KSF / acre
General Commercial	FAR 0.38
1-Story Administrative and Professional Commercial	FAR 1.25
3-Story Administrative and Professional Commercial	FAR 3.75
Specific Plans	--
Civic Center / Library / Post Office	FAR 0.70
Hospitals	FAR 0.44
Schools	FAR 0.23
Parks / Open Space	FAR 0

2.4 Initial Sewage Load Factors

Sewage load factors are used to develop the sewage loads at each manhole for use as initial inputs to the computer model (as discussed in greater detail in Chapter 4 of this report) of the sewer collection system. Sewage loads to each manhole are calculated as a manhole's tributary area multiplied by the corresponding land use load factor (or multiple factors where intersection of multiple land use areas occur) for the land use area that it intersects. Manhole sewage loading is initially calculated using estimated load factors based on empirical data from established agencies. These empirical numbers are later calibrated with adjustment factors that are derived from actual flow data collected in the field.

The initial sewage load factors have been calculated using factors of past sewer Master Plan projects from local utility systems of similar size and population densities. The Irvine Ranch Water District (IRWD) provides sewage generation factors for residential and commercial land use areas for the City of Lake Forest in their Sewer Collection System Master Plan. The City of Lake Forest contains varied land use similar to that in the City of Whittier.

IRWD provides detailed generation factors for various land use categories. These generation factors are provided in units of "gallons per dwelling unit per day" for residential land use and "gallons per thousand square feet (KSF)

per day" for commercial and industrial land use, and can be applied to a land use of any known density. Densities for each land use category have been defined in Table 2-2. Loading for each land use category is calculated by multiplying these land use densities by the IRWD generation factors in order to obtain load factors in gallons per day per acre (gpd/acre). The initial calculated load factors are shown in Table 2-3.

The IRWD Sewer Collection Master Plan does not include generation factors for administrative and professional commercial land use. The initial load factor for the 1-Story and 3-Story Administrative and Professional Commercial land use categories from the Los Angeles Bureau of Engineering Sewer Design Manual of a land use of similar density was utilized.

Table 2-3
Initial Sewage Load Factors

Land Use Designation	Load Factor (gpd/acre)
Hillside / Low Density Residential	2,004
Medium Density Residential	3,750
Medium High / High Density Residential	5,558
General Industrial	3,000
General Commercial	3,431
1-Story Administrative and Professional Commercial	13,000
3-Story Administrative and Professional Commercial	26,000
Specific Plan – Uptown	4,000
Specific Plan – Whittier Blvd	*NA
Specific Plan Whittwood Town Center	3431
Civic Center / Library / Post Office	6,404
Hospitals	4,224
Schools	149
Parks / Open Space	0

*Whittier Blvd Specific Plan loads are included in the general commercial and general industrial land use categories, and are not separately allocated.

2.5 Flow Monitoring and Model Calibration

2.5.1 SmartCovers Level Sensors

Flow monitoring was performed using SmartCover manhole covers by SmartCover Systems. These water level monitoring systems provide continuous real-time information of the wastewater level within a manhole. The SmartCover units are capable of reading the water depth to within a tenth of an inch. Measuring depth is a common way to indirectly measure flow, where the depth is converted to a flow measurement using Manning's equation (with known pipe slope and diameter size). For the range of piping diameters analyzed in this report, the SmartCovers data is capable of providing flow measurement accuracies of approximately ± 5%.

The City has experience using SmartCovers within the sewer collection system in the vicinities of hot spots, areas that require continuous monitoring due to recurring root and/or fats, oils and grease (FOG) build up. Additional SmartCovers were purchased as part of this study and placed at strategic locations in order to gather sewer flow data necessary to determine adjustment factors to the initial sewage load factors. The additional units purchased for use in this report will later be relocated to other hot spots in the City's sewer system to enhance the ongoing monitoring program. The City has the capability to remotely

monitor the data from the units via a secure website and modify the parameters of the equipment if required.

2.5.2 Flow Monitoring

The additional SmartCover installations collected flow data for this report at nine locations crucial to determining the adjustment factors to the initial load factors. Monitoring locations were selected at areas of a predominant land use type so that wastewater generation coefficients could be calibrated for each specific land use. The manhole flow monitoring locations are shown on Figure 2-2.

The goal of the flow monitoring was to capture both dry-weather and wet-weather sewer flow data, where wet-weather data includes increased flow due to incidental rainfall entering the sewer system (known as inflow and infiltration or I/I). The flow monitoring was conducted in the months of October, November, December, and January. Historically, January is a month with high rainfall totals for the City of Whittier as well as for Southern California as a whole.

Two of the monitoring manholes were not able to provide adequate flow data. Manhole 3980, used for monitoring general commercial and administrative and professional commercial, and manhole 1344, used for monitoring medium high / high density residential land use each provided unreliable data. Flow data from both manholes were abnormally high and had a constant intensity that did not vary with a normal diurnal pattern, as was consistent with the remainder of the data collected. The SmartCover monitors at these two locations were adjusted in the field after collecting several weeks of unusable data, but the adjustment was not able to resolve the problem. Ultimately, sewage load factors for these two land use categories were developed by using the initial load factors, and adjusting these load factors based on known calibration results of the other land uses.

SPECIFIC PLAN - MANHOLE 1275
ALLEY BETWEEN GREENLEAF AVE. AND COMSTOCK AVE.
NORTH OF WARDMAN ST.

LOW / MEDIUM DENSITY RESIDENTIAL - MANHOLE 1697
EXISTING SMART COVER MANHOLE
ON BAILEY ST., WEST OF THE INTERSECTION
OF BAILEY ST. AND HILL AVE.

CIVIC CENTER / LIBRARY / POST OFFICE - MANHOLE 13:64
WESTERN MOST MANHOLE
AT THE INTERSECTION OF WALNUT ST AND FRIENDS S:T.

SCHOOL - MANHOLE 1136
MANHOLE IN THE LINDLEY AVE
CUL-DE-SAC WEST OF
WHITTIER HIGH SCHOOL

HILLSIDE /LOW / MEDIUM DENSITY RESIDENTIAL - MANHOLE 3248
CALIFORNIA AVE. SOUTH OF INTERSE:CTION
OF CALIFORNIA AVE. AND LA CUARTA . ST.

GENERAL INDUSTRIAL - MANHOLE 781
WASHINGTON BLVD. EAST OF
WHITTIER BLVD.

HOSPITAL - MANHOLE 3990
JANINE DR. EAST OF COLIMA

MEDIUM HIGH / HIGH DENSITY RESIDENTIAL - MANHOLE 1344
ALLEY BETWEEN MILTON AVE AND COMSTOCK AVE.
NORTH OF LA CUARTA ST.

GENERAL COMMERCIAL
ADMINISTRATIVE / PROFESSIONAL - MANHOLE 3980
WHITTIER BLVD. BETWEEN CO:LIMA AVE. AND LA SERNA AVE.

LEGEND

- HILLSIDE / LOW / DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- MEDIUM HIGH / HIGH DENSITY RESIDENTIAL
- GENERAL INDUSTRIAL
- GENERAL COMMERCIAL
- ADMINISTRATIVE AND PROFESSIONAL COMMERCIAL
- SPECIFIC PLAN
- CIVIC CENTER / LIBRARY / POST OFFICE
- HOSPITAL
- SCHOOLS
- GOLF COURSE / PARK / OPEN SPACE

LAND USE MAP

SCALE: NTS

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CITY OF WHITTIER
SEWER MASTER PLAN

MONITORING MANHOLE LOCATIONS

Project No.:	135-48595-16001
Date:	7/2016
Designed By:	AL
Figure	2-2

Bar Measures 1 inch

2.5.3 Adjusted Sewage Load Allocations

Adjustment factors for the initial average-day dry-weather sewage load factors gpd/acre were developed for the various land use categories based on the field collected dry-weather flow data in comparison to the initial computer model simulation results, as shown on Table 2-4. The initial sewage load factors were first inserted into the computer model (as discussed in greater detail in Chapter 4 of this report), and initial modeled flow data obtained. The initial calculated flowrate from the computer model was compared to the flow data obtained in the field and adjustment factors were determined for calibration of the model. Numerous iterations of computer model simulations were performed, each time utilizing further refined adjustment factors until the flows in the model agreed with the field collected flow data.

Additional adjustments were made to reduce the load factor for the Hillside / low density residential land use areas. Data from the flow monitoring in this land use category was singled out and scrutinized because it includes the majority of the City's total area (60%). The monitoring manhole for this land use category was located on a single family, low density residential street on California Ave. However, real-estate records of the houses on this street indicate they are approximately 20% larger (based on square footage) than the typical median single-family house in Whittier. The load factor for Hillside / low density residential was reduced an additional 10% to account for the larger than typical housing in the monitoring vicinity.

Based on the adjusted load factors a total average-day dry-weather sewage flow of 6,118 gallons per minute (8.8 mgd) is calculated, as shown on Table 2-4. This flow rate equates to a residential per capita wastewater generation of approximately 70 gallons per capita per day (GPCD). In comparison, the total potable water usage per the City's 2015 Urban Water Management Plan is 124 GPCD, and the residential potable water usage as reported to the State's Drinking Water Information Clearinghouse (DRINC) is 85 GPCD, where the latter is representative of residential water usage as served by the City.

Table 2-4 Sewage Load Allocation

Land Use Category	Initial Load Factor (gpd/acre)	Adjustment Factor	Adjusted Load Factor (gpd/acre)	Area (sq. ft.)	Allocated Sewage Load (gpm)
Hillside / low density residential	2004	0.50	999	164,509,868	2,620
Medium density residential	3750	0.81	3038	9,768,542	473
Medium high / high density residential	5558	0.81	4502	10,311,415	740
General industrial	3000	0.89	2670	10,611,885	452
General commercial	3431	0.89	3052	16,903,652	823
Administrative / professional commercial 1-story	13000	0.89	11570	2,248,694	415
Administrative professional commercial 3-story	26000	0.89	23140	101,002	37
Specific plan - Uptown	4000	0.71	2844	8,328,667	378
Specific plan – Whittier Blvd	*NA	*NA	*NA	*NA	*NA
Specific plan – Whittwood Town Center	3431	0.89	3052	1,370,885	66
Civic Center / Library / Post office	6404	0.2	1127	964,908	17
Hospital	4224	0.98	4140	1,111,472	73
Schools	149	0.67	100	14,634,086	23
Golf course / park / open space	0	0.00	0	28,791,691	0.00
				Total	**6,118**

*Whittier Blvd Specific Plan loads are included in the general commercial and general industrial land use categories, and are not separately allocated.

2.6 Dry Weather Peaking Factors

Peaking factors were developed for each land use category. Because the various land use areas differ in the types of usage and activity, land use categories will differ in the time of day the peak flow occurs and also in the magnitude of the peak flow compared to the average day flow. Peaking Factors were developed for each land use category based on flow data collected from the field units. Peaking factors are shown in Table 2-5 below, as well as total peak flows of each land use type.

Table 2-5 Dry Weather Peaking Factors

Land Use Category	Peaking Factor	Total Peak Flow (gpm)
Hillside / low density residential	2.1	5,502
Medium density residential	2.1	993
Medium high / high density residential	2.1	1,554
General industrial	1.3	587
General commercial	1.75	1,440
Administrative / professional commercial 1-story	1.75	726
Administrative professional commercial 3-story	1.75	65
Specific plan - Uptown	1.5	567
Specific plan – Whittier Blvd	1.75	*NA
Specific plan – Whittwood Town Center	1.75	117
Civic Center / Library / Post office	1.0	17
Hospital	2.4	176
Schools	1.5	35
Golf course / park / open space	0	0
	Total	**11,779**

*Whittier Blvd Specific Plan loads are included in the general commercial and general industrial land use categories, and are not separately allocated.

The resulting peaking factors are typical for the land use category represented. As expected, residential land uses have relatively higher peaking factors compared to the industrial and commercial land uses. The average system wide peaking factor is 1.93.

2.7 Wet Weather Flows

As previously mentioned, inflow and infiltration (I/I) is water that enters a sanitary sewer system from a rain event or exposure to ground water. Inflow can enter a sanitary sewer system through surface openings such as manhole lids and from illegal storm water connections. Infiltration from rain-induced groundwater percolation can enter a system through defects such as cracked and broken pipe, joints, and through openings / cracks in manhole walls.

The largest rainfall event during the flow monitoring period occurred on December 23, 2016 (0.96 inches) based on rainfall recorded at Los Angeles International Airport. Sewage flows during the rainfall event were noted as being approximately 10% greater than those observed under dry-weather conditions. The average dry-weather sewage generation factors will be increased by 10% in order to account for wet-weather flow for modeling purposes.

Unlike dry weather flows, wet weather flows are not increased by a (daily) peaking factor. This is because water use trends tend to decline during wet weather, and the same peaking factor that is applied to average dry weather flow does not apply to wet weather. Therefore wet weather flows are modeled as a separate scenario from peak dry weather flows. Wet weather flows are less than peak dry weather flows, and the critical scenario for modeling the system is peak dry weather.

The flows throughout this report, unless otherwise stated, refer to dry weather flows and not wet weather flows.

2.8 Future Sewage Flows

This section discusses future population growth, development, and projected sewer flows for year 2035.

2.8.1 Future Re-Development

The City plans to develop certain Specific Plan areas for varying changes in land use, including the Uptown area, the Whittier Blvd Shopping area, and the Whittwood Town Center.

We have assumed the Uptown area will be re-developed and re-zoned per land use percentages specified in the Uptown Specific Plan. The Uptown specific plan area will generally be re-developed for medium to high density residential construction around the existing core retail (general commercial) areas. The future load factor for the Uptown Specific Plan (5,299 gpd/acre) was calculated by taking the weighted load factor of each land use type based on composite area. This load factor was then increased by 7.2% to reflect the future population increase projected for the City of Whittier by the year 2035.

The Whittier Blvd Specific Plan includes various sections along Whittier Blvd that will continue to be developed or re-developed as general commercial. This Master Plan accounts for sewage loads in the areas along Whittier Blvd according to their associated land use category (mostly general commercial). Because the land use for this Specific Plan is forecasted to remain unchanged there is no additional sewage flow assigned to the future loads due to development.

The Whittwood Town Center Specific Plan area is currently zoned for general commercial land use and will be re-developed to include a small area of high density residential. Changes in land use due to development is not well defined at this point in time and thus gauging changes to the sewage load factors is difficult to estimate. Modern/future code requirements for low-flow plumbing fixtures and other water saving devices could potentially offset a small variation in land use anticipated from development. For these reasons no additional sewage flow is assigned to the future loads due to development at this time for the Whittwood Town Center.

Table 2-7 summarizes the additional flow quantities generated from re-development of the specific plan areas. The additional flow from re-development of the specific plan include increase in flow due to population growth, development of vacant lots, and re-development of existing lots.

Table 2-6
Additional Flow Quantities
from Re-Development of Specific Plan

Land Use Designation	Additional Flow (gpm)	Additional Flow (gpd)
Uptown Specific Plan	479	689,760
Whittier Blvd Specific Plan	0	0
Whittwood Town Center Specific Plan	0	0
TOTAL	**479**	**689,760**

Additionally, the City has also planned for 32 residential town homes near Beverly Blvd and Workman Mill Rd, an area that is currently zoned for administrative and professional commercial. The City has planned a multi-residential redevelopment of the abandoned Nelles Youth Correctional, however, sewer service for this project would tie directly to County sewer facilities and would not affect the City sewer collection system. Because the sewage loads from the development of the former Nelles Facility would not utilize City sewer lines it was not included in the future model (i.e. the flows are conveyed directly with County pipelines).

2.8.2 Future Development of Vacant Lots

The City has provided data on currently vacant parcels within the City. The future 2035 scenario assumes that all vacant lots will be developed, as a conservative worst case scenario. Undeveloped parcels currently make up approximately 3% by area of the City's existing developable parcels. The projected additional sewage flow generated from development of vacant parcels is summarized in Table 2-6. This table excludes additional flows from development of vacant lots in the specific plan area.

Table 2-7
Additional Flow Quantities
from Development of Vacant Lots

Land Use Designation	Additional Flow (gpm)	Additional Flow (gpd)
Hillside / Low Density Residential	76	109,251
Medium Density Residential	5	7,643
Medium High / High Density Residential	11	15,900
General Industrial	23	33,713
General Commercial	52	74,839
1-Story Administrative and Professional Commercial	20	28,217
3-Story Administrative and Professional Commercial	0	0
Specific Plan - Uptown	--	--
Specific Plan – Whittier Blvd	--	--
Specific Plan – Whittwood Town Center	--	--
Civic Center / Library / Post Office	0	0
Hospitals	0	0
Schools	0	0
Parks / Open Space	0	0
TOTAL	**187**	**269,563**

2.8.3 Future Population Growth

The Master Plan considers future projected sewer system requirements for the year 2035. Over this time period the City's total population, along with the land use densities for all land use categories, are anticipated to increase. The total sewage load for all land use categories in the City will be increased by a single global load factor to account for the overall increase in population. The population increase is based on population data from the Southern California Association of Governments (SCAG), which forecasts population changes in various jurisdictions within Los Angeles County. A baseline population was taken in 2015, and the population for the City of Whittier projected up to 2035. In 2015, the City's population was documented as 87,438 persons, and projected to be 93,700 by year 2035. This is an approximate population increase of 7.2%.

A portion of the additional loads due to population growth has already been included as part of the loads added due to specific plan redevelopment and development of vacant lands. As population of the City increases, the areas that tend to occupy first are vacant properties before densifying other areas of the City. As such, the remainder of the sewage load from population increase is distributed throughout the remainder of the City by increasing future 2035 load factors by 1.3%. The Future 2035 sewage load factors are summarized in Table 2-8.

Table 2-8
Future (2035) Sewage Load Factors

Land Use Designation	Load Factor (GPD/Acre)
Hillside / Low Density Residential	1012
Medium Density Residential	3078
Medium High / High Density Residential	4561
General Industrial	2705
General Commercial	3093
1-Story Administrative and Professional Commercial	11723
3-Story Administrative and Professional Commercial	23445
Specific Plan - Uptown	[1]5299
Specific Plan – Whittier Blvd	[2]NA
Specific Plan – Whittwood Town Center	3271
Civic Center / Library / Post Office	1142
Hospitals	4194
Schools	101
Parks / Open Space	0

1 The sewage load factor that accounts for increase in population/density and also redevelopment of the uptown specific plan area.

2 Whittier Blvd Specific Plan loads are included in the general commercial and general industrial land use categories, and are not separately allocated.

The total flow to the system that can be attributed to the future increase in population and density is summarized in Table 2-97.

Table 2-9
Additional Flow Quantities
from Future Population Growth

Land Use Designation	Additional Flow (gpm)	Additional Flow (gpd)
Hillside / Low Density Residential	36	51,244
Medium Density Residential	6	9,092
Medium High / High Density Residential	10	14,277
General Industrial	6	9,031
General Commercial	12	16,625
1-Story Administrative and Professional Commercial	6	8,257
3-Story Administrative and Professional Commercial	1	708
Specific Plan – Uptown	--	--
Specific Plan – Whittier Blvd	--	--
Specific Plan – Whittwood Town Center	--	--
Civic Center / Library / Post Office	1	330
Hospitals	2	1,394
Schools	1	443
Parks / Open Space	0	0
TOTAL	**78**	**111,401**

2.8.4 Total Future Flows

Both future population increase and future development and re-development will contribute to the increase in sewage load in the future system. The total future flow for the year 2035 under average day conditions is 6,863 gpm. This is a 12% increase over the existing average day flow of 6,118 gpm. Table 2-10 has been provided below summarizing the additional future average day flows and total future average day flows in the system.

Table 2-10
Total Future Average Flows

Land Use Category	Existing Flow (gpm)	Additional Flow (gpm)	Total Future Flow (gpm)
Hillside / Low Density Residential	2,620	111	2732
Medium Density Residential	473	12	485
Medium High / High Density Residential	740	21	761
General Industrial	452	30	481
General Commercial	823	64	886
1-Story Administrative and Professional Commercial	415	25	440
3-Story Administrative and Professional Commercial	37	0	37
Specific Plan - Uptown	378	479	857
Specific Plan – Whittier Blvd	*NA	0	0
Specific Plan – Whittwood Town Center	66	1	67
Civic Center / Library / Post Office	17	0	17
Hospitals	73	1	74
Schools	23	0	23
Parks / Open Space	0	0	0
TOTAL	**6,118**	**745**	**6,863**

*Whittier Blvd Specific Plan loads are included in the general commercial and general industrial land use categories, and are not separately allocated.

2.8.5 Summary of Total Flows

Table 2-11 provides a summary of the existing and future sewage flows.

The average system wide peaking factor for the existing 2015 system is 1.93. For the future 2035 system, proportions of landuse change due to development, and the average system wide peaking factor for the future 2035 system is 1.89.

Table 2-11
Flow Summary

Scenario	Wet Weather		Average Day Dry Weather		Peak Dry Weather	
	gpm	mgd	gpm	mgd	gpm	mgd
Existing 2015	6,730	9.7	6,118	8.8	11,779	17.0
Future 2035	7,550	10.9	6,863	9.9	13,000	18.7

CHAPTER 3. – GENERAL SYSTEM DESCRIPTION

3.1 General System Description

The City's sewer system is comprised mostly of vitrified clay pipe VCP that flows by gravity only and does not contain pumping lift stations or force mains. The general flow scheme of the system follows the natural topography of the City. Sewage from the elevated areas of the City's northern boundary flows southerly towards the lower elevation areas south of Whittier Blvd. South of Whittier Blvd, Los Angeles County (County) sewer trunk lines that extend into the City boundary collect City sewer flow at approximately 140 connection points. There are no waste water treatment plants located in the City and all flow is carried out of the City and treated by County facilities.

A map of the existing sewer system is shown on Figure 3-1. The main County sewer lines are generally run along the southern border of the City and merge at a common point near the intersection of Florence Ave and Telegraph Rd.

3.2 System Inventory

There are approximately 194 miles of sewer pipelines in the City's sanitary sewer collection system with piping diameters varying from 4 inches to 15 inches. Most (58%) of the City sewer pipelines are 8-inches in diameter and VCP is the most common (99%) material type. The next most common (36%) of the City sewer pipelines are 6-inches in diameter. There are approximately 4,300 manholes in the City's collection system. An inventory of pipe organized by material is shown on Table 3-1.

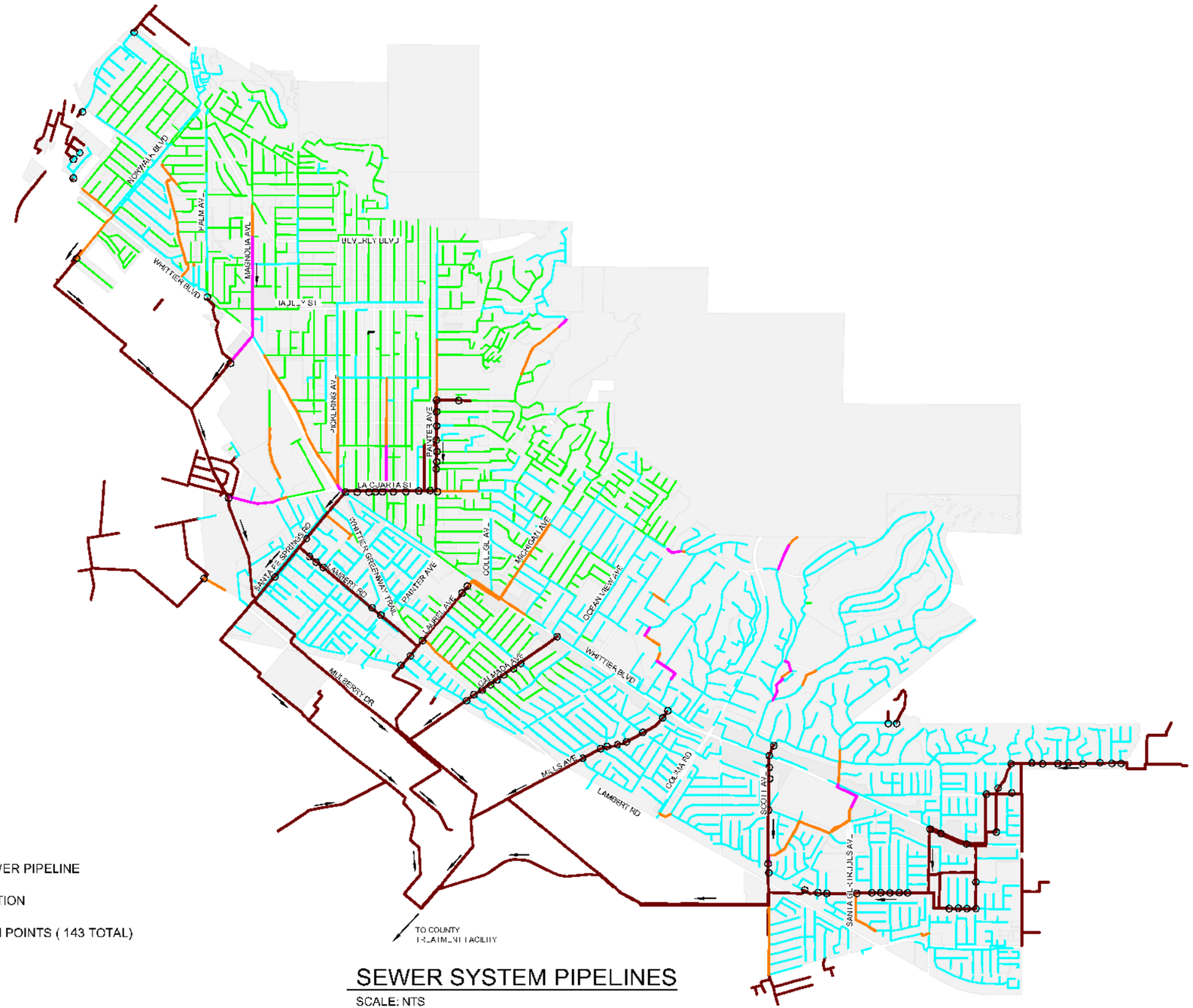
Table 3-1. Inventory of City Sewers by Diameter and Pipe Material

Pipe Diameter	Pipe Material				Total	% Dia
	VCP	CIP	PVC	Unknown		
4	221	-	-	-	221	< 1%
6	368,904	24			368,928	36%
8	594,086	1,464	218		595,768	58%
10	46,441	287			46,728	5%
12	12,060	-	-	-	12,060	1%
15	315	-	-	-	315	< 1%
Unknown	-	-	-	1050	1,050	< 1%
Total (ft.)	1,022,027	1,775	218	1,050	1,025,070	
Total (mi.)	193.57	0.34	0.04	0.20	194.14	
% Material	99.7%	0.2%	0.0%	0.1%	100.0%	

The oldest City sewer lines that remain in operation today can date back to 1917. Most of the system was constructed in the 1950's when the City had its largest growth period. The pipelines can be further grouped into three "generations" (pre-1950, 1950-1958, and post 1958), corresponding to periods of different methods and materials of construction of clay pipe and joints. The three generations often vary in structural condition because of these different methods and materials of construction, as well due to differences in their ages. An inventory of City sewer pipelines are tabulated by installation decade/generation in Table 3-2.

Table 3-2. Inventory of City Sewers by Year Constructed
City Sewer Installed by Era
(Linear Feet)

Pipe Diameter (Inches)	GENERATION 1 (Pre-1950's)				GENERATION 2 (1950-1958)	GENERATION 3 (Post 1958)						Total	% Dia
	1910's	1920's	1930's	1940's	1950's	1958 - 1969	1970's	1980's	1990's	2000's	Unknown		
4	-	-	-	-	-	221	-	-	-	-	-	221	0%
6	3,323	51,311	65,909	77,015	81,116	31,482	16,937	16,859	3,462	-	20,550	367,964	36%
8	-	2,970	11,841	42,528	384,662	110,848	19,112	10,482	4,624	6,283	3,126	596,476	58%
10	-	5,288	5,673	4,219	19,161	3,211	4,505	1,448	900	2,025	1,471	47,901	5%
12	-	-	112	-	4,310	295	3,100	1,864	2,138	-	-	11,819	1%
15	-	-	-	-	314	-	-	-	-	-	-	314	0%
Total (ft.)	3,323	59,569	83,535	123,762	489,563	146,057	43,654	30,653	11,124	8,308	25,147	1,024,695	
Total (mi.)	0.63	11.28	15.82	23.44	92.72	27.66	8.27	5.81	2.11	1.57	4.76	194.03	
Generation %	0.3%	5.8%	8.2%	12.1%	47.8%	14.3%	4.3%	3.0%	1.1%	0.8%	2.5%	100.0%	



SEWER SYSTEM PIPELINES

SCALE: NTS

TETRA TECH
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CITY OF WHITTIER

SEWER MASTER PLAN

SEWER SYSTEM PIPELINES

Project No.:	135-48595-16001
Date:	7/2016
Designed By:	AL
Figure	3-1

Bar Measures 1 inch

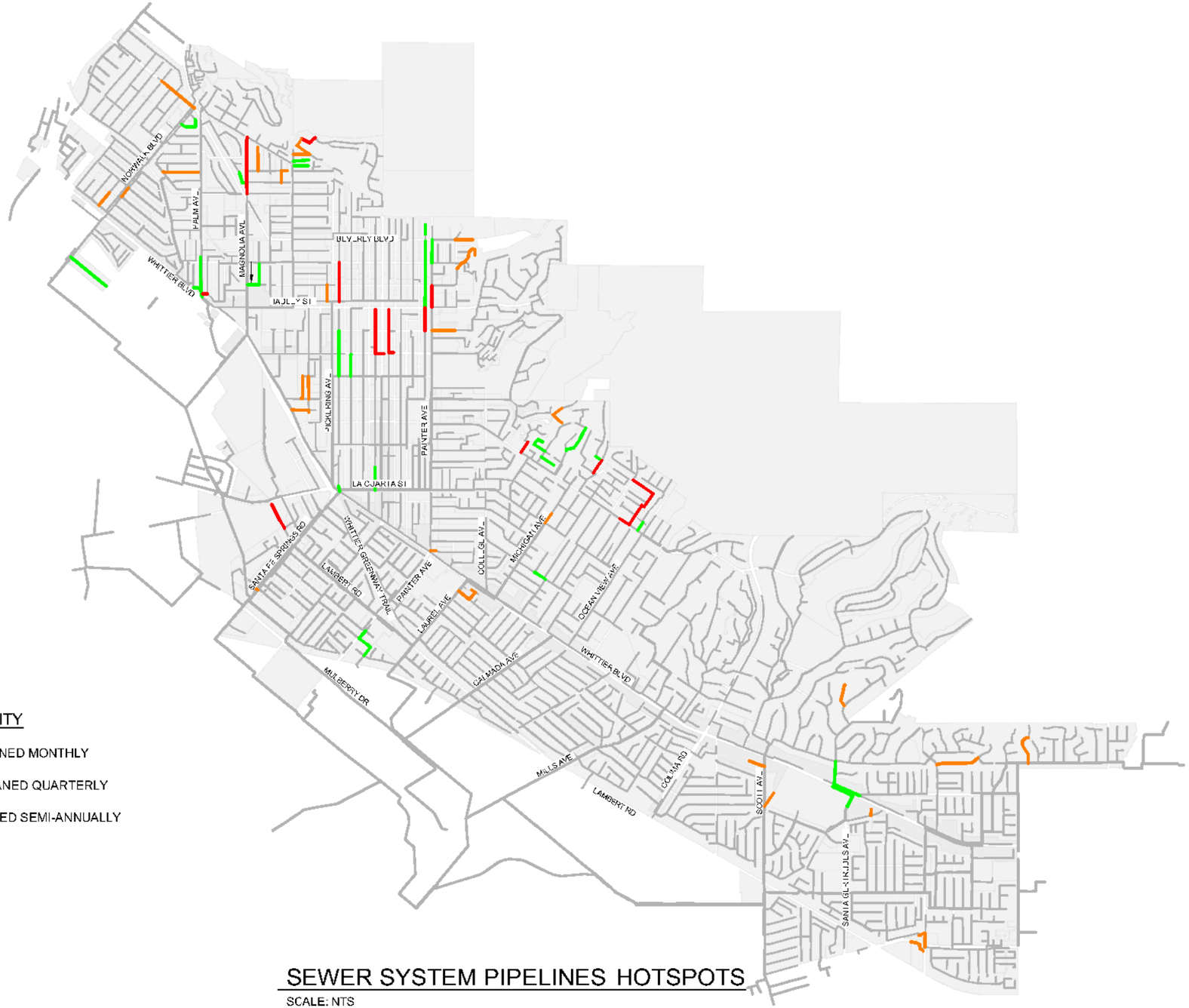
3.3 Historical Maintenance "Hot Spots"

The City regularly cleans the sewers to remove roots, fats, oils and grease (FOG) in order to prevent build-ups that can impede sewer flows or completely block flows, which could result in sanitary sewer overflows (SSO). There are areas in the City with heavy tree and vegetative growth that are more prone to roots entering sewers via sewer pipe joints and laterals. Likewise, there are sewers in commercial areas that are susceptible to FOG and the City has to clean many of them on a recurring basis.

The City proactively cleans every pipe segment in the wastewater collection system at least once a year. Hotspots have been identified that require cleaning on a monthly, quarterly, and semi-annual basis, depending on severity. The City has kept record of maintenance hotspots, as shown on Figure 3-2. Hotspots can be locations that are prone to FOG buildup or areas susceptible to root intrusion. Hotspots can also be locations where pipelines are undersized, where grades are flat and sediment is prone to build up due to slowed velocity of the sewer flow, or where the pipeline is broken or damaged. Maintenance for these areas usually includes jetting the sewer mains and removing any grease, roots, and other foreign matter built up in the pipeline main.

The City documented SSOs between the period of January 2007 and April 2009 to serve as a baseline to measure future sewer maintenance performance. Within this period a total of 74 SSOs were documented, and found 42 cases (57%) of which were caused by root intrusion, and 4 cases (5%) of which were caused by FOG. A table of SSO occurrences since 2007 has been included in Appendix C.

A Sewer System Management Plan (SSMP) summarizing SSO occurrences and outlining maintenance strategies was last revised by the City in 2013. Since the SSMP was completed, SSO occurrences have been reduced.



LEGEND

HOTSPOT SEVERITY

- WORST: CLEANED MONTHLY
- MEDIUM: CLEANED QUARTERLY
- LEAST: CLEANED SEMI-ANNUALLY

SEWER SYSTEM PIPELINES HOTSPOTS

SCALE: NTS

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Tel: 909-305-2930 Fax: 909-305-2959

CITY OF WHITTIER	Project No.: 135-48595-16001
SEWER MASTER PLAN	Date: 7/2016
SEWER SYSTEM PIPELINES HOTSPOTS	Designed By: AL
	Figure 3-2

Bar Measures 1 inch

3.4 Existing Pipe Slope Deficiencies

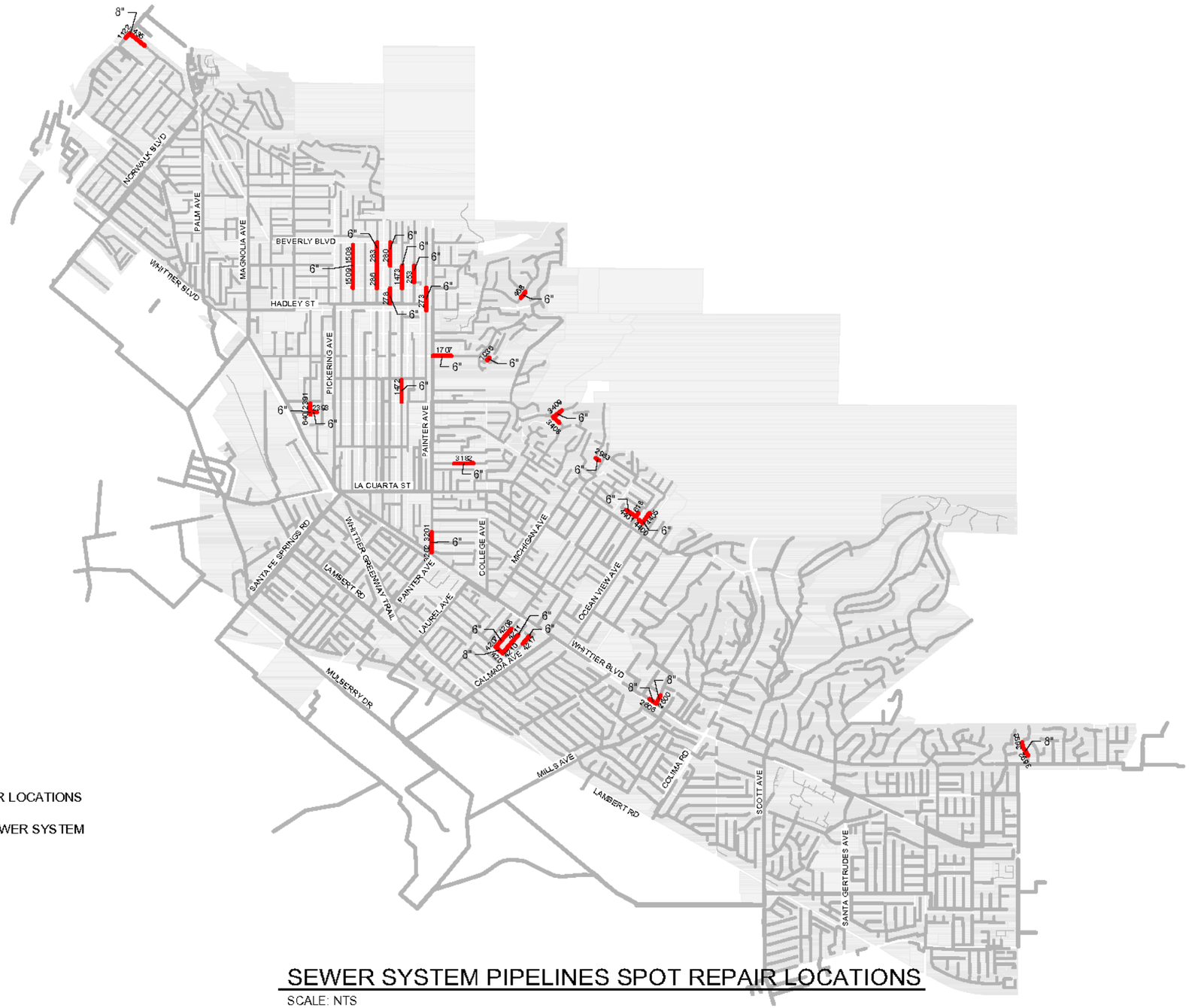
Gravity sewer pipelines require a minimum amount of slope in the pipeline in order to keep the solids from settling and causing an obstruction in the flow. The City uses a minimum velocity of 2.0 feet per second (fps) under peak dry-weather flow conditions for its current design standards. However, many of the existing sewer pipelines do not conform to the current minimum slope design criteria. The majority of these pipes with deficient slopes are located south of Whittier Blvd, where the terrain is generally flatter than the northern part of the City and constitute approximately 430 piping segments.

Of the pipeline segments considered to have deficient slope, not all fail to meet the minimum flow velocity of 2.0 fps under peak dry weather flow. About 8% (or 35) of the pipes with deficient slope meet the minimum flow velocity criteria, as discussed in the computer modeling results in Chapter 5 of this Master Plan.

3.5 Repeated Repairs

The City provided documentation of sewer pipe repairs made over the last several years. Those repairs were evaluated to identify piping segments with 3 or more repairs. The segments with 3 or more repairs are likely to require future repairs, as the history of the segment may indicate a systemic problem. The segments that have been repaired several times may have issues with the initial construction installation, the quality of the fabrication of the piping from the manufacturer, or other problem which might lead to the requirement of still further repairs. This approach seeks to separate repairs that are isolated incidents from those that are more likely to continue to require repeated repairs.

A total of 13,630 feet of 6 inch and less than 1,000 feet of 8 inch piping were identified and associated with 26 locations. The 26 locations are identified on the map in Figure 3-3. A listing of the piping segments by identification number is provided in the Appendix of this report.



LEGEND

PIPE No. (TYP) — XXXX — SPOT REPAIR LOCATIONS

EXISTING SEWER SYSTEM

PIPE SIZE (TYP) — XX"

SEWER SYSTEM PIPELINES SPOT REPAIR LOCATIONS

SCALE: NTS

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CITY OF WHITTIER

SEWER MASTER PLAN

SEWER SYSTEM PIPELINES
SPOT REPAIR LOCATIONS

Project No.:	135-48595-16001
Date:	7/2016
Designed By:	AL
Figure	3-3

Bar Measures 1 inch

CHAPTER 4. – HYDRAULIC MODEL DEVELOPMENT

4.1 Hydraulic Model Software

H2OMAP Sewer (Version 10.5) software was used to develop a hydraulic model of the City's sanitary sewer system in order to evaluate hydraulic performance and identify hydraulic deficiencies. Tetra Tech's unlimited link license was used based on approximately 190 miles of mainline sewers in the existing system with an allowance for future pipe capacity. Geographic Information System (GIS) of the City's sanitary sewer system was also used as part of this project. H2OMAP Sewer is a stand-alone software that works directly with GIS shape files.

4.2 Hydraulic Model Development

Within the software a piping network model is created using data on the sewer piping segments such as elevations, diameter, and material types. Model scenarios are developed to evaluate the response of the sewer collection system to existing and future sewer flow conditions. Model scenarios are also developed to determine the effectiveness of proposed bypass flow projects or other modifications. The model should be considered an ever on-going project that can be updated and utilized to forecast the impact of planned development and improvements to the sewer collection system.

4.2.1 GIS Data Verification and Datum Discrepancies

The City has provided GIS shape files of the City's sanitary sewer system for use in developing a hydraulic model. The GIS data was scrutinized for accuracy before import into the model in an effort to produce the best modeling results. For a number of locations, pipe upstream or downstream elevations were not provided in the GIS shape file attribute data. The majority of these missing pipe invert elevations were resolved by looking up invert elevations from as-built construction data. Where invert elevation as-built data could not be found, invert elevations were estimated based on assuming similar pipe slopes as adjacent pipes with known slopes. There were approximately 100 pipelines with unknown invert elevations at either the upstream end, downstream end, or both. The pipelines with these estimated slopes and invert elevations are identified in the computer model database as "selection sets" titled "Slope _Unknown".

Manhole rim elevations were also missing at numerous locations (approximately 140 manholes). Manhole rim elevations have little effect on prediction of flow in the sewer pipeline, and missing manhole rim elevations at these locations were assumed to be 10 feet above the known manhole inverts. These manholes are saved as a selection set titled "Missing Rim_El".

Elevation discrepancies were found between various sections of the modeled sewer system. These elevation discrepancies are due to various sewer projects that were built based on different elevation datums. The discrepancies result in inaccurate absolute invert elevations when compared to other pipelines in the model. However, the hydraulic model utilizes pipe slopes (pipe slopes are input into the model separately from any elevations) and not absolute elevations to determine flow depth over diameter (d/D) and velocity. Therefore, the inaccurate absolute invert elevations do not affect the flow related calculations. They do, however, result in an unreliable depth of cover over the pipes and unreliable depth of manholes. The height of any surcharges therefore should be checked against the actual depth of manhole (and not the modeled depth) in order to determine how close the sewer is to spilling.

Resolving the differences in datum (approximately 500 were estimated) would require identification of all discrepancies and then adjusting the elevation of all pipe upstream of a discrepancy to the same datum. Completing this task would be impractical since a field survey would be needed to identify the datum for each sewer project. Since the amount of surcharge is not critical to the Sewer Master Plan, the sewer system was modeled without trying to account for differences in datum. The model therefore still provides reliable d/D ratios, but does not provide accurate spill prediction.

4.2.2 Development of Flows

Sewage loads at the modeled manholes are calculated by the software. The load allocation module of the H2OMAP Sewer software allocates wastewater flows to each manhole based on tributary land use areas. Tributary Thiessen polygons are drawn around each manhole and flow allocation to the manholes are calculated based on the intersection of these tributary polygons and the land use areas. The various land use types are assigned calibrated load factors as developed in Chapter 2 to develop average dry weather flow for system manholes. The average dry weather load factors are modified by factors to approximate peak hour flows and wet weather flows.

4.2.3 Sewer Manhole Splits

The sewer system contains several manhole locations designed to split flow from one sewer main to two sewer mains. In the model, flow splitting quantities can be supplied by the user or allowed to be automatically calculated by the software. If determined automatically, flow entering each downstream pipe is calculated based on their invert elevations and downstream slopes. Pipes with the lowest invert are assumed by the software to fill first. As the depth of water increases in the lowest pipe, flow is routed until the next highest invert is achieved. All sewer manhole splits in the model were determined by the program automatically.

4.2.4 County Sewer Pipelines

While information of County pipelines is included in the model, the model runs do not evaluate the hydraulic capacity of County pipelines. Connections of the City sewer pipeline to County pipelines are modeled as outlets and analysis of hydraulic flow does not continue past the connection point.

4.3 Hydraulic Model Electronic Copy

An electronic copy of the hydraulic model is included in the Appendix of this report.

CHAPTER 5. – MODEL RESULTS

5.1 Sanitary Sewer Analysis Criteria

Sanitary sewer analysis criteria were established for maximum depth of flow in the pipe and minimum pipe velocity / minimum pipe slope. The sewer model identifies hydraulic deficiencies in the system based on these criteria.

5.1.1 Maximum Depth Over Diameter (d/D) Ratios

During a rainfall event or when exposed to ground water, water enters the sewer system via openings and defects that is referred to as inflow and infiltration (I/I). This additional water results in wet weather peak flows that can require more sewer pipeline capacity compared to dry weather peak flow conditions. Peak wet weather flows are accounted for by designing sewers to carry peak dry weather flows at maximum sewer flow depth within the pipe divided by the piping diameter d/D ratios. The remainder of the pipe flow area is reserved as spare capacity to carry wet weather flow on top of the peak dry weather flow. This conservative approach of allowing for void space within the sewer pipe allows for airflow that aids in preventing the wastewater from becoming septic and odorous.

In evaluating sewer capacity as part of this Master Plan, the maximum d/D ratio to carry peak dry weather flow will be as show in table 5-1.

Table 5-1 Depth over Diameter

Pipe Size (in.)	Maximum Depth/Diameter (d/D)
6 and less	0.5
8 to 12	0.5
15 and larger	0.75

5.1.2 Minimum Velocity and Pipe Slope

A minimum pipe velocity of 2 feet per second fps at peak dry weather flow is necessary to remove solids from the pipe and prevent deposition on a daily basis. Pipe velocity is dependent on pipe slope such that pipes with steeper slopes tend to have flow of higher velocity. Minimum pipe slope listed by pipe diameter used in this computer model is shown in Table 5-2. These are typical minimum slopes used by similar agencies and cities to help ensure adequate pipe capacities and velocities. Minimum slope is a construction standard that helps ensure the d/D ratios, pipe velocity, and other hydraulic criteria are met. Pipes that have slopes less than the minimum slope will have higher levels and lower velocities at normal flows and are more likely to surcharge at high flows.

5.1.3 Corrective Action Strategies

A number of solutions are available to correct a specific sewer flow issue. A larger diameter or additional parallel pipeline may be appropriate where flow is restricted due to the piping d/D ratio. When insufficient slope is the issue the solutions can be to install a new piping system with greater slope, diversion of a

portion of the flow from the pipeline segment to other routes with spare capacity, or the installation of a pumping station. The next chapter of this report discusses a number of bypass diversion projects for the Whittier sewer system that may eliminate the need to replace large piping segments in flow problem areas.

Table 5-2 Minimum Slope

Pipe Diameter (in.)	Minimum Slope (ft/ft)
6	.004
8	.004
10	.0032
12	.0024
15	.0016

5.2 Model Results

5.2.1 Model Results – Existing System

The calibrated flows were input into the model, and the model of the existing system was run for the dry weather, peak flow scenario. The model results were filtered based on the depth over diameter deficiency criteria and a list of approximately 157 deficient pipe segments was developed, which is included in Appendix D. A map of these deficient pipe is shown in Figure 5-1.

5.2.2 Model Results – Future System

The model of the future system was run under a dry weather, peak flow scenario. For the future system, 60 deficient pipe segments were identified in addition to the existing conditions pipe segments. The list of deficient pipe for the future system is included in Appendix E. A map of these deficient pipe is shown in Figure 5-2.

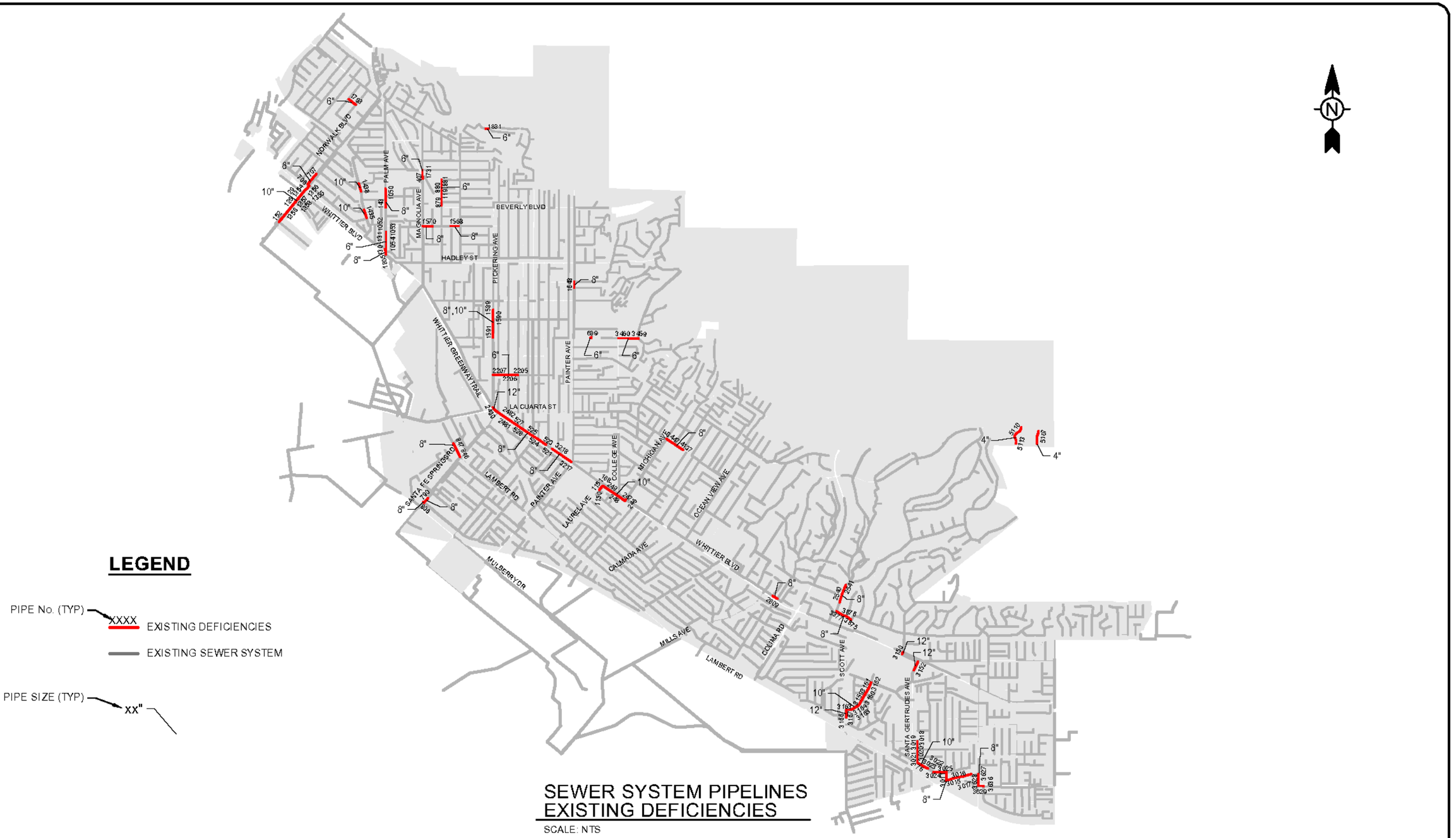
5.2.3 Combined Existing, Future, and Historical Deficiencies

A map combining the model pipeline deficiencies results for existing and future with known historical maintenance issues was prepared and presented in Figure 5-3. The combined deficient map is made up of over 53,000 linear feet of pipeline segments of varying diameters and lengths. Table 5-2 lists a summary of the combined deficient pipelines with their respective linear feet of length and diameter.

Table 5-3: Combined Existing, Future, and Historical Pipeline Deficiencies

Piping Diameter (inches)	Deficient Piping Length (ft)
8	10,876
10	24,849
12	11,202
14	837
16	5,742

In the next chapter, the combined existing, future, and historical pipelines with deficiencies are grouped by priority for costing and scheduling



LEGEND

PIPE No. (TYP) — XXXX — EXISTING DEFICIENCIES

EXISTING SEWER SYSTEM

PIPE SIZE (TYP) — XX"

SEWER SYSTEM PIPELINES EXISTING DEFICIENCIES

SCALE: NTS

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CITY OF WHITTIER

SEWER MASTER PLAN

SEWER SYSTEM PIPELINES
EXISTING DEFICIENCIES

Project No.:	135-48595-16001
Date:	7/2016
Designed By:	AL
Figure	5-1

Bar Measures 1 inch

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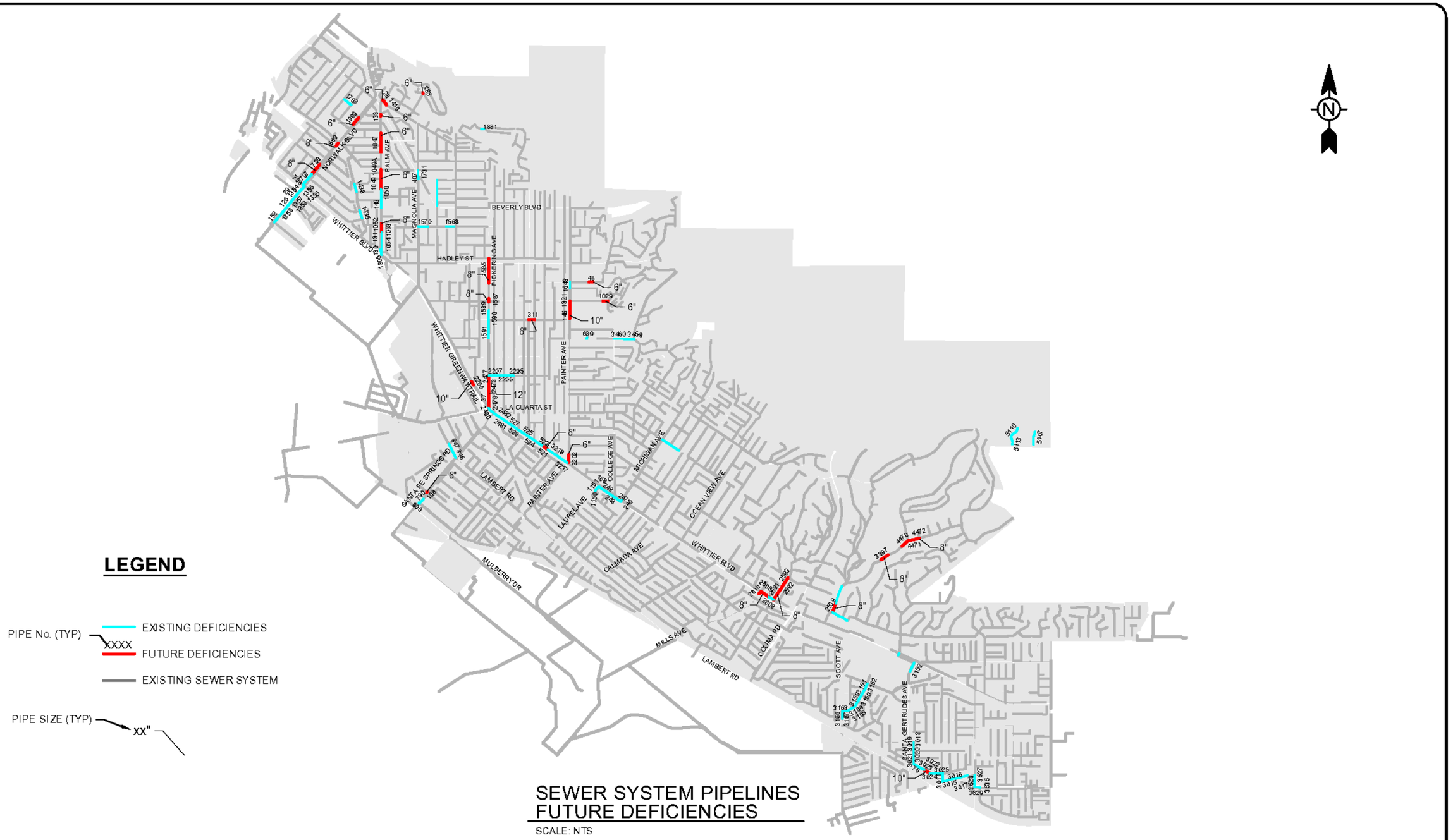

LEGEND

PIPE No. (TYP) — XXXX

- EXISTING DEFICIENCIES
- FUTURE DEFICIENCIES
- EXISTING SEWER SYSTEM

PIPE SIZE (TYP) — XX"

SEWER SYSTEM PIPELINES FUTURE DEFICIENCIES

SCALE: NTS

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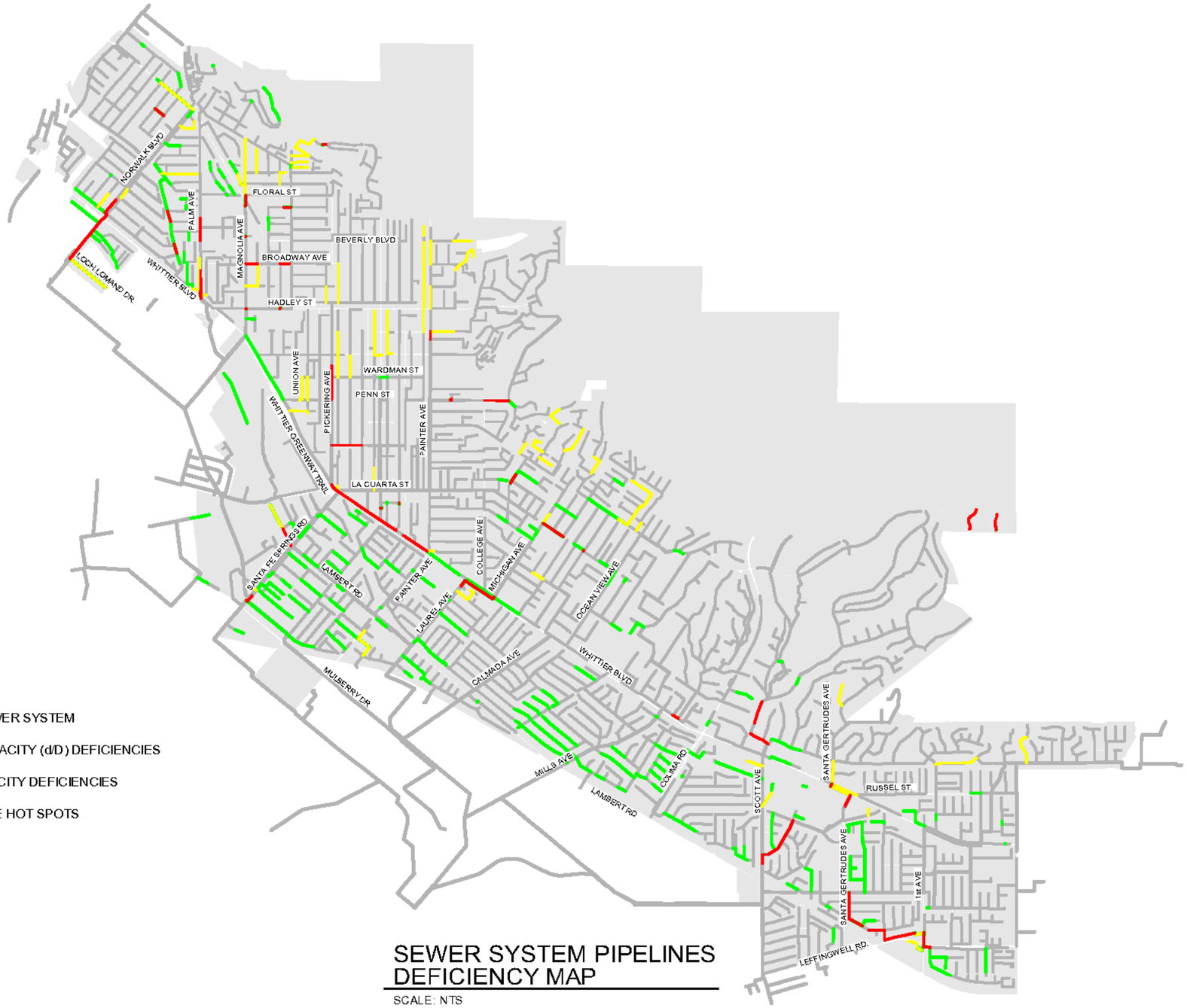
CITY OF WHITTIER
SEWER MASTER PLAN
SEWER SYSTEM PIPELINES
FUTURE DEFICIENCIES

Project No.:	135-48595-16001
Date:	7/2016
Designed By:	AL
Figure	5-2

Bar Measures 1 inch



LEGEND

- EXISTING SEWER SYSTEM
- EXISTING CAPACITY (d/D) DEFICIENCIES
- SLOPE / VELOCITY DEFICIENCIES
- MAINTENANCE HOT SPOTS

SEWER SYSTEM PIPELINES DEFICIENCY MAP

SCALE: NTS

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CITY OF WHITTIER

SEWER MASTER PLAN

SEWER SYSTEM PIPELINES DEFICIENCY MAP

Project No.:	135-48595-16001
Date:	7/2016
Designed By:	AL
Figure	5-3

Bar Measures 1 inch

CHAPTER 6. – RECOMMENDED IMPROVEMENTS AND COST SCHEDULING

6.1 Summary

The hydraulic model identifies pipe in the existing and future system that are flowing with hydraulic depth deficiencies or slope deficiencies. The City has provided a list of sewer maintenance "hotspots" throughout the City. A list of recommended improvements was compiled by analyzing both the hydraulic model results and City maintenance "hotspots". The list is sorted based on the priority criteria that has been developed and discussed later in this section. The listing was further refined by evaluating bypassing projects that may allow overall cost savings by reducing the quantity of piping required to resolve specific sewer system flow issues.

6.2 Priority Criteria

The model results include three categories of priority. Priority 1 is the highest priority and priority 3 is the lowest:

Priority 1 Improvements: These improvements include pipe with a depth over diameter d/D of 0.9 or higher based on the existing model results. This grouping of improvements also includes those sewer mains flowing over capacity (per the criteria of Chapter 5) at known historical maintenance problem areas (or "hotspots") or where repeated spot repairs (as discussed in section 3.5) have been completed. Priority 1 recommendations are based on the model results from the existing system only and does not consider deficiencies predicted in the future system model.

Priority 2 Improvements: These improvements are based on those sewer mains that are predicted to flow full or near full in the future (2035) sewer system, but are not currently posing problems in the existing sewer system. Priority 2 sewer improvements also are based on those sewer mains flowing over capacity in the existing sewer system. Piping segments with a history of 3 or more repeated spot repairs (as discussed in section 3.5) are included in the Priority 2 category, unless they were also identified as having hydraulic issues in which case they are grouped in the Priority 1 improvements.

Priority 3 Improvements: These improvement recommendations are less critical and are the future (2035) sewer mains that are predicted to flow over capacity (but not full) based on the model results from the future system only.

Priorities were adjusted on a case by case basis. For example, improvement projects at lower priorities that are adjacent to larger span projects of higher priority would be promoted to the higher priority project. Additionally, projects that may not have been deemed as deficient may be included in an improvement project if adjacent to an improvement project, for ease of construction.

6.3 Construction Methods

The method of improvement to relieve a deficiency was only surficially explored in this master plan. Generally, deficiencies are assumed to be relieved by upsizing the deficient pipes including replacement of the manholes. However, there are several locations where construction of a bypass (a bypass reduces the flow through the

deficient area by re-routing some of the flow) appears to be more cost effective than simply upsizing the deficient pipes. In those cases, a bypass is the recommended improvement.

At the early stage of a project to relieve any deficiency, some consideration should be given to the project limits and construction method. In other words, bypasses may be considered for many projects and may be desirable if they result in less public inconvenience or lower costs than a simple replacement. Also, there are some conditions where trenchless methods of construction may be advantageous or where alternate materials high density polyethylene (HDPE) should be considered.

A cost analysis was performed to determine if there was a significant cost advantage to constructing

a) Pipeline replacement only where a new sewer was constructed in the alignment of the old sewer (or very close) and the existing manholes were re-used or

b) A complete new parallel pipe and manholes and abandoning the old piping and manholes.

The cost analysis determined that the costs were about equal and there was no cost advantage with either method. There would be other advantages to a complete new parallel pipe and manhole because the manhole would be new, so we assumed this method of construction. A copy of the cost analysis is included in Appendix F of this report with the pipeline replacement identified as Option I and the pipeline and sewer replacement identified as Option II. As an alternative, the City may consider reuse of existing manholes and replacement of VCP sewer piping between manholes.

6.4 Basis of Cost Estimate

Costs in this report are construction costs and are based on the unit construction costs of past sewer pipeline projects in urban areas in and around the City of Whittier. The costs do not include engineering, project administration, construction administration, inspection, or construction management. In order to estimate total project costs, those costs would have to be added to the construction cost.

6.4.1 Unit Construction Costs

Average or typical construction costs were obtained from past projects, and recent city pipeline projects, and represent only the average cost for trenched PVC sewer. Specific project costs could vary significantly depending on specific project requirements for depth of cover, bypass pumping, traffic control, etc. The cost per linear foot for various PVC piping diameters were developed as listed in Table 6-1.

Table 6-1: CIP PVC Piping Unit Costs

Piping Diameter	Unit Cost / LF
8-inch PVC	$270
10-inch PVC	$290
12-inch PVC	$305
14-inch PVC	$320
16-inch PVC	$340

6.4.2 Cost Index

A recent Engineering News Record (ENR) Construction Cost Index of 10385 (August 2016) is noted for users of this report seeking to update the cost estimates presented.

6.5 Bypass Capital Improvement Projects

Replacement of all pipe identified as deficient would be costly, and more cost effective alternate means to reduce excessive flow areas in the system is explored in this section using bypass projects. As part of this report an evaluation was performed of potential projects to divert flow away from piping segments that are exceeding capacity. This may be accomplished by construction of a short segment of bypass pipeline to divert flow to alternate routes that contain excess capacity and/or to avoid construction in congested roadways.

The four bypass capital improvements evaluated are as listed below.

1. La Serna Ave Bypass
2. Russel Ave & Whittier Blvd Bypass
3. Mar Vista St & Calmosa Ave Bypass

6.5.1 La Serna Ave Bypass

Construct 200 ft. of 8-inch pipe On El Venado Blvd.

(Potential Cost Savings $0.6M)

This bypass is recommended for further evaluation as an alternative to replacing piping on La Serna Ave between Janine Dr and Carretera Dr.

Approximately 1,800 ft of pipeline on La Serna Ave located near the County connection at Janine Dr. currently exceeds its flow capacity. This alternative proposes construction of a 200 ft 8-inch diameter bypass pipeline on El Venado Blvd to divert flow from La Serna Ave (see Figure 6-1). This bypass may reduce the amount of replacement pipeline requirements on La Serna Ave by 1,250 feet and potentially provides project cost savings of $0.6M

6.5.2 Intersection of Russel St and Whittier Blvd Bypass

Construct 200 ft. of 8-inch pipe on Whittier Blvd.

(Potential Cost Savings $0.4M)

This bypass is recommended for further evaluation as an alternative to replacing piping on Whittier Blvd. from Santa Gertrudes Ave to Russel St.

City maintenance staff have had maintenance issues with this span of pipe on Whittier Blvd where it intersects Russel St. Sewage flow coming from the east on Russel St, converges with flow on Whittier Blvd and then continues west until it loops back towards Santa Gertrudes Ave. This bypass project proposes a 200 ft span of pipe to cross Whittier Blvd and tie into an 8-inch pipeline on Russel St, to the 12-inch pipeline on Santa Gertrudes Ave (see Figure 6-1). The bypass may eliminate up to 700 ft of replacement piping on the congested Whittier Blvd right-of-way and potentially provide a cost savings of $0.4M.

6.5.3 Mar Vista and Calmosa Ave Bypass

Construct 180 ft. of 8-inch pipe on Calmosa Ave.

(Potential Cost Savings $0.4M)

This bypass is recommended for further evaluation as an alternative piping replacement on Calmosa Ave.

City staff have had issues with a 1050 ft span of 8-inch diameter pipeline on Mar Vista St and Calmosa Ave. The pipe slope is minimal on Mar Vista St before it converges with other laterals at Strub Ave. The flat slope on Mar Vista St may be causing settlement of solids and clogging in the pipe, which is backing up into Calmosa St. Rather than costly replacement of the line on Calmosa St, a 180 ft span of 8-inch bypass pipe is proposed to be constructed to divert flow from Calmosa Ave, north of Mar Vista Ave, to a pipeline on Calmosa Ave south of Mar Vista Ave. This bypass may eliminate up to 700 ft of replacement piping and potentially provides a cost savings of $0.4M.

6.5.4 Summary of Recommended Bypass Projects

A summary of the recommended bypass projects and their potential cost saving is shown in Table 6-2.

Table 6-2: Recommended Flow Bypass Projects

Bypass Project	Potential Cost Savings
La Serna Ave Bypass	$0.6M
Intersection of Russel St and Whittier Blvd Bypass	$0.4M
Mar Vista and Calmosa Ave Bypass	$0.4M
Total	**$1.4M**

6.6 Repeated Spot Repairs Capital Improvement Projects

Piping segments with a history of 3 or more repairs were identified from City maintenance records, as described in Chapter 3. The model results indicate that there are zero instances where hydraulically deficient pipes overlap with pipes where repeated spot repairs were completed. No pipes with repeated spot repairs is included in the Priority 1 Capital Improvements Projects. These pipes are included as Priority 2 projects and are composed of 36 areas with a total of 22,607 feet of 6 and 8 inch piping. The complete list of all repeated spot repair pipes is included in the Appendix J.

6.7 Recommended Capital Improvement Projects

Table 6-3 provides a summary list of the recommended CIP projects broken down by priority, project number and location. Figure 6-1 shows the locations of these projects utilizing the same project numbers. The total construction cost for these pipeline improvements is $16.8 million, which is significantly less than the 6” sewer replacement program.

Table 6-3: Recommended Capital Improvements Projects

Priority	Project #	Location	Replacement Size	Length (ft)	Cost
1	1	Bypass at Russel St and Whittier Blvd	8, 14	541	$ 163,235
	2	Norwalk Blvd from Loch Lomand Dr to Dorland	12, 14	1,749	$ 558,865
	3	Palm Ave between Floral Ave and Broadway Ave	10, 12	1,328	$ 395,102

	4	Whittier Blvd between Michigan and Laurel	14, 16	1,211	$ 409,778
	5	Penn St (at county connection new Guiford)	12	61	$ 18,684
	6	El Rancho between Orange Dr and Rose Dr	14	314	$ 100,501
	7	Magnolia Ave between Floral Dr and Beverly Blvd	10	313	$ 90,727
	8	Alley between Mavis Ave and Rockne Ave	10	330	$ 95,697
	9	Carinthia Dr west of Mount Holly Dr	12	99	$ 30,343
	10	Penn St between College Ave and Canyon Dr	10	711	$ 206,046
	11	New Castle Dr	12	473	$ 144,116
	12	Stoneridge Dr	12, 14	682	$ 208,113
	13	Palm Ave (County Connection at Whittier Blvd)	10	190	$ 55,187
	14	First Ave and Leffingwell Rd	10	1,812	$ 508,65``4
	15	Lambert N of Santa Fe Springs Rd	8	1,328	$ 369,406
	16	Palm between Whittier and Broadway	8	2,957	$ 863,844
	17	Beverly Drive Citrus to Palm	8	2,774	$ 748,980
	18	Alleys bound by Hadley/Beverly and Painter/Newlin	8	10,566	$ 3,814,020
	19	Sunset/Franklin/Hellen between Painter and College	8	4,242	$ 1,145,340
	20	Between Bacon Rd and Linda Vista Dr Alleys	8	3,751	$ 1,012,770
			Subtotal	**35,432**	**$ 9,978,208**
2	**21**	Bypass Pipeline at Mar Vista St and Calmosa Ave	8	200	$ 54,000
	22	Bypass Pipeline at La Serna Ave	8	206	$ 55,620
	23	Pickering Blvd between Hadley St and La Cuarta St	16	302	$ 102,362
	24	Hoover Ave from Orange Dr to Howard St	8, 10	909	$ 248,746
	25	Norwalk Blvd from Orange Dr to Dorland Dr	10	490	$ 142,032
	26	Pickering Blvd between Hadley St and La Cuarta St	10, 12	988	$ 296,615
	27	Whittier Blvd between Painter St and La Cuarta St	10	3,095	$ 897,925
	28	Hornell St between Kentucky St and Santa Fe St	10, 12	1,876	$ 564,951
	29	Santa Fe Springs Rd north of Shreve Rd	10, 14	237	$ 69,681
	30	El Rancho Dr between Howard St and Broadway	14	300	$ 96,019
	31	Broadway between Gregory Ave and Acacia Ave	10	619	$ 179,426
	32	Painter Ave Between Bailey/Olive	8	223	$ 64,542
	33	Whittier Blvd south of Pacific	12	168	$ 51,240
	34	Whittier Blvd west of La Puebla Ave	10	192	$ 55,789
	35	Messina Dr between Scott Ave and Starbuck St	12, 14, 16	1,685	$ 518,611
	36	Janine Dr. / Shiloh St.	8	415	$ 112,050
	37	Summit Dr. / Marshall Ln.	8	545	$ 147,150
	38	Hadley St. / Friends Ave.	8	635	$ 171,450

	39	Bronte Dr. / Bowen Dr.	8	115	$ 31,050
	40	Sunny Slope St. / Pierce Ave.	8	835	$ 225,250
	41	Washington Ave. / Wardman St.	8	635	$ 171,450
	42	Painter Ave. / Ramona Dr.	8	595	$ 160,650
	43	Bronte. Dr. / Elend Ave.	8	320	$ 86,400
	44	Philadelphia St. / Painter Ave.	8	540	$ 145,800
	45	Hillside Ln. / Philadelphia Ave.	8	95	$ 25,650
	46	Boyar Ave / Strub Ave. / Chestnut Dr. / Watson /Oak	8	2,321	$ 626,670
	47	Ben Hur Dr. / Whittier Blvd.	8	510	$ 137,700
	48	Deveron Dr. / Pioneer Blvd.	8	710	$ 191,700
	49	Via Del Palma Dr. / Painter Ave.	8	620	$ 167,400
			Subtotal	**20,382**	**$5,798,128**
3	**50**	Palm Ave north of Hunter Ave	8	66	$ 197,406
	51	Intersection of Rideout Way and Capri Dr	8	26	$ 6,902
	52	Philadelphia St west of Bryn Mahr Way	8	185	$ 49,925
	53	Hoover St between Pilgrim Ave and Broadway Ave	8	343	$ 92,635
	54	Bailey Street	10	215	$ 62,355
	55	Youngwood east of La Serna	10	295	$ 85,517
	56	Youngwood Dr west of Montesino Dr	10	710	$ 205,806
	57	Painter between Wardman St and Philadelphia St	12	329	$ 100,360
			Subtotal	**2,833**	**$ 800,907**
			Total	**58,647**	**$ 16,577,243**

A detailed listing of pipeline segments recommended for replacement under a CIP is included in Appendix G of this report. The listing includes the four bypass capital improvement projects. The total costs included at the end of each capital improvement priority represents a reduction in the total quantity of replacement piping required, assuming the bypass projects are constructed.

The Appendix G table also includes a pavement condition index based on the pavement at the location where the improvement project is proposed. The pavement condition index is listed, but recommendation and prioritizations were not made based on the pavement condition. The City should take into consideration the locations where street pavement replacement is crucial and schedule the sewer capital improvement projects accordingly in order to combine coinciding project costs and avoid duplicate construction efforts and trenching of newly constructed pavement. Similarly, the City should consider where their potable water pipeline capital improvement projects are in the vicinity of the sewer capital improvement projects. The coordination of the street, water, and sewer projects should be performed on an annual basis.

Table 6-4 provides a summary listing of the recommended CIP projects by piping diameter and their estimated costs separated by priority level. The complete Capital Improvement Project list is included in Appendix G.

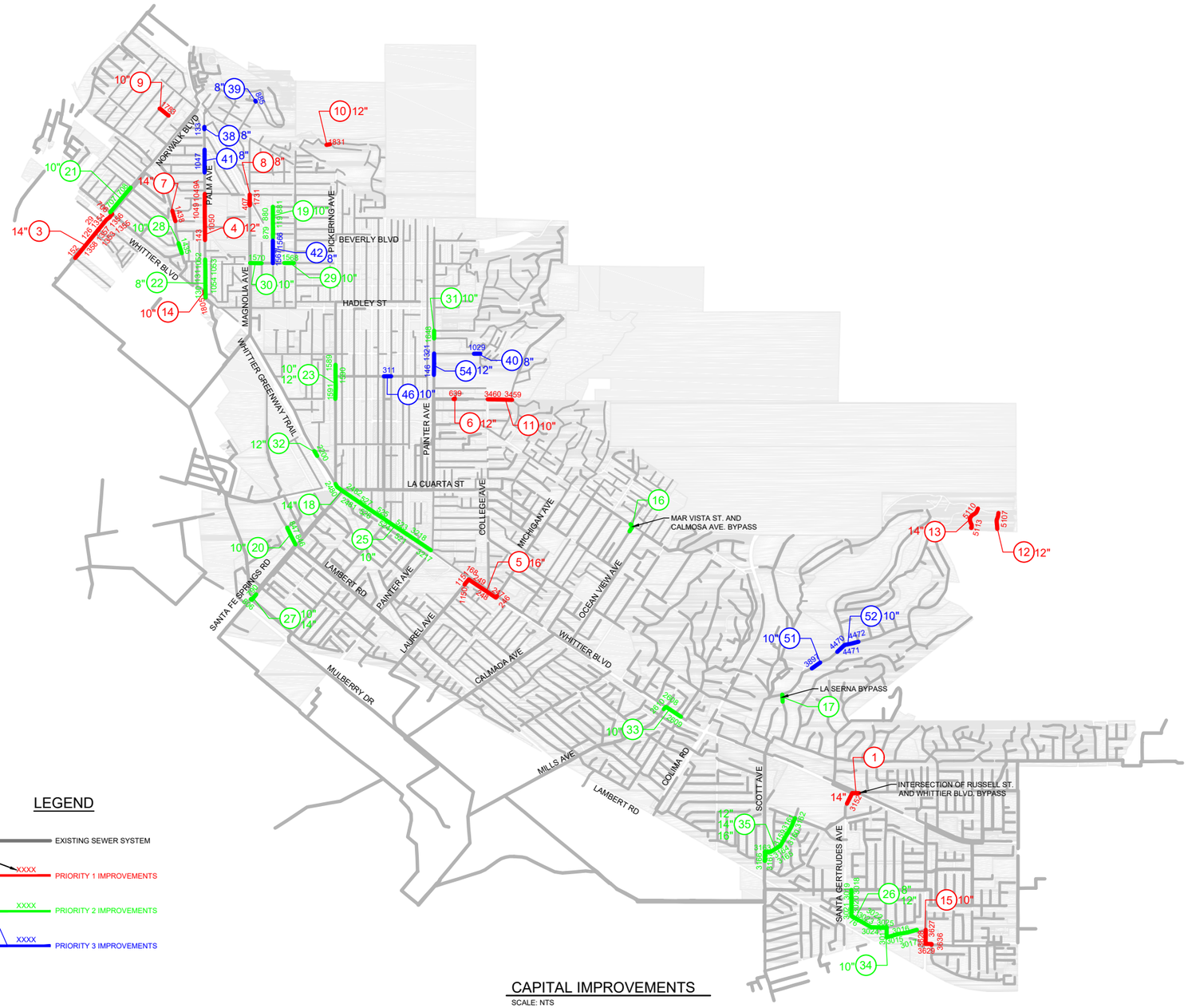
Table 6-4: Recommended CIP Cost Summary by Piping Diameter

	Replacement Piping Diameter (inches)	Replacement Piping Length (ft)	Estimated Cost
Priority 1 Improvements	8	24,388	$6.6M
	10	5,462	$1.6M
	12	2,024	$0.6M
	14	2,444	$0.8M
	16	1113	$0.4M
		Priority 1 Subtotal:	**$10.0M**
Priority 2 Improvements	8	10,048	$2.7M
	10	5,769	$1.7M
	12	3,655	$1.1M
	14	593	$0.2M
	16	316	$0.1M
		Priority 2 Subtotal:	**$5.8M**
Priority 3 Improvements	8	1,285	$0.3M
	10	1,220	$0.4M
	12	329	$0.1M
	14	0	$0
	16	0	$0
		Priority 3 Subtotal:	**$0.8M**
CIP Total	8	32,933	$8.8M
	10	12,451	$3.7M
	12	7,283	$1.8M
	14	3,037	$1.1M
	16	3,821	$0.5M
		Total:	**$16.6M**

The four bypass sewer piping projects have the potential to reduce the overall CIP costs by $0.55M. The cost savings from the four bypass projects appears to be evenly distributed between the Priority 1 and Priority 2 categories of projects. Potentially the four bypass projects could reduce the quantity of new piping required and provide a cost savings representing 6% of all costs for piping identified for replacement. The La Cuarta sewer capacity bypass improvements, with its project costs estimated between $0.6M and $0.9M, provides a cost savings and will be required in order to divert additional sewer flow from development in the Uptown area from County trunk lines.

As discussed in 6.7.2, the City has plans to replace all existing small diameter (6 inch or smaller) collection system piping with 8 inch piping and in is addition to the CIP Cost Summary above.

Small Piping Replacement Program	8	390,000 LF	$105M



LEGEND

- EXISTING SEWER SYSTEM
- PIPE No. (TYP) — XXXX — PRIORITY 1 IMPROVEMENTS
- PROJECT No. (TYP) — XXXX — PRIORITY 2 IMPROVEMENTS
- PROPOSED PIPE SIZE (TYP) — XX" (XX) — XXXX — PRIORITY 3 IMPROVEMENTS

CAPITAL IMPROVEMENTS

SCALE: NTS

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MARK	DATE	DESCRIPTION	BY

CITY OF WHITTIER

SEWER MASTER PLAN

CAPITAL IMPROVEMENTS

Project No.:	135-48595-16001
Designed By:	AL
Drawn By:	TPC
Checked By:	KRB
Figure	6-1

Bar Measures 1 inch

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6.8 Annual Pipe Replacements

6.8.1 General

In addition to the improvements recommended to resolve hydraulic and specific maintenance issues (i.e. the CIP), a rehabilitation/replacement program is required in order to replace aging infrastructure when it gets to the end of its useful life. An annual replacements program is a good preventative program to reduce major breaks and spills.

The construction replacement costs for the entire sewer system is about $250 million. If a significant percentage of pipelines were to reach the end of their useful life around the same time, annual replacement costs could easily reach beyond the City's capacity to replace them in a timely manner. An annual replacements program will also mitigate against this problem.

6.8.2 Small Diameter Pipe Replacements

The City has a focus to replace the older 6-inch (and 4-inch) sewer pipelines with 8-inch pipes. City maintenance staff have noted that 6-inch and 4-inch pipe have had a higher frequency of maintenance problems in comparison to 8-inch and larger pipe.

6-inch and 4-inch pipe diameters are located in the older half of the City generally north of Ocean View Blvd and consist of approximately 390,000 linear feet of pipe and 1,530 segments. The majority of the existing pipe is VCP with approximately 2% consisting of PVC and less than 1% consisting of ductile iron pipe (DIP) and cast iron pipe (CIP). The cost to replace all 6-inch and 4-inch pipes in the system would be approximately $93M. This does not include those pipes already recommended for replacement as part of the Capital Improvements Projects.

6.8.3 Piping System Life Expectancy

Typically gravity sewer pipes similar to the City of Whittier would be estimated to have a life expectancy between 50 and 100 years, depending on many factors including materials used, methods of construction, and local conditions. As a gross estimate, this life expectancy (if construction of the system was completed on a regular annual basis) would require an annual replacement range of 1.0% to 2.0% of the existing system.

However, the system was not constructed regularly and it is instructive to list three "generations" of pipe construction:

1. Generation 1: Pre-1950 (28% of system) Has stood up well
2. Generation 2: 1950 to 1958 (47% of system) Low rate of failure to date
3. Generation 3: Post-1958 (25% of system) Higher rate of defects

Approximately 26% of Generation 1 pipe inspected had severe structural defects. Considering the age of pipe, Generation 1 pipe has stood up relatively well.

The majority of pipe in the system was constructed in Generation 2 (47% of system). We can therefore expect a significant increase in repairs as Generation 2 pipeline components reach the end of their life cycle. Approximately 5% of Generation 2 pipe that was inspected by the City currently have severe structural defects. This is a relatively low rate of failure considering the age of the pipe.

Approximately 16% of Generation 3 pipe inspected had severe structural defects. Generation 3 pipe segments are the latest to be constructed, and appear to be experiencing high defects for their age.

After study of the typical pipe life expectancy and the 3 generations, it becomes clear that it is very difficult to estimate the actual life expectancy with good accuracy. Since the latest generation of pipe has the highest rate of defects, it also becomes clear that there is risk that the generation 3 will reach its end of life overlapping with generations 1 and 2. And generation 2, which includes almost half of the system, is within the 50 to 100 year life expectancy now.

Beginning in 2008, the City began a video inspection program to document the condition of their pipelines. A rehabilitation/replacement program was summarized in Chapter 4 of the City's Sewer System Management Plan completed in October 2013. The purpose of the inspections was to identify high priority defects, and assess each defect to determine if replacement would be required. A 5-year replacement program was then developed.

6.8.4 Annual Pipe Replacements

It is recommended the City continue with their inspection and improvement program in order to maintain the system and help identify high priority replacement projects. In addition, the City should focus on replacing 4" and 6" pipes on an annual basis. The rate of defects/repairs should be monitored and documented and if the City sees an increase in that rate, the annual replacements should be quickly increased in order to avoid a rapid increase in defects, repairs, and spills.

Appendix A.
Land Use

TABLE 2-1
LAND USE IMPLEMENTATION (continued)

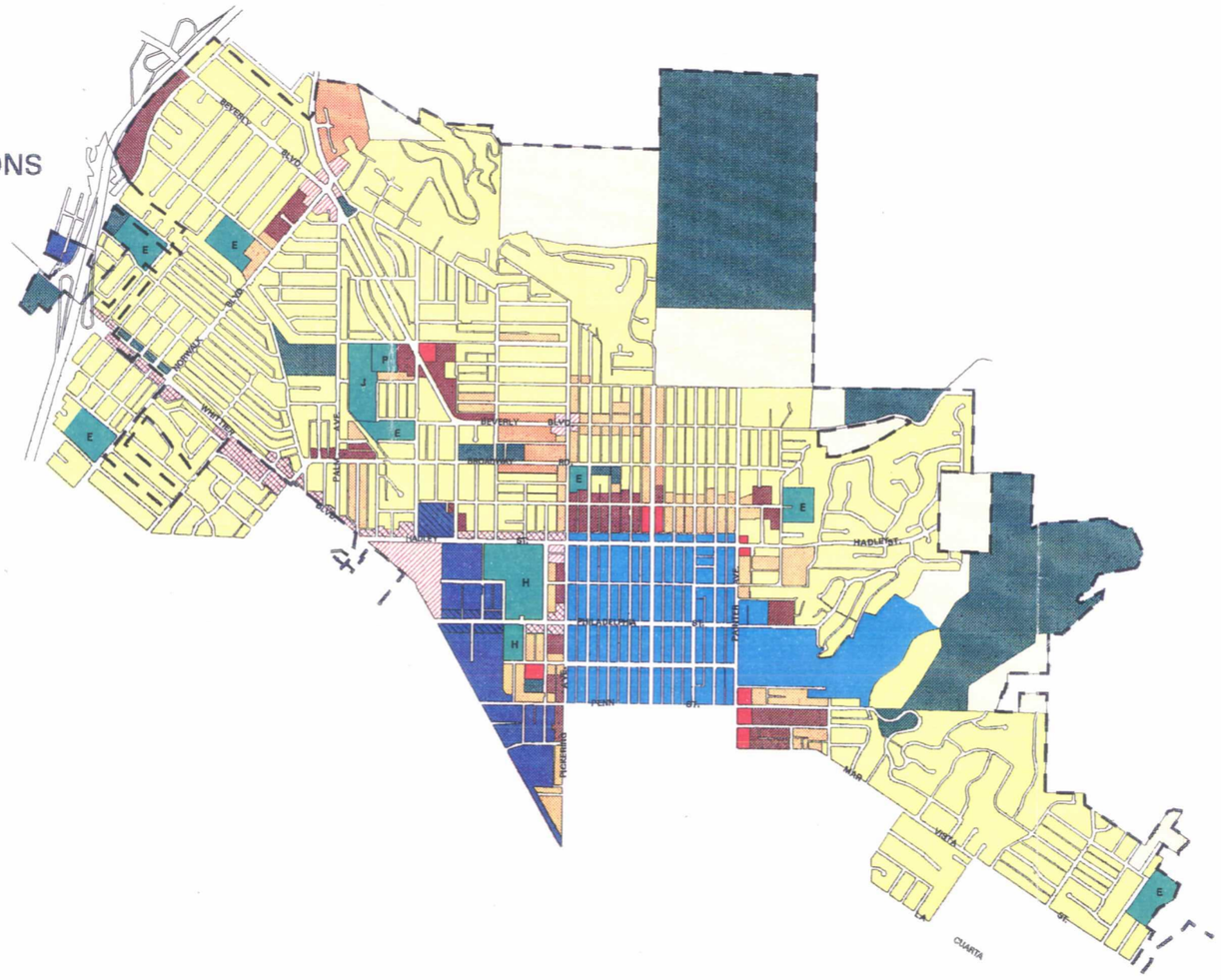
Goal	Policy	Implementation Measure
2. Maintenance and Development of Residential Neighborhoods (continued)	2.5 Encourage development of quality housing.	General Plan & Zoning Ordinance Consistency Environmental Review Program
	2.6 Encourage lot assembly.	Incentives to Create Larger Lots Support Organizations
	2.7 Require new development to consider infrastructure capacity and demand on public services.	Environmental Review Service Commitment Service Capacity Monitoring
	2.8 Implement ongoing planning efforts.	Specific Plan Consistency Program
3. Maintenance and development of commercial and retail uses.	3.1 Promote convenient access and parking areas.	Commercial Development Standards Parking Standards Review
	3.2 Encourage the grouping of commercial uses.	General Plan & Zoning Ordinance Consistency
	3.3 Protect the aesthetic qualities of commercial areas.	Redevelopment Programs Design Review
	3.4 Discourage large temporary and offsite signs.	Sign Ordinance Review
	3.5 Encourage a variety of commercial uses.	Support Organizations
	3.6 Encourage attractive, safe, comfortable commercial developments.	Redevelopment Programs
	3.7 Encourage the use of buffers and landscaping.	Design Review Landscaping and Land Use Buffers
	3.8 Promote energy conservation.	Energy Conservation
	3.9 Require new development to consider infrastructure capacity and demand on public services.	Environmental Review Service Commitment Service Capacity Monitoring

TABLE 2-1
LAND USE IMPLEMENTATION (continued)

Goal	Policy	Implementation Measure
4. Continued improvement of industrial areas.	4.1 Encourage industrial developments to be compatible with adjacent uses.	Environmental Review Design Review Industrial Rehabilitation
	4.2 Encourage industrial diversification in Whittier.	Support Organizations Promotion of Local Industries
	4.3 Require high quality building design and promote the use of buffers.	Landscaping and Land Use Buffers Environmental Review
	4.4 Cooperate with other agencies in limiting adverse impacts of industrial development	Environmental Review Inter-agency Coordination
	4.5 Require industrial development to meet or exceed safety standards.	Environmental Review Design Review Inter-agency Coordination
	4.6 Require new development to consider infrastructure capacity and demand on public services.	Environmental Review Service Commitment Service Capacity Monitoring
5. Provision of Parks and Recreational Opportunities	5.1 Encourage development and retention of parks and recreation areas.	General Plan & Zoning Ordinance Consistency Parks Needs Study Update
	5.2 Purchase new park sites whenever possible.	Parks Needs Study Update Park Fees
	5.3 Development parks and recreation facilities to complement other community facilities.	Parks Needs Study Update
	5.4 Encourage park development to address deficiencies.	Parks Needs Study Update Handicap Access Requirements
	5.5 Discourage the destruction of existing parks.	Parks Needs Study Update Deed Restriction

LAND USE DESIGNATIONS

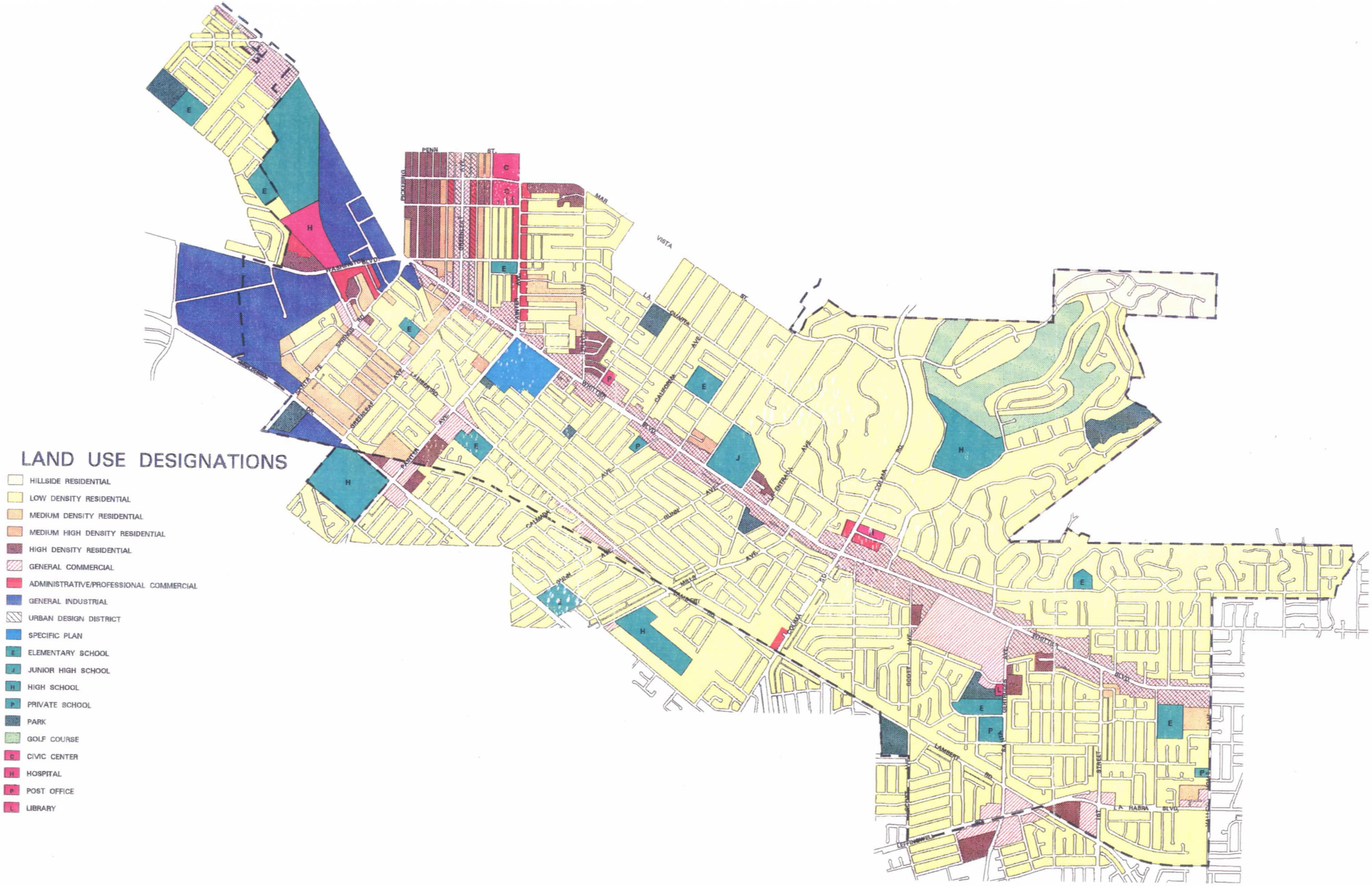
- HILLSIDE RESIDENTIAL
- LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- MEDIUM HIGH DENSITY RESIDENTIAL
- HIGH DENSITY RESIDENTIAL
- GENERAL COMMERCIAL
- ADMINISTRATIVE/PROFESSIONAL COMMERCIAL
- GENERAL INDUSTRIAL
- URBAN DESIGN DISTRICT
- SPECIFIC PLAN
- E ELEMENTARY SCHOOL
- J JUNIOR HIGH SCHOOL
- H HIGH SCHOOL
- P PRIVATE SCHOOL
- PARK
- GOLF COURSE
- C CIVIC CENTER
- H HOSPITAL
- P POST OFFICE
- L LIBRARY



DAVID EVANS AND ASSOCIATES, INC.

City of Whittier
GENERAL PLAN

EXHIBIT 2-1
LAND USE PLAN
(NORTHWEST AREA)



DAVID EVANS AND ASSOCIATES, INC.

City of Whittier
GENERAL PLAN

EXHIBIT 2-2
LAND USE PLAN
(SOUTHEAST AREA)

TABLE 2-1
LAND USE IMPLEMENTATION (continued)

Goal	Policy	Implementation Measure
6. Retention and development of scenic areas and open space.	6.1 Encourage landscaped buffer zones.	Landscaping & Land Use Buffers
	6.2 Maintain and develop sidewalks and parkways.	Sidewalk and Parkway Development and Maintenance Program
	6.3 Promote conversion of railroad rights-of-way to multi-use trails.	Parks Needs Study Update Conversion of Railroad Rights-of-Way
	6.4 Preserve ecological resources in planning area.	Puente Hills Cooperative Planning Program Open Space Acquisition
	6.5 Work with involved individuals and agencies to promote preservation of Puente Hills.	Puente Hills Cooperative Planning Program Open Space Acquisition
7. Promote mixed-use development.	7.1 Encourage new housing in mixed-use districts.	Underutilized Lots General Plan & Zoning Ordinance Consistency
	7.2 Encourage the development of mixed-use districts.	Redevelopment Programs General Plan & Zoning Ordinance Consistency
8. Preserve Institutional Uses.	8.1 Preserve and maintain institutional uses.	General Plan & Zoning Ordinance Consistency
	8.2 Work with Whittier College to preserve its campus.	Specific Plan Consistency Program General Plan & Zoning Ordinance Consistency

LAND USE PLAN

The Land Use Plan is the primary tool for implementing the goals and policies of the Land Use Element. The Plan indicates the location and extent of permitted development in the City to promote compatible development and the maintenance of environmental amenities. The Land Use Plan also reflects the goals and policies in the Land Use Element. Because the City is largely urbanized, the Plan corresponds closely to existing land uses and development throughout the City.

The Whittier Land Use Plan will be the primary tool for implementing the land use goals and policies. The Land Use Plan consists of a map showing land use designations over the planning area and general standards for development permitted in specific areas of the City. State law

requires that these categories also describe standards for *development intensity* and *population density*. This ensures that citizens, staff, and policy makers clearly understand the implications of the Land Use Plan on both existing and future development.

Development intensity refers to the size or degree of development possible within a land use designation. Development intensity standards may use a ratio of a building's floor area to the total lot area (referred to as a floor area ratio), the number of dwelling units per acre, traffic generation, or a number of other factors. In the Whittier General Plan, development intensity is measured using floor area ratios for nonresidential development and units per acre densities for residential development.

Population density applies generally to residential land use designations and is expressed as the number of persons per acre. The population density standard is often derived by multiplying the number of housing units per acre permitted within a particular land use designation by the average household size in the City.

The land use designations are described in greater detail in the following sections. The General Plan land use map is shown in Exhibits 2-1 and 2-2.

Residential Land Use Designations and Standards

Residential land use designations apply to the various densities of residential developments in the City. Generally, higher density areas are located near the city center and low density areas are located on the hillsides. The residential land use designations are summarized in Table 2-2.

- **Hillside Residential** - The Hillside Residential designation applies to large lot development. Approximately 314.27 acres (3.9 percent) of the City is designated as Hillside Residential. This designation will allow development of up to three dwelling units per acre. The population density within these areas would be 9 persons per acre, assuming an average household size of 2.7 persons per household. (The average household size reflects 1990 Census estimates.) This designation corresponds to the Hillside Residential (H-R) Zone of the City Zoning Ordinance.

- **Low Density Residential** - The Low Density Residential designation refers to single-family development which is found throughout Whittier. Generally, this designation characterizes existing residential neighborhoods in the City. This designation will allow developments with maximum densities of 6 or 7 units per acre, depending on the underlying zoning, lot configuration, and development standards. The Low Density Residential designation covers the majority of residential neighborhoods in Whittier or approximately 3,785.87 acres (47.3 percent). The population density within these neighborhoods may average up to 19 persons per acre, with an average household size of 2.7 persons per household. The Low Density Residential designation directly

corresponds to the Low-Density Residential (R-1) Zone and includes the Residential (R-E) Zone.

- **Medium Density Residential** - The Medium Density Residential designation applies to areas of the City with densities between 8 dwelling units per acre to 15 dwelling units per acre. Housing within this density range includes a mix of single-family detached and attached units, duplex, triplex, and garden apartments. The Medium Density Residential designation applies to approximately 225.27 acres (2.8 percent) of the City. The maximum population density in these areas is 41 persons per acre, assuming an average of 2.7 persons per household. This designation corresponds to the Medium Density Residential (R-2) Zone.

- **Medium-High Density Residential** - The Medium-High Density Residential designation reflects areas with housing densities of 16 dwelling units per acre to 25 dwelling units per acre. Developments within this designation include multi-family projects, apartment, condominiums, and planned unit developments. The Medium-High Density Residential designation covers approximately 65.90 acres (0.8 percent) of the City. The maximum population density within these areas is 68 persons per acre. The Medium-High Density Residential designation corresponds to the Medium-High Density Residential (R-3) Zone.

- **High Density Residential** - The High Density Residential designation applies to those areas with multi-family developments and special housing projects with densities of 26 dwelling units per acre to 35 dwelling units per acre. Approximately 184.34 acres, or 2.3 percent of the City, is designated as High Density Residential. The population density in these areas may reach 95 persons per acre (at 2.7 persons per household). This land use designation corresponds to the High Density Residential (R-4) Zone.

TABLE 2-2
SUMMARY OF GENERAL PLAN RESIDENTIAL DESIGNATIONS

Land Use Designation	Maximum Density	Permitted Developments	Corresponding Zone District
Hillside Residential	2 units/acre	Planned residential clusters of single-family units and/or multi-family units	H-R
Low Density Residential	6 to 7 units/acre	Single-family detached units	R-E R-1
Medium Density Residential	15 units/acre	Townhouses, duplex, triplex, garden apartments, and multi-family detached units	R-2

TABLE 2-2 SUMMARY OF GENERAL PLAN RESIDENTIAL DESIGNATIONS (continued)			
Land Use Designation	**Maximum Density**	**Permitted Developments**	**Corresponding Zone District**
Medium-High Density Residential	25 units/acre	Multi-family units, condominiums, Planned Unit Developments	R-3
High Density Residential	35 units/acre	Multi-family units, special housing projects	R-4

Commercial Designations and Standards

Commercial designations in the Plan reflect the different types of commercial land uses: General Commercial, and Administrative and Professional Commercial. Commercial designations are described below and are summarized in Table 2-3.

- **General Commercial** - The General Commercial designation refers to retail, trade and service uses, including highway-related commercial uses, shopping centers, business districts and commercial nodes. Approximately 411.51 acres of the City are designated as General Commercial. The average floor area ratio of developments in these areas is 0.25 to 0.50. This designation corresponds to the C-1, C-2, and C-3 Zones of the Zoning Ordinance.

- **Administrative and Professional Commercial** - The Administrative and Professional Commercial designation applies to areas developed with offices serving business, medical, professional, and administrative uses. This designation permits an average floor area ratio (FAR) of 0.50 to 2.0. Approximately 58.41 acres of the City (0.7 percent) are designated Administrative and Professional Commercial. This designation corresponds directly to the Commercial Office (C-O) and Light Commercial (C-1) Zones.

TABLE 2-3 SUMMARY OF GENERAL PLAN COMMERCIAL DESIGNATIONS			
Land Use Designation	**Maximum Density Average FAR**	**Permitted Developments**	**Corresponding Zone District**
General Commercial	FAR 0.25 to 2.0	Retail, trade and service uses, business district, commercial corridor, sub-regional shopping centers, convenience centers, highway-related commercial uses, high density residential uses	C-1 C-2 C-3

TABLE 2-3
SUMMARY OF GENERAL PLAN COMMERCIAL DESIGNATIONS (continued)

Land Use Designation	Maximum Density Average FAR	Permitted Developments	Corresponding Zone District
Administrative and Professional Commercial	FAR 0.5 to 2.0	Business, medical, professional and administrative offices, special housing projects, high density residential uses	C-1 C-O

Urban Design District Overlay

This land use designation promotes the revitalization and improvement in four key corridors within the City. The designation goes beyond the Scenic Corridor designations discussed in the Environmental Resource Management Element which focuses on landscaping and the preservation and maintenance of amenities. The Urban Design District applies to portions of Whittier Boulevard, Greenleaf Avenue, Philadelphia Street, and Hadley Street. It promotes specific urban design measures and guidelines and calls for specific types of land uses and accompanying development standards tailored for each use. This designation does not change the maximum density allowed by the underlying zoning designations though the overlay expands the development that is currently permitted under the base zone designations. Table 2-4 summarizes this land use designation and the actions associated with the implementation of the overlay designation for each of the districts.

The Urban Design District designation applies to the following:

- **Whittier Boulevard Urban Design District** - This district generally extends along the entire length of Whittier Boulevard and applies to a majority of parcels where infill or design guidelines are desirable. The Plan calls for design guidelines or a specific plan to be prepared and adopted to provide direction related to architectural design, site planning, signage, and streetscape treatments along Whittier Boulevard. The Whittier Boulevard Urban Design District designation will also permit mixed-use developments (which may include a mix of residential and commercial land uses on a single parcel) once design standards have been prepared. In other areas, the intent is to provide for the establishment of commercial nodes and centers to more efficiently utilize the available land. Existing residential and public land uses located along the corridor will not be affected by this designation.

- **Hadley Street Urban Design District** - This designation promotes the upgrading of Hadley Street between Whittier Boulevard and the Uptown area. The Plan calls for the preparation of design guidelines or a specific plan to establish direction concerning the nature and extent of development desirable in the future. The General Plan envisions

the need to establish design guidelines for this key roadway while promoting mixed-use (residential/commercial) and residential development in those areas where underutilized properties are found.

- **South Greenleaf Urban Design District** - This designation applies to that portion of Greenleaf Avenue between Uptown and Whittier Boulevard. This area is included within the South Greenleaf Redevelopment Project Area and has been the focus of planning efforts related to improved urban design. The Overlay designation, as it applies to this corridor, also permits mixed-use development (residential/commercial) and residential development. Commercial development is also permitted under the base zoning.

- **Philadelphia Street Urban Design District** - This street is a highly visible link between Whittier Boulevard and the Uptown Area. The overlay designation, as it applies to this corridor, focuses on improving the corridor's appearance through design guidelines. The average permitted density in these areas shall be regulated by the density allowed by the underlying designation.

TABLE 2-4
SUMMARY OF URBAN DESIGN DISTRICT DESIGNATION

District Name	Maximum Average Density	Applicable Standards
Whittier Boulevard	FAR 0.25 to 2.0 (with the floor area for the residential use calculated as part of the FAR)	Specific Plan or Design Guidelines will be prepared. Base zoning will remain unchanged along corridor. Commercially zoned parcels may be redeveloped in mixed-use residential/commercial on same parcel.
Hadley Street	FAR 0.25 to 2.0 (with the floor area for the residential use calculated as part of the FAR)	Specific Plan or Design Guidelines will be prepared. Base zoning will remain unchanged along corridor. Commercially zoned parcels may be redeveloped in mixed-use residential/commercial on same parcel.

TABLE 2-4 SUMMARY OF URBAN DESIGN DISTRICT DESIGNATION (continued)		
District Name	**Maximum Average Density**	**Applicable Standards**
South Greenleaf Avenue	FAR 0.25 to 2.0 (with the floor area for the residential use calculated as part of the FAR)	Specific Plan or Design Guidelines will be prepared. Base zoning will remain unchanged along corridor. Commercially zoned parcels may be redeveloped in mixed-use residential/commercial on same parcel.
Philadelphia Street	Base zoning applies	Design guidelines only.

Industrial Designation

The General Industrial designation refers to all industrial and manufacturing land uses, including warehouses. In Whittier, approximately 262.28 acres (3.3 percent of the City's total land area) are designated as General Industrial. The average floor area ratio of these areas is 0.6 to 1.0. The General Industrial designation corresponds to the Manufacturing (M) Zone in the Zoning Ordinance. The standards are summarized in Table 2-5.

TABLE 2-5 SUMMARY OF GENERAL PLAN INDUSTRIAL DESIGNATION			
Land Use Designation	**Average FAR**	**Permitted Developments**	**Corresponding Zone District**
General Industrial	FAR 0.6 to 1.0	Warehouses, light and heavy industrial uses	M

Public and Quasi-Public Designations

Public and Quasi-Public designations, (summarized in Table 2-6) apply to land uses operated and maintained for public administration, and welfare. These land uses include public elementary, junior high and high schools, private schools, parks, the Civic Center, hospitals, post offices, libraries, and the golf course. The Land Use Plan identifies the different institutional and public uses in the City. Approximately 1,232.26 acres of the City (15.4 percent) is designated for the different Public and Quasi-Public uses. This designation is consistent with all zoning categories in which these uses are permitted.

TABLE 2-6 SUMMARY OF GENERAL PLAN PUBLIC/QUASI-PUBLIC DESIGNATION			
Land Use Designation	**Average FAR**	**Permitted Developments**	**Corresponding Zone District**
Public and Quasi-Public	FAR 0.5 to 2.0	Schools, institutional uses, private clubs and organizations, parks and recreation facilities, cultural and civic centers, utility facilities	All

Specific Plan Designation

Specific Plans are designed to provide specific guidance concerning land use and development standards, infrastructure requirements (including streets), and design standards for areas included within a specific plan's boundaries. Once adopted, a specific plan can only be changed by amending the plan. The areas designated as Specific Plan correspond to areas of adopted and future specific plans. Specific plans may be developed for other areas of the City where there is a need to exercise more control over the development of the area. The following Specific Plans are provided for under this General Plan:

- The Uptown Whittier Village is located in a specific plan area which contains the City's original commercial district. It covers 33 city blocks developed with retail stores, specialty shops, restaurants, residences, and offices. The specific plan for Uptown Whittier was developed specifically to preserve the historic character of the area. The plan calls for rebuilding of the retail commercial base, development of mixed-uses, restoration of historic buildings, development of buildings which complement the existing architectural style, promotion of the area's retail uses, creation of entertainment opportunities, and development of support residential and offices uses.

- The Quad at Whittier Specific Plan covers the area developed with the Quad shopping center on Whittier Boulevard between Painter and Laurel Avenues. The site covers 32.4 acres.

- Whittier College has also been designated a Specific Plan area. This will allow development within the college to proceed according to a proposed Master Plan. Whittier College is developed with school buildings, dormitories and game fields.

Land Use Plan

The Land Use Plan, as shown in Exhibits 2-1 and 2-2, indicates the location and extent of development permitted under the Land Use Plan. As indicated previously, most development in the City is going to be preserved under this Plan. The focus of future revitalization and redevelopment will be along the commercial arterial roadways and in scattered infill.

The development capacity of a city may depend on a number of factors such as availability of infrastructure, vacant land, topography, and the maximum development permitted under the General Plan. The maximum development possible under a plan is referred to as a *build-out*. Build-out is generally expressed in number of housing units for residential development and square-footage of structural gross floor area for nonresidential.

Theoretical build-out refers to the development possible if all land uses were developed to the maximum intensity permitted under the General Plan. The major limitation of theoretical build-out is the assumption that existing development will be replaced by newer development over the life of the Plan. Effective build-out is a more realistic measure in that the measure recognizes that new development will be limited to certain parcels. Many parcel's configurations will not allow further development. In communities that are urbanized, effective build-out is generally around 80% of theoretical build-out.

The Whittier Land Use Plan, under effective build-out, will result in approximately 28,451 to 35,564 housing units, 4.6 to 5.8 million square feet of commercial uses and 5.5 to 6.8 million square feet of industrial uses. Table 2-6 indicates the effective and theoretical build-out for the General Plan. The effective buildout is 80 percent of the theoretical capacity. It accounts for lot size, irregular parcels and other areas that cannot accommodate development at maximum density. Assuming an average household size of 2.7 persons per household, the resident population at build-out and full occupancy is 96,023 persons. Table 2-7 estimates the Plan's carrying capacity.

TABLE 2-7
LAND USE PLAN BUILD-OUT

Land Use Designation	Acres	Density/FAR	Total Build-out	Effective Build-out
Hillside Residential	314.27	2 du/acre	628	502
Low Density Residential	3,785.87	6 du/acre	22,715	18,172
Medium Density Residential	225.27	15 du/acre	3,379	2,703
Medium-High Density Residential	65.90	25 du/acre	1,648	1,318
High Density Residential	184.34	35 du/acre	6,452	5,162

TABLE 2-7
LAND USE PLAN BUILD-OUT (continued)

Land Use Designation	Acres	Density/FAR	Total Build-out	Effective Build-out
General Commercial	411.51	FAR 0.25 to 0.50	4,481,344 sf	3,585,075 sf
Administrative and Professional Commercial	58.41	FAR 0.5 to 2.0	1,272,170 sf	1,017,736 sf
General Industrial	262.28	FAR 0.60 to 1.0	6,854,950 sf	5,483,960 sf
Urban Design District	296.74	25 du/ac	742 du*	594 du
Public and Quasi-Public				
Elementary School	166.22	FAR 0.5	7,317,427 sf	5,853,941 sf
Junior High School	38.65	FAR 0.5		
High School	114.74	FAR 0.5		
Private School	16.36	FAR 0.5		
Park	492.18	FAR 0.01	214,394 sf	171,515 sf
Civic Center	17.27	FAR 0.70	526,597 sf	421,277 sf
Hospital	27.41	FAR 1.0 to 2.0	1,193,980 sf	955,184 sf
Post Office	1.80	FAR 0.5	39,204 sf	31,363 sf
Golf Course	121.25	FAR 0.01	52,817 sf	42,253 sf
Library	1.19	FAR 0.5	25,918 sf	20,735 sf
Specific Plan	235.19	FAR 0.5 to 2.0	5,122,438 sf	4,097,950 sf
Streets	1,465.79	---	---	---
TOTAL	8,005.90		35,564 units + 27 million sq.ft.	28,451 units + 22 million sq.ft.

* Assumes 10% is developed with residential uses at 25 du/ac and with commercial or industrial use calculated under the base designation.

Appendix B.
Bureau of Engineering Sewer Design

PUBLIC AND COMMERCIAL FACILITIES AVERAGE DAILY FLOW PROJECTIONS
TABLE F229

Units	Ave. daily flow (gpd/unit)	Type description
SEAT	5/SEAT	AUDITORIUM
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	AUTO PARKING
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	AUTO REPAIR GARAGE
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	BAKERY
7 GR.SQ.FT.	5/7 GR.SQ.FT.	BALLROOM
1000 GR.SQ.FT.	200/1000 GR.SQ.FT.	BANK: HEADQUARTERS
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	BANK: BRANCH
15 GR.SQ.FT.	20/15 GR.SQ.FT.	BANQUET RMS/CONFERENCE
SEAT	20/SEAT	BAR: FIXED SEAT
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	BAR: JUICE (NO FOOD)
15 GR.SQ.FT.	20/15 GR.SQ.FT.	BAR:PUB. AREAS(TABLES)
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	BARBER SHOP
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	BEAUTY COLLEGE
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	BEAUTY CLG. STRG>15%
1000 GR.SQ.FT.	200/1000 GR.SQ.FT.	BEAUTY COLLEGE:OFFICE>
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	BEAUTY PARLOR
OFFICE	200/OFFICE	BLDG. CONSTR. OFFICE
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	BOWLING ALLEY
SEAT	50/SEAT	CAFETERIA: FIXED SEAT
GPM PEAK	412/GPM	CARWASH: BASED ON PEAK
STALL	206/STALL	CAR WASH: COIN-OPERATED
5 GPM PEAK	412/GPM	CARWASH: IN BAY
SEAT	5/SEAT	CHURCH:FIXED SEAT
1000 GR.SQ.FT.	300/1000 GR.SQ.FT	CHIROPRACTIC OFFICE
OCCUPANT	10/OCCUPANT	ChurchSch:DayCare/Elem.
20 GR.SQ.FT.	5/20 GR.SQ.FT.	CHURCH SCH: 1 DAY USE/W
N/A	NO CHARGE	CITY: BLDG. CONTS. OFC.
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	CLINIC
SEAT	20/SEAT	COCKTAIL LOUNGE:FXD ST
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	COLD STORAGE:NO SALES
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	ColdStorage:RetailSales
FIXTURE	120/FIXTURE	COMFORT STATION:PUBLIC
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	COMMERCIAL USE
OCCUPANT	5/OCCUPANT	COMMUNITY CENTER
1000 GR.SQ.FT.	200/1000 GR.SQ.FT.	CREDIT UNION
GPM PEAK	412/GPM	DAIRY
GPM PEAK	412/GPM	DAIRY: BARN
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	DAIRY: RETAIL AREA
7 GR.SQ.FT.	5/7 GR.SQ.FT.	DANCE HALL
15 GR.SQ.FT.	20/15 GR.SQ.FT.	DISCOTEQUE
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	DOUGHNUT SHOP
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	DRUG ABUSE
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	
FILM PROCESSINGGPM PEAK	412/GPM	FOOD PROCESSING PLANT
URINAL OR W.C.	120/W.C.	GAS STATION:SELF SERVE
STATION	430/STATION	GAS STATION:4 BAYS MAX

1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	GYMNASIUM
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	HANGAR (AIRCRAFT)
BED	85/BED	HOSPITAL: CONVALESCENT
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	HOSPITAL: DOG AND CAT
BED	85/BED	HOSPITAL: NONPROFIT
BED	500/BED	HOSPITAL: SURGICAL
UNIT	150/UNIT	HOUSEKEEPING:LIGHT
GPM PEAK	412/GPM	INDUSTRIAL
INMATE	85/INMATE	JAIL
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	DOG KENNEL/OPEN
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	LAB: COMMERCIAL
GPM PEAK	412/GPM	LAUNDROMAT:INDUSTRIAL
WASHER	220/WASHER	LAUNDROMAT
WASHER	220/WASHER	LAUNDROMAT:AUTOMATIC
50 GR.SQ.FT.	50/50 GR.SQ.FT.	LIBRARY:PUBLIC AREA
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	LIBRARY:STACKS/STORAGE
SEAT	5/SEAT	LODGE HALL
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	MACHINE SHOP
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	MNFG/INDUSTRY
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	MASSAGE PARLOR
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	MEDICAL BLDG
1000 GR.SQ.FT.	200/1000 GR.SQ.FT.	MINI-MALL (SHELL)
7 GR.SQ.FT.	5/7 GR.SQ.FT.	MORTUARY:CHAPEL
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	MORTUARY: LIVING AREA
ROOM	150/ROOM	MOTEL
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	MUSEUM: ALL AREAS
1000 GR.SQ.FT.	200/1000 GR.SQ.FT.	OFFICE OVER 15%
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	MUSEUM: SALE AREA
1000 GR.SQ.FT.	200/1000 GR.SQ.FT.	OFFICE BUILDING
GPM PEAK	412/GPM	PLATING PLANT
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	POOL HALL(NO BEER/WINE)
1000 GR.SQ.FT.	120/1000 GR.SQ.FT.	POST OFFICE: FLOOR PLAN
STUDENT	85/STUDENT	DORM: COLLEGE OR RES.
DWELLING UNIT	330/DU	RES: TOWNHS/SET GRD
DWELLING	150/DU	RES: APT. - 1 BDR
DWELLING	200/DU	RES: APT. - 2 BDR
DWELLING	250/DU	RES: APT. - 3 BDR
DWELLING	100/DU	RES: APT. - BACH/SNGLE
BED	85/BED	RES: BOARDING HOUSE
DWELLING	150/DU	RES: CONDO-1 BDR
DWELLING	200/DU	RES: CONDO-2 BDR
DWELLING	250/DU	RES: CONDO-3 BDR
DWELLING UNIT	300/DU	RES: DUPLEX
HOME SPACE	200/SPACE	RES: MOBILE HOME
DWELLING UNIT	330/DU	RES: SNGL FAM DWL.
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	RES: ARTIST (2/3 AREA)
DWELLING	100/DU	
RES: ARTIST	330/DU	RES: GUEST HOUSE W/KIT.
RESDNCE.DWELLING UNIT		
BED	85/BED	REST HOME
SEAT DINING	50/SEAT	RESTAURANT: DRIVE-UP
PARKING STALL	100/STALL	RESTAURANT: DRIVE-UP
SEAT	50/SEAT	RESTAURANT: FIXED SEAT
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	RESTAURANT: TAKE-OUT

1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	RETAIL AREA
CHILD	10/CHILD	SCHL: DAY CARE CENTER
STUDENT	10/STUDENT	SCHL: ELEMENTARY/JR-HI
STUDENT	15/STUDENT	SCHL: HIGH SCHOOL
35 GR.SQ.FT.	10/35 GR.SQ.FT.	SCHL: KINDERGARTEN
CHILD	10/CHILD	SCHL: NURSERY-DAY CARE
STUDENT	10/STUDENT	SCHL: SPECIAL CLASS-LAC
STUDENT	15/STUDENT	SCHL: TRADE OR VOCTNL
STUDENT	20/STUDENT	SCHL: UNIV. OR COLLEGE
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	StorageBldg-RentingSpace
1000 GR.SQ.FT.	10/1000 GR.SQ.FT.	ICE CREAM STORE(RETAIL)
70 GR.SQ.FT.	5/7 GR.SQ.FT.	STUDIO: MOTION PICTURE
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	STUDIO: RECORDING
VEHICLE	12/VEHICLE	THEATRE: DRIVE-IN
SEAT	5/SEAT	THEATRE: FIXED SEAT
1000 GR.SQ.FT.	5/SEAT	THEATRE: MOVIE HOUSE
1000 GR.SQ.FT.	300/1000 GR.SQ.FT.	VETERINARIAN
1000 GR.SQ.FT.	25/1000 GR.SQ.FT.	WAREHOUSE
STATION	430/STATION	WASTE DUMP: RECREATIONAL
1000 GR.SQ.FT.	215/1000 GR.SQ.FT.	WINE TASTING RM: KTCHN
1000 GR.SQ.FT.	100/1000 GR.SQ.FT.	WineTastingRm: AllArea

EXPLANATION FOOTNOTES

1. The column headings are:
   Average Daily Flow = flow in gallons per day (gpd) per unit as indicated. For example, "5/7 gr. sq. ft." means 5 gpd per every 7 gross square feet of development. Type description - type of development or process.

2. Gr. sq. ft. = gross square feet: area included within the exterior of the surrounding walls of a building excluding courts.

3. Gpm Peak = peak flow in gallons per minute. There is an assumption that the peak to average flow ratio is 3.5. Therefore, 1 gpm x 1440 min/day) 3.5 = 412 gpd which is the unit flow factor in the table.

4. Example Calculation - Assume a 10,000 sq. ft. office building is proposed. The estimated average daily flow is calculated as 10,000 sq. ft. x 200 gpd/1000 sq. ft. = 2000 gpd.

5. Another Example - Assume a car wash (in bay type) is proposed. The estimated peak flow is 5 gpm as determined by industrial waste permit or other data. The average daily flow is estimated as 5 gpm x 412 gpd/gpm = 2060 gpd.

Appendix C.
Sanitary Sewer Overflow Log 2016

City of Whittier Sewer Overflow Log

	Event ID	Spill Date	Spill Gals		Source / Cause	Location	Spill Category	GPS Coords.	Roots	Debris	Grease	Pipe	Other / Unknown
1	647503	1/19/2007	300		Manhole / Roots	Intersection 7th & Calmosa		33'58.017N 118'00.745W	1				
2	647487	1/2/2007	50		Manhole / Roots	Bailey & Hill		33'58.905N 118'01.723W	1				
3	647494	1/11/2007	400		Possible main break	Intersection Painter & Helen		33'58.169N 118'01.947W					1
4	647497	1/11/2007	10		Manhole / Roots	14136 Bronte		33'58.296N 118'01.099W	1				
5	647501	1/11/2007	500		Manhole / Roots	9736 La Serna		33'56.979N 118'00.097W	1				
6	647506	1/23/2007	100		Manhole / Roots	7855 Bacon		33'58.177N 118'00.996W	1				
7	649868	3/13/2007	117		Manhole / Unknown	Magnolia & Pilgrim Way		33'59.302N 118'03.037W					1
8	649867	3/26/2007	500		Manhole / Roots	8717 La Puebla		33'57.204N 118'00.411W	1				
9	☆	3/5/2007	90		Building clean out	12607 Philadelphia		33'58.477N 118'02.483W					1
10	651241	4/15/2007	175		Manhole / Debris	Sunrise & Euclid		33'58.135N 118'01.505W		1			
11	651240	4/13/2007	50		Manhole / Unknown	Bailey btwn Newlin & Pickering		33'58.852N 118'02.480W					1
12	653155	5/26/2007	200		Manhole / Roots	8058 Calmosa		33'58.014N 118'00.742W	1				
13	653149	5/26/2007	100		Manhole / Roots	10603 Groveland		33'56.328N 117'59.251W	1				
14	656177	7/30/2007	500		Manhole / Roots	6526 Painter		33'58.192N 118'01.958W	1				
15	656178	7/26/2007	300		Grease	12911 Philadelphia		33'58.748N 118'02.289W			1		
16	656179	7/30/2007	300		Manhole / Roots	7005 Hillside		33'58.725N 118'01.645W	1				
17	656176	7/20/2007	100		Private Cleanout / Roots	6344 Painter		33'58.989N 118'01.954W					1
18	657711	8/12/2007	600		Manhole / Roots	Hill & Bailey		33'58.905N 118'01.723W	1				
19	706819	9/8/2007	300		Manhole / Roots	7760 Painter		33'59.537N 118'04.043W	1				
20	706815	9/18/2007	300		Manhole / Roots	Ben Hur & Whittier		33'59.536N 118'04.045W	1				
21	708507	10/13/2007	35		Manhole / Unknown	Broadway btwn Friends & Painter		33'59.178N 118'01.996W					1
22	708505	10/15/2007	20		Manhole / Roots	6728 Stamford Pl.		33'58.776N 118'01.752W	1				
23	708503	10/10/2007	10		Manhole / Roots	7025 Bryn Mawr		33'58.704N 118'01.687W	1				
24	708435	10/2/2007	300		Manhole / Roots	7014 Hillside Ln.		33'58.499N 118'01.957W	1				
25	708429	10/14/2007	5		Manhole / Unknown	7816 Bowen		33'58.251N 118'01.019W					1
26	710152	11/28/2007	25		Manhole / Unknown	14154 Bronte		33'58.239N 118'01.073W					1
27	710150	11/18/2007	70		Manhole / Roots	7900 blk Forest St.		33'58.097N 118'01.563W	1				
28	710148	11/22/2007	125		Manhole / Unknown	6524 Hill		33'58.931N 118'01.705W					1
29	710147	11/18/2007	25		Manhole / Roots	Broadway e/o Milton		33'59.182N 118'02.348W	1				
30	712078	12/15/2007	50		Manhole / Roots	16262 Pasada		33'56.787N 117'58.924W	1				
31	712074	12/27/2007	25		Manhole / Unknown	5517 Mesa Grove		33'59.180N 118'02.358W					1
32	712070	12/26/2007	50		Manhole / Unknown	Orange Grove / Mesa Grove		33'59.975N 118'03.835W					1
33	712083	12/24/2007	240		Manhole / Roots	7954 Forest Av.		33'58.096N 118'01.566W	1				
34	712082	12/13/2007	800		Manhole / Roots	Whittier & Santa Gertrudes		33'55.616N 117'59.499W	1				
	Total Spills (gals) 2007		**6772**					**Cause Totals**	**20**	**1**	**1**	**0**	**11**

City of Whittier Sewer Overflow Log

	Event ID	Spill Date	Spill Gals		Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other / Unknown
1	714536	1/27/2008	100		Manhole / Roots	Mar Vista & Euclid		33'58.250N 118'01.405W	1				
2	714398	1/26/2008	60		Manhole / Roots	8823 Watson		33'57.365N 118'01.439W	1				
3	714395	1/13/2008	200		Manhole / Roots	Scott & Leffingwell		33'55.747N 118'00.055W	1				
4	714392	1/15/2008	10		Manhole / Unknown	7271 Canyon Crest		33'58.601N 118'01.493W					1
5	714386	1/12/2008	90		Manhole / Unknown	12921 Rose Dr.		33'59.442N 118'02.248W					1
6	714384	1/8/2008	60		Manhole / Roots	5436 Cadbury Rd.		33'56.786N 117'58.894W	1				
7	714382	1/7/2008	200		Manhole / Roots	Bacon & Mar Vista		33'58.091N 118'01.113W	1				
8	714381	1/5/2008	200		Manhole / Roots	Painter & Helen		33'58.200N 118'01.936W	1				
9	714406	2/4/2008	30		Manhole / Roots	12208 Honolulu Ter.		33'59.750N 118'02.666W	1				
10	714405	2/18/2008	15		Manhole / Roots	11724 Beverly Dr. (in alley)		33'56.786N 118'58.894W	1				
11	715034	3/18/2008	700		Manhole / Roots	Intersection Second & California		33'57.62N 118'01.217W	1				
12	716361	4/20/2008	25		Manhole / Roots	14402 Tedemory		33'57.672 118'01.017W	1				
13	716322	4/18/2008	40		Manhole / Unknown	Calmosa / Mar Vista		33'57.903N 118'00.821W					1
14	717007	5/1/2008	800		Manhole / Debris	Lambert & Washington		33'57.903N 118'00.820W		1			
15	718245	5/20/2008	150		Cleanout / Roots	13514 Olive Dr.		33'57.903N 118'00.820W	1				
16	718247	5/23/2008	500		Manhole / Unknown	Scott & Messina		33'56.353N 118'00.028W					1
17	719042	5/31/2008	125		Manhole / Unknown	Palm & Floral		33'59.506N 118'03.259W					1
18	719146	6/5/2008	200		Manhole / Roots	10353 Cole		33'56.410N 118'00.309W	1				
19	719862	6/14/2008	50		Manhole / Unknown	10630 La Alba		33'56.288N 117'59.948W					1
20	721009	6/24/2008	500		Manhole / Unknown	7034 Hillside Ln.		33'58.712N 118'.01.662W					1
21	721164	6/28/2008	520		Manhole / Grease	16138 Leffingwell		33'55.975N 117'59.180W			1		
22	722241	7/12/2008	200		Manhole / Roots	Painter & Philadelphia		33'58.755N 118'01.900W	1				
23	724613	8/11/2008	200		Manhole / Roots	5577 Pioneer Bl.		34'00.56N 118'03.92W	1				
24	724981	8/14/2008	100		Manhole / Roots	14521 Mar Vista		33'57.869N 118'00.768W	1				
25	725459	8/27/2008	20		Mahonle / Debris	125000 Washington Bl.		33'58.112N 118'02.654W		1			
26	726002	9/8/2008	150		Manhole / Unknown	Bowen & Bacon		33'58.205N 118'00.988W					1
27	726167	9/10/2008	500		Manhole / Unknown	14235 Mar Vista		33'58.081N 118'01.103W					1
28	726171	9/10/2008	50		Manhole / Roots	7766 Vale		33'58.268N 118'01.298W	1				
29	727305	9/29/2008	200		Manhole / Roots	14029 Mar Vista		33'58.240N 118'01.417W	1				
30	727331	9/30/2008	150		Manhole / Roots	7023 Hillside Ln.		33'58.718N 118'01.655W	1				
31	727333	10/2/2008	100		Manhole / Roots	6701 Pickering		33'58.775N 118'02.524W	1				
32	727878	10/9/2008	10		Manhole / Roots	Palm & Clare		33'59.649N 118'03.296W	1				
33	728121	10/16/2008	400		Manhole / Roots	13653 Camilla		33'59.060N 118'01.629W	1				
34	728122	10/16/2008	60		Manhole /Debris	6536 Hill		33'58.867N 118'01.729W		1			
35	728394	10/21/2008	200		Manhole / Unknown	7034 Hillside Ln.		33'58.720N 118'01.661W					1
36	731058	12/18/2008	700		Broken pipe	Bright & Walnut		33'58.324N 118'02.184W				1	
37	731522	12/26/2008	600		Cleanout / Unknown	13417 Franklin		33'50.478N 118'01.915W					1
38	731523	12/27/2008	100		Manhole / Roots	Ocean View & Mar Vista		33'57.905N 118'00.779W	1				
	Total Spills (gals) 2008		**8315**					**Cause Totals**	**22**	**3**	**1**	**1**	**11**

City of Whittier Sewer Overflow Log

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other / Unknown
1	731739	1/8/2009	500		Manhole / Grease	Euclid & Sunrise	1	33'58.144N 118'01.482W			1		
2	731772	1/12/2009	200		Manhole / Unknown	Helen St. & Painter Av.	1	33'58.184N 118'01.911W					1
3	733407	2/3/2009	75		Manhole / Unknown	Palm Ave. & Howard St.	1	33'59.330N 118'03.297W					1
4	735852	3/28/2009	300		Manhole / Grease	Villaverde & Youngwood	1	33'57.291N 117'59.968W			1		
5	736301	4/6/2009	100		Manhole / Roots	13941 Summit	1	33'58.396N 118'01.468W	1				
6	736888	4/23/2009	60		Manhole / Roots	Pioneer & Brian Ct.	1	34'00.116N 118'03.874W	1				
7	737126	5/4/2009	20	20	Manhole / Roots	15287 Youngwood	1	33'57.253N 118'00.029W	1				
8	737167	5/5/2009	100		Manhole / Debris	12401 Washington Bl.	1	33'58.116N 118'02.662W		1			
9	739551	6/16/2009	400		Manhole / Unknown	Whittier Bl. & Western	1	33'59.027N 118'03.325W					1
10	740874	7/7/2009	100		Manhole / Unknown	Newlin & Broadway	1	33'59.182N 118'02.436W					1
11	741169	7/12/2009	800		Manhole / Unknown	15301 Youngwood	1	33'57.226N 117'59.824W					1
12	741487	7/17/2009	500		Manhole / Roots	7th & Calmosa	1	33'58.025N 118'00.743W	1				
13	742252	7/28/2009	100		Private Lat. / Unknown	13453 Beverly Bl.	1	33'59.286N 118'01.884W					1
14	743520	8/17/2009	100		Cleanout / Roots	Painter & Philadelphia	1	33'58.749N 118'.01.998W	1				
15	744320	9/2/2009	200		Manhole / Unknown	7815 Bowen	1	33'58.247N 118'01.019W					1
16	744481	9/4/2009	60		Manhole / Roots	13225 Walnut	1	33'58.309N 118'02.015W	1				
17	745004	9/22/2009	100		Manhole / Roots	12217 Honolulu Terr.	1	33'59.644N 118'02.563W	1				
18	745348	10/1/2009	200		Manhole / Unknown	8118 Davista	1	33'57.949N 118'00.629W					1
19	745718	10/15/2009	200		Manhole / Roots	11312 Claire St.	1	33'59.647N 118'03.315W	1				
20	746283	10/23/2009	50		Manhole / Roots	Helen St. & Painter Av.	1	33'58.201N 118'01.939W	1				
21	746479	11/2/2009	100		Manhole / Roots	14010 Marsha Ln.	1	33'58.423N 118'01.218W	1				
22	74666	11/3/2009	300		Manhole / Roots	Janine & Pasada	1	33'94.622N 117'98.022W	1				
23	747205	11/18/2009	200		Manhole / Roots / Grease	7815 Bowen Dr.	1	33'58.229N 118'01.033W	1				
24	747214	11/19/2009	100	100	Manhole / Roots	Painter Av. & Philadelphia	2	33'58.752N 118'01.923W	1				
25	747216	11/30/2009	200		Manhole / Roots	Mar Vista & Ocean View	1	33'57.893N 118'00.742W	1				
26	747295	11/26/2009	400		Manhole / Roots	6562 Hill St.	1	33'58.980N 118'01.937W	1				
27	747296	11/29/2009	100		Cleanout / Roots	6354 Painter	2	33'58.233N 118'01.033W	1				
28	747417	12/3/2009	100		Manhole / Grease	12804 Rose Dr.	1	33'59.444N 118'02.371W			1		
29	747418	12/4/2009	50		Cleanout / Debris (private)	8036 Ocean View Av.	1	33'58.871N 118'01.723W		1			
30	747420	12/3/2009	400		Manhole / Grease	12803 Rose Dr.	1	33'59.444N 118'02.371W			1		
31	747423	12/6/2009	200		Manhole / Roots	Beverly Bl. & Haviland	1	33'59.248N 118'01.881W	1				
32	747747	12/16/2009	200		Unknown	7034 Hillside Ln.	1	33'58.720N 118'01.661W					1
	Total Spills (gals) 2009		**6515**	**120**	**Total Recovered (gals)**			**Cause Totals**	**17**	**2**	**4**	**0**	**9**
	Total unrecovered gallons			**6395**									

City of Whittier Sewer Overflow Log

	Event ID	Spill Date	Spill Gals		Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other / Unknown
1	748300	1/9/2010	100		Manhole / Roots	14402 Tedemory	1	33'59.443N 118'02.369W	1				
2	748728	1/15/2010	200		Manhole / Roots	Washington / Walnut	1	33'57.664N 118'01.011W	1				
3	748731	1/19/2010	100		Manhole / Roots	13726 Philadelphia	1		1				
4	750481	3/5/2010	400		Unknown	Santa Gerturdes / La Forge	1	33'56.541N 117'59.580W					1
5	751254	3/30/2010	100		Manhole / Roots	14459 Mar Vista	1	33'57.901N 118'00.787W	1				
6	751434	4/3/2010	200		Manhole / Roots	10334 Santa Gertrudes	1	33'56.601N 117'59.554W	1				
7	752576	5/15/2010	100		Manhole / Roots	9931 Shiloh	1	33'56.884N -117'58.595W	1				
8	753071	5/28/2010	100		Manhole / Roots	Cole Rd / Dittmar Av	1	33'56.417N 118'00.323W	1				
9	754128	6/23/2010	200		Manhole / Roots	Bailey / Hill	1	33'58.909N 118'01.749W	1				
10	754134	6/28/2010	40		Cleanout / Roots	Philadelphia / Painter	1	33'58.744N 118'01.936W	1				
11	754287	6/27/2010	400		Manhole / Roots / Grease	Villaverde & Youngwood	1	33'571.271N 117'59.978W	1				
12	754442	7/1/2010	300		Manhole / Roots	Whittier Bl / Santa Gertrudes	1	33'56.655N 117'59.625W	1				
13	755960	8/8/2010	175		Manhole / Roots	Canyon Dr / Canyon Crest	1	33'58.605N 118'01.495W	1				
14	755963	8/7/2010	660		Manhole / Grease	7901 Pickering Av	1	33'58.312N 118'02.513W			1		
15	758208	10/24/2010	70		Manhole / Unknown	15723 Whittier Bl	1	33'56.715N 117'59.688W					1
16	758346	11/1/2010	20		Manhole / Roots	Intersection 7th St / Calmosa	1	33'58.017N 118'00.735W	1				
17	758476	11/6/2010	100		Manhole / Roots	7023 Hillside Ln.	1	33'58.718N 118'01.655W	1				
18	758491	11/9/2010	200		Manhole / Roots	7023 Hillside Ln.	1	33'58.718N 118'01.655W	1				
19	759036	11/26/2010	300		Manhole / Roots	Santa Gerturdes / La Forge	1	33'56.496N, -117'59.561W	1				
20	759195	12/2/2010	100		Manhole / Roots	Hadley / Painter	1	33'58.969N 118'01.931W	1				
	Total Spills (gals) 2010		**3865**					**Cause Totals**	**17**	**0**	**1**	**0**	**2**

City of Whittier Sewer Overflow Log

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other / Unknown
	Total unrecovered gallons			0									
1	762675	2/1/2011	70	0	Manhole / Roots	14461 Seventh St / Calmosa	1	33'58.014N 118'00.741W	1				
2	763954	2/25/2011	70	0	Cleanout / Grease	8234 Painter Av / Ramona St	1	33.96390N -118.03247W			1		
3	764659	3/11/2011	200	50	Manhole / Roots	Villaverde & Youngwood	1	33'571.271N 117'59.978W	1				
4	764681	3/14/2011	100	0	Manhole / Roots	Whittier Bl / Santa Gertrudes	1	33'56.655N 117'59.625W	1				
5	766549	3/24/2011	60	25	Manhole / Unknown	Penn St / Canyon Dr	1	33.97557N -118.02490W					1
6	765349	4/6/2011	60	0	Manhole / Roots	Condessa Dr / Santa Gertrudes	1	33'56.588N 117'00.201W	1				
7	765812	4/23/2011	600	0	Manhole / Grease	Citrus Av / Howard St	1	33.98274N -118.04592W			1		
8	765815	4/25/2011	200	0	Manhole / Unknown	12815 Rose Dr	1	33.99091N -118.03912W					1
9	766153	4/30/2011	15	15	Manhole / Unknown	5546 Adele	2	33.99869N, -118.06142W					1
10	766519	5/10/2011	100	0	Manhole / Roots	Painter Av / Earlham St	1	33.95458N, -118.04144W	1				
11	766855	5/21/2011	70	0	Manhole / Roots	7816 Bowen	1	33.97083N, -118.01658W	1				
12	767773	6/21/2011	350	100	Manhole / Roots	6760 Painter Av	1	33.58.742N, 118.01.938W	1				
13	767910	6/24/2011	425	50	Manhole / Roots	Hill & Bailey	1	33'58.905N 118'01.723W	1				
14	767921	6/25/2011	130	0	Manhole / Debris	Hadley St / Hoover Av	1	33.98322N, -118.04847W		1			
15	769667	8/6/2011	300	0	Manhole / Unknown	10814 Monte Vista	1	33'59.700N, 118'03.508W					1
16	770318	8/24/2011	100	20	Manhole / Unknown	12717 Broadway	1	33.98654N, -118.04017W					1
17	771419	9/17/2011	20	0	Manhole / Debris	7326 Painter Ave.	1	33.97474N, -118.03265W		1			
18	771465	9/21/2011	50	0	Lamphole / Roots	13612 Philadelphia St.	1	33.97905N, -118.02920W	1				
19	771622	9/27/2011	70	15	Manhole / Unknown	La Cuarta St / Pickering Av	1	33.96822N, -118.04134W					1
20	772149	10/13/2011	50	10	Manhole / Unknown	7816 Bowen	1	33.97083N, -118.01658W					1
21	773510	11/25/2011	15	0	Manhole / Roots	Santa Gertrudes / Whittier Blvd	1	33.94447N, -117.99345W	1				
22	774700	12/21/2011	100	0	Manhole / Roots	Penn St. w/o Union	1	33.97548N, -118.04530W	1				
23	774799	12/25/2011	25	10	Cleanout / Roots	Eastridge Drive w/o Ocean View	1	33.96599N, -118.01238W	1				
	Total Spills (gals) 2011		3180	295	Total Recovered (gals)			Cause Totals	12	2	2	0	7
	Total unrecovered gallons			2885									

City of Whittier Sewer Overflow Log

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other / Unknown
1	775406	1/1/2012	100	0	Manhole / Roots	14084 Mar Vista @ Elden	1	33.96918N, -118.02122W	1				
2	775411	1/4/2012	312	312	Manhole / Roots	13716 Penn @ Guilford	2	33.97513N, -118.02908W	1				
3	776306	1/22/2012	120	0	Manhole / Roots	12204 Honolulu Ter @ Citrus	1	33.99560N, -118.04403W	1				
4	776600	1/30/2012	275	120	Manhole / Roots	15655 Mar Vista @ Cordero Rd	2	33.96377N, -117.99173W	1				
5	776855	2/4/2012	80	20	Manhole / Roots	Hill St & Bailey Av	1	33.98159N, -118.02765W	1				
6	777874	2/21/2012	50	0	Roots from private lateral	8216 Ramona	1	33.96409N, -118.03263W	1				
7	778546	3/6/2012	5	5	Manhole / Roots	13656 Sunset	2	33.97019N, -118.02873W	1				
8	778597	3/9/2012	20	0	Manhole / Debris	Penn St / Union Ave	1	33.97517N, -118.04483W	1				
9	778941	3/18/2012	100	10	Manhole / Roots	Camilla & Southwind	1	33.98451N, -118.03736W	1				
10	779245	3/25/2012	450	0	Manhole / Roots	Whittier Bl / Santa Gertrudes	1	33.94469N, -117.99292W	1				
11	779850	4/7/2012	80	15	Manhole / Roots	Hillside Lane / Bailey St	1	33.97896N, -118.02709W	1				
12	780272	4/15/2012	100	25	Manhole / Debris	12349 Penn St	1	33.97565N, -118.04513W		1			
13	780533	4/19/2012	450	100	Broken pipe	Penn St / Guilford Way	1	33.97516N, -118.03066W				1	
14	781666	5/22/2012	525	45	Manhole / Roots	Whittier Bl / Santa Gertrudes	1	33.94540N, -117.99583W	1				
15	782131	6/8/2012	3375	275	Manhole / Roots	Whittier Bl / Santa Gertrudes	1	33.94540N, -117.99583W	1				
16	782383	6/19/2012	1400	546	Manhole / Roots	6527 Painter / Hadley	1	33.98183N, -118.03301W	1				
17	784818	8/4/2012	100	0	Manhole / Grease	Santa Gertrudes / Whittier Blvd	1	33.94540N, -117.99583W			1		
18	785251	8/15/2012	25	0	Manhole / Roots	Helen St / Painter Ave	1	33.96995N, -118.03268W	1				
19	786215	9/10/2012	30	0	Broken pipe	Beverly Bl / Pioneer Bl	1	34.00373N, -118.06231W				1	
20	787549	10/19/2012	200	0	Manhole / Roots	Whittier Bl / Santa Gertrudes	1	33.94419N, -117.99311W	1				
21	787711	10/26/2012	25	25	Manhole / Roots	Philadelphia St / Bailey	2	33.98148N, -118.02436W	1				
22	787871	10/31/2012	800	800	Manhole / Roots	Santa Gertrudes / La Forge	1	33.94244N, -117.99203W	1				
23	787964	11/5/2012	20	0	Manhole / Roots	16430 Janine	1	33.94619N, -117.97959W	1				
24	787966	11/5/2012	180	180	Manhole / Roots / Grease	12208 Honolulu Terrace	2	33.99605N, -118.04426W	1				
25	787971	11/6/2012	160	160	Manhole / Roots / Grease	12204 Honolulu Terrace	2	33.99560N, -118.04403W	1				
26	788295	11/20/2012	650	300	Private Cleanout / Roots	6354 Painter Ave / Hadley	1	33.98296N, -118.03214W	1				
27	788737	11/25/2012	200	200	Manhole / Unknown	13863 Penn / Canyon Crest	2	33.97538N, -118.02519W					1
28	788743	12/2/2012	100	0	Manhole / Roots	8823 Watson / Chestnut	1	33.95622N, -118.02417W	1				
29	789700	12/30/2012	170	120	Manhole / Unknown	7214 Canyon Crest / Penn St.	1	33.97715N, -118.02344W					1
	Total Spills (gals) 2012		**9832**	**3138**	**Total Recovered (gals)**			**Cause Totals**	**22**	**1**	**1**	**2**	**1**
	Total unrecovered gallons			**6694**									

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other	Comments
1	790266	1/10/2013	450	0	Manhole / Roots	14459 Mar Vista St / Calmosa	1	33.96574N, -118.01361W	1					Upstream line cleaning may have contributed; checking video & rerunning lines.
2	791450	2/7/2013	215	0	Cleanout / Roots	13612 Franklin St / Painter	1	33.97424N, -118.03041W	1					
3	793045	3/26/2013	1800	1000	Manhole / Roots	15545 Whittier Bl /Santa Gertrudes	1	33.64540N, -117.99583W	1					Line scheduled for root foaming next month.
4	793392	4/14/2013	500	0	Manhole / Roots	8948 Ben Hur / Whittier Bl	1	33.95127N, -118.01084W	1					
5	793643	4/23/2013	50	15	Manhole / Grease / Debris	Penn St / Union Ave	1	33.97544N, -118.03442W		1				Pieces of broken clay pipe found, along with some grease and paper towels.
6	794111	5/9/2013	50	8	Manhole / Roots	14521 Mar Vista	1	33.96512N, -118.01267W	1					Line was just foamed for roots which may have contributed to the blockage.
7	794287	5/15/2013	45	0	Private Lateral / Roots	6057 Pickering Ave	1	33.97918N, -118.03284W	1					Line was just foamed for roots which may have contributed to the blockage.
8	794449	5/22/2013	800	100	Manhole / Roots	11511 Beverly Dr / Cadbury	1	33.99784N, -118.05297W	1					
9	794542	5/24/2013	110	45	Manhole / Debris	13412 Via Del Palma	1	33.97226N, -118.03207W		1				
10	796265	6/26/2013	200	0	Manhole / Unknown	12611 Broadway / Pickering	1	33.98651N, -118.04168W					1	Line added to scheduled repair list.
11	797539	8/2/2013	250	117	Manhole / Roots / Debris	7214 Canyon Drive	1	33.97725N, -118.02414W	1					
12	798229	8/23/2013	160	0	Manhole / Grease	6266 Western Ave	1	33.98440N, -118.05524W			1			6 inch main w/ a relatively flat grade to it; being run semi-annually.
13	799299	9/29/2013	125	100	Manhole / Roots	12816 Broadway	1	33.98630N, -118.03960W	1					
14	799481	10/1/2013	140	140	Manhole / Roots	7902 Painter Ave	3	33.96984N, -118.03230W	1					Heavy root problem in this area due to City ficus trees.
15	800696	11/5/2013	144	0	Manhole / Grease	Pioneer & Beverly	1	34.00373N, -118.06231W			1			Offset section of pipe under a traffic signal. Will increase maintenance to quarterly.
16	800755	11/12/2013	1283	8	Manhole / Roots / Debris	12127 Beverly Dr / Hoover	1	33.99508N, -118.04747W	1					Due to PD's practices for call outs, 17 hrs elapsed from call in to SSO end. This was a low flow spill est. at 1.0 to 2.5 gpm.
17	801267	11/24/2013	400	400	Cleanout / Roots	5450 Cadbury	3	33.99633N, -118.05195W	1					3 calls from resident to PD before PD notified crew. Est. flow at 1 gpm; resident stated that was how it was flowing all day.
18	801438	12/4/2013	40	0	Manhole / Roots / Debris	14459 Mar Vista St / Calmosa	1	33.96570N, -118.01360W	1					CCTV shows broken & missing pipe. Scheduling contractor for repair in the next 60 days.
Total Spills (gals) 2013			**6762**	**1933**	**Total Recovered (gals)**			**Cause Totals**	**13**	**2**	**2**	**0**	**1**	
		Total unrecovered gallons	**4829**											

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Category	GPS Coords	Roots	Debris	Grease	Pipe	Other	Comments
1	802534	1/2/2014	150	150	Cleanout / Roots / Debris	5555 Greenleaf Av / Acheson Dr.	3	33.99340N, -118.03849W	1					CCTV--appears coming from private lateral. Will continue to observe.
2	802526	1/5/2014	900	0	Manhole / Unknown	Intersection Magnolia & Floral	1	33.99178N, -118.05034W					1	CCTV'd.
3	802556	1/7/2014	175	0	Manhole / Roots / Debris	Intersection Cole Rd & Dittmar	1	33.94010N, -118.00541W	1					Paper towel debris. Monitoring line--video shows possible grease issue.
4	802931	1/16/2014	105	0	Manhole / Grease / Roots	7603 Milton (alley) @ Mar Vista	1	33.97347N, -118.04005W	1					Possible grease issue; will rerun line in a month.
5	803292	1/24/2014	60	0	Manhole / Unknown	13658 Sunset w/o College	1	33.97043N, -118.03040W					1	Line to be videod.
6	803440	1/31/2014	690	380	Cleanout / Unknown	10115 Santa Gertrudes / Whittier Bl.	1	33.94574N, -117.99454W					1	Line to be videod.
7	803447	2/1/2014	925	63	Manhole / Roots / Grease)	8216 Painter Ave / Valna	1	33.96437N, -118.03229W	1					Heavy roots. Root sawing scheduled on 2/4/14.
8	803579	2/5/2014	95	95	Manhole / Roots / Debris	6253 Southwind Dr / Sycamore	3	33.98523N, -11802338W	1					Appears roots from lateral pushed into city main. Paper towel debris.
9	805471	4/11/2014	850	337	Cleanout / Roots / offset	13409 Philadelphia St / Painter Av	1	33.97910N, -118.03262W				1		Scheduled for repair.
10	805792	4/25/2014	125	0	Manhole / Debris	12921 Rose Dr @ Painter	1	33.99099N, -118.03754W		1				CCTV.
11	806031	5/11/2014	537	537	Manhole / Roots	14445 7th St. / Calmosa	3	33.96715N, -118.01288W	1					Sched CCTV; 2010 CCTV shows no issues.
12	806906	6/7/2014	1500	63	Manhole / Roots	Intersection of Painter & Bailey	1	33.98103N, -118.03231W	1					CCTV to evaluate condition.
13	807203	6/23/2014	555	0	Manhole / Roots	14513 Mar Vista / Calmosa	1	33.96522N, -118.01286W	1					Evaluated CCTV, main break, will be replaced by end of July.
14	808594	8/16/2014	225	0	Manhole / Roots	Youngwood & La Serna	1	33.95392N, -117.99699W	1					Reviewed CCTV records; not a problem spot.
15	808596	8/17/2014	75	0	Manhole / Unknown	8250 Painter / Ramona	1	33.96349N, -118.03248W					1	CCTV.
16	808720	8/21/2014	130	0	Manhole / Roots	7th (14461) & Calmosa	1	33.96708N, -118.01229W	1					CCTV'd--roots. Line on a monthly CCTV determined this area not being reached. Supervisor changed cleaning method.
17	808928	8/31/2014	100	2	Manhole / Debris	15545 Whittier Bl / Santa Gertrudes	1	33.94583N, -117.99540W		1				Will CCTV this week.
18	809190	9/15/2014	500	0	Manhole / Unknown	6044 Palm Ave / Broadway	1	33.98694N, -118.05434W					1	CCTV to determine cause.
19	809522	9/26/2014	75	0	Manhole / Roots	7902 Elden Ave / Eastridge Dr	1	33.97016N, -118.01997W	1					Repair scheduled Nov 2014.
20	809827	10/7/2014	92	31	Manhole / Roots	16246 Posada / Bogardus	1	33.97918N, -118.03284W	1					Video shows heavy roots, break in pipe. Will maintain and schedule repair in next 6 mos.
21	810395	10/29/2014	80	60	Debris (paper towels)	15111 Whittier Bl / Colima	1	33.94861N, -118.00491W		1				Large amount of paper towels found in line. Not a problem area.
22	810503	10/31/2014	450	0	Roots / Debris (paper towels)	7002 Founders Hill / Philadelphia	1	33.97885N, -118.03065W	1					Reviewed CCTV records; if a problem is apparent, repair will be scheduled.
23	810506	11/3/2014	558	292	Roots / Debris (paper towels)	6354 Painter Av / Hadley St	1	33.98296N, -118.03214W	1					CCTV sheduled this week. Plan to make spot repair.
24	810602	11/6/2014	520	0	Manhole / Roots	9003 Rufus Ave / Dalman St	1	33.95188N, -118. 01608W	1					Not a problem area; root ball in lateral. Will re-run in a month as a follow-up.
25	810756	11/10/2014	150	0	Manhole / Roots	8015 Ocean View / Linda Vista	3	33.96745N, -118.01066W	1					Spill ended in grass. Will review video to determine if repairs are necessary.
26	810759	11/12/2014	100	0	Manhole / Roots	7815 Bowen / Bronte	1	33.97120N, -118.01725W	1					Will review video to determine if repairs or increased maintenance is needed.
27	810781	11/12/2014	500	0	Manhole / Unknown	8234 Painter Ave / Ramona	1	33.96390N, -118.03248W					1	Previous CCTV to be reviewed and schedule repairs, if necessary.
28	810791	11/14/2014	60	60	Manhole / Unknown	7855 Bacon / Bronte	3	33.96970N, -118.01683W					1	Land only. CCTV to be reviewed.
29	810796	11/12/2014	225	225	Manhole / Roots	13702 Philadelphia / Hillside	3	33.97904N, -118.02781W	1					Land only. CCTV to be reviewed.
30	81102	11/26/2014	1500	40	Manhole / Debris	8315 California / La Cuarta	3	33.96307N, -118.01849W		1				Checked 2009 CCTV, shows minor roots. Line will be CCTV'd again next week.
31	81109	11/27/2014	38	38	Manhole / Debris	13608 Walnut / Painter	3	33.97135N, -118.03046W		1				Recovered. Location will be CCTV'd this week.
32	811112	11/29/2014	175	0	Manhole / Unknown	8223 Painter Ave / Ramona	1	33.96388N, -118.03280W					1	Will CCTV this week.
33	811191	12/2/2014	375	375	Bldg / Roots / Debris	12412 Dorland St / Pickering	3	33.98698N, -118.04379W	1					2010 CCTV shows roots at several locations (medium to heavy). Will re-video within a week to reevaluate.
34	811286	12/6/2014	2750	8	Manhole / Debris (rags)	9706 La Serna / Janine	1	33.95043N, -118.00092W					1	This is a newer line. CCTV is scheduled this week to determine issue.
35	812197	12/25/2014	15	15	Cleanout / Roots	5702 Newlin / Janine	3	33.99124N, -118.04054W	1					CCTV to be checked and line will be monitored and repaired if necessary.

36	812203	12/25/2014	60	0	Cleanout / Roots	13417 Franklin / Painter	3	33.97479N, -118-.03196W	1					Sewer main scheduled for repair 12/29/14 & 1/5/15. **REPAIRED as stated per H.M. 1/12/15.**
37	812207	12/26/2014	855	745	Cleanout / Roots	13508 Bailey St / Painter Av	3	33.98074N, -118.02988W	1					Main on Bailey St is shallow and lacks manholes. The two problem root areas that causes backup will be removed by contractor Jan 2015. **14' of main replaced 5'-20' w/o MH #1696 on 1/12/15.**
38	812214	12/28/2014	100	0	Cleanout / Grease / Debris	6252 Franklin / Camilla	3	33.98477N, -118.03353W			1			Main has a sag in it. Moved to a monthly cleaning. Line is recommended for a CIP project.
Total Spills (gals) 2014			**16375**	**3516**	**Total Recovered (gals)**			**Cause Totals**	**22**	**5**	**1**	**1**	**9**	
		Total unrecovered gallons	**12859**											

Sanitary Sewer Overflow Log -- 2015

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Cat	GPS Coords	Roots	Debris	Grease	Pipe	Other	Comments	Disposition
1	812232	1/1/2015	64	0	Lamphole / roots & debris	5828 Milton / Orange Dr	3	33.98911N, -118.03936W	1					Will check CCTV to determine action to be taken.	Repaced pipe and remove abandon Y 58' e/o MH # 702
2	812238	1/4/2015	80	80	Building / debris	13502 Beverly Bl / Alta Av	3	33.98784N, -118.03013W		1				Will check CCTV to determine problem.	Root mass at Y replaced on 9/29/15 with SDR pipe 58' e/o MH # 1627
3	812242	1/9/2015	100	0	Manhole / roots & debris	13225 Walnut / Friends	1	33.97204N, -118.03423W	1					Repeat location. To be scheduled for spot repair.	Multiple root enteries, this section is going to be placed on a Quarterly cleaning
4	812249	1/11/2015	175	0	Manhole / unknown	5341 Carley / Beverly Bl	1	34.00106N, -118.05850W					1	Cause unknown. Will check CCTV to determine possible issue.	Checked video - video shows grease issue
5	812255	1/11/2015	125	0	Manhole / grease	11012 Maple / Florence	1	33.99329N, -118.05781W			1			CCTV will be double checked & line re-run in two months.	video shows that this is a flat line where sediment can backup
6	813260	2/20/2015	125	19	Manhole / debris (baby wipes)	11845 Beverly Dr / Magnolia	1	33.99639N, -118.05003W		1				Line to be videoed week of 1/25/15.	No real sign of a possible blockage location. Will monitor location
7	813267	2/22/2015	100	0	Cleanout / grease	8745 Painter Av / Lambert	3	33.95867N, -118.03793W			1			Spill land only. 1st time grease issue. Will re-jet next month and monitor location.	see Comments
8	813322	2/24/2015	500	0	Manholes / grease	10814 Monte Vista / Norwalk	1	33.99467N, -118.05849W			1			2011 video shows broken, rooted section of pipe 76' s/o MH #306.	To be repaired in Fall of 2015
9	813768	3/3/2015	750	0	Cleanout / roots	13411 Philadelphia / Painter	1	33.97910N, -118.03261W	1					Schedule line burst for Fall of 2015	Replaced section of line 4 ft e/o MH at Painter and Philadelphia on 3/17/15
10	813770	3/4/2015	1250	0	Manhole / unknown	11807 Rideout / Beverly Dr	1	33.99935N, -118.04945W					1	Unknown blockage. Line CCTV'd same day and nothing in line and pipe looks fine. Will monitor line.	see comments
11	813958	3/13/2015	175	50	Manhole / roots	5637 Greenleaf Av / Rose Dr	1	33.99128N, -118.03703W	1					CCTV scheduled for 3/20/15.	
12	814299	3/22/2015	50	0	Private lateral / roots	9945 Shiloh Av / Janine Dr	3	33.94757N, -117.97616W	1					CCTV scheduled for 3/23/15.	Repairs made on 9/17/15. 72' s/o MH # 4975
13	814433	4/7/2015	980	344	Roots	6526 Painter Av / Bailey St	1	33.98188N, -118.03235W	1					Roots stuck @ MH1619; broke free and got stuck @ MH1615. Previous video to be reviewed. If a need for repair is indicated, it will be scheduled.	Two roots masses were found and repaired on 5/13 and 5/18/15 n/o Bailey St.
14	815893	6/6/2015	360	0	clean out under house / roots	6052 Newlin / Broadway	3	33.98661N, -118.04055W	1					CCTV shows broken pipe n/o MH#1236 in alley. Line should be repaired this summer.	two spot repairs were made on this line on 7/22 and 8/11/15 to prevent future SSO
15	815898	6/11/2015	200		Manhole / roots	6536 Hill St / Bailey	1	33.98163N, -118.02841W	1					Repeat location. To be scheduled for spot repair in the next three months.	Two spot repairs were made on this section of line on 7/20 and 7/21/2015
16	816233	6/17/2015	120	20	backyard clean out / roots	Alley behind 14411 Bronte Dr	3	33.969N, - 118.013W	1					This section of main in the alley has been scheduled for monthly cleaning with the rest of the alley	Line has been included in monthly cleaning and to be foamed in Feb 2016
17	816238	6/18/2015	100	50	Roots	14461 7th Street	1	33.967N, - 118.012W	1					Roots from upstream broke free the day before which caused the stoppage. This line is on a monthly already	A spot repair was made on a root mass on 8/20/15. 19' s/o MH # 3049
18	816242	6/18/2015	50	50	Roots	7023 Hillside Lane	3	33.979N, - 118.028W	1					Large root mass removed from MH 1775. line is clear and this MH will be inspected more often.	Line is scheduled for Foaming and to be bursted in CIP FY 16-17
19	816408	7/5/2015	2250	0	Roots	9551 La Serna Drive	1	33.952N, - 117.999W	1					A spot repair is scheduled for July 28th , 2015 - to replace section of pipe with existing root mass	On 8/4/15 broken abandon lateral with roots was removed from main sewer line.
20	816535	7/8/2015	50	50	Grease	13525 Whittier Blvd	3	33.96248N, - 118.03100W			1			Heavy grease from restaurants in area. Need to check Bldg Dept for grease interceptor requirements	Main is cleaned monthly and cleaning method is changed using front throw jetter nozzle
21	816535	7/19/2015	40	0	Roots	5459 Adele Ave.	3	34.00009N, -118.06085W	1					Roots in city main. Spill was out of clean out on private property	Root mass in main scheduled to be repaired in Feb 2016
22	817085	7/25/2015	800	0	Roots	Elden @ Mar Vista	1	33.96978N, - 118.02089W	1					Roots were pulled from the main. Exact location of root stoppage unknown	Main cameraed in Aug. 2015. No roots found. Roots must have flowed down from above
23	817465	8/9/2015	86	0	roots/rags in main	13438 Beverly Blvd @ Haviland	1	33.98791N,- 118.03125W	1					We think roots are coming from a Lateral. Main to be cameraed in October 2015	Main was repaired in November of 2015
24	818914	10/21/2015	125	0	roots/unknown	13801 Penn St @ College Ave	1	33.97568N ,-118.02728W	1	1				We believe it to be roots, but we will re CCTV line in Oct-Nov of 2015	CCTV line on 12/30/16 - Nothing found
25	819289	11/1/2015	315	90	roots	15929 Youngwood	1	33.95680N, -117.98977	1					Found Roots and will CCTV in November 2015	CCTV shows no root issue, but there is a protruding lateral / liner in the Youngwood main
26	819345	11/3/2015	250	0	unknown / wipes and possibly roots	Philadelphia St 200 e/o Painter	1	33.97883N, -118.03226	1	1				Found wipes on line , will CCTV in November 2015	Found root masses at three abandon wye's - all repaired in January 2016
26	819529	11/15/2015	50	0	roots	13712 Valna Drive	3	33.96475N, -118.02817W	1					head of line , low flow, not a problem area. Will CCTV in December 2015	
27	819649	11/23/2015	500	55	roots	8361 Enramada s/o Mar Vista	1	33.96064N, -118.00851W	1					will CCTV in Dec 2015. Not a problem area	CCTV line on 12/30/16 - Nothing found
28	820338	12/17/2015	245	0	Grease	10201 Beverly Blvd.	1	34.00373N, - 118.06231W			1			will increase the maintenance intervals for this short section of pipe	Sewer main has an off-set under traffic signal at NE corner which is contributing to problem

Sanitary Sewer Overflow Log -- 2015

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	Total Spills (gals) 2015		10015	808	Total Recovered (gals) 2015			Cause Totals	20	4	5	0	2	
		Total unrecovered gallons			9207									

Sanitary Sewer Overflow Log 2016

	Event ID	Spill Date	Spill Gals	Gals Recov	Source / Cause	Location	Spill Cat	GPS Coords	Roots	Debris	Grease	Pipe	Other	Comments	Disposition
1	802797	1/1/2016	300	0	hillside joint/ roots	7695 Vale Dr	1	33.97370N. -118.01833W	1					Heavy roots in one spot on hillside easement per CCTV on January 2016	line was root foamed in February 2016 after first being cleaned with CCTV assist
2	821415	1/23/2016	200	0	manhole / roots	10707 El Rancho Dr	1	33.99441N.-118.06054W	1					Broken damage missing pipe with roots. Schedule repair	8 foot section repaced on 2/11/2016 with new SDR pipe
3	822206	2/20/2016	50	0	manhole / roots	6759 Hillside Lane	1	33.97974N.-118.02657W	1					heavy roots in various spots in stairway easement.	Line root foamed Feb 2016 and scheduled for bursting CIP in 2017 FY
4	822764	3/7/2016	750	0	manhole / roots	7930 Elden @ mar Vista	1	33.96944N,-118.02054W	1					root blockage east of Euclid. 4 manholes holding. CCTV line in March or April 2016	CCTV showed no issue in line. Troubling area. Great SMARTCOVER location
5	823667	4/2/2016	475	0	manhole / roots	Orange Grove at Mesa Grove	3	33.99946N,-118.06376W	1					We believe roots floated down stream and got caught up in MH 94	CCTV showed no issues in line 2 months before SSO or after SSO three day later
6	824421	4/26/2016	350	75	bathtub/cleanout/roots	9817 Santa Gertrudes	3	33.94940N,-117.99339W	1					CCTV on 5/3/16 showed minor roots in main just s/o their lateral.	Staff will re CCTV main in six months and check on root growth
7	824849	5/25/2016	40	0	manhole/debris	Mar Vista @ Calmosa	1	33.96545N,-118.01324W		1				Flat main line with sediment. The Smart Cover was not adjusted correctly	We lowered the Smartcover flow detector from its original setting from SC
8	826169	6/24/2016	75	10	manhole debris	Mar Vista @ Calmosa	1	33.96545N,-118.01324W		1				Flat main line with sediment. The Smart Cover was not adjusted correctly	The Smart Cover is now adjusted to only 1.5 inches above flow. This should fix it.
9	827473	8/21/2016	200	0	manhole / roots	Southwind n/o Sycamore	1	33.98573N,-118.02252W	1					we believe roots from a lateral floated down stream and got caught up in the main	CCTV line in Sept
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30															
31															
32															
33															
34															
	Total Spills (gals) 2016		**2440**	**85**	**Total Recovered (gals) 2016**			**Cause Totals**	**7**	**2**	**0**	**0**	**0**		

Appendix D.
Model Results – Existing Deficiencies

ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpm)	Velocity (ft/s)	d/D	Water Depth (ft)	Critical Depth (ft)	Cleaning Frequency	Deficiency Type
29	24	23A	10	30.706	0.003	543.773	2.221	1	0.833	0.472		Flow Depth
38	1469	1468	6	240.475	0	108.737	1.234	1	0.5	0.065		Flow Depth / Velocity
126	23	22	10	219.35	0.003	548.445	2.24	1	0.833	0.471		Flow Depth
143	367	366	8	380.265	0.001	182.563	1.165	1	0.667	0.266		Flow Depth / Velocity
152	21	20	10	102.403	0.003	549.965	2.247	1	0.833	0.478		Flow Depth
247	2056	2055	10	279.021	0.002	475.626	1.943	1	0.833	0.44		Flow Depth / Velocity
248	2055	2054	10	368.068	0.002	478.631	1.955	1	0.833	0.438		Flow Depth / Velocity
249	2054	2053	10	288.018	0.002	479.436	1.958	1	0.833	0.451		Flow Depth / Velocity
407	541	540	6	82.658	0	126.972	1.441	1	0.5	0.065		Flow Depth / Velocity
639	1790	SD181	6	61.258	0	15.015	0.17	1	0.5	0.065		Flow Depth / Velocity
706	32	31	8	75.272	0.004	379.359	2.421	1	0.667	0.413		Flow Depth
1050	368	367	8	267.255	0.001	165.62	1.057	1	0.667	0.267		Flow Depth / Velocity
1151	2058	2057	10	177.904	0.001	412.14	1.684	1	0.833	0.401		Flow Depth / Velocity
1353	25	24	10	264.239	0.003	523.207	2.137	1	0.833	0.47		Flow Depth
1355	30	29	10	109	0.003	515.143	2.104	1	0.833	0.474		Flow Depth
1357	23A	23	10	112.77	0.003	543.993	2.222	1	0.833	0.474		Flow Depth
1358	22	21	10	604.437	0.003	549.11	2.243	1	0.833	0.468		Flow Depth
1438	296	295	10	314.066	0	56.016	0.229	1	0.833	0.151		Flow Depth / Velocity
1731	542	541	6	230.193	0.001	93.329	1.059	1	0.5	0.226		Flow Depth / Velocity
1783	123	119	6	329.989	0	7.985	0.091	1	0.5	0.065		Flow Depth / Velocity
1831	648	647	6	99.484	0	18.262	0.207	1	0.5	0.065		Flow Depth / Velocity
3459	1799	1798	6	374.684	0.004	168.969	1.917	1	0.5	0.302		Flow Depth
3460	1798	1797	6	335.819	0.004	175.142	1.987	1	0.5	0.302		Flow Depth
5107	4054LS	4050	4	472.513	0	6.709	0.171	1	0.333	0.042		Flow Depth
5110	4051LS	4048	4	669.175	0	9.53	0.243	1	0.333	0.042		Flow Depth
1356	31	30	10	128	0.003	514.27	2.401	0.817	0.681	0.477		Flow Depth
1354	29	25	10	103.805	0.003	516.18	2.543	0.773	0.644	0.478		Flow Depth
2480	1123	1122	12	104.503	0.005	1030.24	3.573	0.762	0.762	0.648		Flow Depth
2482	1122	SD27	12	196.562	0.005	1030.992	3.672	0.743	0.743	0.648		Flow Depth
1435	292	291	10	300.059	0	70.836	0.371	0.728	0.607	0.171		Flow Depth / Velocity
880	599	598	6	173.656	0.003	127.59	1.88	0.719	0.36	0.269		Flow Depth / Velocity
168	2053	2058	10	21.099	0.002	411.803	2.204	0.713	0.594	0.425		Flow Depth
130	346	SD3	6	47.13	0.016	266.855	4.07	0.697	0.348	0.392		Flow Depth
806	827	SD9	10	30.483	0.002	318.707	1.812	0.675	0.563	0.371		Flow Depth / Velocity
1150	2057	2050	10	17.872	0.003	413.087	2.363	0.672	0.56	0.425		Flow Depth
1805	348	SD3	8	190.3	0	13.393	0.121	0.664	0.442	0.078	Semi-Annual	Flow Depth / Velocity / Maintenance
3166	4386	SD73	12	14.197	0.003	653.85	2.662	0.657	0.657	0.511		Flow Depth
1568	613	612	8	279.17	0.006	325.94	3.008	0.653	0.435	0.402		Flow Depth
246	2063	2056	10	59.011	0.004	470.194	2.817	0.645	0.537	0.455		Flow Depth
2207	1297	1187	6	186.098	0.017	238.978	4.086	0.63	0.315	0.372		Flow Depth
3025	4615	4614	8	228.934	0.005	263.858	2.556	0.626	0.417	0.36		Flow Depth
3627	4622	4621	8	179.552	0.002	187.746	1.824	0.625	0.416	0.302	Quarterly	Flow Depth / Velocity / Maintenance
3024	4614	4613	8	224.169	0.005	267.585	2.614	0.622	0.414	0.363		Flow Depth
3628	4623	4622	8	231.775	0.002	184.943	1.829	0.615	0.41	0.299	Quarterly	Flow Depth / Velocity / Maintenance
526	1374	1373A	8	311.37	0.008	335.115	3.331	0.613	0.408	0.408		Flow Depth
2206	1298	1297	6	352.611	0.014	203.096	3.62	0.608	0.304	0.343		Flow Depth
3011	4616	4615	8	286.392	0.004	235.247	2.375	0.605	0.403	0.339		Flow Depth
3163	4388	4387	10	165.211	0.01	652.284	4.23	0.603	0.502	0.54		Flow Depth
3164	4389	4388	10	224.47	0.01	651.114	4.231	0.602	0.501	0.539		Flow Depth
1570	592	535	8	339.539	0.013	406.764	4.171	0.597	0.398	0.451		Flow Depth
3218	1380	1379	8	371.387	0.005	268.047	2.747	0.597	0.398	0.363		Flow Depth
881	600	599	6	306.389	0.005	118.69	2.167	0.596	0.298	0.259		Flow Depth
2205	1299	1298	6	346.723	0.007	137.949	2.523	0.595	0.298	0.28		Flow Depth
3018	4607	SD78	10	29.012	0.002	295.83	1.956	0.593	0.494	0.357		Flow Depth / Velocity
3165	4390	4389	10	104.654	0.01	629.874	4.213	0.587	0.49	0.53		Flow Depth
3159	4391	4390	10	199.263	0.01	628.926	4.217	0.586	0.488	0.53		Flow Depth
3167	4387	4386	12	262.87	0.004	653.053	3.043	0.586	0.586	0.511		Flow Depth
3015	4617	4616	8	324.718	0.004	220.612	2.317	0.585	0.39	0.328		Flow Depth
76	4611	4610	10	344.851	0.002	278.205	1.884	0.582	0.485	0.346		Flow Depth / Velocity
3023	4612	4611	10	78.668	0.002	275.751	1.866	0.582	0.485	0.344		Flow Depth / Velocity
3160	4392	4391	10	267.055	0.01	625.873	4.24	0.581	0.484	0.528		Flow Depth
3162	4394	4393	10	232.384	0.01	614.518	4.216	0.575	0.479	0.523		Flow Depth
3161	4393	4392	10	215.703	0.01	616.024	4.244	0.573	0.478	0.524		Flow Depth
1054	361	346	6	301.825	0.016	198.646	3.835	0.569	0.285	0.339		Flow Depth
3019	4608	4607	10	254.533	0.002	295.36	2.057	0.568	0.473	0.357		Flow Depth
3016	4618	4617	8	298.346	0.004	208.669	2.291	0.564	0.376	0.319		Flow Depth
525	1375	1374	8	387.148	0.009	317.753	3.507	0.562	0.374	0.397		Flow Depth
790	827F	827	8	206.643	0.007	275.727	3.045	0.561	0.374	0.369		Flow Depth
131	362	361	6	227.05	0.017	197.363	3.888	0.56	0.28	0.338		Flow Depth

3017	4619	4618	8	287.797	0.004	206.627	2.287	0.56	0.374	0.317		Flow Depth
1053	363	362	6	225.229	0.017	196.493	3.881	0.559	0.279	0.337		Flow Depth
3875	4000	SD70	8	178.075	0.018	439.844	4.893	0.558	0.372	0.47		Flow Depth
3876	4001	4000	8	152.131	0.018	429.384	4.806	0.555	0.37	0.464		Flow Depth
3020	4609	4608	10	268.153	0.002	287.878	2.067	0.554	0.462	0.352		Flow Depth
3021	4610	4609	10	208.539	0.002	280.613	2.03	0.551	0.459	0.347		Flow Depth
3217	1381	1380	8	462.436	0.006	237.677	2.694	0.55	0.366	0.341		Flow Depth
527	1373A	1373	8	102.6	0.012	336.83	3.868	0.544	0.363	0.409		Flow Depth
2481	1373	SD27	8	605	0.012	340.29	3.906	0.544	0.363	0.412		Flow Depth
3636	4625	4624	8	25.329	0.002	135.63	1.587	0.536	0.357	0.255		Flow Depth / Velocity
1589	1194	1193	8	331.235	0.014	354.887	4.16	0.535	0.357	0.421		Flow Depth
5113	4051	4051LS	8	12.546	0	9.53	0.113	0.532	0.354	0.066		Flow Depth / Velocity
846	837	836	8	259.471	0.004	187.65	2.22	0.531	0.354	0.301		Flow Depth
2609	3843	3842	8	192.375	0.008	271.34	3.221	0.53	0.353	0.366		Flow Depth
3447	2088	2087	8	354.746	0.003	158.512	1.879	0.53	0.354	0.276		Flow Depth / Velocity
879	597	596	6	271.173	0.011	144.98	3.068	0.528	0.264	0.288		Flow Depth
707	59	32	8	489.764	0.012	329.21	3.928	0.527	0.352	0.405		Flow Depth
524	1376	1375	8	280.473	0.011	305.478	3.659	0.526	0.351	0.389		Flow Depth
3877	4002	4001	8	258.295	0.021	428.196	5.172	0.522	0.348	0.463		Flow Depth
847	838	837	8	285.342	0.004	182.026	2.203	0.521	0.348	0.297		Flow Depth
4137	2089	2088	8	351.991	0.003	153.904	1.871	0.52	0.346	0.272		Flow Depth / Velocity
523	1377	1376	8	321.146	0.01	290.059	3.53	0.519	0.346	0.379		Flow Depth
1591	1192	1191	10	330.209	0.008	458.19	3.573	0.519	0.432	0.449		Flow Depth
3629	4624	4623	8	177.71	0.002	137.857	1.69	0.516	0.344	0.257		Flow Depth / Velocity
1590	1193	1192	10	327.356	0.008	444.584	3.558	0.508	0.423	0.442		Flow Depth
2540	4004	4003	8	350.315	0.023	422.148	5.31	0.506	0.337	0.46		Flow Depth
3150	4405	4404	12	85.265	0.002	352.884	1.978	0.505	0.505	0.371	Semi-Annual	Flow Depth / Velocity / Maintenance
2541	4005	4004	8	315.784	0.023	419.972	5.309	0.504	0.336	0.459		Flow Depth
3152	4402	4401	12	344.735	0.002	360.65	2.027	0.504	0.504	0.375	Semi-Annual	Flow Depth / Maintenance
1648	1619	1618	8	222.559	0.011	283.499	3.591	0.503	0.335	0.374		Flow Depth
2200	1125	1124	10	168	0.003	273.842	2.224	0.502	0.419	0.343		Flow Depth

Appendix E.
Model Results – Future Deficiencies

ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpm)	Velocity (ft/s)	d/D	Water Depth (ft)	Critical Depth (ft)
29	24	23A	10	30.706	0.003	544.234	2.223	1	0.833	0.472
5110	4051LS	4048	4	669.175	-0.061	9.662	0.247	1	0.333	0
5107	4054LS	4050	4	472.513	-0.108	8.37	0.214	1	0.333	0
119	598	597	6	158.334	0.003	152.081	1.726	1	0.5	0.29
126	23	22	10	219.35	0.003	548.97	2.243	1	0.833	0.471
3460	1798	1797	6	335.819	0.004	252.24	2.862	1	0.5	0.302
3459	1799	1798	6	374.684	0.004	242.936	2.757	1	0.5	0.302
2482	1122	SD27	12	196.562	0.005	1,250.46	3.547	1	1	0.684
143	367	366	8	380.265	0.001	200.839	1.282	1	0.667	0.266
2480	1123	1122	12	104.503	0.005	1,249.70	3.545	1	1	0.673
152	21	20	10	102.403	0.003	550.507	2.249	1	0.833	0.478
1831	648	647	6	99.484	0	19.237	0.218	1	0.5	0.065
1783	123	119	6	329.989	0	7.985	0.091	1	0.5	0.065
247	2056	2055	10	279.021	0.002	528.521	2.159	1	0.833	0.44
248	2055	2054	10	368.068	0.002	530.499	2.167	1	0.833	0.438
249	2054	2053	10	288.018	0.002	531.305	2.17	1	0.833	0.451
1731	542	541	6	230.193	0.001	96.016	1.09	1	0.5	0.226
354	1391	1396	6	31.754	0	7.985	0.091	1	0.5	0.065
1438	296	295	10	314.066	0	56.41	0.23	1	0.833	0.151
1358	22	21	10	604.437	0.003	549.641	2.245	1	0.833	0.468
1357	23A	23	10	112.77	0.003	544.456	2.224	1	0.833	0.474
1356	31	30	10	128	0.003	517.75	2.115	1	0.833	0.478
1355	30	29	10	109	0.003	518.329	2.117	1	0.833	0.474
1353	25	24	10	264.239	0.003	523.845	2.14	1	0.833	0.47
639	1790	SD181	6	61.258	0	15.268	0.173	1	0.5	0.065
706	32	31	8	75.272	0.004	383.377	2.447	1	0.667	0.413
1151	2058	2057	10	177.904	0.001	435.962	1.781	1	0.833	0.401
1050	368	367	8	267.255	0.001	183.672	1.172	1	0.667	0.267
5113	4051	4051LS	8	12.546	-0.29	9.662	0.062	1	0.667	0
880	599	598	6	173.656	0.003	139.886	1.901	0.778	0.389	0.282
1354	29	25	10	103.805	0.003	519.01	2.544	0.777	0.647	0.479
2207	1297	1187	6	186.098	0.017	299.99	4.25	0.747	0.373	0.414
168	2053	2058	10	21.099	0.002	435.335	2.221	0.747	0.622	0.437
1435	292	291	10	300.059	0	71.641	0.372	0.735	0.612	0.172

130	346	SD3	6	47.13	0.016	284.982	4.111	0.734	0.367	0.404
2205	1299	1298	6	346.723	0.007	180.698	2.657	0.721	0.36	0.323
2206	1298	1297	6	352.611	0.014	256.62	3.783	0.719	0.36	0.385
311	1245	1244A	8	215.018	0.003	244.757	2.044	0.714	0.476	0.346
1150	2057	2050	10	17.872	0.003	437.726	2.387	0.701	0.584	0.438
246	2063	2056	10	59.011	0.004	524.945	2.875	0.698	0.582	0.482
806	827	SD9	10	30.483	0.002	328.927	1.822	0.691	0.576	0.377
407	541	540	6	82.658	0.005	136.211	2.156	0.674	0.337	0.279
881	600	599	6	306.389	0.005	130.612	2.211	0.635	0.318	0.273
1805	348	SD3	8	190.3	0	12.397	0.119	0.629	0.419	0.075
3025	4615	4614	8	228.934	0.005	262.528	2.553	0.624	0.416	0.359
3627	4622	4621	8	179.552	0.002	187.299	1.823	0.624	0.416	0.301
1570	592	535	8	339.539	0.013	432.2	4.227	0.621	0.414	0.466
3024	4614	4613	8	224.169	0.005	266.304	2.611	0.62	0.413	0.362
3628	4623	4622	8	231.775	0.002	184.504	1.827	0.614	0.41	0.299
1029	1747	1746	6	184.909	0.005	123.64	2.183	0.613	0.307	0.265
1591	1192	1191	10	330.209	0.008	590.475	3.79	0.608	0.507	0.513
1054	361	346	6	301.825	0.016	217.135	3.913	0.603	0.301	0.355
3011	4616	4615	8	286.392	0.004	233.367	2.371	0.601	0.401	0.338
3875	4000	SD70	8	178.075	0.018	487.472	5.009	0.596	0.397	0.494
1590	1193	1192	10	327.356	0.008	573.496	3.779	0.595	0.496	0.505
3876	4001	4000	8	152.131	0.018	475.753	4.92	0.593	0.395	0.489
131	362	361	6	227.05	0.017	215.835	3.968	0.593	0.296	0.354
3018	4607	SD78	10	29.012	0.002	295.04	1.955	0.592	0.493	0.357
526	1374	1373A	8	311.37	0.008	317.799	3.293	0.592	0.394	0.397
1053	363	362	6	225.229	0.017	214.954	3.961	0.591	0.296	0.353
3166	4386	SD73	12	14.197	0.003	558.134	2.575	0.591	0.591	0.471
3218	1380	1379	8	371.387	0.005	262.096	2.734	0.588	0.392	0.359
3015	4617	4616	8	324.718	0.004	218.538	2.312	0.582	0.388	0.326
3023	4612	4611	10	78.668	0.002	274.692	1.864	0.58	0.484	0.344
76	4611	4610	10	344.851	0.002	277.178	1.882	0.58	0.484	0.345
790	827F	827	8	206.643	0.007	285.261	3.069	0.573	0.382	0.375
3019	4608	4607	10	254.533	0.002	294.563	2.056	0.567	0.473	0.356
3016	4618	4617	8	298.346	0.004	206.437	2.285	0.56	0.374	0.317
1589	1194	1193	8	331.235	0.014	380.724	4.23	0.559	0.372	0.436
2479	1184	1123	10	287.924	0.026	956.612	6.808	0.558	0.465	0.654

37	1184A	1184	10	210.657	0.026	953.522	6.798	0.557	0.465	0.653
3017	4619	4618	8	287.797	0.004	204.723	2.282	0.557	0.371	0.316
2478	1185	1184A	10	77.528	0.026	949.85	6.787	0.556	0.464	0.652
879	597	596	6	271.173	0.011	157.507	3.129	0.556	0.278	0.301
3877	4002	4001	8	258.295	0.021	472.115	5.294	0.554	0.37	0.487
2477	1186	1185	10	289.879	0.026	944.873	6.785	0.554	0.462	0.65
3020	4609	4608	10	268.153	0.002	286.981	2.066	0.553	0.461	0.352
2476	1187	1186	10	290.93	0.026	940.428	6.778	0.553	0.46	0.648
3636	4625	4624	8	25.329	0.002	142.409	1.605	0.552	0.368	0.261
3021	4610	4609	10	208.539	0.002	279.619	2.029	0.55	0.458	0.347
3217	1381	1380	8	462.436	0.006	237.25	2.693	0.549	0.366	0.341
3163	4388	4387	10	165.211	0.01	556.55	4.08	0.545	0.454	0.497
3164	4389	4388	10	224.47	0.01	555.36	4.08	0.544	0.453	0.497
525	1375	1374	8	387.148	0.009	301.67	3.464	0.544	0.363	0.386
846	837	836	8	259.471	0.004	194.773	2.24	0.543	0.362	0.307
2609	3843	3842	8	192.375	0.008	278.93	3.242	0.539	0.359	0.371
847	838	837	8	285.342	0.004	191.07	2.229	0.537	0.358	0.304
2540	4004	4003	8	350.315	0.023	465.96	5.44	0.537	0.358	0.483
3447	2088	2087	8	354.746	0.003	161.61	1.887	0.537	0.358	0.279
1568	613	612	8	279.17	0.006	239.67	2.81	0.535	0.357	0.343
2541	4005	4004	8	315.784	0.023	462.998	5.437	0.534	0.356	0.482
3165	4390	4389	10	104.654	0.01	536.105	4.057	0.531	0.443	0.487
3167	4387	4386	12	262.87	0.004	557.327	2.932	0.531	0.531	0.47
707	59	32	8	489.764	0.012	332.5	3.937	0.531	0.354	0.407
3629	4624	4623	8	177.71	0.002	144.119	1.708	0.53	0.354	0.263
3159	4391	4390	10	199.263	0.01	535.143	4.06	0.53	0.442	0.487
1648	1619	1618	8	222.559	0.011	306.605	3.661	0.527	0.351	0.39
527	1373A	1373	8	102.6	0.012	319.438	3.819	0.527	0.351	0.398
2481	1373	SD27	8	605	0.012	322.291	3.855	0.526	0.351	0.4
4137	2089	2088	8	351.991	0.003	156.894	1.88	0.526	0.351	0.275
3160	4392	4391	10	267.055	0.01	532.05	4.081	0.526	0.438	0.486
2200	1125	1124	10	168	0.003	290.587	2.257	0.52	0.434	0.354
885	510	472	6	25.564	0	4.258	0.092	0.52	0.26	0.047
3162	4394	4393	10	232.384	0.01	520.544	4.053	0.519	0.433	0.48
3161	4393	4392	10	215.703	0.01	522.069	4.08	0.518	0.432	0.481
524	1376	1375	8	280.473	0.011	293.062	3.622	0.513	0.342	0.381

3897	4014	4013	8	294.887	0.01	283.49	3.512	0.512	0.341	0.374
4470	4016	4015A	8	295.049	0.01	277.95	3.463	0.51	0.34	0.37
133	375	374	6	66.133	0.012	144.364	3.212	0.508	0.254	0.287
1052	364	363	8	300.383	0.006	213.649	2.691	0.505	0.337	0.323
523	1377	1376	8	321.146	0.01	276.964	3.491	0.505	0.337	0.37
146	1616A	1616	10	329.049	0.012	556.717	4.501	0.504	0.42	0.497
4471	4017	4016	8	198.936	0.004	172.486	2.181	0.504	0.336	0.288
1567	594	593	6	343.091	0.021	186.053	4.19	0.503	0.252	0.328
4472	4018	4017	8	215.691	0.004	170.115	2.168	0.501	0.334	0.286

Appendix F.
Conceptual Cost Estimate

TETRA TECH

PROJECT SUMMARY

PROJECT : City of Whittier Sewer Master Plan — **DATE :** 3/14/2017
SITE : Palm Avenue Sewer Line Replacement (Bypass) — **BY :** SMW
JOB # : 135-48595-16001 — **REVIEWED:** KRB
COST ESTIMATE LEVEL: CONCEPTUAL PLANNING

NO.	DESCRIPTION		OPTION I: OPEN CUT HDPE & REPLACE EXISTING PIPE NEW SEWER PIPING - REUSE MANHOLES				OPTION II: OPEN CUT HDPE & ABANDON EXISTING PIPE NEW SEWER PIPING AND NEW MANHOLES			
			Quantity	Units	Unit Price	Total	Quantity	Units	Unit Price	Total
						1.46%				1.46%
1	Mobilization/Demobilization	1.5%	1	LS	$ 10,000	$ 10,000	1	LS	$ 10,000	$ 10,000
2	Traffic Control		1	LS	$ 5,000	$ 5,000	1	LS	$ 5,000	$ 5,000
3	Construction Information Signs		3	EA	$ 500	$ 1,500	3	EA	$ 500	$ 1,500
4	Dewatering Operations		2,950	LF	$ 20	$ 59,000	2,950	LF	$ 20	$ 59,000
5	Sheeting, Shoring, & Bracing (Including OSHA Permits)		1	LS	$ 10,000	$ 10,000	1	LS	$ 10,000	$ 10,000
6	Pothole and Utility Locating		1	LS	$ 5,000	$ 5,000	1	LS	$ 5,000	$ 5,000
7	Temporary Bypass Wastewater System, Monitoring, and Coordination w / Service Area Residents		1	LS	$ 12,000	$ 12,000	1	LS	$ 12,000	$ 12,000
8	Remove and Dispose Existing 6-inch Sewer		2,950	LF	$ 30	$ 88,500	0	LF	$ 30	$ -
9	Install New 8-inch PVC (Including Service Lateral Connection Wyes)		2,950	LF	$ 70	$ 206,500	2,950	LF	$ 70	$ 206,500
10	Rehab Existing Sewer Pipeline with CIPP Lining System and Reconnect Service Laterals		0	LF	$ 60	$ -	0	LF	$ -	$ -
11	Disconnect Service Laterals and Reconnect to New 8-inch Sewer		77	EA	$ 500	$ 38,500	154	EA	$ 500	$ 77,000
12	Existing Manhole Modifications		6	EA	$ 1,000	$ 6,000	2	EA	$ 1,000	$ 2,000
13	New Sewer Manholes (48-inch)		0	EA	$ 7,000	$ -	6	EA	$ 7,000	$ 42,000
14	Abandon in Place Existing Sewer Piping and MH's (Cap and Slurry Seal)		0	LS	$ 10,000	$ -	1	LS	$ 10,000	$ 10,000
15	Pressure Testing of New Piping		1	LS	$ 3,000	$ 3,000	1	LS	$ 3,000	$ 3,000
16	Lamping / CCTV Alignment and Deflection Inspections of New Gravity Sewer Piping		1	LS	$ 4,000	$ 4,000	1	LS	$ 4,000	$ 4,000
17	AC Pavement Restoration		2,950	LF	$ 80	$ 236,000	2,950	LF	$ 80	$ 236,000
18	Landscaping Restoration		0	LF	$ 10	$ -	0	LF	$ 10	$ -
	TOTAL DIRECT COSTS					**$ 685,000**				**$ 683,000**
	ESTIMATED EQUIPMENT/MATERIAL COSTS					**$ 147,500**				**$ 149,100**
	DESIGN CONTINGENCY	40%				$274,000				$274,000
	GENERAL CONDITIONS	20%				$192,000				$192,000
	GENERAL CONTRACTOR OH&P	10%				$116,000				$115,000
	SALES TAX	7.25%				$11,000				$11,000
	TOTAL ESTIMATED CONSTRUCTION COST					**$1,278,000**				**$1,275,000**
	ENGINEERING, LEGAL & ADMIN. FEES	30%				$384,000				$383,000
	OWNER'S RESERVE FOR CHANGE ORDERS	5%				$64,000				$64,000
	TOTAL ESTIMATED PROJECT COST					**$1,726,000**				**$1,722,000**
	OVERALL COST PER LINEAR FOOT OF SEWER					**$585**				**$584**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Tetra Tech has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Tetra Tech cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.

Appendix G.
Capital Improvement Projects

Capital Improvement Projects
Priority 1

Project	ID	Location	Pavement Condition Index	Recommendation	Existing Pipe Size (in)	Replacement Size (in)	Length (ft)	d/D[1]	Priority	Deficiency Type	Unit Cost ($/Ft.)	Cost
1	--	Bypass at Russel St. and Whittier Blvd.	61-80	Replace	--	8	196	--	1	Bypass Pipeline	$ 240	$ 47,040
	3152		61-80	Replace	12	14	345	0.504	1		$ 285	$ 98,249
											Subtotal	**$ 145,289**
1[2]	3148	Whittier Blvd. between Santa Gertrudes and Russel St.	NA	Replace	12	14	299	0.499	1	Future Flow Depth / Velocity / Maintenance	$ 285	$ 85,307
	3149			Replace	12	14	324	0.496	1	Future Flow Depth / Velocity / Maintenance	$ 285	$ 92,420
	3150			Replace	12	14	85	0.506	1	Flow Depth / Velocity / Maintenance	$ 285	$ 24,301
											Subtotal	**$ 202,027**
2	29	Norwalk Blvd. from Loch Lomand Dr. to Dorland	61-80	Replace	10	14	31	1	1	Flow Depth	$ 285	$ 8,751
	126		61-80	Replace	10	14	219	1	1	Flow Depth	$ 285	$ 62,515
	152		41-60	Replace	10	14	102	1	1	Flow Depth	$ 285	$ 29,185
	706		61-80	Replace	8	12	75	1	1	Flow Depth	$ 270	$ 20,323
	1353		61-80	Replace	10	14	264	1	1	Flow Depth	$ 285	$ 75,308
	1354		61-80	Replace	10	14	104	0.773	1	Flow Depth / Future Full	$ 285	$ 29,584
	1355		61-80	Replace	10	14	109	1	1	Flow Depth	$ 285	$ 31,065
	1356		61-80	Replace	10	14	128	0.817	1	Flow Depth / Future Full	$ 285	$ 36,480
	1357		61-80	Replace	10	14	113	1	1	Flow Depth	$ 285	$ 32,139
	1358		61-80	Replace	10	14	604	1	1	Flow Depth	$ 285	$ 172,265
											Subtotal	**$ 497,616**
3	1050	Palm Ave. between Floral Ave. and Broadway Ave.	61-80	Replace	8	12	267	1	1	Flow Depth / Velocity	$ 270	$ 72,159
	143		61-80	Replace	8	12	380	1	1	Flow Depth / Velocity	$ 270	$ 102,672
	1049		61-80	Replace	8	10	669	0.459	1	Future Flow Depth	$ 255	$ 170,699
	1049A		61-80	Replace	8	10	12	0.455	1	Future Flow Depth	$ 255	$ 3,060
											Subtotal	**$ 348,590**
4	247	Whittier Blvd. between Michigan and Laurel	NA	Replace	10	16	279	1	1	Flow Depth / Velocity	$ 300	$ 83,706
	248		NA	Replace	10	16	368	1	1	Flow Depth / Velocity	$ 300	$ 110,420
	249		NA	Replace	10	16	288	1	1	Flow Depth / Velocity	$ 300	$ 86,405
	168		NA	Replace	10	14	21	0.713	1	Flow Depth	$ 285	$ 6,013
	246		61-80	Replace	10	14	59	0.645	1	Flow Depth	$ 285	$ 16,818
	1150		61-80	Replace	10	14	18	0.672	1	Flow Depth	$ 285	$ 5,094
	1151		61-80	Replace	10	16	178	1	1	Flow Depth / Velocity	$ 300	$ 53,371
											Subtotal	**$ 361,828**
5	639	Penn St. (at county connection near Guilford)	61-80	Replace	6	12	61	1	1	Flow Depth / Velocity	$ 270	**$ 16,540**
6	1438	El Rancho between Orange Dr. and Rose Dr.	81-100	Replace	10	14	314	1	1	Flow Depth / Velocity	$ 285	**$ 89,509**
7	1731	Magnolia Ave. between Floral Dr. and Beverly Blvd.	61-80	Replace	6	10	230	1	1	Flow Depth / Velocity	$ 255	$ 58,699
	407		61-80	Replace	6	10	83	0.641	1	Flow Depth / Maintenance	$ 255	$ 21,078
											Subtotal	**$ 79,777**
8	1783	Alley between Mavis Ave. and Rockne Ave.	NA	Replace	6	10	330	1	1	Flow Depth / Velocity	$ 255	**$ 84,147**
9	1831	Carinthia Dr. west of Mount Holly Dr.	81-100	Replace	6	12	99	1	1	Flow Depth / Velocity	$ 270	**$ 26,861**
10	3459	Penn St. between College Ave. and Canyon Dr	61-80	Replace	6	10	375	1	1	Flow Depth	$ 255	$ 95,544
	3460		61-80	Replace	6	10	336	1	1	Flow Depth	$ 255	$ 85,634
											Subtotal	**$ 181,178**
11	5107	New Castle Dr.	NA	Replace	4	12	473	1	1	Flow Depth	$ 270	**$ 127,579**
12	5110	Stoneridge Dr.	NA	Replace	4	12	669	1	1	Flow Depth	$ 270	$ 180,677
	5113		NA	Replace	8	14	13	0.532	1	Flow Depth / Velocity	$ 285	$ 3,576

												Subtotal	**$**	**184,253**
13	1805	Palm Ave. (County Connection at Whittier Blvd.)	61-80	Replace	8	10	190	0.664	1	Flow Depth / Velocity / Maintenance	$	255	**$**	**48,527**
	3627	First Ave. and Leffingwell Rd.	81-100	Replace	8	10	180	0.625	1	Flow Depth / Velocity / Maintenance	$	255	$	45,786
	3628		81-100	Replace	8	10	232	0.615	1	Flow Depth / Velocity / Maintenance	$	255	$	59,103
14	3629		81-100	Replace	8	10	178	0.516	1	Flow Depth / Velocity	$	255	$	45,316
	3636		81-100	Replace	8	10	25	0.536	1	Flow Depth / Velocity	$	255	$	6,459
												Subtotal	**$**	**156,663**
							8,618					**Total**	**$**	**2,348,356**

[1] d/D based on existing pipe sizes modeled under existing demand conditions

[2] Projects highlighted in red are alternative projects in lieu of the bypass project. Red highlighted projects are not included in the table totals.

Capital Improvement Projects
Priority 2

Project	ID	Location	Pavement Condition Index	Existing Pipe Size (in)	Replacement Size (in)	Length (ft)	Velocity (ft/s)	d/D[1]	Priority	Deficiency Type	Unit Cost ($/Ft.)	Cost
15	--	Bypass Pipeline at Mar Vista St. and Calmosa Ave.	81-100	--	8	200		--	2	Bypass Pipeline	$ 240	$ 48,000
15[2]	3447	La Cuarta between Strub and Michigan	61-80	8	10	355		0.520	2	Flow Depth / Velocity	$ 255	$ 90,460
	4137		81-100	8	10	352		0.530	2	Flow Depth / Velocity	$ 255	$ 89,758
											Subtotal	**$ 180,218**
16	--	Bypass Pipeline at La Serna Ave.	61-80	--	8	206		--	2	Bypass Pipeline	$ 240	$ 49,440
16[2]	2539	La Serna and Janine Dr.	61-80	8	10	335		0.461	2	Adjacent to Deficiency	$ 255	$ 85,425
	2540		61-80	8	10	350		0.506	2	Flow Depth	$ 255	$ 89,250
	2541		61-80	8	10	316		0.504	2	Flow Depth	$ 255	$ 80,580
	3875		81-100	8	10	178		0.558	2	Flow Depth	$ 255	$ 45,390
	3876		81-100	8	10	152		0.552	2	Flow Depth	$ 255	$ 38,760
	3877		81-100	8	10	258		0.522	2	Flow Depth	$ 255	$ 65,790
											Subtotal	**$ 405,195**
17	2480	Pickering Blvd. between Hadley St. and La Cuarta St.	NA	12	16	105	3.573	0.762	2	Flow Depth / Future Full	$ 300	$ 31,351
	2482		NA	12	16	197	3.672	0.743	2	Flow Depth / Future Full	$ 300	$ 58,969
											Subtotal	**$ 90,320**
18	119	Hoover Ave. from Orange Dr. to Howard St.	81-100	6	10	158	1.825	0.776	2	Future Full	$ 255	$ 40,375
	880		81-100	6	8	174	1.88	0.719	2	Flow Depth	$ 240	$ 41,677
	879		NA	6	8	271	3.068	0.528	2	Flow Depth	$ 240	$ 65,082
	881		81-100	6	8	306	2.167	0.596	2	Flow Depth	$ 240	$ 73,533
											Subtotal	**$ 220,667**
19	846	Lambert Rd. North of Santa Fe Springs Rd.	81-100	8	10	259	2.22	0.531	2	Flow Depth	$ 255	$ 66,165
	847		81-100	8	10	285	2.203	0.521	2	Flow Depth	$ 255	$ 72,762
											Subtotal	**$ 138,927**
20	707	Norwalk Blvd. from Orange Dr. to Dorland Dr.	81-100	8	10	490	3.928	0.527	2	Flow Depth	$ 255	**$ 124,890**
21	130	Palm Ave. between Whittier Blvd. and Broadway Blvd.	61-80	6	8	47	4.07	0.697	2	Flow Depth	$ 240	$ 11,311
	131		61-80	6	8	227	3.888	0.56	2	Flow Depth	$ 240	$ 54,492
	1052		41-60	8	10	300	2.734	0.525	2	Future Flow Depth	$ 255	$ 76,598
	1053		61-80	6	8	225	3.881	0.559	2	Flow Depth	$ 240	$ 54,055
	1054		61-80	6	8	302	3.835	0.569	2	Flow Depth	$ 240	$ 72,438
											Subtotal	**$ 268,894**
22	1589	Pickering Blvd. between Hadley St. and La Cuarta St.	41-60	8	10	331	4.16	0.535	2	Flow Depth	$ 255	$ 84,465
	1590		41-60	10	12	327	3.558	0.508	2	Flow Depth	$ 270	$ 88,386
	1591		41-60	10	12	330	3.573	0.519	2	Flow Depth	$ 270	$ 89,156
											Subtotal	**$ 262,007**
23	523	Whittier Blvd. between Painter St. and La Cuarta St.	NA	8	10	321	3.53	0.519	2	Flow Depth	$ 255	$ 81,892
	524		NA	8	10	280	3.659	0.526	2	Flow Depth	$ 255	$ 71,521
	525		NA	8	10	387	3.507	0.562	2	Flow Depth	$ 255	$ 98,723
	526		NA	8	10	311	3.331	0.613	2	Flow Depth	$ 255	$ 79,399
	527		NA	8	10	103	3.868	0.544	2	Flow Depth	$ 255	$ 26,163
	2481		NA	8	10	605	3.906	0.544	2	Flow Depth	$ 255	$ 154,275
	3217		NA	8	10	462	2.694	0.55	2	Flow Depth	$ 255	$ 117,921

	3218		NA	8	10	371	2.747	0.597	2	Flow Depth	$	255	$	94,704
	521		NA	8	10	171	3.634	0.487	2	Adjacent to Deficiency	$	255	$	43,536
	522		NA	8	10	84		0.453	2	Adjacent to Deficiency	$	255	$	21,421
												Subtotal	**$**	**789,555**
	3023	Hornell St. between Kentucky St. and Santa Fe St.	81-100	10	12	79	1.866	0.582	2	Flow Depth / Velocity	$	270	$	21,240
	76		81-100	10	12	345	1.884	0.582	2	Flow Depth / Velocity	$	270	$	93,110
	3019		21-40	10	12	255	2.057	0.568	2	Flow Depth	$	270	$	68,724
	3020		21-40	10	12	268	2.067	0.554	2	Flow Depth	$	270	$	72,401
24	3021		21-40	10	12	209	2.03	0.551	2	Flow Depth	$	270	$	56,306
	3022		81-100	10	12	238	2.337	0.489	2	Adjacent to Deficiency	$	270	$	64,185
	3024		81-100	8	10	224	2.614	0.622	2	Flow Depth	$	255	$	57,163
	3025		81-100	8	10	229	2.556	0.626	2	Flow Depth	$	255	$	58,378
	3018		21-40	10	12	29	1.956	0.593	2	Flow Depth / Velocity	$	270	$	7,833
												Subtotal	**$**	**499,340**
	790	Santa Fe Springs Rd. north of Shreve Rd.	81-100	8	10	207	3.045	0.561	2	Flow Depth	$	255	$	52,694
25	806		81-100	10	14	30	1.812	0.675	2	Flow Depth / Velocity	$	285	$	8,688
												Subtotal	**$**	**61,382**
26	1435	El Rancho Dr. between Howard St. and Broadway	81-100	10	14	300	0.371	0.728	2	Flow Depth / Velocity	$	285	**$**	**85,517**
27	1568	Broadway between Gregory Ave. and Citrus Ave.	61-80	8	10	279	3.008	0.653	2	Flow Depth	$	255	**$**	**71,188**
28	1570	Broadway between Magnolia Ave. and Acacia Ave.	61-80	8	10	340	4.171	0.597	2	Flow Depth	$	255	**$**	**86,582**
29	1648	Painter Ave. between Bailey St. and Olive Dr.	81-100	8	10	223	3.591	0.503	2	Flow Depth	$	255	**$**	**56,753**
30	2200	Whittier Blvd. south of Pacific	NA	10	12	168	2.224	0.502	2	Flow Depth	$	270	**$**	**45,360**
31	2609	Whittier Blvd. west of La Puebla Ave.	41-60	8	10	192	3.221	0.53	2	Flow Depth	$	255	**$**	**49,056**
	3011	Leffingwell Rd. west of 1st Ave.	41-60	8	10	286	2.375	0.605	2	Flow Depth	$	255	$	73,030
	3015		41-60	8	10	325	2.317	0.585	2	Flow Depth	$	255	$	82,803
32	3016		41-60	8	10	298	2.291	0.564	2	Flow Depth	$	255	$	76,078
	3017		41-60	8	10	288	2.287	0.56	2	Flow Depth	$	255	$	73,388
												Subtotal	**$**	**305,300**
	3166	Messina Dr. between Scott Ave. and Starbuck St.	61-80	12	16	14	2.662	0.657	2	Flow Depth	$	300	$	4,259
	3167		61-80	12	14	263	3.043	0.586	2	Flow Depth	$	285	$	74,918
	3163		61-80	10	12	165	4.23	0.603	2	Flow Depth	$	270	$	44,607
	3164		61-80	10	12	224	4.231	0.602	2	Flow Depth	$	270	$	60,607
	3165		61-80	10	12	105	4.213	0.587	2	Flow Depth	$	270	$	28,257
33	3159		81-100	10	12	199	4.217	0.586	2	Flow Depth	$	270	$	53,801
	3160		81-100	10	12	267	4.24	0.581	2	Flow Depth	$	270	$	72,105
	3161		81-100	10	12	216	4.244	0.573	2	Flow Depth	$	270	$	58,240
	3162		81-100	10	12	232	4.216	0.575	2	Flow Depth	$	270	$	62,744
												Subtotal	**$**	**459,537**
	3692	Janine Dr. / Shiloh St.	41-60	6	8	285			2	Spot Repair / Maintenance	$	240	$	68,400
34	3693		41-60	6	8	130			2	Spot Repair	$	240	$	31,200
												Subtotal	**$**	**99,600**
	3408	Summit Dr. / Marshall Ln.	81-100	6	8	225			2	Spot Repair / Maintenance	$	240	$	54,000
35	3409		61-80	6	8	320			2	Spot Repair / Maintenance	$	240	$	76,800
												Subtotal	**$**	**130,800**
36	273	Hadley St. / Friends Ave.	81-100	6	8	635			2	Spot Repair / Maintenance	$	240	**$**	**152,400**
37	2963	Bronte Dr. / Bowen Dr.	81-100	6	8	115			2	Spot Repair / Maintenance	$	240	**$**	**27,600**
	618	Calmosa Ave. / Eastridge Dr.	81-100	6	8	125			2	Spot Repair / Maintenance	$	240	$	30,000
38	4401		81-100	6	8	350			2	Spot Repair	$	240	$	84,000

												Subtotal	**$**	**114,000**
39	640	Sunny Slope St. / Pierce Ave.	81-100	6	8	65			2	Spot Repair / Maintenance	$	240	$	15,600
	2391		81-100	6	8	250			2	Spot Repair	$	240	$	60,000
	2393		41-60	6	8	520			2	Spot Repair	$	240	$	124,800
												Subtotal	**$**	**200,400**
40	253	Broadway / Washington Ave.	61-80	6	8	535			2	Spot Repair	$	240	**$**	**128,400**
41	1473	Bright Ave / Broadway Ave.	81-100	6	8	635			2	Spot Repair	$	240	**$**	**152,400**
42	278	Bright Ave. / Camillia St.	61-80	6	8	460			2	Spot Repair	$	240	**$**	**110,400**
43	280	Greenleaf Ave. / Broadway Ave.	41-60	6	8	670			2	Spot Repair	$	240	**$**	**160,800**
44	286	Greenleaf Ave. / Broadway Ave.	81-100	6	8	665			2	Spot Repair	$	240	$	159,600
	283		81-100	6	8	665			2	Spot Repair	$	240	$	159,600
												Subtotal	**$**	**319,200**
45	1509	Newlin Ave. / Broadway Ave.	61-80	6	8	665			2	Spot Repair	$	240	$	159,600
	1508		81-100	6	8	600			2	Spot Repair	$	240	$	144,000
												Subtotal	**$**	**303,600**
46	1472	Washington Ave. / Wardman St.	61-80	6	8	635			2	Spot Repair	$	240	**$**	**152,400**
47	3201	Painter Ave. / Ramona Dr.	61-80	6	8	275			2	Spot Repair	$	240	$	66,000
	3202		81-100	6	8	320			2	Spot Repair	$	240	$	76,800
												Subtotal	**$**	**142,800**
48	3399	Bronte. Dr. / Elend Ave.	81-100	6	8	320			2	Spot Repair	$	240	**$**	**76,800**
49	3182	Sunset Dr. / Painter Ave.	61-80	6	8	560			2	Spot Repair	$	240	**$**	**134,400**
50	1707	Philadelphia St. / Painter Ave.	81-100	6	8	540			2	Spot Repair	$	240	**$**	**129,600**
51	1036	Hillside Ln. / Philadelphia Ave.	41-60	6	8	95			2	Spot Repair	$	240	**$**	**22,800**
52	4210	Boyar Ave. / Strub Ave. / Whittier Ave.	21-40	8	8	275			2	Spot Repair	$	240	$	66,000
	4202		61-80	6	8	355			2	Spot Repair	$	240	$	85,200
	4211		21-40	6	8	355			2	Spot Repair	$	240	$	85,200
												Subtotal	**$**	**236,400**
53	4217	Oak St. / Watson Ave.	81-100	6	8	300			2	Spot Repair	$	240	**$**	**72,000**
54	4207	Strub Ave. / Chestnut Dr.	21-40	6	8	355			2	Spot Repair	$	240	$	85,200
	4208		21-40	6	8	355			2	Spot Repair	$	240	$	85,200
												Subtotal	**$**	**170,400**
55	4405	Eastridge St. / Calamosa Ave.	81-100	6	8	155			2	Spot Repair	$	240	$	37,200
	4400		81-100	6	8	370			2	Spot Repair	$	240	$	88,800
												Subtotal	**$**	**126,000**
56	2606	Ben Hur Dr. / Whittier Blvd.	81-100	6	8	230			2	Spot Repair	$	240	$	55,200
	2600		61-80	6	8	280			2	Spot Repair	$	240	$	67,200
												Subtotal	**$**	**122,400**
57	1122	Deveron Dr. / Pioneer Blvd.	41-60	8	8	170			2	Spot Repair	$	240	$	40,800
	435		81-100	8	8	540			2	Spot Repair	$	240	$	129,600
												Subtotal	**$**	**170,400**
58	1672	Via Del Palma Dr. / Painter Ave.	81-100	6	8	80			2	Spot Repair	$	240	$	19,200
	468		81-100	6	8	540			2	Spot Repair	$	240	$	129,600
												Subtotal	**$**	**148,800**
						29,354						**Total**	**$**	**7,317,514**

Capital Improvement Projects
Priority 3

Project	ID	Location	Pavement Condition Index	Existing Pipe Size (in)	Replacement Size (in)	Length (ft)	d/D[3]	Priority	Deficiency Type	Unit Cost ($/Ft.)	Cost
59	133	Palm north of Hunter	61-80	6	8	66	0.508	3	Future Flow Depth	$ 240	**$ 15,872**
60	885	intersection of Rideout and Capri	61-80	6	8	26	0.52	3	Future Flow Depth	$ 240	**$ 6,135**
61	1029	Philadelphia west of Bryn Mahr	81-100	6	8	185	0.613	3	Future Flow Depth	$ 240	**$ 44,378**
62	1567	Hoover between Pilgrim and Broadway	41-60	6	8	343	0.503	3	Future Flow Depth	$ 240	$ 82,342
										Subtotal	**$ 82,342**
63	311	Wardman east of Greenleaf	41-60	8	10	215	0.714	3	Future Flow Depth	$ 255	**$ 54,830**
64	3897	Youngwood east of La Serna	41-60	8	10	295	0.512	3	Future Flow Depth	$ 255	**$ 75,196**
65	4470	Youngwood west of Montesino	41-60	8	10	295	0.51	3	Future Flow Depth	$ 255	$ 75,237
	4471		21-40	8	10	199	0.504	3	Future Flow Depth	$ 255	$ 50,729
	4472		21-40	8	10	216	0.501	3	Future Flow Depth	$ 255	$ 55,001
										Subtotal	**$ 180,967**
66	146	Painter between Wardman and Philadelphia	81-100	10	12	329	0.504	3	Future Flow Depth	$ 270	$ 88,843
										Subtotal	**$ 88,843**
						2,168				**Total**	**$ 548,564**

[3] d/D based on existing pipe sizes modeled under future demand conditions

Appendix H.
Technical Memorandum - La Cuarta

TETRA TECH

DRAFT Technical Memorandum

Date:	January 17, 2017		
To:	Kyle Cason		
Cc:			
From:	Ken Berard		
Project:	Whittier Sewer Master Plan	***Project Number:***	135-48595-16001
Subject:	La Cuarta County Sewer Capacity Issues		

Background

Sewer capacity concerns have prevented the City from allowing new development or redevelopment in its Uptown area. The Uptown area is generally served with small (i.e. 6") City sewers which convey flows to Los Angeles County sewers. In addition to the City's concerns about their sewer capacities, the County indicated that their 10" sewer main on La Cuarta St., between Greenleaf and Whittier Blvd., currently has capacity issues and have expressed concerns about any development that would increase flows into their 10" sewer.

Wastewater from the Uptown area flows southerly to the County's La Cuarta 10" sewer where flows are then conveyed westerly to the "Five Points" intersection. At that intersection, the County's sewer increases to a 16" pipe and flows southwesterly down Santa Fe Springs Rd. Once the wastewater reaches the 16" sewer in Santa Fe Springs Rd., capacity does not appear to be a problem.

Criteria

The sewer system model was run in dry-weather conditions with peak flows. Pipelines were considered to be adequate if the d/D<0.5 for pipe 12" and smaller. This is typical criteria and allows for inflow and infiltration and some air flow to keep the wastewater from becoming septic. Based on limited data, inflow and infiltration in the City generally appears to be about 10 to 15%, so a maximum d/D of 0.5 would be appropriate.

Existing Conditions

The model results indicate that there are pipeline capacity issues in both City pipelines and County pipelines within the study area which is consistent with observations from the City's field crew.

The model shows that the 12" City sewer main on Whittier Blvd., between Pickering Ave. and La Cuarta St., is flowing full (d/D>1.0) and is surcharging under existing conditions. City field crew has confirmed issues with this segment of pipe, and has also indicated that sediment buildup occurs here.

160 Via Verde, Suite 200, San Dimas, CA 91773
Tel 909.305.2930 **Fax** 909.305.2959 **tetratech.com**

The 10" City sewer main on Pickering Ave., north of Whittier Blvd., flows more than half full under existing conditions and the 6" sewer main on Walnut St., east of Pickering Ave., is flowing near full under existing conditions. The City's 12" sewer in Whittier Blvd. at the 5 points intersection surcharges and flows full.

The model also identified flow in the 10" County sewer pipeline on La Cuarta Ave is more than half full (d/D>0.5) under existing conditions. The majority of the flow to the County pipeline on La Cuarta is fed from a 12" line on Greenleaf Ave. The Greenleaf Ave. pipeline conveys flow directly from the Uptown area and also picks up flow from Walnut St. from the east, via a bypass connection at the intersection of Walnut St. and Greenleaf Ave.

Refer to Exhibit 1 for more details of the flows and d/D ratios of the existing system.

The configuration of the sewers at the intersection of Greenleaf Ave. and Walnut St. is noteworthy. As the Walnut St. sewer flows to the west and approaches the Greenleaf Ave. sewer, there is a short bypass pipe that diverts about 75 percent of the flow into Greenleaf Ave. and allows about 25 percent of the flows to continue in Walnut St. Within the intersection itself, the Greenleaf Ave. sewer flows under the Walnut St. sewer, and all of the Greenleaf Ave. flows continue south.

Future Conditions

The future sewer system model was developed by adding wastewater generated from future development as well as redevelopment. The future scenario assumes that all undeveloped lots as depicted in the existing City maps will be developed and contribute sewage flow per its intended future land use. Redevelopment was accounted for by increasing existing Uptown flows by approximately 30%. The 30% increase was estimated by calculating the specific future land use for an area in Uptown (including a mix of commercial and residential uses) and comparing to existing estimated flows for an area in Uptown (based on field flow testing).

As expected, the model showed existing deficiencies becoming more severe, and some pipelines that were adequate under existing conditions becoming deficient under future conditions.

The 10" sewer main on Pickering Ave., north of Whittier Blvd., receives approximately 200 gpm additional sewage flow and becomes approximately 12% more full. Also, an additional 700 ft. of pipe on Pickering Ave., north of Walnut Ave., fails to meet the flow criteria. The 6" sewer main on Walnut St., east of Pickering Ave., receives approximately 50 gpm additional sewage flow and remains full. An additional 350 ft. of 6" pipe on Walnut St. (to the east) fails to meet the flow criteria.

Flows in the 10" County sewer pipeline on La Cuarta Ave. increase by approximately 100 gpm and becomes approximately 10% more full.

Improvement Alternatives

Three alternatives have been analyzed that will intercept flow from the Uptown area at Walnut St. and reduce flow to the County's 10" pipe on La Cuarta St. All alternatives generally intercept the flow down Greenleaf Ave. and redirect this flow east along Walnut St., then south to the 5-points convergence point. By intercepting the flows at Walnut St., flows in the La Cuarta County sewer can be decreased in the future (although total flows in the area will increase).

The connection of the Walnut St. to Greenleaf Ave. lines will require construction of new 12" pipeline on Greenleaf Ave. to the manhole 350 ft. north of Walnut St. The pipeline must be reconstructed at a

shallower slope to meet the grade of the Walnut St. pipe. This intersection could be simply constructed by completely separating the Greenleaf Ave. sewer south of Walnut St. Or, if desired, this intersection could be reconstructed with a removable plug to Greenleaf Ave. south of Walnut St., which could increase system flexibility.

All alternatives reduce flows in the County's La Cuarta sewer thereby enabling the development or redevelopment of the Uptown area. The alternatives differ in the route taken to ultimately connect to the 5-points convergence from Pickering Ave. Alternative 1 diverts flows about halfway down Pickering Ave. to Newlin Ave. This diversion minimizes construction within the 5-points intersection. Refer to Exhibit 2. This alternative reduces flows in Pickering and resolves the existing high d/D problem in Pickering as well as in Whittier Blvd. in the 5 points intersection. However, the diversion from Pickering Ave. to Newlin Ave. must be further evaluated to verify that right-of-way and required grades are available.

Alternative 2 is similar to Alternative 1 except that the improvements continue down Pickering Ave. and enters the 5-points intersection at the north westerly end. Refer to Exhibit 2.This alignment also improves the existing Pickering Ave. / 5 points intersection d/D flows but requires about 500' of improvements in Whittier Blvd. in the 5-points intersection.

Alternative 3 diverts Walnut Ave. flow south through the alley between Newlin Ave. and Milton Ave., and then west through a proposed parallel pipe on La Cuarta St. Refer to Exhibit 3. This alternative makes minimal improvements to the Pickering Ave. / 5 points intersection d/D flows by reducing those flows by about 100 gpm. However, it does not reduce those d/D's to less than 0.5. This alternative may offer less public inconvenience and easier construction than the other alternatives.

<u>Alternative 1 – Construct 15" sewer main in Alley east of Pickering Ave.</u>

- Construct approx. 480 LF of 12" sewer main to divert Greenleaf Ave. flow east on Walnut St.
- Abandon connection of the 8" Walnut St. sewer main to the 12" Greenleaf Ave. sewer main
- Construct approx. 1,200 LF of 15" sewer main on Walnut St.
- Construct approx. 600 LF of 15" sewer main on Pickering Ave.
- Construct approx. 900 LF of 15" sewer main diversion in alley between Pickering St. and Newlin Ave. Plug connection to existing 10" pipe on Pickering Ave. south of diversion point.

<u>Alternative 2 – Construct 15" sewer main on Whittier Blvd.</u>

- Construct approx. 480 LF of 12" sewer main to divert Greenleaf Ave. flow east on Walnut St.
- Abandon connection of the 8" Walnut St. sewer main to the 12" Greenleaf Ave. sewer main
- Construct approx. 1,200 LF of 15" sewer main on Walnut St.
- Construct approx. 1,200 LF of 15" sewer main on Pickering Ave.
- Construct approx. 300 LF of 15" sewer main on Whittier Blvd. to connect to the 5-points convergence.

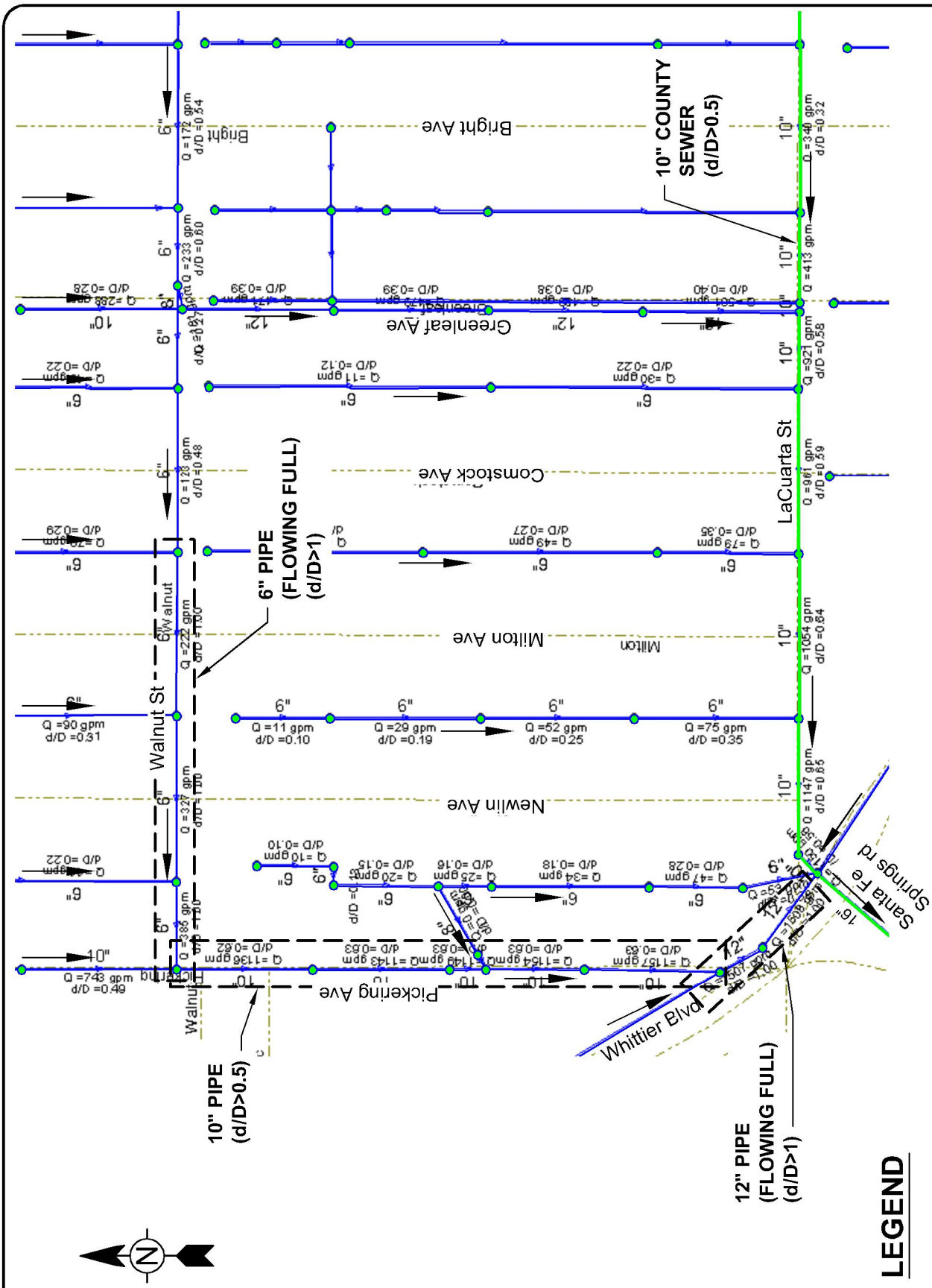
<u>Alternative 3 – Construct 12" sewer main within alley between Newlin Ave. and Milton Ave.</u>

- Construct approx. 480 LF of 12" sewer main to divert Greenleaf Ave. flow east on Walnut St.

- Abandon connection of the 8" Walnut St. sewer main to the 12" Greenleaf Ave. sewer main
- Construct approx. 700 LF of 15" sewer main on Walnut St.
- Construct approx. 1,400 LF of 12" sewer main within the alley between Newlin Ave. and Milton Ave.
- Construct approx. 300 LF of 12" parallel sewer main on La Cuarta to connect to the existing manhole.

The improvement alternatives will reduce flow to the County pipeline in La Cuarta St. from a future peak dry weather flow of 1,250 gpm to a peak dry weather flow of 680 gpm. All improvement alternatives will mitigate the high flows to the 10" County sewer on La Cuarta St. to below the flow criteria for both existing and future conditions.

It should be noted that the pipeline slopes in Walnut St. vary and it would be possible to improve some reaches to only 12" and still provide adequate capacity. However, the pipeline size would go from 15" down to 12" and back up to 15" while flows were increasing. A 15" pipe is included for the entire length for simplicity. It should also be noted that if the Walnut St. pipeline were to be regraded with a consistent slope, a 12" pipe would just be over the design criteria with a d/D ratio of 0.55 for the future flows.



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San Dimas, CA 91173
Tel: 909-305-2930 Fax: 909-305-2959

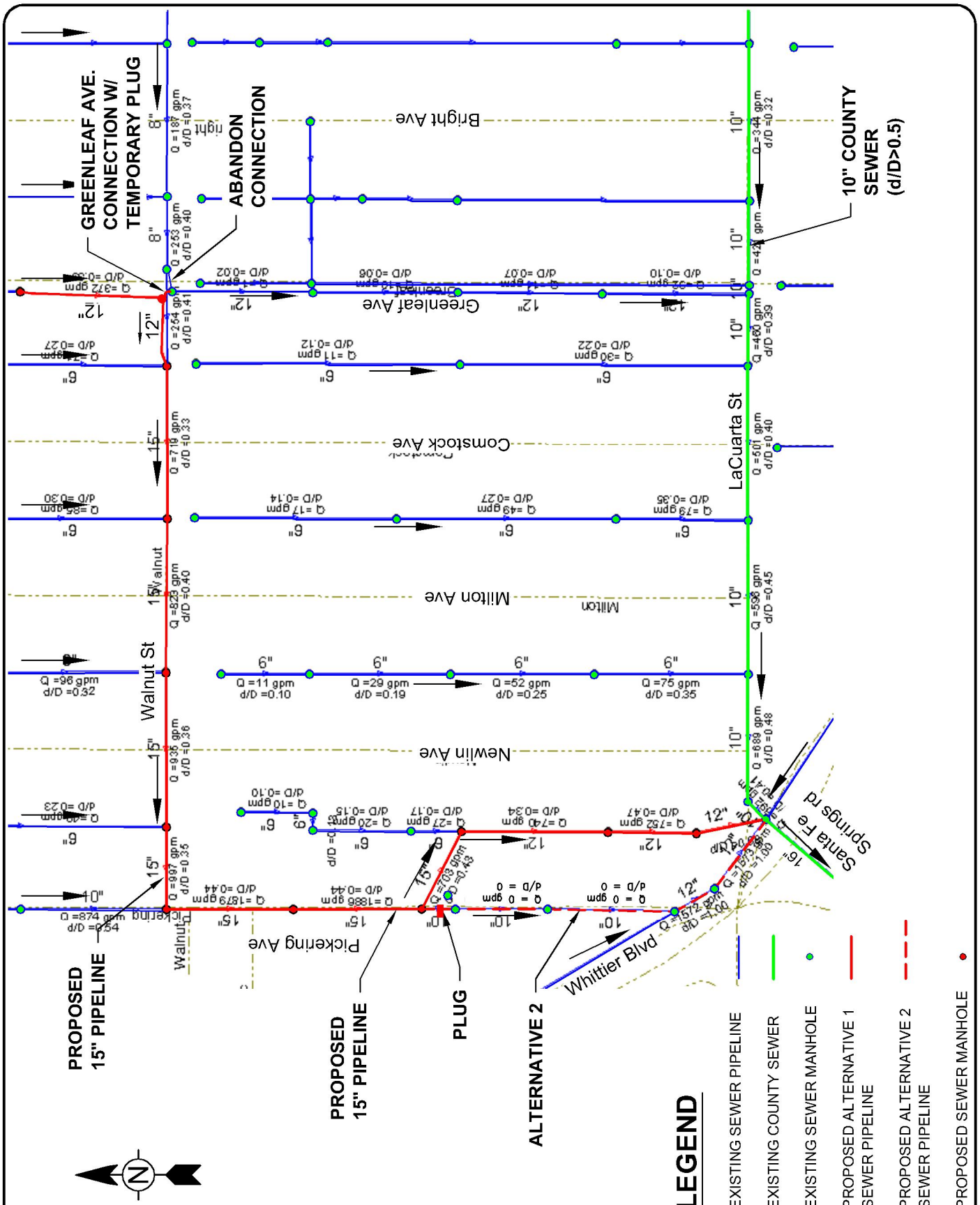
CITY OF WHITTIER

SEWER SYSTEM MASTER PLAN

SEWER PIPELINES
EXISTING CONDITIONS

Project No.:	135-48595-16001
Date:	12-2016
Designed By:	A.L.
Exhibit	1

Bar Measures 1 inch



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CITY OF WHITTIER

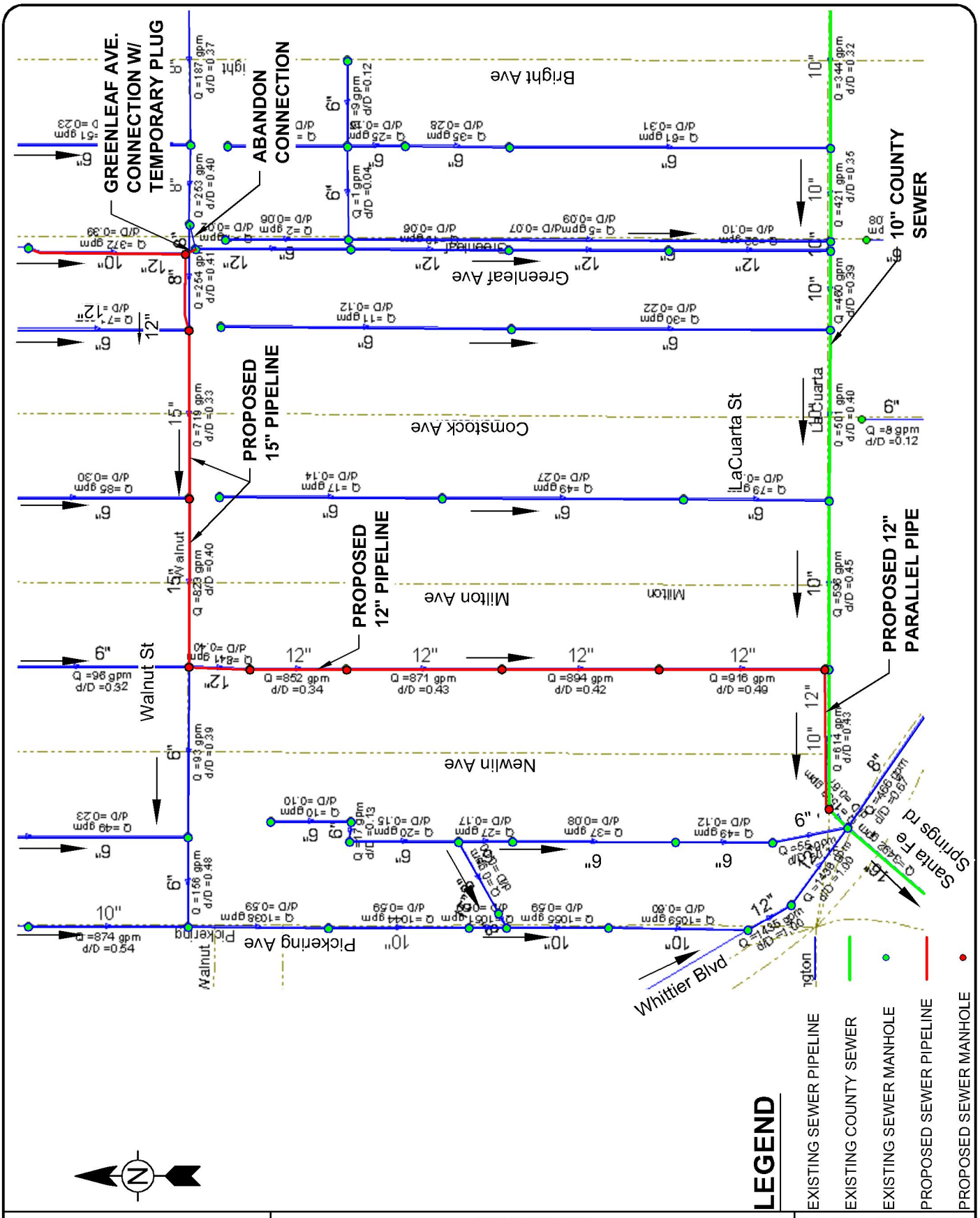
SEWER SYSTEM MASTER PLAN

SEWER PIPELINES
ALTERNATIVE 1 AND 2
FUTURE CONDITIONS

Project No.:	135-48595-16001
Date:	12-2016
Designed By:	A.L.
Exhibit	2

Bar Measures 1 inch

1/17/2017 11:36:27 AM - P:\48595\135-48595-16001\CAD\SHEETFILES\C-807-FIGURE_SEWERSYSTEMPIPELINES-ALT-1_FUTURE.DWG - LEE, ADRIAN



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CITY OF WHITTIER

SEWER SYSTEM MASTER PLAN

SEWER PIPELINES
ALTERNATIVE 3
FUTURE CONDITIONS

Project No.:	135-48595-16001
Date:	12-2016
Designed By:	A.L.
Exhibit	3

Bar Measures 1 inch

Appendix I.
Letter – Los Angeles County Sanitation Districts

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

July 13, 2017

Mr. Carl Hassel
Capital Projects Administrator
City of Whittier
13230 Penn Street
Whittier, CA 90602-1772

Dear Mr. Hassel:

Worsham Creek Trunk Sewer – Uptown Whittier Development

The County Sanitation Districts of Los Angeles County (Districts) received your letter dated June 27, 2017 requesting the Districts upgrade its sewer system in the area of Uptown Whittier to accommodate build-out flows to the year 2035, including flows from future development projects. On May 11, 2017, City of Whittier staff met with the Districts and provided a summary of projected flows for Uptown Whittier, with additional flows of 0.33 cubic feet per second (cfs) generated within the next 3.5 years and a total of 2.06 cfs generated by 2035. Most of the additional flow in the Uptown Whittier area will be due to future development projects. The City indicated that this flow would discharge to their existing 12-inch sewer in Greenleaf Avenue, which ultimately discharges to the Districts' Worsham Creek Trunk Sewer (Manhole 960A) in the intersection of Greenleaf Avenue and La Cuarta Street.

The Districts have reviewed your request and have the following comments:

1. The wastewater flow originating from the proposed projects will discharge to a local sewer line in Greenleaf Avenue, which is not maintained by the Districts, for conveyance to the Districts' Worsham Creek Trunk Sewer, connecting in the intersection of La Cuarta Street and Greenleaf Avenue. At this location, the Districts' 9.4 inch PVC lined VCP trunk sewer has an average capacity of 3 cubic feet per second (cfs) and conveyed a dry peak flow of 1.86 cfs when last measured in 2009. Therefore, the existing Districts' Worsham Creek Trunk Sewer will have the capacity to handle the projected flow of 0.33 cfs within the next 3.5 years.

2. Although the existing Worsham Creek Trunk Sewer has the capacity to handle the 0.33 cfs of flow generated in the next 3.5 years, the sewer does not have the capacity to handle the projected flow of 2.06 cfs in the long term planning by year 2035. Consequently, the Districts will place a relief sewer project into the Capital Improvement Plan to address this issue.

3. It is important that the City keeps the Districts informed on a timely manner with any increase/decrease to the flows as projected or any other changes to the flow generated which may affect the capacity of the existing sewer. Similarly the Districts will monitor flow levels in the Worsham Creek Trunk Sewer to substantiate the City's flow projections.

Doc. #4214913

4. The Districts should review individual developments within the proposed project area in order to determine whether or not sufficient trunk sewer capacity exists to serve each project and if Districts' facilities will be affected by the project.

5. The Districts are empowered by the California Health and Safety Code to charge a fee for the privilege of connecting (directly or indirectly) to the Districts' Sewerage System for increasing the strength or quantity of wastewater attributable to a particular parcel or operation already connected. This connection fee is a capital facilities fee that is imposed in an amount sufficient to construct an incremental expansion of the Sewerage System to accommodate the proposed project area. Payment of a connection fee will be required before a permit to connect to the sewer is issued. For more information and a copy of the Connection Fee Information Sheet, go to www.lacsd.org, Wastewater & Sewer Systems, click on Will Serve Program, and search for the appropriate link. For more specific information regarding the connection fee application procedure and fees, please contact the Connection Fee Counter at (562) 908-4288, extension 2727.

6. In order for the Districts to conform to the requirements of the Federal Clean Air Act (CAA), the design capacities of the Districts' wastewater treatment facilities are based on the regional growth forecast adopted by the Southern California Association of Governments (SCAG). Specific policies included in the development of the SCAG regional growth forecast are incorporated into clean air plans, which are prepared by the South Coast and Antelope Valley Air Quality Management Districts in order to improve air quality in the South Coast and Mojave Desert Air Basins as mandated by the CCA. All expansions of Districts' facilities must be sized and service phased in a manner that will be consistent with the SCAG regional growth forecast for the counties of Los Angeles, Orange, San Bernardino, Riverside, Ventura, and Imperial. The available capacity of the Districts' treatment facilities will, therefore, be limited to levels associated with the approved growth identified by SCAG. As such, this letter does not constitute a guarantee of wastewater service, but is to advise you that the Districts intend to provide this service up to the levels that are legally permitted and to inform you of the currently existing capacity and any proposed expansion of the Districts' facilities.

If you have any questions, please contact Rosann Paracuelles of this office at (562) 908-4288, extension 1637.

Very truly yours,

Mike Tatalovich
Section Head
Sewer Design Section

MT:kl

cc: Sullivan
Paracuelles

Doc. #4214913

Appendix J.
Repeated Spot Repairs

Repair Group	Repair MH ID	Area	Manholes Involved	Pipe ID	Piping Segements Affected	6 Inch Diameter	8 Inch Diameter	Pipe Length, Ft
1	1170	Sunny Slope St/Pierce Ave	1170, 1171, 1172LH	640	MH 1172 TO MH 1170	6	-	65
				2391	MH 1170 TO MH 1171	6	-	250
				2393	MH 1170 TO MH 1127LH	6	-	520
2	1208	Broadway/Washington Ave	1207, 1208	253	MH 1208 TO MH 1207	6	-	535
3	1215	Bright Ave/Broadway	1214, 1215	1473	MH 1215 TO MH 1214	6	-	635
4	1220	Bright Ave/Camillia St	1202, 1220	278	MH 1220 TO MH 1202	6	-	460
5	1221	Greenleaf Ave/Broadway	1221, 1222	280	MH 1221 TO MWH 1222	6	-	635
6	1227	Greenleaf Ave/Broadway	1226, 1227, 1228	286	MH 1226 TO MH 1227	6	-	635
				283	MH 1227 TO MH 1228	6	-	635
7	1236	Newlin Ave/Broadway	1235, 1236, 1237	1509	MH 1236 TO MH 1237	6	-	0
				1508	MH 1235 TO MH 1236	6	-	600
8	1252	Hadley St/Friends Ave	1251, 1252	273	MH 1251 TO MH 1252	6	-	635
9	1316	Washington Ave/Wardman St	1315, 1316	1472	MH 1316 TO MH 1315	6	-	635
10	1411	Painter Ave/Ramona Dr	1410, 1411, 1412	3201	MH 1410 TO MH 1411	6	-	275
				3202	MH 1411 TO MH 1412	6	-	320
11	1484	Summit Dr/Marsha Ln	1483, 1484, 1485	3408	MH 1483 TO MH 1484	6	-	225
				3409	MH 1484 TO MH 1485	6	-	320
12	1522	Bronte Dr/Elend Ave	1521, 1522	3399	MH 1521 FTO MH 1522	6	-	320
13	1570	Sunset Dr/Painter Ave	1569, 1570	3182	MH 1569 TO MH 1570	6	-	560
14	1617	Philadelphia St/Painter Ave	1617, 1745	1707	MH 1617 TO MH 1745	6	-	540
15	1777	Hillside Ln/Philadelphia Ave	1777, CO-1777	1036	MH 1777 TO CO 1777	6	-	95
16	2015	Boyar Ave/Strub Ave/Whiittier Ave	2014, 2015, 2029	4210	MH 2014 T OMH 2015	-	8	275
				4202	MH 2015 TO MH 2029	6	-	355
17	2022	Oak St/Watson Ave	2021, 2022	4217	MH 2021 TO MH 2022	6	-	300
18	2026	Boyar Ave/Whittier Blvd	2015, 2026, 2027	4210	MH 2015 TO MH 2026	6	-	355
				4211	MH 2026 TO MH 2027	6	-	355
19	2029	Strub Ave/Chestnut Dr	2014, 2029, 2030	4207	MH 2014 TO MH 2029	6	-	355
				4208	MH 2029 TO MH 2030	6	-	355
20	3029	Eastridge/Calamosa Ave	3029, 3030, 3043	4405	MH 3043 TO MH 3029	6	-	155
				4400	MH 3029 TO MH 3030	6	-	370
21	3046	Eastridge/Calamosa Ave	3046, 3047, 3092	618	MH 3046 TO MH 3047	6	-	125
				4401	MH 3046 TO MH 3092	6	-	350
22	3123	Bronte Dr/Bowen Dr	3122, 3123	2963	MH 3123 TO MH 3122	6	-	115
23	3770	Ben Hur/Whittier Blvd	3770, 3771, 3787	2606	MH 3770 TO MH 3771	6	-	230
				2600	MH 3770 TO MH 3787	6	-	280
24	4975	Janine Dr/Shiloh	4974, 4975, 4976	3692	MH 4974 TO MH 4975	6	-	285
				3693	MH 4975 TO MH 4976	6	-	130
25	18E	Deveron Dr/Pioneer Blvd	18C., 18D, 18F	1122	MH 18C TO MH 18D	-	8	170
				435	MH 18 D TO MH 18F	-	8	540
26	SD 40	Via Del Palma/Painter Ave	1587, 1612, SD40, SD40E	1672	MH 1587 TO SD40	6	-	80
				468	MH 1612 TO SD 40E	6	-	540

Total 6 Inch Piping **13630** **ft**
Total 8 Inch Piping **985** **ft**

Appendix K.
Technical Memorandum
GIS Data Verification

TETRA TECH

Technical Memorandum

Date:	June 15, 2016		
To:	Kyle Cason		
Cc:			
From:	Ken Berard		
Project:	Whittier Sewer Master Plan	***Project Number:***	135-48595-16001
Subject:	GIS Data Verification		

Purpose: The GIS manhole invert, horizontal location, and pipe size will be imported into hydraulic software to form the basis of the computer model. There is a concern that the manhole invert elevations throughout the City are based on various datum. This memorandum estimates the accuracy of the GIS manhole inverts and pipe slope data compared to as-built drawings, estimates the hydraulic impacts due to probable inaccuracies, and provides some methods to improve inaccuracies if any.

GIS Data: It appears that the GIS data was obtained from the sewer record drawings.

Pipe Slopes: GIS sewer pipe slopes were read directly from the record drawings. This means that the GIS pipe slope represents the actual pipe slope calculated from the difference in invert elevation of the pipe manhole connections at each end and the length of pipe between those elevations. The slope does not represent the difference in GIS manhole invert elevations divided by the distance between manhole centers.

QA/QC Checks

Check: Identify missing pipe invert data (upstream and downstream) by sorting on invert elevations. Pipes lacking invert data are identified as 'NA'.

Finding: 101 pipes have 'NA' for either the upstream elevation, downstream elevation, or both. 18 of the pipes are private sewers and have as-built references but those as-builts were not provided to us with the rest of the as-builts. These 18 pipes are typically at the beginning of a sewer flow path. 21 of the pipes are identified as 'another agency' and did not have any as-builts referenced. These 21 pipes are also generally at the beginning of a sewer flow path. The remaining 62 were City owned manholes with as-builts referenced. Those as-builts were found but they did not include data for the pipes marked 'NA'. These 62 pipes were located throughout the flow path (i.e. some were located at the head, middle and downstream end of the flow path).

Check: Spot check GIS pipe Inverts (upstream and downstream) for correctness. Randomly chose 20 locations (about .4% of the sewer pipes) and compared the GIS pipe invert to the as-built pipe invert.

Finding: GIS pipe invert elevations matched as-built pipe invert elevations at all 20 locations.

Check: Compare GIS street elevations and manhole rim elevations. If the street elevations generally match rim elevations, that would show compatibility between the datum for the street elevations and the datum for the

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manholes. If that is the case, manhole rim elevations that didn't match the street elevations would provide an easy method to identify manholes on a different datum

Finding: There is no typical variation between the manhole street elevations and the manhole rim elevations.

Check: Sort on pipe slopes and check the highest GIS pipe slopes against the as-built slopes. Steep pipe slopes may be an indication of erroneous data. The steep slopes may be a result of upstream and downstream manhole elevations on different as-built datum.

Finding: The GIS model indicates that there are 41 pipes with slopes larger than 20%. 6 of these pipes were checked against as-built data. The 6 pipes that were check had GIS pipe slope data of 69%, 59%, 49%, 38%, 30%, and 21%. GIS pipe slopes matched the as-built pipe slopes for all 6 pipes. High slopes don't appear to be an indicator of changing datums.

Check: Randomly choose 5 locations where the pipe material changes (e.g. from VCP to ABS). These can be found by plotting the material type from the GIS and visually locating changes.

Finding: 4 out of the 5 locations indicated there was a change in datum. It appeared that the GIS database randomly selected from one of the two as-built sets to input as the manhole invert elevation. The 1 location where as-built data matched was from the as-builts of two separate construction projects that were constructed in the same year but were constructed with different material.

Check: Search for pipes that appear to flow in the wrong direction. This can be done by plotting the flow direction from the GIS and visually locating any arrows that appear to reverse from the general flow.

Finding: No abnormal flow directions were found.

Check: Identify locations where there are substantial slope changes. This can be done by randomly choosing 3 flow paths (i.e. a set of continuous reaches) and importing the data into a spreadsheet. The spreadsheet can then be set up to calculate the difference in slope for adjacent reaches and identify significant changes in slopes.

Finding: The 3 flow paths included 76 reaches. 28 reaches were identified to have a significant change in slope and these 28 reaches were checked against the record drawings to determine if they occurred at the boundary of a construction project and if there was a datum change. There were 4 cases that identified a datum change. These were found to occur for as-built plans for projects constructed in different years.

Check: Identify pipes of adjacent reaches constructed during different years. For the highest differences in years constructed, check the as-built plans for manhole invert elevations at each of the two as-builts to see if they match. This can be done by randomly choosing 3 flow paths and exporting into a spreadsheet.

Finding: Within the 3 flow paths there were 76 reaches which were found to have 10 changes in year constructed. Five of those ten showed a change in datum.

Modeling Accuracy

The hydraulic modeling software will calculate the normal depth of the pipe based on pipe slope and flow quantity. The software will also calculate the depth at the sewer manholes. The normal depth of the pipe is used to estimate the remaining capacity in the pipe (i.e. d/D) and this is the main focus of the hydraulic model.

We can import the GIS pipe invert information into the hydraulic model and then have the hydraulic model calculate the slope based on the difference in elevation and length of pipe. It therefore will not use the slope identified in the GIS. This will allow us to obtain actual slopes of the pipes per the record drawings. Where a difference in datum occurs, it will show up in a manhole. But the hydraulic modeling software does not use the manholes to calculate depths in pipes, so the pipe depths will be unaffected by the change in datum.

The foregoing was determined by performing trial runs and through discussion with the software developer, Innovyze.

Although inaccurate manhole depths will not affect the d/D, it will have some impacts. The manhole depths are used for manhole surcharge and overflow determination in the program. Therefore, manhole overflow cannot be reliably predicted in the model. Other features in the model will also not be reliable. The pipe profile features, which graphically depicts pipe and manhole profiles and adjusted flow depths, cannot be used with confidence. However, these features are not a necessity.

Summary: Data discrepancies appear to be due to datum differences. Entry errors (i.e. typographical mistakes in copying as-built data to the GIS) do not appear to be a systemic problem. The datum differences are between projects and no datum differences were found within a project.

There are an estimated 1000 construction projects. We found a datum discrepancy between 50% of the construction projects found, which leads to an estimate of 500 total discrepancies in the GIS.

Changes in pipe material appears to be a very good indicator that a datum difference may exist. Years between construction of adjacent projects does not appear to be a good indicator.

1) Recommendation for 101 'NA' pipes:

   The pipes identified as 'private' and 'other agency' are located at the upstream end of a sewer reach which is a location not prone to having a capacity problem. These pipes could be left out of the model without affecting the downstream sewers (the tributary flows would simply be applied to the next manhole).

   The pipes identified as 'City' pipes and at the upstream end of a flow path could also be left out of the model for the same reason as the 'private' and 'other agency'. For the other 'City' pipes, it appears that the inverts can usually be calculated based on an adjacent manhole and slope as provided in the as-built drawings. We recommend we include those calculated inverts in the model.

2) General Data Integrity:

   We did not find typographical errors between the as-built drawings and the GIS, so the GIS data generally appears to be good.

3) Recommendation for finding/rectifying datum differences:

   Resolving the 500 or so differences in datum would require identification of all 500 datum discrepancies, and then adjusting the elevation of all pipe upstream of a discrepancy which would be a major task.

The change in datum will make the hydraulic model manhole depths unreliable. However, since the manhole depths are of interest only when d/D is one, it will be possible to look at individual cases where d/D is one to see if there is a datum difference. If there is no change in datum, the manhole will identify the actual head in the sewer pipe. If there is a change in datum the amount of surcharge identified in the model would not be reliable.

Since the amount of surcharge is not paramount to the sewer master plan, we recommend modeling the inverts without trying to account for the differences in datum. This will provide reliable d/D ratios but will not provide reliable amounts of surcharging.