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10 January 2007

Mr. Robert Gardner, P.E.
City of Pasadena
Department of Public Works
117 E. Colorado Blvd.
Pasadena, CA

Subject: City of Pasadena Master Sewer Plan
K/J 0485010

Dear Mr. Gardner:

In accordance with our Agreement, we are pleased to submit the Final Report of the Master Sewer Plan for the City of Pasadena (City). This report is intended to serve the City as a plan for future study regarding potential capital and operational program requirements of the wastewater utility system. The identified capital projects are developed to provide relief for areas of potential concern, provide the ability to serve future growth, and replace aging infrastructure requirements. The operational and maintenance evaluations are developed to supplement the basic system facility hydraulic evaluations in order to assess opportunities for the continued efficient use the City's sewer infrastructure.

It has been a pleasure working with you and your staff on this interesting project. We want to take this opportunity to thank you for your support and we look forward to working with you in the future. Please contact us if you have any questions of need additional information.

Very truly yours,

Roger Null, V.P.
Project Manger

Jon Wells, P.E.

Project Engineer

Enclosure

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City of Pasadena
Master Sewer Plan

January 2007

Prepared for

City of Pasadena
Department of Public Works
117 E. Colorado Blvd.
Pasadena, CA

K/J Project No. 0485010

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Executive Summary

BACKGROUND

The City of Pasadena (City) was incorporated in 1886, on land originally part of the San Gabriel Mission, which was the fourth such mission in California. From a population of 391 people recorded in 1890, the City has grown to support 100,000 jobs and an estimated population of approximately 146,000 people. The City recognizes its Sphere of Influence as the existing city boundary.

The City of Pasadena is located in Los Angeles County and is approximately 10 miles northeast of the downtown area of the City of Los Angeles. The City encompasses approximately 23 square miles and owns and operates a wastewater collection system that serves the local residential and commercial community. The City's wastewater system includes approximately 350 miles of sewer pipelines ranging from 6" to 42" in diameter, 2 sewer pump stations, and approximately 7,430 manholes. It should be noted that no sewer treatment takes place within the City of Pasadena sewer service area. All sewer flow generated within the service area is conveyed to Los Angeles County Sanitation District (LACSD) treatment facilities.

The City last performed a Master Sewerage Plan in 1973, which was updated in 1977. The 1977 Master Sewerage Plan long range Capital Improvement Program was based upon a projected population of approximately 125,000 people in the year 2010. The City has experienced significant growth since the last Master Sewerage Plan update, and actually exceeded the long range population estimate of 125,000 people in 1985.

Given that growth has exceeded the prior planning projections, the City has identified the need to renew its planning efforts to assure that reliable capacity is available for existing and future customers. This Master Sewer Plan is conducted to identify the areas of improvement needed to provide that long-term system reliability.

AUTHORIZATION AND SCOPE OF SERVICES SUMMARY

Several key utility management goals and objectives were derived and integrated in a methodical scope of services for an updated Master Sewer Plan. The general scope of services for this study is summarized as follows:

- Update the Sewer System Data in the City's Geographic Information System (GIS)
- Modernize the GIS Data in Conformance with Current ESRI Data Model Structures
- Develop Comprehensive Atlas Maps to Support O&M and Engineering Activities
- Conduct a Comprehensive Wet Weather Sewer System Flow Monitoring Program
- Establish Current and Projected Sewer Discharge Characteristics and Flow Projections
- Evaluate the Existing Sewer Collection and Pumping System Hydraulic Adequacy
- Establish Operation and Maintenance (O&M) Goals and Staffing Requirements
- Prepare a Prioritized Sewer System Capital Improvement Program (CIP)
- Develop Updated Capital Facility Charges
- Prepare a Sewer Rate Study to Fund the Identified CIP and O&M Requirements
- Prepare Master Sewer Plan Documentation

The focus of this master planning effort is to evaluate the capability of the City's existing sewer collection and pumping system to provide service through a planning period that extends to the year 2020. The primary by-product of this effort is the projection and identification of the City's sewer facility requirements and the development of a prioritized capital improvement program.

An important element of the project for citywide utility management was updating the Geographic Information System (GIS) sewer utility layer in GIS. Updated sewer utility maps were developed by extracting information from over 2,200 capital project drawings of the sewer pipeline system. Field evaluations and measurements were performed as needed by city staff to supplement unavailable or contradictory record drawing data. The results of the mapping efforts are provided in the form of updated 11' x 17" sewer utility atlas sheets and corresponding facility data base elements. The 109 atlas sheets and associated data files were delivered to the City as a separate submittal of the master planning project.

To preserve the capital investment in sewer infrastructure, the City's existing sewer O&M program was evaluated and contrasted with typical industry performance parameters. Maintenance program goals were established and a staffing plan was prepared to implement the defined programs. A financial planning effort was also performed to support the implementation of the identified programs and improvements. A summary of the key project elements and findings is provide in the following sections.

SEWER FLOW MONITORING PROGRAM

To provide a comprehensive assessment of sewer flow within the City of Pasadena, an extensive flow monitoring program was planned and conducted by KJ in association with ADS Environmental, Inc. (ADS). There were two primary objectives of the temporary flow monitoring program: 1) establish average and peak sewer values at key locations within the system for calibration of the computerized hydraulic model, including land use loading factors, and 2) obtain measured data during the rainy winter season to evaluate the impact of wet-weather conditions on sewer system flows.

Based on the above-mentioned prescribed purposes, a flow monitoring plan was prepared using the newly-created GIS data. Monitor points were selected such that flow basins created by those points were hydraulically isolated from each other. As a result of the relatively large number of manholes with flow splits within the City of Pasadena's downtown areas, multiple monitor points were often required to capture all of the flow from a given basin.

Ultimately, 30 monitors were placed to divide the City into 20 basins. In addition to the 30 flow monitors, ADS field personnel installed five rain gauges on City of Pasadena-owned locations. These rain gauges divide the City in appropriate rainfall basins for the rainfall dependant inflow and infiltration (RDII) portion of the study.

The flow monitors and rain gauges were installed to captured data between February 16 and March 23, 2005. Sewer flow and rainfall data was captured at 15-minute intervals throughout the study period. The raw flow and rainfall data was developed into base infiltration (BI), average dry weather flow (ADWF), peak dry weather flow (PDWF), and peak wet weather flow (PWWF) factors for each monitor and basin.

In general, the flow monitoring study found the City of Pasadena's sewer collection system to be reasonably tight with respect to RDII. However, the study did find some individual basins with both high BI and RDII values. These basins include portions of the downtown areas and the Laguna area west of Arroyo Seco. The City is aware of the findings and has ongoing investigation programs in place to address these areas of high infiltration. In addition, specific pipeline improvements are made in Section 7 of this report that ameliorate capacity insufficiencies caused by high infiltration. A full description of this process and its results can be found in Volume 2 of this Master Sewer Plan.

SEWER SYSTEM FINDINGS AND RECOMMENDATIONS

The findings of this study are based on a comprehensive evaluation of available data and an analysis of the existing sewer system's ability to meet existing and ultimate flows. These primary findings and recommendations are summarized herein to address the key elements of the Master Sewer Plan. Additional minor recommendations are presented within this Master Plan document. The primary findings and recommendations are summarized as follows:

General System Findings and Recommendations

Through the conduct of the Master Sewer Plan, there are a number of general system findings and recommendations identified. A few of these key elements are provided in this section.

- The City of Pasadena Planning Department measures and projects residential and non-residential dwelling units and net building square footage, respectively. The number of dwelling units and net building square footage are tracked by APN for each parcel within the City of Pasadena.

- Existing sewer flows were determined by utilizing utility billing data to attach monthly waster consumption to each individual parcel within the City. Return-to-sewer ratios (RTS) were applied based upon land use to determine sewer flows. These flows were calibrated to the flow monitoring information described above. When the City identified growth in units and net building square footage is applied to sewage flows, future average dry weather flows are projected to increase by approximately 24%. This value corresponds consistently to the ultimate growth indicated in the City's recent Water Master Plan.

- Given the magnitude of potential growth, the development and adoption of a revised sewer capital facility charge is desirable to generate revenues commensurate with new development's impact on existing system capacity and provide for capital reinvestment. This charge is further discussed in a subsequent section of this Executive Summary.

Operations and Maintenance Program Findings and Recommendations

The City of Pasadena Public Works Street Maintenance & Integrated Waste Management (SMIWM) Division is responsible for the operation and maintenance of all City-owned sewer and storm drainage collection and pumping facilities. Ongoing and proactive O&M is an important element of the City's sewer utility program and provides a substantial return on investment by extending the useful of life of its facilities and minimizes the risk and liability associated with uncontrolled sewage spills.

During the preparation of this Master Plan, the City's Operations and Maintenance (O&M) activities were reviewed to assess potential procedural conflicts and/or inadequacies and to develop an appropriate O&M program. A summary of O&M procedural, staffing, and budgetary findings and recommendations are provided in this section.

- It is the goal of the Sewer and Storm Drain section to clean each maintenance area once annually. However, the diversion of manpower for emergency and auxiliary activities generally prevents the SMIWM Division from meeting this goal. In addition, the lack of appropriate equipment and the presence of difficult-to-access sewers in easements and private right-of-ways hinder the achievement of this goal.

- The existing field personnel appear to be operating efficiently as their sewer cleaning production rate (4,000 lf/day/crew) is slightly higher than the typical performance measures (3,000 lf/day/crew) generally used by many other sewer agencies.

Accordingly, the inability to meet the annual cleaning goal is directly associated with the quantity of dedicated field staff regularly assigned to this activity.

- To accomplish the pipeline cleaning activities in conformance with the City's annual cleaning goal would require four two-man crews to annually clean the full sewer system and clean high maintenance (oil/grease intensive and root-infested) areas quarterly. Based on the program activities and maintenance goals of the SMIWM, it is recommended that one additional full-time crew be assigned to routine sewer line maintenance. It is further recommended to equip this crew with new vactor/hydro combo unit and easement machine at a cost of $320,000 and $50,000, respectively.

- In addition to the sewer system cleaning operation, the City's SMIWM Division supports the assessment of sewer pipeline condition through ongoing video inspection services. This important program supports the City's prioritization of its annual capital investment in infrastructure replacement. Currently, the City co-owns its TV equipment with two other agencies under a tri-city arrangement.

- Based on discussions with City staff, the goal of the video inspection program is to televise the entire wastewater collection system approximately every five to seven years, with an increased frequency of up to once per year for very old facilities or areas of specific concern. Since this goal can not be met under the co-ownership program, the City has encumbered approximately $400,000 per year over the last 5 years to attain a city-wide assessment.

- A financial analysis of performing this service in-house versus ongoing outside contracting indicates that the cost to purchase this equipment and utilize in-house services is more cost effective than the use of outside contractual services under the five to seven year program. Accordingly, in addition to the increase in dedicated sewer maintenance services personnel for pipeline cleaning, it is also recommended that the City purchase the necessary camera truck for approximately $250,000, and hire and train an additional sewer crew to operate and maintain this equipment.

Collection and Pumping System Findings and Recommendations

The evaluation of the condition, capacity, and reliability of the City's sewer collection and pumping system is the foundation of the City's Master Sewer Plan. The findings and recommendations provided herein are based on the results of the computerized hydraulic model, available information on system condition, and discussions with City staff. These findings and recommendations are summarized in this section.

- Over the last few years the City has undertaken a video inspection process to assess the condition of the entire sewer collection system. Most of the City's collection system appears to be in generally good condition because of the City's strong maintenance, repair, replacement, and rehabilitation efforts.

- The majority of the City's wastewater collection system is composed of VCP sewer lines. VCP is a commonly used sewer pipeline material and is generally considered to provide reliable service for 90 to 110 years. As one of the oldest municipalities in its region, the City's sewer system contains sewer lines older than those seen in most neighboring service areas. Approximately 35% of the City's system is over 80 years old, and over 60% of the system is over 70 years old. While the video inspection has indicated that much of the older system is in good condition, the City should program for the replacement of many of these facilities in the coming years. Moreover, the City should consider replacing any pipeline that is over 100 years old during the resurfacing or reconstruction of any City streets.

- The results of the hydraulic evaluation indicate that the majority of the City's collection system has adequate capacity. However, under various current and future peak dry and peak wet weather conditions, approximately 45,000 feet had insufficient capacity. These deficiencies were prioritized and grouped geographically into projects to facilitate efficient budgeting and scheduling over the next several years. The estimated cost of these improvements is approximately $14,000,000, as shown in Table ES-1.

- The City has two sewer pumping stations. Although both pump stations are over 50 years old, these facilities were recently refurbished with new pumps. The Busch Gardens facility was upgraded in 1999, while the Rosemont facility was upgraded in 2004. Although these facilities were not evaluated for hydraulic adequacy in this study, additional reliability improvements have been identified. These include the need for dedicated stand by power and to remediate deteriorating facility conditions. A cost of approximately $150,000 was incorporated in the CIP of this Master Sewer Plan for these improvements.

Financial Planning Findings and Recommendations

In recognition of the need to remain current and integrate the new Master Plan costs, a development of an appropriate Sewer Facility Charge and financial plan was prepared. The purpose of this effort is to: 1) assure that future customers pay their fair share of the costs of the system's capacity for existing facilities and new facilities to be constructed in the future that are of benefit to the customer paying this charge, and 2) quantify the level of additional funding and associated rate increases that may be needed to implement the financial obligation of the Master Sewer Plan findings. The findings and recommendations of these two financial elements are provided in this section.

- A Sewer Facility Charge equitably distributes facility costs to future users based on their demands on the sewer system. The assets that are used to collect and pump the City's sewage are the basis for the costs of capacity in the system. In accordance with the subscribed methodology, proposed charges were derived by developing a value of the City's sewer system, and unitizing this value by dividing by the ultimate system demands. The resulting value of the City's sewer system was estimated to be $6.19 per gallon per day. This value is comparable to the current charge that is assessed to allow new development to connect without paying for the cost of total pipeline replacement and equates to a cost of approximately $1,540 for a new single family dwelling to connect to the sewer system. Additionally, the City should consider reviewing this charge periodically and escalating the charge on an annual basis to generally preserve the current relationship of costs and charges.

- An assessment of the City's sewer system costs and associated sewer use fee revenues was performed to quantify the implications of implementing the Master Sewer Plan findings on current rates and charges. As authorized by Chapter 4.52 of the Pasadena Municipal Code, the City charges a sewer use fee to recover the costs of providing sewer service. The charge is administered based on the quantity of water used by each customer in hundred cubic feet (Hcf). Residential properties also have a maximum level per year to acknowledge the quantity of exterior seasonal water usage.

- The projected revenue plan is developed to compare the sewer utility's revenues with revenue requirements for the six-year study period. The financial projection is based on the estimated change in customer demands, the projected O&M expenses, the inclusion of the comprehensive capital improvement program, and discussions with City staff.

- The findings of the financial plan are shown in Table ES-2. The evaluation clearly indicates that the $3 million per year generated by current rates will be inadequate to meet the identified financial obligations. Accordingly, without additional funds, the cash balance of the City's sewer fund is projected to be depleted in FY 2008. As such, the revenue plan proposes a substantial increase in revenues over the six-year planning period to fund the identified obligations and maintain a comparable level of sewer fund balance.

- The plan includes the adoption of an initial rate increase to implement the Master Sewer Plan findings for hydraulic improvements and the need to provide the funds necessary for capital reinvestment of aging infrastructure. These findings are shown Table ES-3 and indicate an initial increase of approximately 60% to fund the new programs identified in the Master Sewer plan findings.

TABLE ES-3: PROPOSED SEWER FEES

Description	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
$/Hcf - homes served by Code	$0.19	$0.30	$0.31	$0.32	$0.33	$0.34	$0.35
Maximum per year	$90.34	$144.54	$148.59	$152.75	$157.03	$161.74	$166.59
$/Hcf - homes not served by Code	$0.24	$0.38	$0.39	$0.41	$0.42	$0.43	$0.44
Minimum per month	$7.49	$11.98	$12.32	$12.66	$13.02	$13.41	$13.81
$/Hcf - all other sources	$0.34	$0.54	$0.56	$0.57	$0.59	$0.61	$0.63
Projected Percent Increase	3.85%	60.00%	2.80%	2.80%	2.80%	3.00%	3.00%

- The proposed rates are designed to infuse the sewer fund with additional revenues to meet current and projected costs. While the initial increase of 60% may appear to be a substantial percentage, it represents an increase of only $0.11/Hcf of water used for a typical City resident. Moreover, this increase represents a maximum per month increase of only $4.52, which is approximately $0.15/day.

- In addition to the financial findings and recommendations provided herein, it is further recommended the City consider a more formal segregation of the sanitary sewer and storm drain sewer funds as specified in Chapter 4.52 of the City's Municipal Code. Pursuant to the data reviewed during the conduct of the sewer revenue plan, it appears that sanitary sewer and storm drain sewer costs are commingled, and only separated by estimated percentages. In consideration of the requirements of Proposition 218, the City may desire to either establish separate funds for these activities or, at a minimum, establish distinct object codes for each related activity within the same fund. Proceeding in this manner would provide a more distinct nexus between costs and benefits and may provide additional administrative conformance with current government code.

Section 1: Introduction

This section presents the background, objectives, and a summary scope of the work for this Sewer System Master Plan.

1.1 Background

The City of Pasadena (City), located in Los Angeles County, is approximately 10 miles northeast of the downtown area of the City of Los Angeles. The City encompasses approximately 23 square miles and owns and operates a wastewater collection system that serves approximately 137,000 residents. The City's wastewater system includes approximately 350 miles of sewer pipelines ranging form 6" to 42" in diameter, 2 sewer pump stations, and approximately 7,430 manholes.

The City last performed a Master Sewerage Plan in 1973, which was updated in 1977. The 1977 Master Sewerage Plan long range Capital Improvement Program was based upon a projected population of approximately 125,000 people in the year 2010. The City has experienced significant growth since the last Master Sewerage Plan update, and actually exceeded the long range population estimate of 125,000 people in 1985. As such, the City has requested the preparation of this comprehensive plan for the City's future wastewater system goals and objectives.

1.2 Objectives

The following key objectives are integral to the City of Pasadena's Master Sewer Plan (MSP) project:

- Development of a project approach with the City of Pasadena as a key team member to support project data gathering, criteria development, GIS, and wastewater system simulation. This approach will provide an efficient means of developing a cost-effective comprehensive management plan and will enhance project communication throughout its development.

- Development of an ArcGIS-compatible, user-friendly dynamic hydraulic modeling package for the City's infrastructure planning needs that is fully compatible with the City's existing wastewater data model.
- Training the City staff in the modeling software to be able to run and maintain the provided model.
- Development of accurate dry and wet weather flow data to develop valid duty factors, sound design criteria, tight model calibration, and a more detailed understanding and prioritization of existing I&I problem areas.
- Identification of future projects that are cost-effective, technically feasible, address both capacity constraints and operational problems, and are coordinated with other improvement projects.
- Development of a prioritized and time-phased Capital Improvements Plan.
- Delivery of clear and concise Management Plan that provides the City with the information necessary for sound decision-making.

By addressing each of these issues, this Master Sewer Plan delivers not only a successful Management Plan and CIP, but new tools and methods that will empower the City of Pasadena engineering, operations, and planning staff to perform their duties more effectively and efficiently in the future.

1.3 Summary Scope of Work

The Master Sewer Plan provides a comprehensive plan that enhances the City's GIS, evaluates the hydraulic capacity of the sewer collection system, and develops a capital improvement program that mitigates existing and future system deficiencies. The Engineering Services herein include the following tasks:

1.3.1 Data Collection and Review

1.3.1.1 Conduct Kick-off Meeting

Kennedy/Jenks Consultants met with City staff to establish the goals, needs, and desires of the study, confirm project objectives, discuss approach and criteria, establish departmental contacts and lines of communication, and discuss data availability. In addition, KJ met with the City to decide on a mutually agreeable digital deliverable format for ease of use throughout this project.

1.3.1.2 Review of Existing Planning, Utilities and Engineering Documents

A review was conducted of previous reports by the City of Pasadena and/or Consultants to the City relating to population, land use, water consumption, sewer discharge values, and system characteristics. The review also included: the City's General Plan; growth plans from City Planning staff and SCAG, atlas maps, sewer maps, CAD drawings, topographic maps, operations and maintenance (O&M) records of locations of pipeline breaks and excessive maintenance; sewer video tape summary findings, industrial waste pretreatment flow data, most recent Urban Water Management Plan, Rate Study, and water usage data; current mapping of land use and sewer systems facilities; and appropriate resolutions and ordinances pertaining to water conservation and sewer fees and charges. The data review also a meeting with Public Works Sewer O&M staff and Planning Department staff to gather specific local information.

1.3.1.3 Review City's existing Geographic Information System (GIS)

A review of the City's existing GIS was conducted to determine available layers applicable to this project. Approximately 5 out of the 17 existing sewer zones had been converted to an MS Access database. This database was reviewed to determine the level of effort required to convert this data to the Sanitary Sewer Database, being developed as part of this project. The GIS review included a review of existing hardware and software currently being utilized for GIS to ensure that all digital data created as part of this project is compatible with the City's current configuration.

1.3.1.4 Develop Flow Criteria and Flow Projections

An analysis of existing sewage flows by land use classification was conducted. Peaking factors, I&I rates, and flow generation factors were developed for average flow conditions using: the latest land use data available; existing and new flow monitoring data; water consumption data, census data, and other existing/available information. I&I allowances were estimated based on:

new flow monitoring data; an assessment of sewer system age/material; operations and maintenance data, and discussions with City staff.

Future flow generation factors were developed using current flow factors, combined with population and housing unit projections, and general build-out conditions as specified in the City's General Plan.

1.3.1.5 GIS Conversion

This task included the effort necessary to develop the Sanitary Sewer Database for use with this project. As the Sanitary Sewer Database is a critical component of this Master Sewer Plan, the detailed scope of work for this subtask has been broken into four sections: Project Initiation, Database Design and UML Review, Project Pilot, and Data Conversion.

1.3.1.6 Project Initiation

Members of Kennedy/Jenks Consultants, Nobel Systems, and the City of Pasadena met to determine project goals, gather information about end users, and learn about the City’s workflow. The City’s existing sewer master plan, reports, atlas maps, sewer sheets, general plan, topographic and hydrology maps, major facilities drawing, correspondence, records and sewer video tape were reviewed to become familiar with City’s Sewer system. The information gathered from this meeting was used to develop the technical procedures that guided the remainder of the project. The meeting also addressed issues such as QA/QC procedures and review time periods.

Once the City’s needs and workflow were understood, the technical procedures were developed that guided the project. Consulting with all the staff members before the procedures were written allowed the team to ensure that the documented procedures worked for the conversion team, and that their needs and workflow were also adequately represented in the procedures manual. Individual staff members also identified critical factors in the project’s success, and allowed the team to customize the technical procedures to meet these critical factors. A project plan was then drafted. For this project, this procedures manual included information on the following topics:

1. Project Initiation

- Database design and Unified Modeling Language review
- Draft QA/QC plan

2. Pilot Project

- Document review and verification
- Pilot data conversion

3. Data Conversion

- Document review
- Data conversion
- QA/QC plan and review

4. Project Management

- Project communications
- Project review meetings
- Progress reports and schedule

The Project Plan clearly identified the QA/QC methods that were used to ensure compliance with the City project requirements. It also identified the procedures for submitting and reviewing converted data.

1.3.1.7 Database Design and UML Review

The database review was used as a technical review and evaluation of the proposed geodatabase models. The database model review addressed the completeness of the database design, the accuracy of the database design with respect to the sewer facilities, and the abilities of the database design to meet the requirements of the City.

Review of the UML class diagram ensured that the placement of object and feature classes in the class diagram is organized to maximize the efficiency of inherited methods and attributes. Domains, attributes, subtypes, and the relative placement of the classes were assessed in terms of consistency and completeness for the UML. Specifically, there was focused review of the following aspects of the class diagram:

- Types of Classes: Object, Abstract, and Feature Classes
- Subtypes
- Domains
- Attributes

1.3.1.8 Pilot Project

The purpose of the Pilot Project was to:

- Complete the conversion of two grids or few sewer maps selected by the City to execute and validate all procedures.
- Evaluate and choose among alternative techniques, if applicable.
- Produce a model ArcGIS GeoDatabase covering the pilot area.
- Complete the final database design, Procedure Manual, and QA/QC plan, covering the entire project.

The next step in the Pilot Project involved completing the sewer data conversion, using the sewer maps as the primary source, and atlas maps as the secondary source, together with the City's parcel base as the reference. All attributes were scrubbed for ease of finding, and the graphics were captured per the methodology described herein.

It was endured that all sources were referenced, including the index/atlas sheets, so that the data entered is the most current. Upon completion of the data capture, a plot was generated for data within the tiling grid boundary. This plot underwent a QA/QC process that included attribute QC plots. Next, the migration to ArcGIS 8 GeoDatabase was completed and annotation checkplots were reviewed. Upon approval, the final Pilot Project data and plots were produced.

1.3.1.9 Data Conversion

This subtask describes the data conversion methodology used on the project. The key technical question involved was the standard and method of graphic data capture. The Project Team reviewed the samples provided by the City and converted data using an AutoCAD data capture method to digitize the utility features. Consultant converted the data on the existing atlas maps and from these attributes, displayed those desired by the City on the final atlas maps. The data attributes converted include:

- Sewer pipe ID number
- Depth
- Slope
- Material
- Manhole ID number
- Manhole station number
- Manhole invert elevation
- Plan number
- Distance between manholes
- Indicator for drop manholes
- Grade separation locations
- Flow direction indicators (i.e. flow direction arrows)
- Address block numbers on corners
- Designation for LACSD facilities
- Designation for LA County of Public Works Facilities
- Designation of Private facilities
- Sewer easements
- Corresponding Scanned Image .Tif file

Additional graphic elements were also captured. These elements were captured at the equivalent accuracy of the sewer source plans, which was used as the primary source. Line types and text sizes were maintained in accordance with the source documents. The graphic elements converted include:

- Sewer Mains
- Sewer Lateral Connections
- Sewer Manholes

The source ID number was entered in the database for each feature. This allowed querying of the data, either by clicking on the feature, querying by source number, or bringing up the actual sewer plan. Unique Manhole numbers were generated in an orderly manner, from left to right and top to bottom, for each tile.

Using a custom VBA application, the AutoCAD drawing file was exported to DXF files, and the object data exported as text files. The AutoCAD drawings were converted to ArcInfo coverages using the custom tools. These coverages were smoothly integrated into the City's landbase as the "sewer layer". A custom application was then run to generate a plot in ArcPlot with the attributes and graphics plotted for each feature.

The Project Team reviewed the attribute checkplots and performed a 100-percent check of the source documents against the QC plot, marking errors on the plot. If no errors were found, that grid will move to the next process step. If any errors were detected, the grid looped back to editing for correction. Corrections of all errors marked on the QC plots were made in AutoCAD.

1.3.2 Sewer System Model

1.3.2.1 Model Selection

Kennedy/Jenks assisted the City in evaluating three commercially available software programs that use dynamic hydraulic simulations to evaluate sewer system capacity. A selection recommendation was made based on criteria established with input from the City. A Technical Memorandum (TM) was prepared documenting the needs assessment, criteria, evaluation and selection. The TM discussed the pros and cons of each application package and will be submitted to the City for review. Upon review and acceptance of the recommendations in the TM, two individual licenses of the selected software were purchased for the City.

1.3.2.2 Model Development/GIS Integration

The Sanitary Sewer Database developed in Task 1.6 formed the basis of the input data for the hydraulic model. The Sanitary Sewer Database was imported into the hydraulic model and linked for ease of future update. A "dry-run" analysis was performed to verify network connectivity and data integrity of the modeling data. Upon successful completion of the "dry-run", a map was created and delivered to the City for review and approval of the existing system configuration. Consistent with our proposal, every pipeline contained within the Sanitary Sewer Database was incorporated into the hydraulic model.

1.3.2.3 Parcel-Level Loading

Upon completion of the sewer system model development, the model was loaded at the parcel-level. A parcel to pipe link was created for each parcel within the City's parcel database. Once this link was established, each parcel was loaded with wastewater flow corresponding to the projected ultimate land use of that parcel. These wastewater flows were calculated by attaching water consumption records to each parcel. Water consumption was determined for each parcel before being multiplied by return-to-sewer ratios to develop parcel-level wastewater flows. Wastewater unit duty factors in gallons/day/acre, developed in Subtask 1.4, were used to estimate the existing and future wastewater flow for each parcel.

1.3.2.4 Develop Design and Unit Cost Criteria

Evaluation of the sewer system required the development of key design criteria. Design criteria included the type of sewer use (backbone vs. local), maximum depth of flow, pipeline roughness coefficients, minimum velocities, and pump station redundancy, standby power, and cycling criteria, as applicable. These criteria were based on City standard specifications, physical and hydraulic pipeline conditions, and discussions with City staff, existing literature, model requirements, and our experience on other similar projects. These criteria were documented for review and concurrence by the City prior to proceeding with the system analysis phase of the project.

In addition, unit cost estimates were developed for new pipeline construction and rehabilitation technologies, based upon pipe materials, size, depth of construction, trench width, etc. These defined cost parameters were used to estimate the design and construction costs of underground facilities.

The development of each criteria and specifications described in this task were developed in close coordination with the City. The findings of this subtask were documented in a Technical Memorandum (TM) for City review and integrated in the final master plan documents.

1.3.2.5 Identify Known Sewer System Problems

A meeting was held with the City operating and engineering staff to ascertain known problem areas. Capacity, odor, and excessive maintenance problems were discussed with a focus on the process of mitigating these deficiency conditions.

1.3.2.6 Calibrate Model and Analyze System

The hydraulic adequacy of the existing system was analyzed as a multi-step process. The first step was to impose the sewer discharge factors associated with the land use data file on the sewer system input file of the computerized modeling program. The initial modeling simulation was conducted and the results calibrated with the supporting flow monitoring data, and pump station data, previously derived. Based upon the findings, adjustments were made in the model for final calibration, and the modeling simulation regenerated.

The system model was calibrated so that the computer simulations of the existing sewer system yield results comparable to the observed system operation and flow monitoring data. This process produced a high confidence level in the results of the hydraulic simulations. Once the model was calibrated, it was utilized to perform several simulations.

1.3.2.7 Compile Prioritized List of System Deficiencies

Once the "current condition" simulation of design loads was conducted, a list of existing hydraulic deficiencies were compiled and discussed with the City. These deficiencies were classified as the priority capital improvements required to resolve the current hydraulic capacity problems of the City's sewer system. System deficiencies that occur under future conditions or are the result of future sewer discharges were compiled to represent the intermediate and long-term capital improvements.

1.3.2.8 Model Installation and Implementation

Kennedy/Jenks Consultants installed the hydraulic model software components and configured and fully implemented the system for the City. City IT staff were available to support KJ during the installation process.

1.3.2.9 Training and Support

The Consultant provided training for up to 5 City staff members on the operation, use, and update of hydraulic model. Training consisted of one two-day course (up to 16 hours) within one month from the City receiving the base reconciled hydraulic model and one one-day course (up to 8 hours) within one month after the submittal of the CIP. Telephone support was provided throughout the training period.

1.3.2.10 Develop O&M Program Recommendations

In conjunction with the system hydraulics evaluation, Kennedy/Jenks Consultants developed and recommended a general operation and maintenance schedule of operation for the City's field sewer collection and pumping system. Recommendations documented existing field maintenance operations, and detailed any suggested operational charges at prescribed frequencies. Recommendations were based on discussions with City staff, review of sewer use ordinances and policies, review of service records of performance during emergencies, general service calls, history of sewer system back-ups, size and slopes of sewer lines, and land uses, etc. The resulting maintenance schedule reflected semi-annual, annual and/or biannual activities.

1.3.3 Flow Monitoring

1.3.3.1 Develop Flow Monitoring Work Plan

Kennedy/Jenks Consultants developed a flow monitoring system to ascertain actual usage data for the various land uses in the City and to provide data for calibrating a hydraulic model of the sewer system. Flow measurements were designed and collected to determine if there is inflow and infiltration of storm waters into the sewage system. The flow monitoring plan was submitted to the City prior to equipment installation.

1.3.3.2 Flow Monitoring Program

Consultant performed measurement of existing flows by means of metering and visual inspection as needed. Flow monitoring were performed during the wet weather season for 36 days. Based on the system evaluation, 30 sites were monitored with flow meters and five rain gauge meters installed during the field testing program.

A flow monitoring report as prepared that includes an I/I Analysis and a prioritization of basins with the worst I/I problems. An I/I Assessment Action Plan was prepared that identifies where the City may wish to conduct subsequent physical inspections and test activities to more particularly characterize and alleviate I/I in the worst problem areas.

1.3.4 Capital Improvement Program and Connection Fees

1.3.4.1 Develop Capital Improvements

Using the results from the prior tasks, the Consultant developed a Capital Improvement Program (CIP) through the build-out condition that clearly outlines the findings of the City's deficiencies, priorities, and related sewer system costs. A comprehensive list of Capital Improvements that addresses the existing deficiencies and projected demands placed on the existing sewer system was included in the draft and final submittal of the Sewer Master Plan.

1.3.4.2 Develop CIP Priorities and Costs

The Consultant established a prioritized list of capital improvements to eliminate the deficiencies identified in the sewer system and pumping stations. Estimated costs for design, construction, and administration improvements were developed based on the prioritized capital improvement list.

1.3.4.3 Develop CIP Summary of Findings

The Capital Improvement list included tables that summarize pipeline sizes, materials, slope, capacity, design flows, and estimated budgetary costs in 2005 dollars. To support any forthcoming financial planning, capital costs were separated and prioritized as annual improvements for the first five years and into five-year intervals thereafter. Other components of the prioritization process included evaluation of materials with shorter useful life and areas experiencing extra grease and root cleaning currently, the inclusion of other known utility infrastructure (road and underground pipeline) improvements, cost avoidance implications, and the implications of forthcoming regulatory requirements.

1.3.4.4 Prepare Sewer Connection Fee Study

In this task, the appropriateness of the City's current sewer capital facilities connection charges was evaluated. This task was performed in the following steps:

- **Assess Current Fees**. Reviewed the City's current sewer use charge rate structure.
- **Identify Facilities**. Utilizing system asset data provided by the City, estimated the value of the existing facilities based on the original asset costs and an estimated replacement cost new methodology. Discussed the cost findings with City staff and obtain direction on the desired methodology. Integrated the costs of additional capacity associated with the City's capital improvement program.
- **Calculate Unit Value**. Derived the unit cost of capacity by dividing the system value and capital program by the ultimate build-out sewer flows, as derived in this master planning effort.
- **Develop Proposed Charges**. Developed new capital facility connection charges for the recovery of the unit costs of service for a new sewer connection on system capacity.

1.3.5 Master Plan Report

1.3.5.1 Report Preparation

The Sewer Master Plan Report included documentation on each work subtask, and specifically:

- Documented the design of the hydraulic model, the methodology used to create the data input, and any equations used through the hydraulic model process. Also documented the user procedures needed to perform engineering functions on the hydraulic model.
- Assessed the impact of I&I on the collection system and propose a methodology to address each issue.
- All work necessary to prepare a report studying the capacity of the existing sanitary sewer system.
- Reviewed impacts of future developments
- Recommended system improvements

- Described of data development for the computer model and GIS
- Discussed the operational plan and implications associated with the current plan and plant bypass and diversion scenarios.

1.3.5.2 Draft Sewer Master Plan

Consultant submitted four (4) draft copies of the Sewer Master Plan bound in three-ring binders. The City will review the draft report and submit comments to the Consultant for integration in the final Sewer Master Plan document.

1.3.5.3 Final Sewer Master Plan

The final Sewer Master Plan will be submitted in hard copy and electronic format. Consultant shall submit six (6) copies of the primary final report bound in three-ring binders and two (2) copies of any secondary and separately bound appendices. The electronic copy will be submitted on compact discs and will include all reports, manuals, and digital database products including model input and output files under each modeling scenario, and other documentation submitted throughout the Sewer Master Plan process. The City's Sewer ArcGIS 8.3 geodatabase will be submitted back to the City following the completion of data cleaning and reviews by the City. Per City staff, no workshops or presentations will be required to present the final work product to the City.

1.3.6 Atlas Maps

As described above, Kennedy/Jenks Consultants developed atlas maps for the sewer system using GIS software (ArcGIS8.3). The maps were produced using the Sanitary Sewer Database created as part of Subtask 1.6. The entire sewer system can be broken down into sections with overlapping portions.

The maps included all aspects that are currently on the City's sewer maps as well as additional information. These attributes include:

- sewer pipe diameter, depth, slope, length, and material
- manhole numbers (using the current manhole numbering scheme, e.g.1710-120), manhole station numbers, manhole invert and rim elevations

- station numbers of all lateral connections
- plan numbers for associated plan and profile drawings
- house connection station numbers (approximately one on each lot)
- distance between manholes
- indicators for drop manholes
- grade separation locations
- flow direction indicators
- address numbers per lot

1.3.6.1 Submit Draft Atlas Map

Submitted a draft copy of one sample atlas map page in electronic PDF format and four hard copies of this same sample map sized 24" x 36". The hard copies should be printed using the same plotter that will be used to print the final maps. The City must review the draft map and corrections must be made before a final set of atlas maps may be submitted.

1.3.6.2 Submit Final Atlas Maps

The final atlas maps will be submitted in hard copy and electronic format (ArcGIS 8.3). The electronic formats should include a PDF copy of each map and a copy of any GIS project files used to create the map layouts (MXD files) so that city staff can easily reproduce the maps. Two sets of hard copy maps sized 11" x 17" will be submitted in 3-ring binders.

1.4 Conduct of Study

The information used in preparing this study includes review of existing information, development of new and/or updated data, and discussions with City of Pasadena staff. Initial study tasks were focused on collecting and evaluating all data, reports, and other information to define existing conditions and identify future considerations. Based on this information, an assessment of the adequacy of the existing system was made and improvements were recommended to meet current and future considerations.

1.5 Abbreviations and Definitions

The following abbreviations and definitions are used within the report:

Abbreviation	Definition
ac	acre
ADD	Average Day Demand
ADWF	Average Dry Weather Flow
APN	Assessor Parcel Number
AWWF	Average Wet Weather Flow
cf	cubic feet
cfs	cubic feet per second
City	City of Pasadena
CP	Concrete Pipe
d/D	depth to Diameter
dia.	diameter
DU	Dwelling Unit
DWR	California Department of Water Resources
EDU	Equivalent Dwelling Unit
ENR	Engineering News Record
EPA	United States Environmental Protection Agency
GIS	Geographic Information System
gpad	gallons per acre day
gpm	gallons per minute
gpd	gallons per day
HGL	Hydraulic Grade Line
hp	horsepower
I&I	inflow and infiltration
in	inches
idm	inch-diameter miles
LACPW	Los Angeles County Public Works
LACSD	Los Angeles County Sanitation Department
KJ	Kennedy/Jenks Consultants

LF	linear foot
MG	million gallons
MGD	million gallons per day
NWS	National Weather Service
O&M	Operations and Maintenance
PDWF	Peak Dry Weather Flow
pph	persons per household
psi	pounds per square inch
PWWF	Peak Wet Weather Flow
RCP	Reinforced Concrete Pipe
RPM	Revolutions Per Minute
SCAG	Southern California Association of Governments
SFC	Sewer Facility Charge
sf	square feet
TDH	Total Dynamic Head
VCP	vitrified clay pipe

1.6 Acknowledgments

The following individuals contributed to the preparation of this Master Sewer Plan:

Robert Gardner, PE	City of Pasadena
Yannie Wu, PE	City of Pasadena
Gil Weiss, PE	City of Pasadena
Quang Nguyen, PE	City of Pasadena
Rowena Hingco, PE	City of Pasadena
Michael Neeley	City of Pasadena
Brian Sims	City of Pasadena
Robert Koehler	City of Pasadena
Sam Ho Lam	City of Pasadena

Section 2: Study Area, Land Use, and Population

This section assesses the physical environment, incorporates the City of Pasadena's land use plans, and develops population projections within the City of Pasadena's sewer system service area. An overview of the physical environment will identify geographic and climatic factors that may influence the design and construction requirements for sanitary sewer facilities. Future land use and population data are developed based on the growth and land use projections provided by the City of Pasadena and the Southern California Association of Governments (SCAG). These projections of future land use and population will be used to verify general trends and locations of growth and to project future wastewater flows and requirements.

The information in this section is based upon the best available data relative to the study area and includes projections of future land use and population, as defined in the City of Pasadena's most recent General Plan Land Use Element, adopted in 2005. The City's GIS database and community development demographic information were integral elements of the land use and population evaluation provided herein.

2.1 Study Area

The selection of the study area is based on the potential need for sewer services within the City of Pasadena's Sphere of Influence. The General Plan Land Use Element outlines the areas of increased growth, identifies the potential for future development and land use transitions, and incorporates planned/approved specific development plans.

2.1.1 Study Area Description and Boundaries

The City of Pasadena was incorporated in 1886, on land originally part of the San Gabriel Mission, which was the fourth such mission in California. From a population of 391 people recorded in 1890, the City has grown to an estimated 146,000 people in 2005. In addition, the City of Pasadena is home to approximately 100,000 jobs. These populations live and work within an area of approximately 23 square miles, through which 320 miles of road run.

Located 10 miles northeast of downtown Los Angeles, the City is bordered by the San Gabriel Mountains to the north and seven cities-La Canada Flintridge, South Pasadena, Arcadia, Sierra

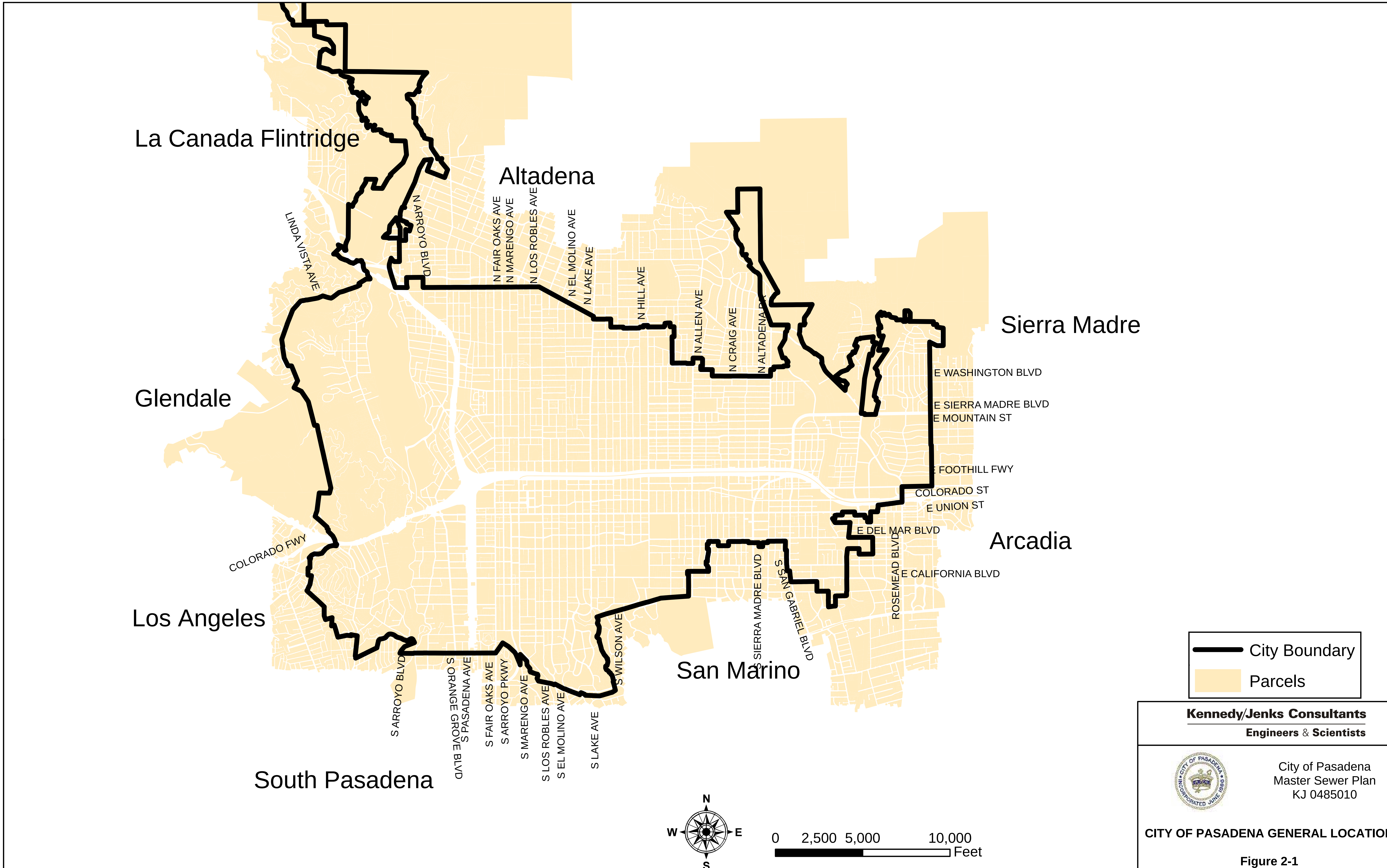
Madre, San Marino, Glendale, Los Angeles-and the unincorporated area of Altadena. The City of Pasadena recognizes its Sphere of Influence as the existing city boundary. This City's municipal location and boundary are shown in Figure 2-1.

2.1.2 Geography and Climate

The City of Pasadena sits at an elevation is 864 feet above sea level, with elevation increasing to the north towards the San Gabriel Mountains. This elevation, in combination with the relatively southern latitude of the City results in a climate that is sub-tropical and semi-arid. The average daytime temperature is 78° F. annually. The average nighttime temperature is 53° F. The overall average temperature is 65° F. The highest recorded temperature was 113° F. on June 17, 1917, while the lowest was 21° F. on January 7, 1913. The average yearly rainfall is 20 inches of precipitation, received primarily in the winter months of December through May. During the winter months it is sunny or partly sunny 75% of the time. It has snowed twice in the City's history: January 13, 1932 and January 11, 1949.

2.1.3 Existing City Service Area

The existing sewer service area includes all of the City of Pasadena. As described above, the City is delineated by the city boundary shown in Figure 2-1. It should be noted that no sewer treatment takes place within the City of Pasadena sewer service area. All sewer flow generated within the service area is conveyed to Los Angeles County Sanitation District (LACSD) treatment facilities. Sewer flow is either collected in LACSD interceptors within the City, or it flows by gravity across the City boundary into San Marino, where it is intercepted. These facilities and flow patterns are described further in Section 3.



CITY OF PASADENA GENERAL LOCATION

Figure 2-1

2.2 Land Use

The City of Pasadena's Comprehensive General Plan Land Use Element creates and regulates a compatible and functional inter-relationship between the various land uses in the City. The Land Use Plan designates the ultimate land use pattern envisioned for the City, within the time frame of the plan. As such, the currently adopted General Plan Land Use Element is used herein to define the ultimate land use for parcels with the City of Pasadena.

According to the Comprehensive General Plan:

> The Land Use Element targets higher density development into specific areas in order to protect residential neighborhoods and to create mixed use urban environments oriented to transit and pedestrian activities. This targeted development will be of high quality and reflect the historic scale and character of Pasadena while ensuring the continued vitality of Pasadena's economy.

The Land Use Element accomplishes this targeted growth through the following strategies:

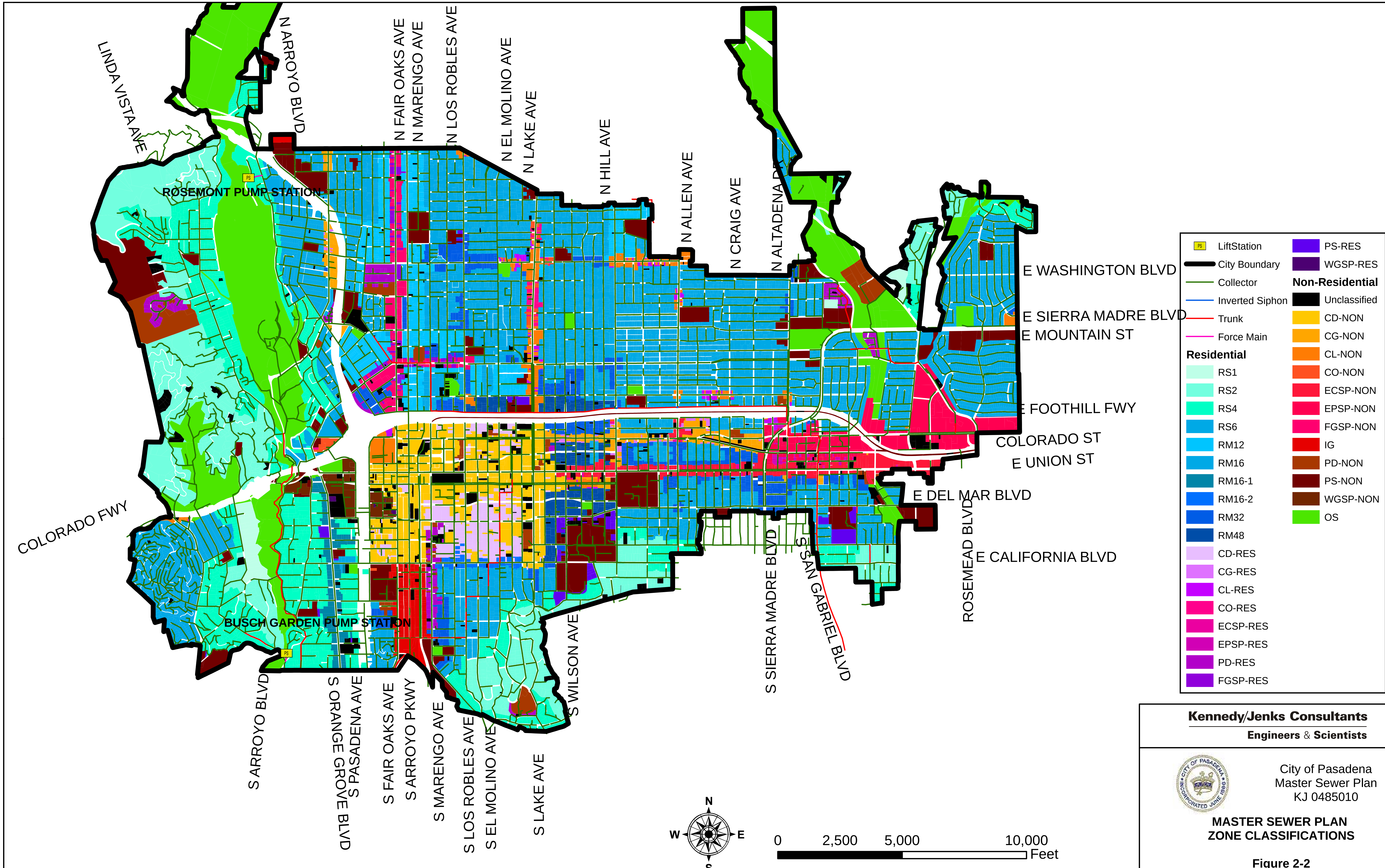
- Specific plans determine precise land use patterns, zoning, setbacks, and design within defined boundaries.
- Redevelopment areas absorb sufficient development to accomplish the objectives which have been established for these areas in order to encourage the retention and expansion of existing businesses and the creation of jobs for Pasadena residents.
- Rezoning areas will reduce the potential for growth in selected areas.
- In addition to the above strategies, the Master Sewer Plan incorporates specific redevelopment projects identified by City staff in the Department of Public works to identify existing and future land use within the City of Pasadena. This identification of land use is central to the process of quantifying existing and future sewer flows generated within the City of Pasadena service area.

2.2.1 Existing Land Use

Analyzing sewer flows from existing land uses and predicting flows from future land uses require that general plan land use classifications be functionally grouped according to similar wastewater flow generation characteristics. According to the General Plan Land Use Element, zoning classifications are the means by which existing use of land within the City of Pasadena is described and controlled. For the purposes of this Master Sewer Plan, zoning classifications described within the Land Use Element were combined with planning department descriptions of residential versus non-residential activity to create functional master sewer plan zoning classifications. These classifications are shown in Table 2-1, and their locations throughout the City of Pasadena are shown in Figure 2-2.

Table 2-1: Master Sewer Plan Zone Classsification Codes

General Plan Land Use Element Zone Description	Master Sewer Plan Zone Code	
RS1	RS1	Residential
RS2	RS2	
RS4	RS4	
RS6	RS6	
RM12	RM12	
RM16	RM16	
RM16-1	RM16-1	
RM16-2	RM16-2	
RM32	RM32	
RM48	RM48	
Parcels in zones with 'CG' prefix designated residential by planning department	CG-RES	
Parcels in zones with 'CO' prefix designated residential by planning department	CO-RES	
Parcels in zones with 'CL' prefix designated residential by planning department	CL-RES	
Parcels in zones with 'PS' prefix designated residential by planning department	PS-RES	
Parcels in zones with 'CD' prefix designated residential by planning department	CD-RES	
Parcels in zones with 'EC' prefix designated residential by planning department	ECSP-RES	
Parcels in zones with 'EP' prefix designated residential by planning department	EPSP-RES	
Parcels in zones with 'FG' prefix designated residential by planning department	FGSP-RES	
Parcels in zones with 'PD' prefix designated residential by planning department	PD-RES	
Parcels in zones with 'WG' prefix designated residential by planning department	WGSP-RES	
Parcels in zones with 'CG' prefix designated non-residential by planning department	CG-NON	Non-Residential
Parcels in zones with 'CO' prefix designated non-residential by planning department	CO-NON	
Parcels in zones with 'CL' prefix designated non-residential by planning department	CL-NON	
Parcels in zones with 'PS' prefix designated non-residential by planning department	PS-RES	
Parcels in zones with 'CD' prefix designated non-residential by planning department	CD-NON	
Parcels in zones with 'EC' prefix designated non-residential by planning department	ECSP-NON	
Parcels in zones with 'EP' prefix designated non-residential by planning department	EPSP-NON	
Parcels in zones with 'FG' prefix designated non-residential by planning department	FGSP-NON	
Parcels in zones with 'PD' prefix designated non-residential by planning department	PD-NON	
Parcels in zones with 'WG' prefix designated non-residential by planning department	WGSP-NON	
IG	IG	
OS	OS	



Kennedy/Jenks Consultants
Engineers & Scientists

City of Pasadena
Master Sewer Plan
KJ 0485010

MASTER SEWER PLAN
ZONE CLASSIFICATIONS

Figure 2-2

The City of Pasadena Planning Department measures and projects residential and non-residential using dwelling units and net building square footage, respectively. The number of dwelling units and net building square footage are tracked by APN for each parcel within the City of Pasadena. Table 2-2 summarizes the amount of dwelling units and net building square footage contained throughout the City by Master Sewer Plan Zoning Classification. It shall be noted that the Land Use Element of the General Plan allows for a limited number of residential dwelling units on land classified non-residential. Thus, approximately 6% of the dwelling units found within the City are found on non-residential classified parcels.

Regardless of a given parcel's Master Sewer Plan Zoning Classification - residential/non-residential status, and number of dwelling units and/or net building square feet - this parcel may be occupied or un-occupied at any given time. The City of Pasadena Planning and Development Department tracks occupied versus vacant status as a distinct category for each parcel within the City. Vacant parcels are of particular importance during the master planning process because they represent areas not currently contributing sewer flows that must be accounted for in all future scenarios. Because of this importance, vacant land as identified by the planning department was cross-referenced with water billing information to ensure that parcels identified as vacant were not receiving water bills. Table 2-3 summarizes the vacant parcels identified throughout the City. Figure 2-3 identifies the location of these vacant parcels within the City.

2.2.2 Land Use Development Projections

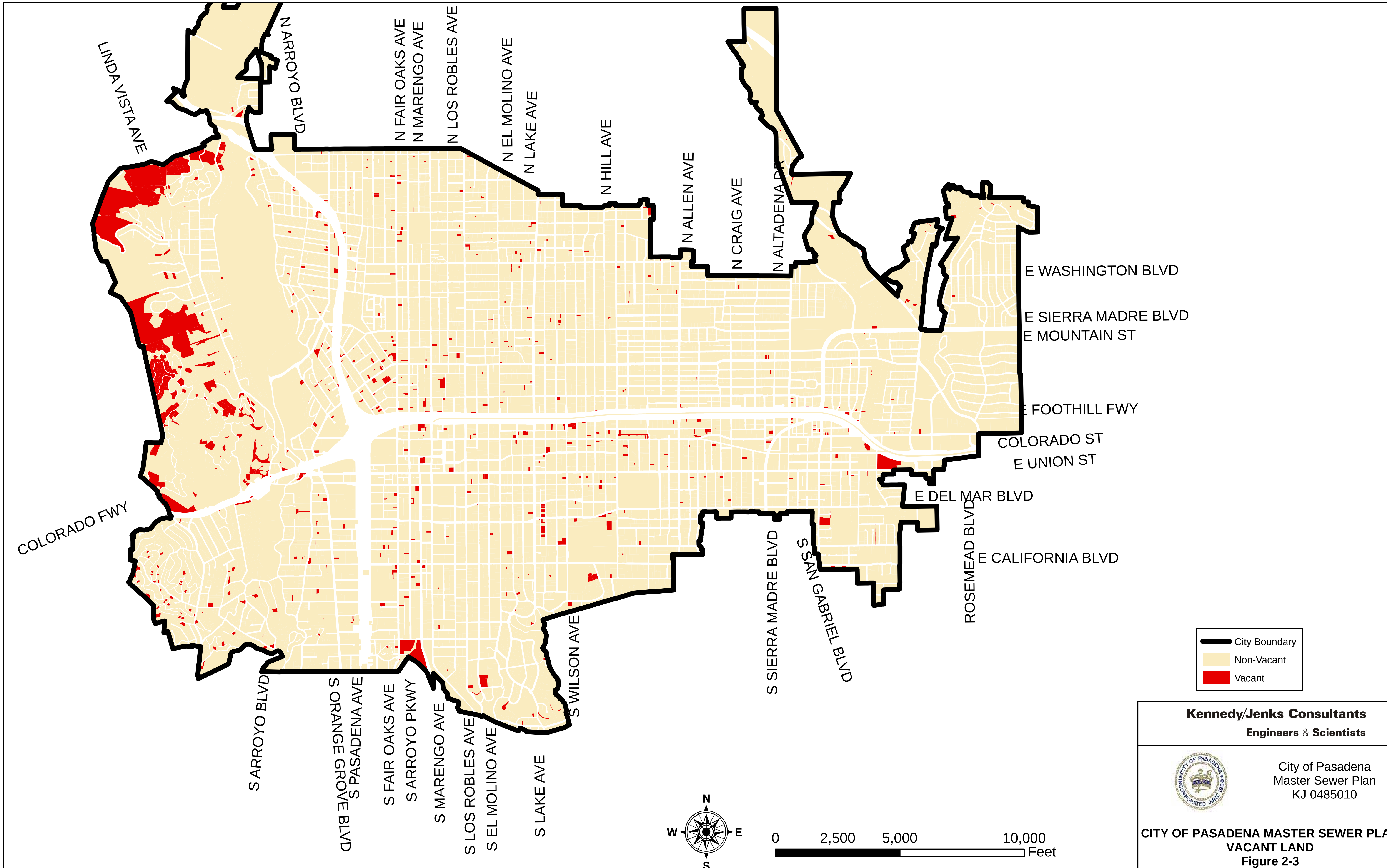
The current Land Use Element of the General Plan identifies the allowed growth in both residential dwelling units and non-residential net building square footage throughout the City of Pasadena over the General Plan time horizon. At the direction of City of Pasadena Staff, this Master Sewer Plan accepts the time horizon adopted in the General Plan. Table 2-4, which is a reproduction of Table 3 in the General Plan (page 42 of the Land Use Element), quantifies all such allowed growth. In accordance with the targets and procedures listed in the City of Pasadena General Plan Land Use Element, future land use development identified in Table 2-4 within the City of Pasadena was identified, quantified, and located in the following manner for this Master Sewer Plan:

Table 2-2: Sewer Master Plan Zone Classification Summary

	Master Sewer Plan Zone	Acreage	Acreage %	Net Building Square Footage	Dwelling Units
Residential	RS1	71	0.60%	0	43
	RS2	1,125	9.57%	0	1,216
	RS4	1,187	10.10%	0	3,428
	RS6	2,932	24.96%	0	16,455
	RM12	390	3.32%	0	4,292
	RM16	346	2.95%	0	4,286
	RM16-1	69	0.58%	0	801
	RM16-2	22	0.19%	0	584
	RM32	335	2.85%	0	7,126
	RM48	132	1.12%	0	3,967
	CG-RES	13	0.11%	0	104
	CO-RES	13	0.11%	0	275
	CL-RES	23	0.19%	0	260
	PS-RES	61	0.52%	0	433
	CD-RES	148	1.26%	0	5,713
	ECSP-RES	4	0.03%	0	38
	EPSP-RES	9	0.07%	0	120
	FGSP-RES	30	0.25%	0	508
	PD-RES	103	0.88%	0	1,443
	WGSP-RES	2	0.02%	0	22
Non-Residential	CG-NON	94	0.80%	1,994,329	442
	CO-NON	18	0.16%	313,054	11
	CL-NON	116	0.99%	4,171,679	87
	PS-NON	730	6.21%	5,166,245	258
	CD-NON	394	3.36%	16,766,826	1,124
	ECSP-NON	123	1.05%	3,311,155	740
	EPSP-NON	238	2.03%	7,007,541	57
	FGSP-NON	95	0.81%	1,633,141	84
	PD-NON	175	1.49%	2,712,604	326
	WGSP-NON	57	0.48%	818,265	10
	IG	88	0.75%	1,725,010	36
	OS	2,350	20.01%	77,462	6
	Unclassified	255	2.17%	0	123
	Total	**11,747**	**100.00%**	**45,697,311**	**54,418**

Table 2-3: City of Pasadena Summary of Vacant Land

	Master Sewer Plan Zone	Acreage	Vacant Parcel Count	Vacant Parcel Acreage	Percentage of Acreage Vacant
Residential	RS1	71	0	0	0.00%
	RS2	1,125	205	242	21.51%
	RS4	1,187	114	26	2.17%
	RS6	2,932	200	20	0.69%
	RM12	390	49	6	1.43%
	RM16	346	35	5	1.33%
	RM16-1	69	1	0	0.51%
	RM16-2	22	0	0	0.00%
	RM32	335	37	7	2.04%
	RM48	132	10	2	1.33%
	CG-RES	13	6	1	7.59%
	CO-RES	13	1	0	0.01%
	CL-RES	23	1	0	0.39%
	PS-RES	61	7	8	12.37%
	CD-RES	148	7	1	0.72%
	ECSP-RES	4	0	0	0.00%
	EPSP-RES	9	0	0	0.00%
	FGSP-RES	30	6	1	2.23%
	PD-RES	103	3	2	1.75%
	WGSP-RES	2	0	0	0.00%
Non-Residential	CG-NON	94	33	6	6.62%
	CO-NON	18	3	1	5.46%
	CL-NON	116	18	2	1.90%
	PS-NON	730	13	4	0.60%
	CD-NON	394	70	15	3.73%
	ECSP-NON	123	10	10	7.93%
	EPSP-NON	238	22	4	1.66%
	FGSP-NON	95	34	7	7.80%
	PD-NON	175	11	64	36.55%
	WGSP-NON	57	1	0	0.24%
	IG	88	16	16	18.46%
	OS	2,350	34	279	11.87%
	Unclassified	255	0	0	0.00%
	Total	**11,747**	**947**	**728**	**6.20%**



CITY OF PASADENA MASTER SEWER PLAN
VACANT LAND
Figure 2-3

- Development/redevelopment projects identified by the City of Pasadena Department of Public Works were located by specific parcel, as shown in Table 2-5. Dwelling units and/or net building square footage were adjusted for each parcel according to the project description. Total dwelling units and net building square footage appropriated in this manner was subtracted from allowable totals shown in Table 2-4.

- Remaining dwelling units and/or net building square footage allowed in Specific Plan areas were appropriated in these areas. This appropriation was done by first "filling" vacant parcels with maximum allowable dwelling units and/or net building square footage. Remaining allowable growth was evenly spread over remaining parcels identified as part of the identified Specific Plan.

- Non-Specific Plan growth was appropriated in a similar manner. Vacant parcels were filled to maximum allowable density. Remaining dwelling units and/or net building square footage was spread over remaining parcels in each classification. This procedure accounts for general densification within the City of Pasadena over the planning horizon.

- Parcels that were identified for development/redevelopment are shown in Figure 2-4. As can be seen, the Land Use Element of the General Plan has focused growth into corridors and other easily-identifiable Specific Plan Areas.

Table 2-4: City of Pasadena General Plan Allowable Growth

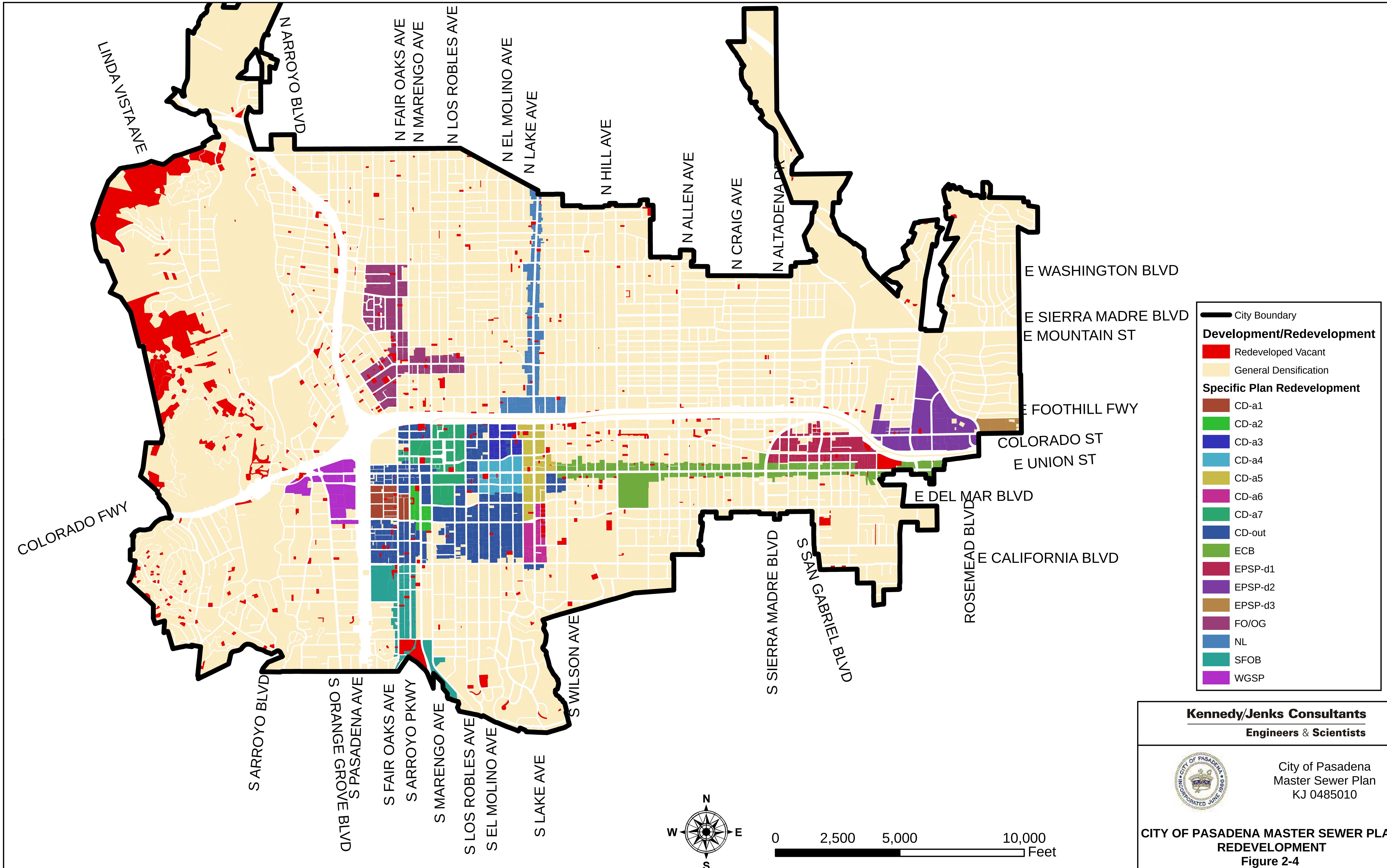
	New Development		Total Development (New + Existing)	
	Units	sq. footage	units	sq.footage
Low Density Residential (0 - 6 units/acre)	390		23,988	
Low -Medium Density Residential (0 - 2 units/lot)	508		4,568	
Medium Density Residential (0 - 16 units/ acre)	666		5,990	
Medium High Density Residential (0 - 32 units/acre)	1,266		11,008	
High Density Residential (0 - 48 units/ acre)	601		5,260	
Planned Development	0	0	1,460	1,280,000
General Commercial - Maximum FAR = 0.80		1,570,780		3,671,240
Neighborhood Commercial - Maximum FAR = 0.70		483,780	671	1,881,360
Industrial - Maximum FAR = 0.90		456,531		805,650
Institutional (Existing Master Plans)		1,837,124		4,837,124
Institutional (Future Master Plans + others) *		500,000		
Subtotal	3,431	4,848,215	52,945	12,475,374
SPECIFIC PLANS				
A. CENTRAL DISTRICT (CD)				
Urban Village	1,000	150,000	1,005	459,316
Santa Fe Transportation Center	350	325,000	350	337,500
Urban Housing Area	800	100,000	940	409,680
Playhouse District	350	825,000	401	1,989,575
Lake - 210 to Cordova / Del Mar	0	1,225,000	6	2,414,737
Lake - Cordova / Del Mar south	150	675,000	218	3,029,628
Civic Center Plan	855	1,317,000	1,211	3,865,000
Outside of the above areas	1,590	1,600,000	3,639	13,929,312
Subtotal - entire Specific Plan area	5,095	6,217,000	7,770	26,434,748
B. SOUTH FAIR OAKS BIOMEDICAL	300	1,550,000	301	3,064,185
C. WEST GATEWAY	150	800,000	219	1,725,304
D. EAST PASADENA				
East Foothill Industrial District	0	890,000	141	1,950,423
Foothill / Rosemead / Sierra Madre Villa	400	1,175,000	400	2,979,990
Hastings Ranch / Foothill - Rosemead	0	35,000	0	589,983
Subtotal - entire East Pasadena area	400	2,100,000	541	5,520,396
E. EAST COLORADO	750	650,000	750	2,092,261
F. NORTH LAKE	500	175,000	850	889,783
G. FAIR OAKS / ORANGE GROVE	150	500,000	to be determined	
REDEVELOPMENT AREAS (outside of Specific Plans)				
Lincoln Avenue	100	200,000	102	513,000
Lincoln Triangle	145	1,000	260	5,323
TOTAL	11,021	17,041,215	63,738	52,720,374

Table 2-5: City of Pasadena Department of Public Works Development/Redevelopment Projects

Development Address	Project Scope	Amount of Flow (gpd)	Point of Connection
100 W Green St	60-unit condominium plus retail	14,030	Green St
1000 Rose Ave	35 single family residences	9,100	Rose Ave
1000 S Raymond Ave	124-unit Art Center student housing	26,200	Raymond Ave
1150 N Allen Ave	8-unit condominium plus office and retail	2,274	Allen Ave
130-140 N Fair Oaks Ave	34-unit condominium plus retail	4,783	Fair Oaks Ave
1446 N Garfield Ave	11-unit condominium	2,400	Garfield Ave
1695-1703 N Fair Oaks Ave	24-unit condominium	6,000	Fair Oaks Ave
175 S Lake Ave (160 S Hudson Ave)	110-unit condominimum plus 22 offices	34,059	16059 to Lake Ave; 18000 to Hudson Ave
203 N Lake Ave	25,000 S.F. from office to restaurant	10,045	Lake Ave
208 S Chester Ave	8-unit condominium	2,000	Chester Ave
220 N Lake Ave	106-unit condominium plus commercial	23,120	Lake Ave
220 N San Rafael Ave	2 single family residences	520	San Rafael Ave
240 - 260 S Arroyo Pkwy	55-unit condominium plus restaurant	11,100	Arroyo Pkwy
2445 S Oswego Ave	9-unit condominium	2,050	Oswego Ave
2448 S Oswego Ave	8-unit condominium	1,900	Oswego Ave
2459 Oswego Ave	9-unit condominium	2,250	Oswego Ave
250 E Union St	52-unit condominium	8,200	Union St
267 N Craig Ave	3-unit condominium	750	Craig Ave
300 E Green St	Convention Center Expansion	20,813	Marengo Ave
300 W Green St	Maranatha High School Expansion	9,750	St John Ave

Development Address	Project Scope	Amount of Flow (gpd)	Point of Connection
300 W Green St	212-Senior Unit and 70-unit condo	58,190	St John Ave
355 E. Colorado Blvd	46-unit condominium plus retail	12,000	Colorado Blvd
39 S Raymond Ave	Restaurant Expansion	445	Raymond Ave
53-71 S San Gabriel Blvd	14-unit condominium	3,400	San Gabriel Ave
58-68 N Allen Ave	11-unit condominium	2,700	Allen Ave
635-641 S Lake Ave	12-unit condominium	2,600	Lake Ave
653 S Lake Ave	5-unit condominium	1,250	Lake Ave
692 S Marengo Ave	10-unit condominium	2,000	Marengo Ave
70 W California Blvd	Medical office and parking	33,400	California Blvd
78 N Marengo Ave	32-unit condo or office	4,800	Marengo Ave
810 N Marengo Ave	18-unit condominium	4,500	Marengo Ave
83-155 S Hill Ave	church	3,414	Hill Ave
951 S Fair Oaks Ave	92-bed covalescent home	7,820	Fair Oaks Ave
960 S Marengo Ave	16-unit condominium	3,900	Marengo Ave
96-110 N Craig Ave	18-unit condominium	3,600	Craig Ave
97 N Wilson Ave	6-unit condominium	1,400	Wilson Ave
985 N Michillinda Ave	13-unit condominium plus retail	3,288	Michillinda Ave
Annadale Canyon Estates	24 single family residences	6,240	Glen Oaks Blvd
SW Hudson and Walnut	70-unit condominium plus retail	14,600	Walnut St & Hudson Ave

1



CITY OF PASADENA MASTER SEWER PLAN
REDEVELOPMENT
Figure 2-4

Section 3: Existing Sewer System Condition

The focus of this section is a discussion and description of the existing sewer system and an assessment of system condition. Key elements and features of these facilities are described and evaluated in subsequent sections of the study. In addition, a narrative summary of the developments and enhancements to the City of Pasadena's Sewer GIS performed within this study is provided herein.

3.1 Geographic Information System (GIS)

A key component of the City of Pasadena's Sewer System Master Plan was the creation of a comprehensive sewer system GIS. This GIS database that resulted from this effort forms the backbone upon which the sewer system hydraulic model, the City's operations and maintenance maps, and the financial analysis of sewer system assets rest. As such, the sewer system GIS is a dynamic repository of spatial and attribute information for the City's entire sewer system.

3.1.1 Sewer System GIS Data Model

A properly structured GIS data model ensures that all required attributes and spatial information are captured, stored, and related accurately and efficiently within the GIS geodatabase. Given that the required attributes for a given organization will vary widely, each data model must be customized to the purposes of the organization that will use the data.

Toward this end, KJ worked in conjunction with Nobel Systems to assess the needs of the City. The various end uses of the GIS system were evaluated from engineering, operations, and maintenance points of view. A series of database reviews were used as a technical review and evaluation of the proposed geodatabase models. The database model reviews addressed the completeness of the database design, the accuracy of the database design with respect to the sewer facilities, and the abilities of the database design to meet the requirements of the City.

Review of the Uniform Machine Language (UML) class diagram ensured that the placement of object and feature classes in the class diagram was organized to maximize the efficiency of inherited methods and attributes. Domains, attributes, subtypes, and the relative placement of the classes were assessed in terms of consistency and completeness for the UML. Specifically, there was focused review of the following aspects of the class diagram:

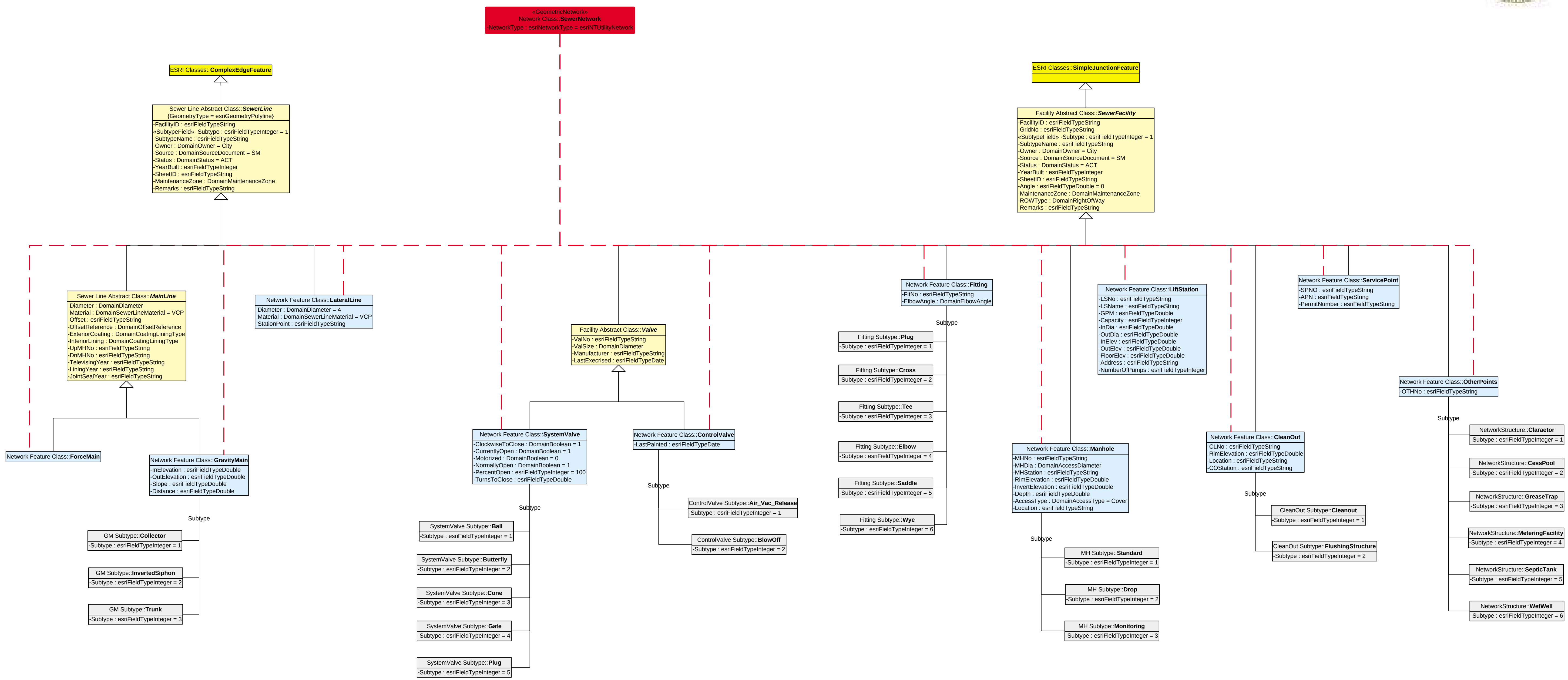
- Types of Classes: Object, Abstract, and Feature Classes
- Subtypes
- Domains
- Attributes

The ultimate goal of these exercises was to determine the simplest, most efficient database design that met all of the organizational needs of the City. Such simplicity minimizes both storage size of the database and effort required to update of the data. The ultimately chosen data model is shown in schematic layout in Figure 3-1.

ArcGIS™ Sewer UML Model for City of Pasadena

ArcGIS™ Sewer Release - May 2004

Network Subsystem Classes



SEWER SYSTEM DATA MODEL

Figure 3-1

Modified by: Srinivas AS

3.1.2 Sewer System GIS Conversion

Prior to conversion into GIS geodatabase format, the City's sewer system information resided on over 2200 .tif image files that had been scanned into electronic format from capital project drawings that had been filed with the City. In addition, limited attribute information was stored in a Microsoft Access database.

What follows below is the data conversion methodology used in order to capture elements identified in the data model from sources described above. The key technical question involved the standard and method of graphic data capture. Nobel Systems reviewed the samples provided by the City and converted data using an AutoCAD data capture method to digitize the utility features. The data attributes converted include:

- Sewer pipe ID number
- Depth
- Slope
- Material
- Manhole ID number
- Manhole station number
- Manhole invert elevation
- Plan and profile sheet number
- Distance between manholes
- Indicator for drop manholes
- Grade separation locations
- Flow direction indicators (i.e. flow direction arrows)

- Address block numbers on corners
- Designation for Los Angeles County Sanitation District facilities
- Designation for Los Angeles County Department of Public Works Facilities
- Designation of Private facilities
- Sewer easements

Additional graphic elements were also captured. These elements were captured at the equivalent accuracy of the sewer source plans, which was used as the primary source. Line types and text sizes were maintained in accordance with the source documents. The graphic elements converted include:

- Sewer Mains
- House Sewer Connections
- Sewer Manholes

Each of the spatial and data attributes listed above was captured according the plan set forth in the GIS Conversion Manual created by Nobel Systems for this project. This document is included as Appendix A of this Master Sewer Plan. Field surveying was not done as part of the conversion except as required by City staff to verify small questions of system connectivity and configuration. The City's existing parcel landbase was used as the baseline for spatial location of sewer system components. As City staff is primarily concerned with the spatial location of sewer system components relative to property and right-of-way boundaries, this baseline served City business purposes well.

In addition to the sewer system information converted from existing documents, a City-wide grid of tiles was created and numbered by Nobel Systems. Each tile in this grid corresponds to a page in the Operations and Maintenance atlas map book set. As described in the scope of work, each tile corresponds to an 11"x17" atlas map page. As part of conversion, the source ID number was entered in the database for each feature. This allowed querying of the data, either by clicking on the feature, querying by source number, or bringing up the actual sewer plan. Unique manhole identification numbers were generated in an orderly manner, from left to right and top to bottom, for each tile in the grid.

Using a custom VBA application, the AutoCAD drawing files were exported to DXF files, and the object data exported as text files. The AutoCAD drawings were converted to ArcInfo coverages using the custom tools. These coverages were smoothly integrated into the City's landbase as the "sewer layer". A custom application was then run to generate a plot in ArcPlot with the attributes and graphics plotted for each feature.

Nobel Systems reviewed the attribute checkplots and performed a 100-percent check of the source documents against the Quality Control (QC) plot, marking errors on the plot. If no errors were found, that grid was moved to the next process step. If any errors were detected, the grid looped back to editing for correction. Corrections of all errors marked on the QC plots were made in AutoCAD.

At the end of the QC process performed by Nobel Systems, new checkplots were generated for delivery to the City. These checkplots broke the entire GIS deliverable into nine batches for review by the City. City staff performed random quality control on these plots and returned comments to Nobel Systems for implementation. In addition, basic checks for connectivity and network relationships were performed using standard features of hydraulic modeling software. Only after all of these reviews were performed was data considered final for inclusion into the geodatabase.

3.1.3 Sewer System Geodatabase and System Maps

The result of the conversion work described in Section 3.1.2 is a personal geodatabase organized according the data model shown above. The personal geodatabase was delivered to the City under separate cover. Figure 3-2 demonstrates the data and network relationships contained in the geodatabase.

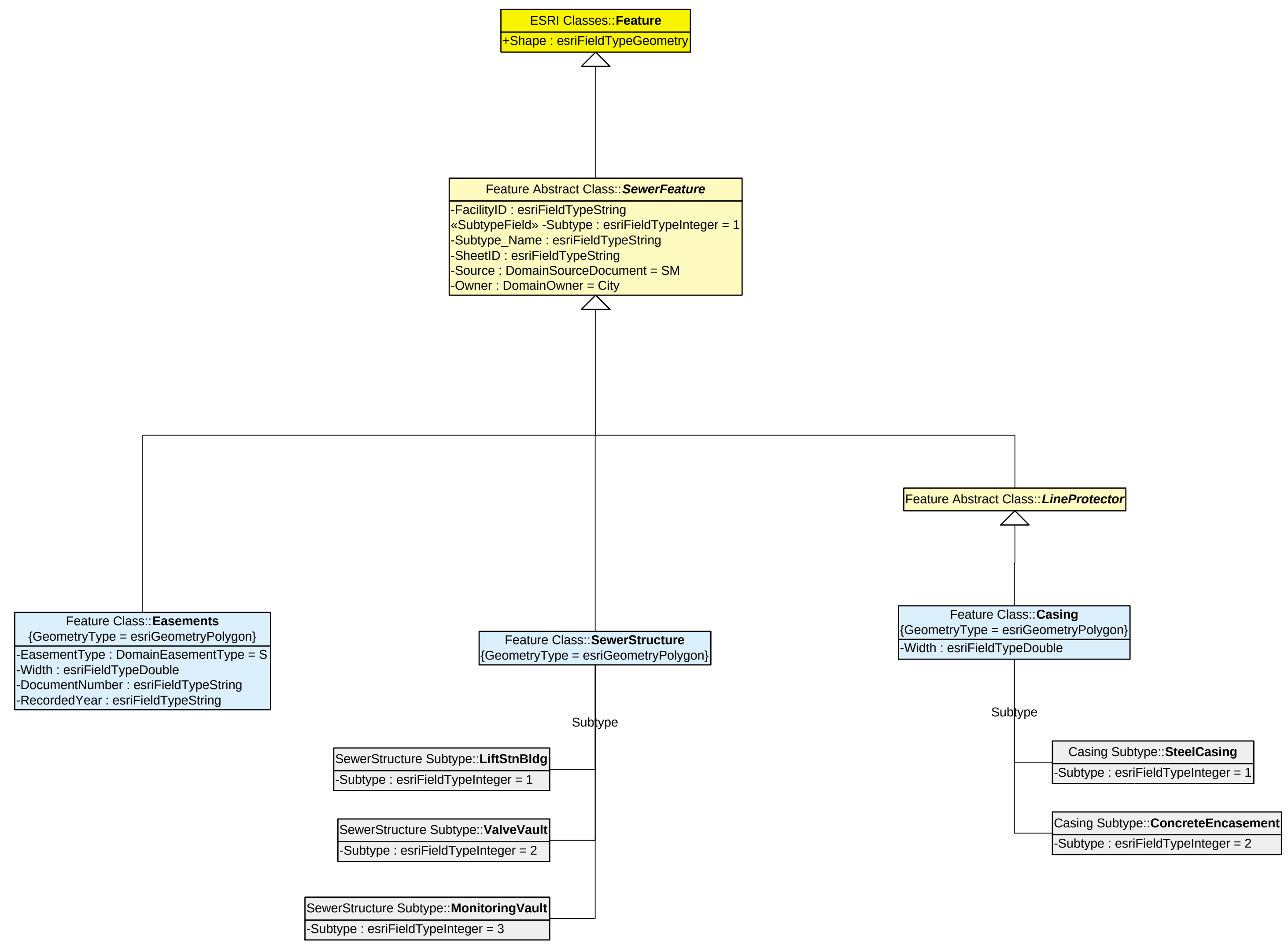
Accurate, readable, update-able sewer system atlas maps are a critical tool for continued performance of the City of Pasadena's engineering, operations, maintenance and planning departments. Using the data contained in the personal geodatabase, Nobel Systems created a layout and symbology for a book of atlas maps that would cover the entire sewer service area. The layout incorporates each map in the book onto an 11”x17” sheet with appropriate margins and data. The symbology includes a color and visual symbol to create a thematic map of all the sewer elements desired for display. In addition to the symbology, annotation layers were created to allow labeling of key elements. The annotations are feature-linked to the geodatabase, which allows annotations to update dynamically as attributes are updated. All labels in the annotations were hand placed in each grid for maximum visibility and clarity.

The resulting atlas map books were delivered to the City under separate cover. Figure 3-3 and Figure 3-4 demonstrate a sample data attribute sheet and sample atlas map sheet from the atlas map books. The updating of the sewer system geodatabase and sewer system maps will be of critical importance to the City of Pasadena. Appendix A contains some guidelines obtained from the Orange County Sanitation District for update standards.

ArcGIS™ Sewer UML Model for City of Pasadena

ArcGIS™ Sewer Release - May 2004

Feature Subsystem Classes



SEWER GIS FEATURE RELATIONSHIPS

Figure 3-2

Modified by: Srinivas AS

Pipeline, Manhole and Cleanout Data of Tile - 1713

Pipelines

From	To	UP_Elev	DN_Elev	Slope	Year Built
1713-100	1713-113	1109.81	1109.05	0.30%	1952
1713-101	1713-107	1106.09	1101.10	2.50%	1912
1713-102	1713-105	1107.75	1106.38	1.70%	1921
1713-103	1713-111	1111.00	1108.82	1.00%	1921
1713-104	1713-118	1097.52	1092.51	2.50%	1923
1713-105	1713-109	1106.38	1104.20	1.80%	1921
1713-106	1713-105	1110.73	1106.55	3.40%	1921
1713-107	1713-122	1100.38	1094.99	1.40%	1912
1713-108	1713-107	1103.84	1100.61	1.10%	1912
1713-109	1713-121	1104.20	1100.29	1.00%	1905
1713-110	1713-109	1106.27	1104.20	0.80%	1905
1713-111	1713-123	1108.82	1104.95	1.00%	1905
1713-112	1713-114	1107.91	1099.61	2.70%	1907
1713-113	1713-111	1109.05	1108.82	2.90%	1952
1713-114	1713-124	1098.90	1093.40	1.40%	1907
1713-115	1713-116	1097.33	1095.46	0.60%	1910
1713-116	1713-118	1095.46	1092.51	0.60%	1910
1713-117	1713-119	1085.49	1072.81	7.50%	1923
1713-118	1713-125	1092.51	1081.28	2.40%	1910
1713-119	1613-101	1072.81	1060.32	7.30%	1923
1713-120	1713-126	1091.55	1079.77	3.00%	1910
1713-121	1713-127	1100.29	1096.29	1.00%	1905
1713-122	1713-128	1094.99	1089.56	1.40%	1912
1713-123	1713-131	1104.95	1101.00	1.00%	1905
1713-124	1713-130	1093.40	1088.22	1.30%	1907
1713-125	1713-135	1081.28	1061.78	4.10%	1910
1713-126	1713-134	1079.77	1065.67	3.50%	1910
1713-127	1713-142	1096.29	1093.77	0.70%	1905
1713-128	1713-140	1089.56	1087.80	0.50%	1912
1713-129	1713-128	1096.34	1089.87	1.80%	1912
1713-130	1713-139	1088.22	1081.57	2.30%	1907
1713-131	1713-144	1101.00	1096.83	1.00%	1905
1713-132	1713-134	1072.63	1065.72	2.40%	1910
1713-133	1713-135	1062.59	1061.73	0.30%	1910
1713-134	1713-146	1065.67	1050.99	3.50%	1910
1713-135	1713-145	1061.78	1050.68	3.00%	1910
1713-136	1613-155	1060.58	1036.41	8.10%	1923
1713-137	1713-138	1095.89	1093.33	1.30%	1924
1713-138	1713-139	1093.33	1086.58	3.40%	1924
1713-139	1713-143	1081.57	1079.28	2.30%	1907
1713-140	1713-147	1087.80	1085.53	0.30%	1912
1713-141	1713-140	1091.29	1087.81	1.00%	1912
1713-142	1713-148	1093.77	1091.23	0.60%	1905
1713-143	1713-149	1079.28	1063.70	4.00%	1907
1713-144	1713-150	1096.83	1090.76	1.60%	1905
1713-145	1712-100	1050.68	1038.83	3.00%	1910
1713-146	1712-102	1050.99	1036.86	3.50%	1910
1713-147	1712-103	1085.53	1083.57	0.50%	1912
1713-148	1712-104	1091.23	1085.14	1.60%	1905
1713-149	1712-105	1063.70	1055.35	2.20%	1907
1713-150	1712-106	1090.76	1082.62	2.20%	1905
1714-102	1713-114	1101.09	1098.90	1.00%	1924
1714-104	1713-116	1097.46	1095.46	1.00%	1923
1813-162	1813-160	1084.02	1080.04	1.70%	1912

Manholes

MH No.	Rim_Elev	Location
1713-100	1117.60	2083 RAYMOND AVE
1713-101	1113.00	2075 N MARENGO AVE
1713-102	1115.60	2076 SUMMIT AVE
1713-103	1116.60	2078 N RAYMOND AVE
1713-104	1105.20	2075 NAVARRO AVE
1713-105	1113.90	2064 SUMMIT AVE
1713-106	1114.90	2065 SUMMIT AVE
1713-107	1107.30	MONTANA ST & MARENGO AVE
1713-108	1110.00	169 E MONTANA ST
1713-109	1110.70	MONTANA ST & SUMMIT AVE
1713-110	1113.90	101 E MONTANA ST
1713-111	1115.30	MONTANA ST & RAYMOND AVE
1713-112	1113.30	46 E MONTANA ST
1713-113	1115.20	MONTANA ST & RAYMOND AVE
1713-114	1106.10	MONTANA ST & FAIR OAKS AVE
1713-115	1104.40	MONTANA ST, 164 FT W/O FAIR OAKS AVE
1713-116	1102.00	MONTANA ST & EL SERENO AVE
1713-117	1093.50	150 W MONTANA ST
1713-118	1097.20	MONTANA ST & NAVARRO AVE
1713-119	1079.30	181 W MONTANA ST
1713-120	1098.00	2020 EL SERENO AVE
1713-121	1108.20	1988 SUMMIT AVE
1713-122	1101.60	1977 N MARENGO AVE
1713-123	1110.85	1980 N RAYMOND AVE
1713-124	1102.60	1979 N FAIR OAKS AVE
1713-125	1089.00	1964 NAVARRO AVE
1713-126	1086.37	1950 EL SERENO AVE
1713-127	1104.40	DEARBORN ST & SUMMIT AVE
1713-128	1096.30	DEARBORN ST & MARENGO AVE
1713-129	1102.50	160 DEARBORN ST
1713-130	1099.20	1914 N FAIR OAKS AVE
1713-131	1107.20	1916 N RAYMOND AVE
1713-132	1082.70	25 W TREMONT ST
1713-133	1071.40	85 W TREMONT ST
1713-134	1072.00	TREMONT ST & EL SERENO AVE
1713-135	1068.50	TREMONT ST & NAVARRO AVE
1713-136	1066.70	TREMONT ST, 130 FT W/O NAVARRO AVE
1713-137	1103.70	TREMONT ST, 86 FT W/O RAYMOND AVE
1713-138	1100.80	TREMONT ST, 200 FT E/O FAIR OAKS AVE
1713-139	1092.60	TREMONT ST & FAIR OAKS AVE
1713-140	1094.10	TREMONT ST & MARENGO AVE
1713-141	1099.70	160 E TREMONT ST
1713-142	1100.90	1853 SUMMIT AVE
1713-143	1089.90	1860 N FAIR OAKS AVE
1713-144	1103.10	1842 N RAYMOND AVE
1713-145	1056.80	1833 NAVARRO AVE
1713-146	1057.79	1826 EL SERENO AVE
1713-147	1092.50	FLOWER ST & MARENGO AVE
1713-148	1097.20	1788 SUMMIT AVE
1713-149	1074.60	1787 N FAIR OAKS AVE
1713-150	1096.40	1790 N RAYMOND AVE

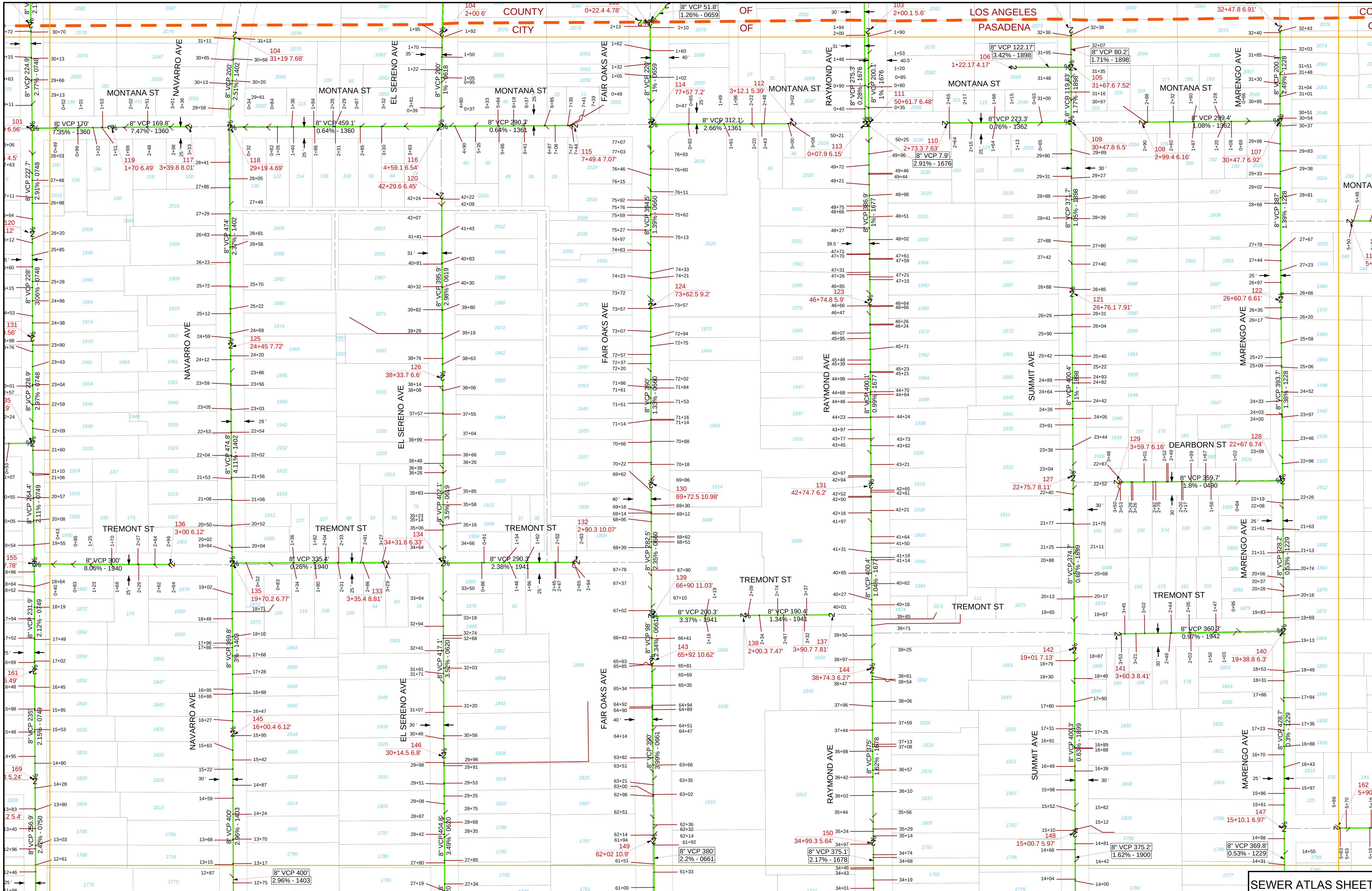
Cleanouts

CL No.	Rim_Elev	Location

SEWER ATLAS MAP
SAMPLE DATA SHEET

Figure 3-3

SEE MAP 1714



1713	Scale: 1" = 200' NOT FOR CONSTRUCTION USE		CITY OF PASADENA Department Of Public Works	Sewer Atlas Book	DISCLAIMER: This map represent a visual aid intended to assist Public Utility Department personnel with the management of Sewer System Facility. Data provided hereon is not a guarantee of actual field conditions nor a substitute for record drawings and field verification.	January 2

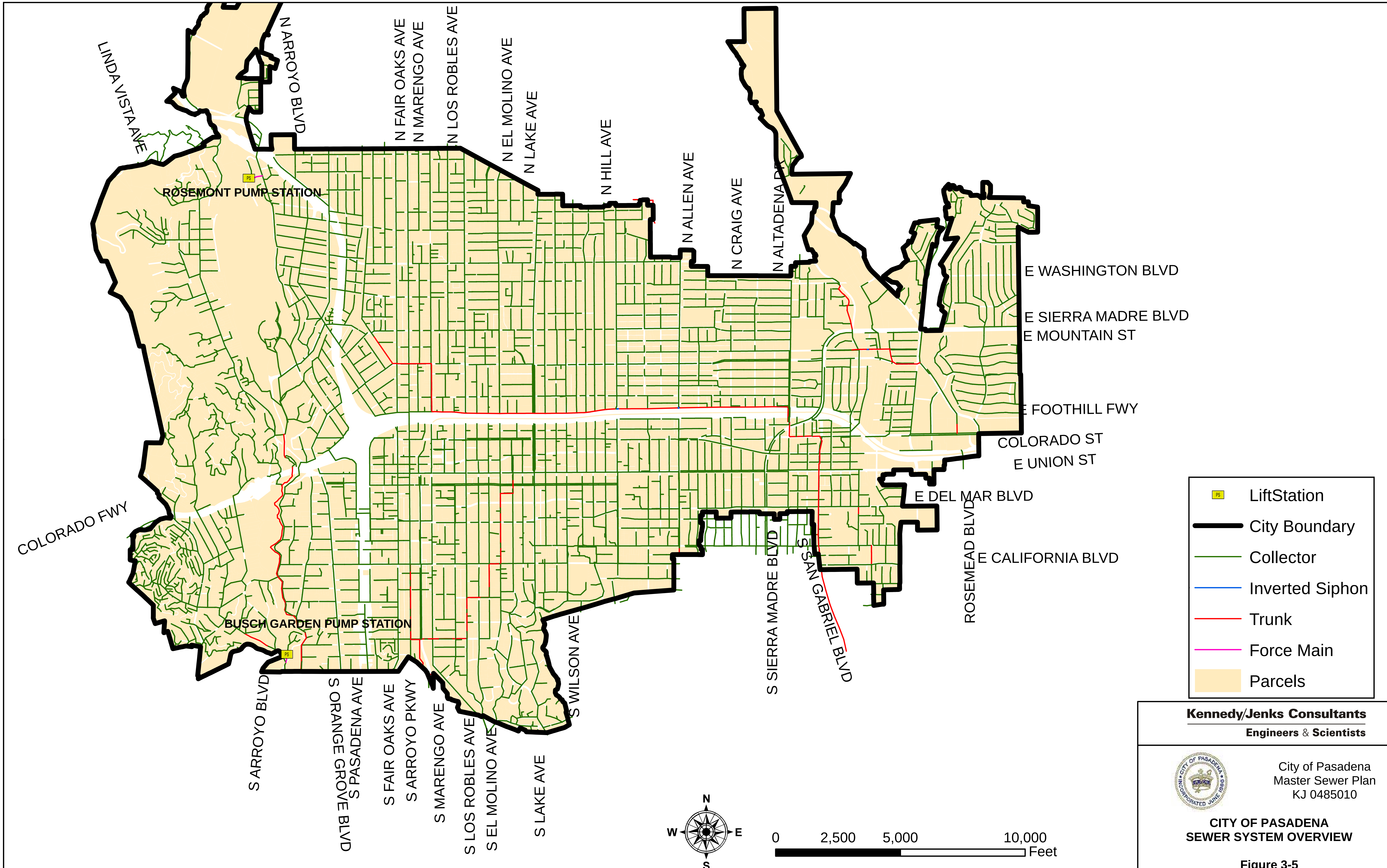
SEWER ATLAS SHEET
SAMPLE MAP

Figure 3-4

SEE MAP 1712

3.2 General Sewer System Description

The City of Pasadena's existing sewer system comprises two types of facilities. These facilities include gravity collection system pipelines and manholes, and two sewer lift stations with associated force mains. As described in Section 2, the City treats none of the sewer flows generated within its service area; hence, no treatment facilities are included in this study. The facility evaluation elements of this sewer system master plan focus on a hydraulic evaluation of the existing collection system pipelines, manholes, and pump stations, and a reliability assessment of these facilities through the development of an appropriate ongoing capital repair and replacement program. Figure 3-5 shows an overview of the major components of the City of Pasadena's existing sewer system.



CITY OF PASADENA
SEWER SYSTEM OVERVIEW

Figure 3-5

3.2.1 Sewer Collection Pipelines

The existing sewer collection system within the City of Pasadena sewer service area contains approximately 350 miles of underground sewer pipelines. These pipelines range from 6 inches to 42 inches in diameter for LACSD trunk lines, and the predominant material of these pipelines is vitrified clay pipe (VCP). In general, sewer that flows north of the Colorado Freeway winds up in LACSD trunk lines which convey the flows out of the City; the majority of flows south of the Colorado Freeway are collected in various smaller trunk lines and flow out of the City service area subsequently to be collected in LACSD trunk lines. In addition to the trunk lines owned by the LACSD, the City of Pasadena sewer service area also contains sewer lines owned by the Los Angeles County Department of Public Works (LACPW) and by private property owners. Table 3-1 hereon summarizes the length of sewer line within the service area by owner. Figure 3-6 displays the sewer lines graphically within the service area symbolized by owner.

Table 3-1: City of Pasadena Sewer Service Area Lines By Owner

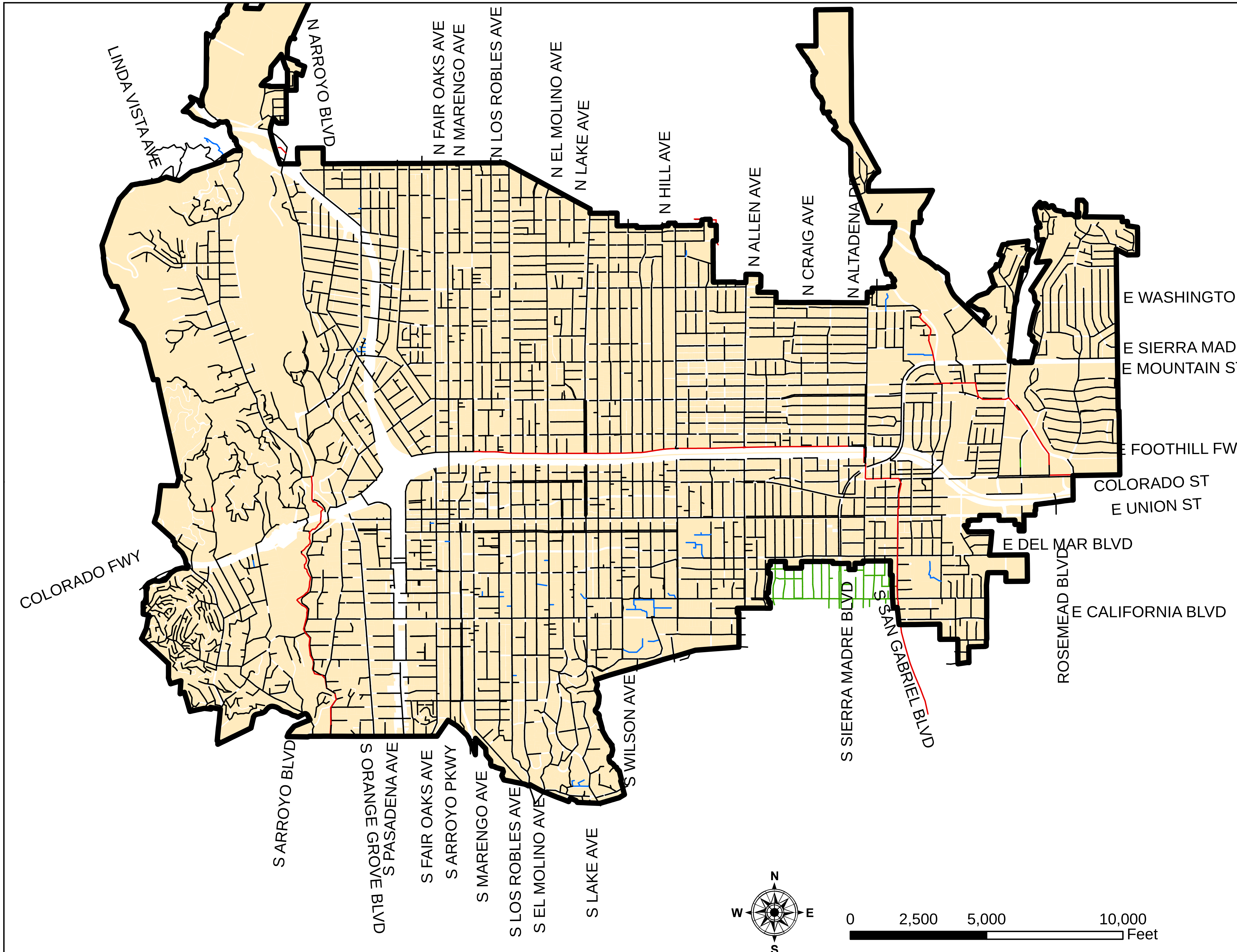
Owner	Linear Feet	%
City	1,731,568	94%
LACSD	48,726	3%
LACPW	29,575	2%
Private	25,037	1%
Total	1,834,906	100%

As shown in Figure 3-5, the majority of the sewer lines within the City service area are collectors that eventually flow into trunk lines for conveyance. Thus, it is logical that the majority of the sewer lines in the service area are less than 20" in diameter. Table 3-2 summarizes the lines by diameter. Figure 3-7 maps the lines within the service area by diameter.

Table 3-2: City of Pasadena Sewer Service Area Lines by Diameter

Diameter	Linear Feet	%
6	34,757	1.9%
8	1,488,369	81.1%
10	88,567	4.8%
12	67,084	3.7%
14	8,683	0.5%
15	27,080	1.5%
16	22,278	1.2%
18	29,892	1.6%
20	1,530	0.1%
21	8,582	0.5%
22	11,950	0.7%
24	23,385	1.3%
27	6,598	0.4%
30	3,776	0.2%
33	3,549	0.2%
36	1,038	0.1%
39	4,105	0.2%
42	3,684	0.2%
Total	1,834,906	100.0%

As stated, the sewer lines within the City service area are primarily constructed of VCP. However, a variety of other materials were used over the course of the City's history. The most prevalent of these alternate materials is concrete, as can be seen in Table 3-3 and Figure 3-8. The location of these concrete sewer lines is of particular importance because concrete does not exhibit the inert properties of VCP when exposed to the corrosive properties of hydrogen sulfide gas generated as a byproduct of sewage. Thus, the useful life of concrete sewer pipes is less than that of VCP, and concrete pipes must be monitored more closely for condition assessment.



City Boundary

Gravity Main

Owner

- City of Pasadena
- Los Angeles County Dept Of Public Works
- Los Angeles County Sanitation Dist
- Private
- Parcels

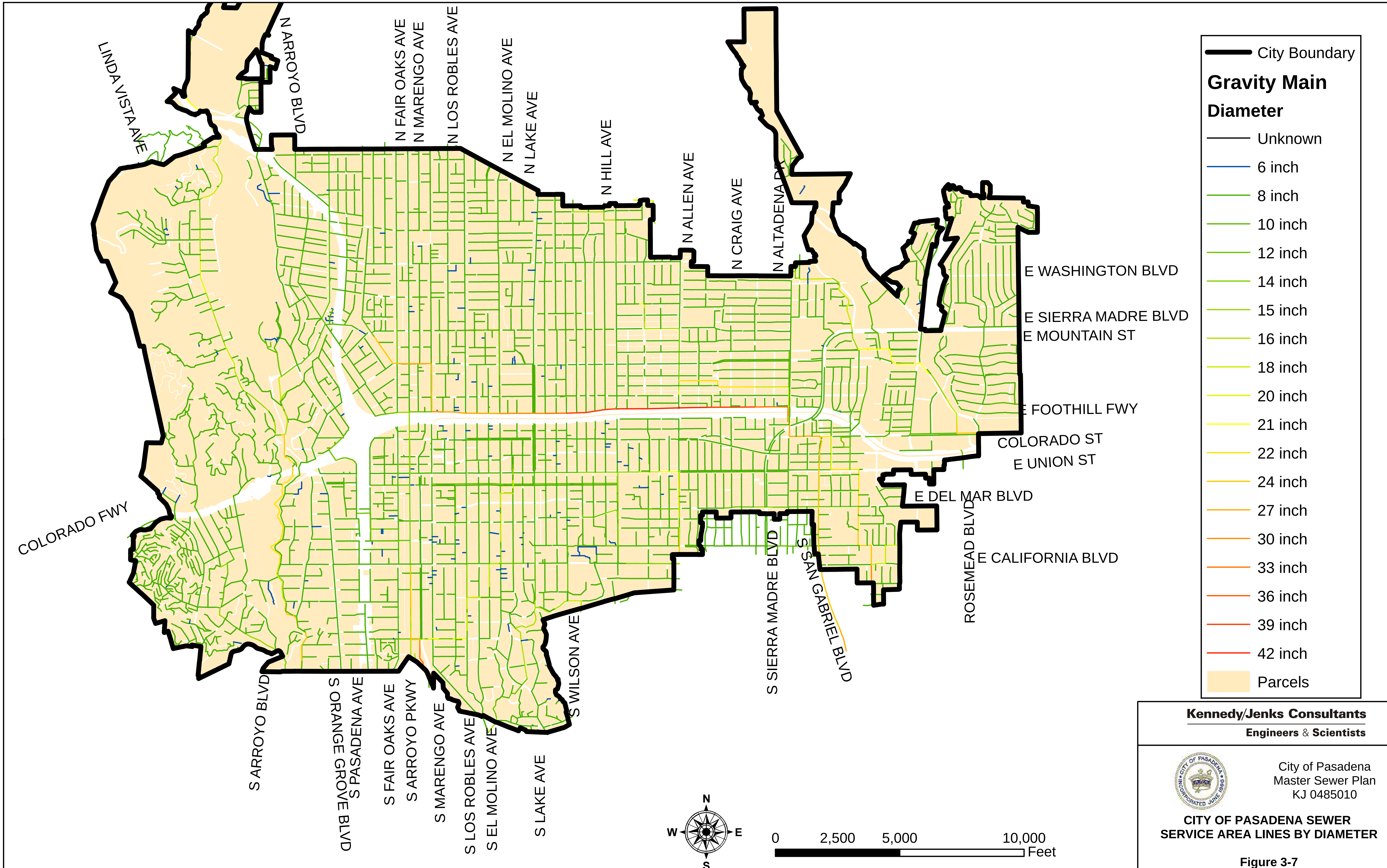
Kennedy/Jenks Consultants

Engineers & Scientists

City of Pasadena
Master Sewer Plan
KJ 0485010

CITY OF PASADENA SEWER SERVICE AREA LINES BY OWNER

Figure 3-6



Kennedy/Jenks Consultants
Engineers & Scientists

City of Pasadena
Master Sewer Plan
KJ 0485010

CITY OF PASADENA SEWER SERVICE AREA LINES BY DIAMETER

Figure 3-7

Table 3-3: City of Pasadena Sewer Service Area Lines By Material

Material	Linear Feet	%
Cast Iron Pipe	17,598	1.0%
Concrete Pipe	157,591	8.6%
Ductile Iron Pipe	2,788	0.2%
Poly Vinyl Chloride Pipe	214	0.0%
Reinforced Concrete Pipe	21,977	1.2%
Vitrified Clay Pipe	1,634,020	89.1%
Unknown	719	0.0%
Total	1,834,906	100.0%

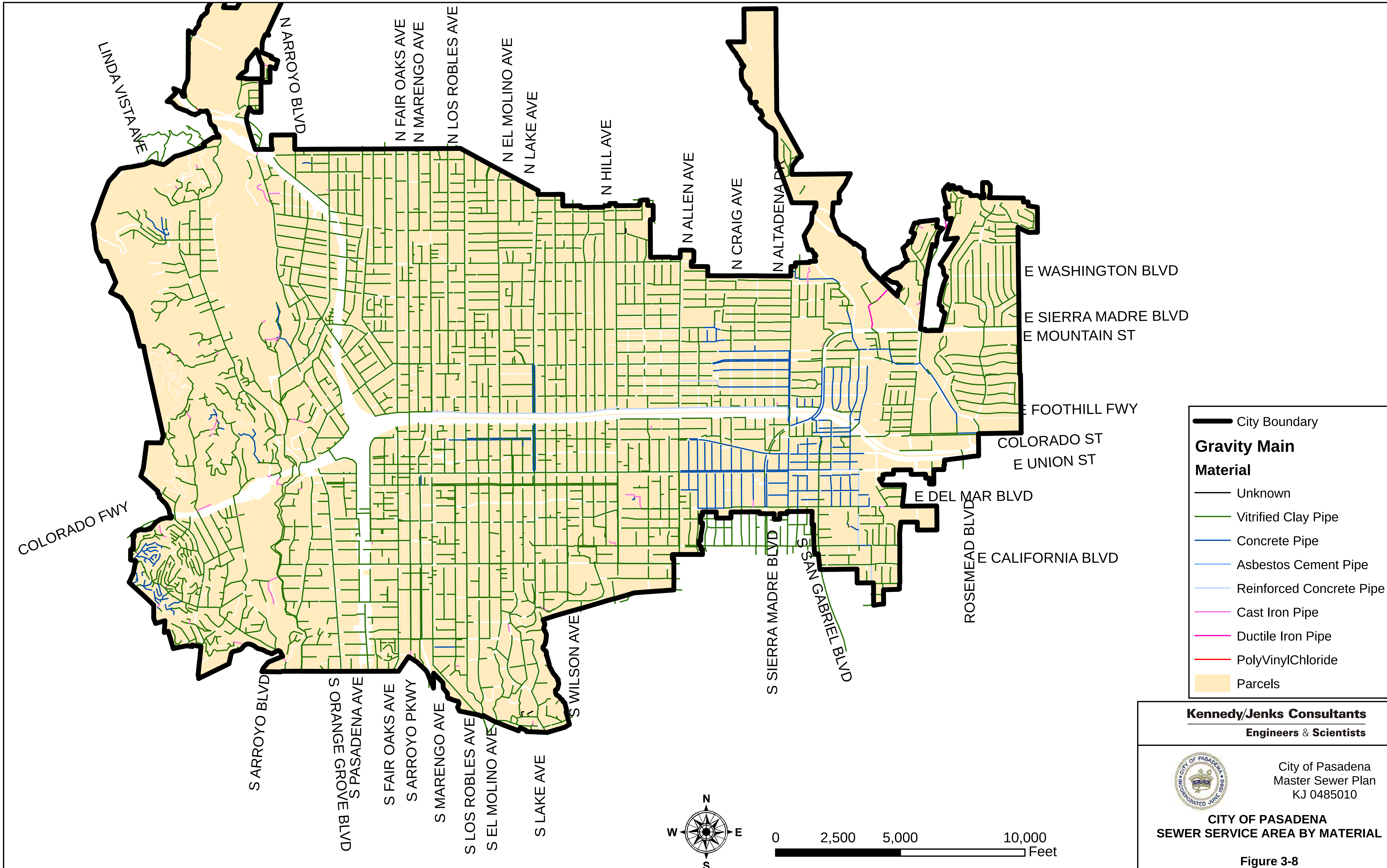
An important component of monitoring the condition of sewer lines is establishing service ages so that those lines that are approaching the end of their useful lives can be more closely monitored and repair and/or replacement can be more appropriately scheduled. As one of the oldest municipalities in its region, the City of Pasadena sewer service area contains sewer lines older than those seen in most neighboring service areas. Knowing this, the City made the capture of construction date an important task in the GIS conversion described above.

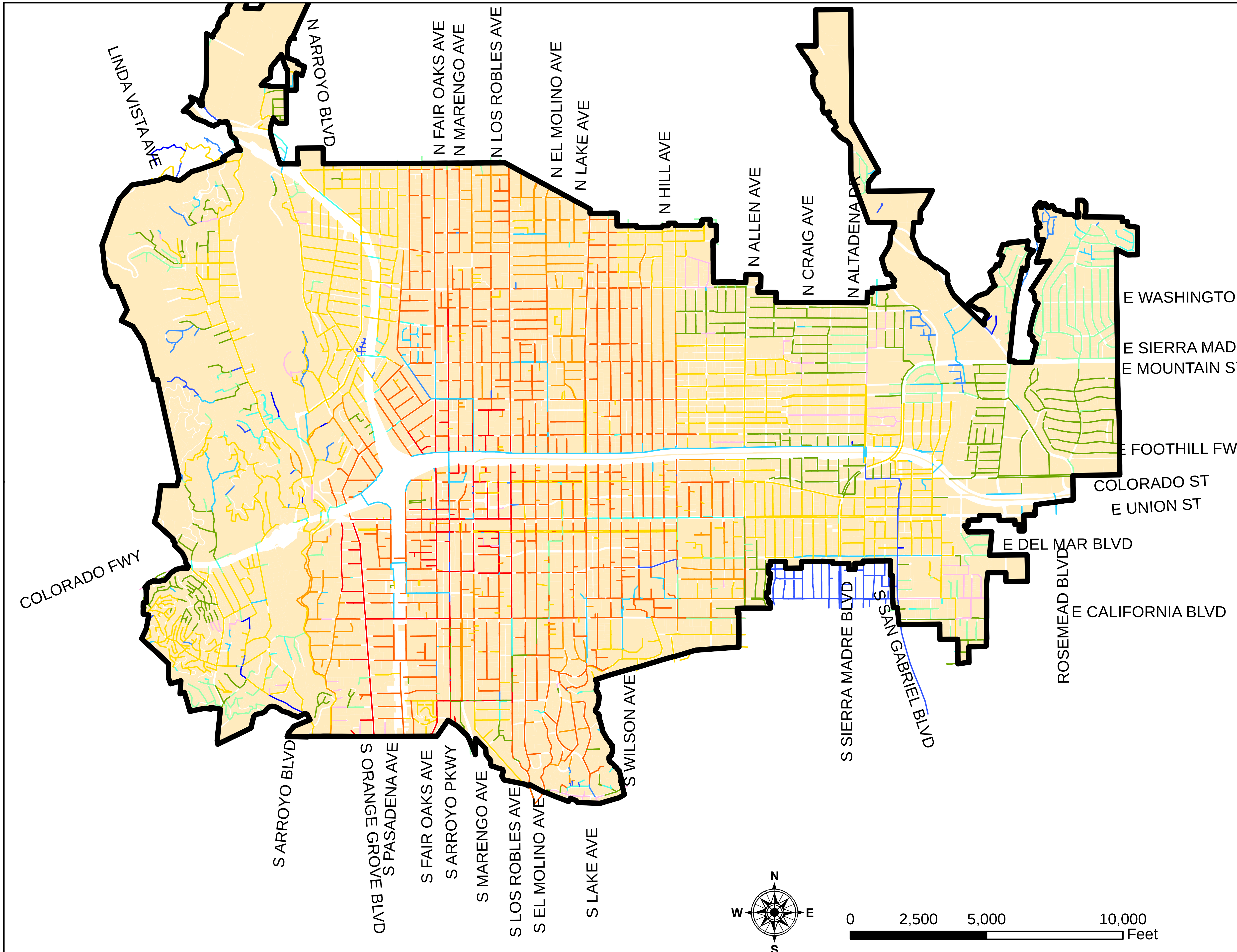
The GIS shows that the oldest sewer lines within the City service area were constructed in 1896 of VCP. Recent inspection of these lines by City staff has shown them to be in acceptable condition despite the advanced age. Table 3-4 breaks down the lines within the City of Pasadena service area by decade installed. Figure 3-9 displays the same information spatially across the City.

As shown in Table 4, approximately 35% of the City's system is over 80 years old, and over 60% of the system is over 70 years old. While the City's video inspection has indicated that much of the older system is in good condition, the City should program for the replacement of many of these facilities in the coming years.

Table 3-4: City of Pasadena Sewer Service Area Lines by Decade Installed

Decade	Linear Feet	%
1880 & Before	30,119	1.6%
1890	22,423	1.2%
1900	383,399	20.9%
1910	219,538	12.0%
1920	519,236	28.3%
1930	41,389	2.3%
1940	227,814	12.4%
1950	174,840	9.5%
1960	37,962	2.1%
1970	83,837	4.6%
1980	33,343	1.8%
1990	50,343	2.7%
2000 and After	10,663	0.6%
Total	1,834,906	100.0%


LINDA VISTA AVE
N ARROYO BLVD
N FAIR OAKS AVE
N MARENGO AVE
N LOS ROBLES AVE
N EL MOLINO AVE
N LAKE AVE
N HILL AVE
N ALLEN AVE
N CRAIG AVE
N ALTADENA DR
E WASHINGTON BLVD
E SIERRA MADRE BLVD
E MOUNTAIN ST
E FOOTHILL FWY
COLORADO ST
E UNION ST
E DEL MAR BLVD
E CALIFORNIA BLVD
ROSEMEAD BLVD
COLORADO FWY
S ARROYO BLVD
S ORANGE GROVE BLVD
S PASADENA AVE
S FAIR OAKS AVE
S ARROYO PKWY
S MARENGO AVE
S LOS ROBLES AVE
S EL MOLINO AVE
S LAKE AVE
S WILSON AVE
S SIERRA MADRE BLVD
S SAN GABRIEL BLVD
N
W
E
S
0
2,500
5,000
10,000
Feet
City Boundary
Gravity Main
Material
Unknown
Vitrified Clay Pipe
Concrete Pipe
Asbestos Cement Pipe
Reinforced Concrete Pipe
Cast Iron Pipe
Ductile Iron Pipe
PolyVinylChloride
Parcels
Kennedy/Jenks Consultants
Engineers & Scientists
City of Pasadena
Master Sewer Plan
KJ 0485010
CITY OF PASADENA
SEWER SERVICE AREA BY MATERIAL
Figure 3-8



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Engineers & Scientists

City of Pasadena
Master Sewer Plan
KJ 0485010

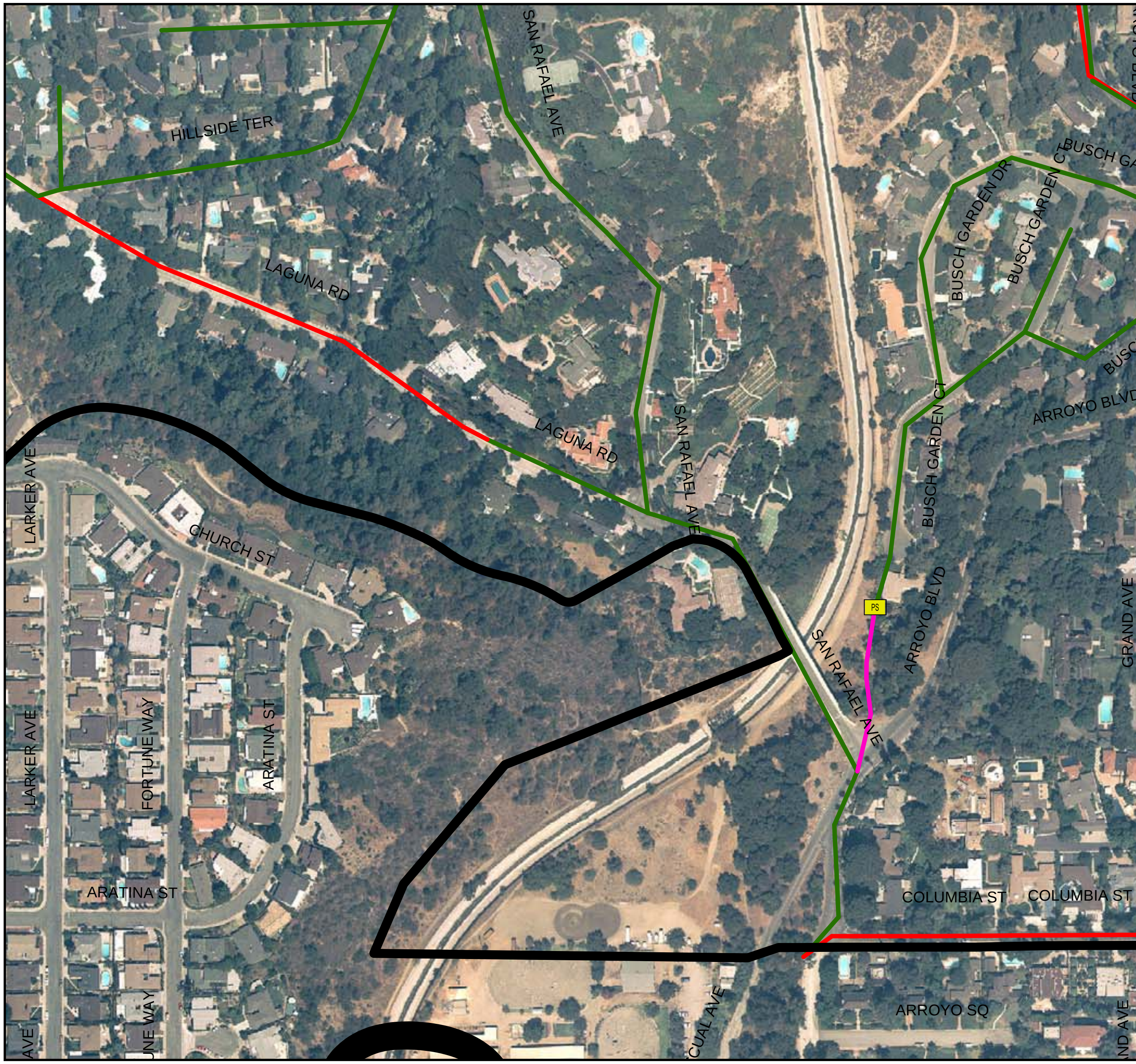
CITY OF PASADENA
SEWER SERVICE AREA BY DECADE

Figure 3-9

3.2.2 Sewer Pump Stations

The City of Pasadena currently operates two sewer pump stations, both of which are shown in Figure 3-5. The Rosemont Pump Station was constructed in 1946 to service a small section of the City that would otherwise gravity flow into the Arroyo Seco. This pump station lifts sewer flow from an elevation of 938 feet on Rosemont Ave. to an elevation of 1045 feet on Arroyo Blvd. This is accomplished through 550 ft. of 4" diameter cast iron forcemain. Figure 3-10 shows the layout of this pump station.

The Busch Garden Pump Station was constructed in 1950 and serves to lift sewer flows from an elevation of 615 feet on Busch Garden Drive to an elevation of 671 feet on Arroyo Blvd. Over 250 ft. of 6" diameter cast iron force main is required for this lift. As can be seen in Figure 3-11, the Busch Garden Pump Station serves a small neighborhood whose elevation isolates it from the trunk sewer to the east or the collectors to the south.



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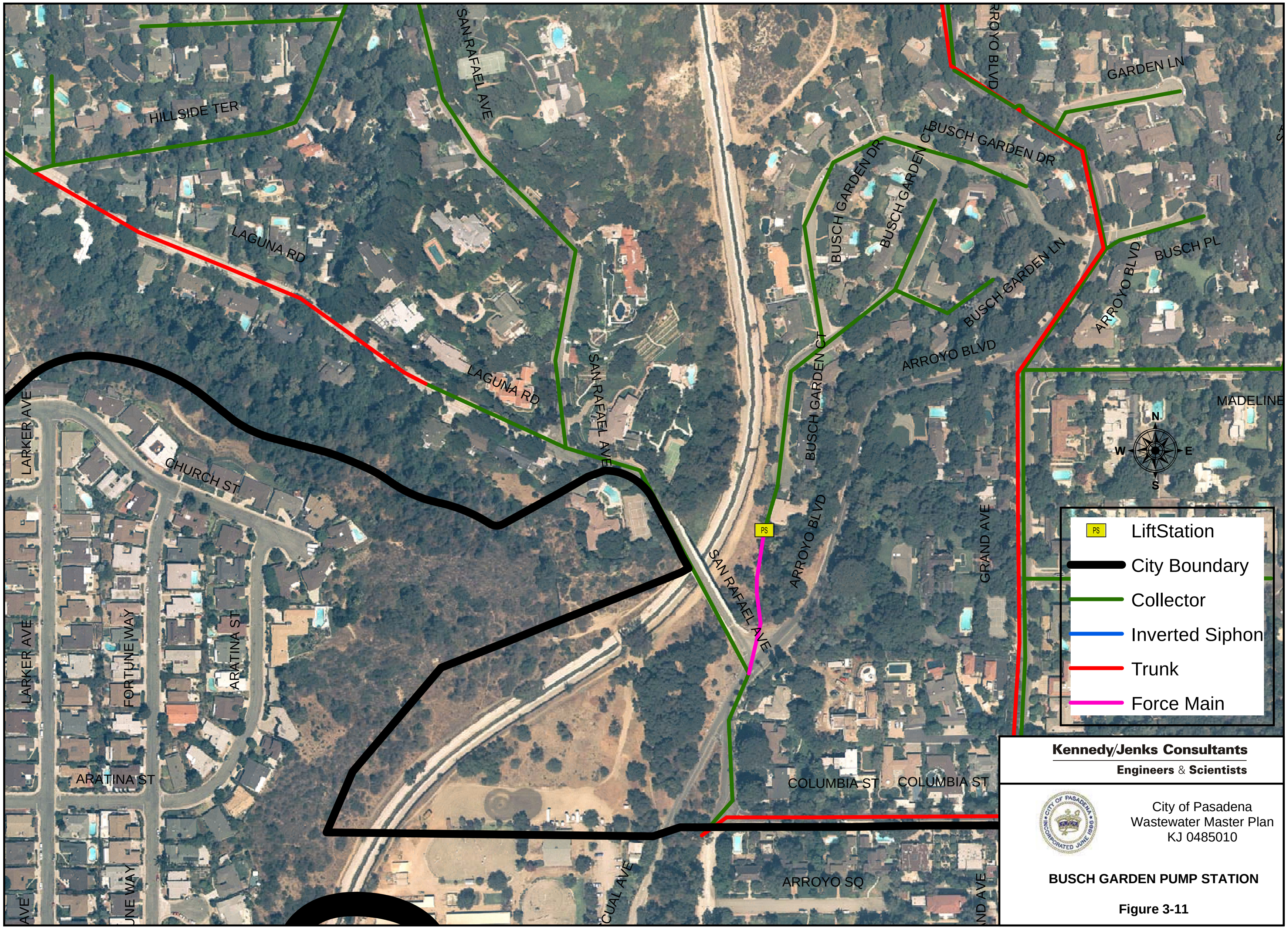
City of Pasadena
Master Sewer Plan
KJ 0485010

BUSCH GARDEN PUMP STATION

Figure 3-11



Kennedy/Jenks Consultants
Engineers & Scientists

City of Pasadena
Wastewater Master Plan
KJ 0485010

BUSCH GARDEN PUMP STATION

Figure 3-11

3.3 Existing Sewer System Condition and Improvements

This section of the Sewer System Master Plan assesses the general physical condition of wastewater facilities and equipment within the City of Pasadena's existing sewer system. This assessment was based primarily on a review of the record drawings and reports, as well as field reviews of key sewer system facilities.

As previously discussed, the City's sewer system contains elements ranging from those that were installed in the first years of incorporation (pre-1900) to those that were recently installed as part of Capital Improvement Programs (CIP). According to the State of California Controller's Office, the suggested useful life of wastewater utility fixed assets is 50 years for pipelines and maintenance holes, while the useful life of pumping station assets is generally less (approximately 20 years), based on structure, equipment, pump types, etc. However, it should be noted that the actual useful life of fixed assets typically extends beyond the "book value" used for asset depreciation.

3.3.1 Sewer Collection System

In the past few years, the City has undertaken a video inspection process to assess the condition of the entire sewer collection system. Most of the City's collection system appears to be in generally good condition because of the City's strong maintenance, repair, replacement, and rehabilitation efforts. Nonetheless, there exist areas of concern that are typical of most sewer collection systems. These areas may require more effort or new techniques to maintain acceptable performance of the system.

3.3.1.1 Collection System Service Life History

As shown in Figure 3-8, the majority of the City's wastewater collection system is composed of VCP sewer lines. Due to the inert nature of VCP, it is generally considered to provide the longest useful life of most materials commonly used in wastewater pipeline construction. VCP pipelines are generally considered to provide reliable service for 90 to 110 years if they are properly designed, constructed, and maintained. By this standard, the oldest portions of the

City's VCP sewer lines are nearing or have passed into the end of their useful life. This portion of the system should be prioritized for analysis from video inspection data.

Figure 3-8 shows that significant portions of the City's sewer lines are constructed of concrete. Concrete has a much shorter useful life than VCP (50-70 years) and is much less resistant to corrosion. The lines identified as concrete, especially the older ones, should also be prioritized for analysis and identified for inclusion in the City's proactive pipeline replacement program.

In consideration of the performance of the City's system and discussions with City staff, it is suggested that the City include all VCP over 100 years in a pipeline replacement/rehabilitation watch program. Moreover, the City should consider replacing any pipeline that is over 100 years old during the resurfacing or reconstruction of any City streets.

3.3.1.2 Fats, Oils, and Grease Build-up

Fats, Oils, and Grease (FOG) build-up in pipelines and on maintenance hole inverts and benches causes flow restrictions, reduces hydraulic capacity, and significantly increases maintenance requirements. Large pieces of built-up materials can break off and lodge in pipelines and pump station wet wells, leading to acute failure and overflow. FOG build-up is generally attributed to restaurants and other food processing uses.

The City of Pasadena has recognized FOG accumulations in the downtown area where restaurants are concentrated. In addition to reducing hydraulic capacity within the sewer system lines, the high Biochemical Oxygen Demand (BOD) concentration of the FOG components is suspected of causing some noticeable odor issues under night-time low flow conditions.

3.3.1.3 Tree Root Intrusion

Tree roots can rapidly grow inside collection pipelines and usually enter through pipe joints or cracks and openings in pipeline walls and maintenance holes. Root intrusion can cause pipeline blockages and further deteriorate the pipeline if not maintained.

The City of Pasadena sewer collection system has root intrusion areas that are recognized and maintained by City Operations and Maintenance staff. Ficus and eucalyptus trees planted next to sewer lines in the right-of-way present a particular problem in this regard.

3.3.1.4 Infiltration and Inflow (I&I)

Groundwater and storm water runoff can enter the system at deteriorated pipelines and maintenance holes, or at illegal connections such as roof leaders. As a result, I&I flows take up sewer line capacity that should be available for sanitary flows, increasing the chances of failure and surcharge.

City staff is aware of areas of high I&I in the sewer collection system, and thus undertook a wet weather flow monitoring study as part of this Sewer System Master Plan. The flow monitoring was performed over 36 days in February and March, 2005. The results of this study are included as Volume Two of this Sewer System Master Plan, and the results are discussed in more detail in Section 5. Figure 3-12, taken from Volume Two of this Master Sewer Plan, shows areas within the City of Pasadena's sewer service area that are experiencing high I&I flows, both rainfall dependent I&I (RDII) and base infiltration. As can be seen, the areas of higher I&I are primarily concentrated in the old downtown and Laguna areas of the City.

3.3.2 Sewer Pump Station Facilities

The two pump stations within the City's service area were evaluated through review of record drawings and maintenance records, in conjunction with discussions with City staff. Upgrades incorporating these discussions are included in Section 7.

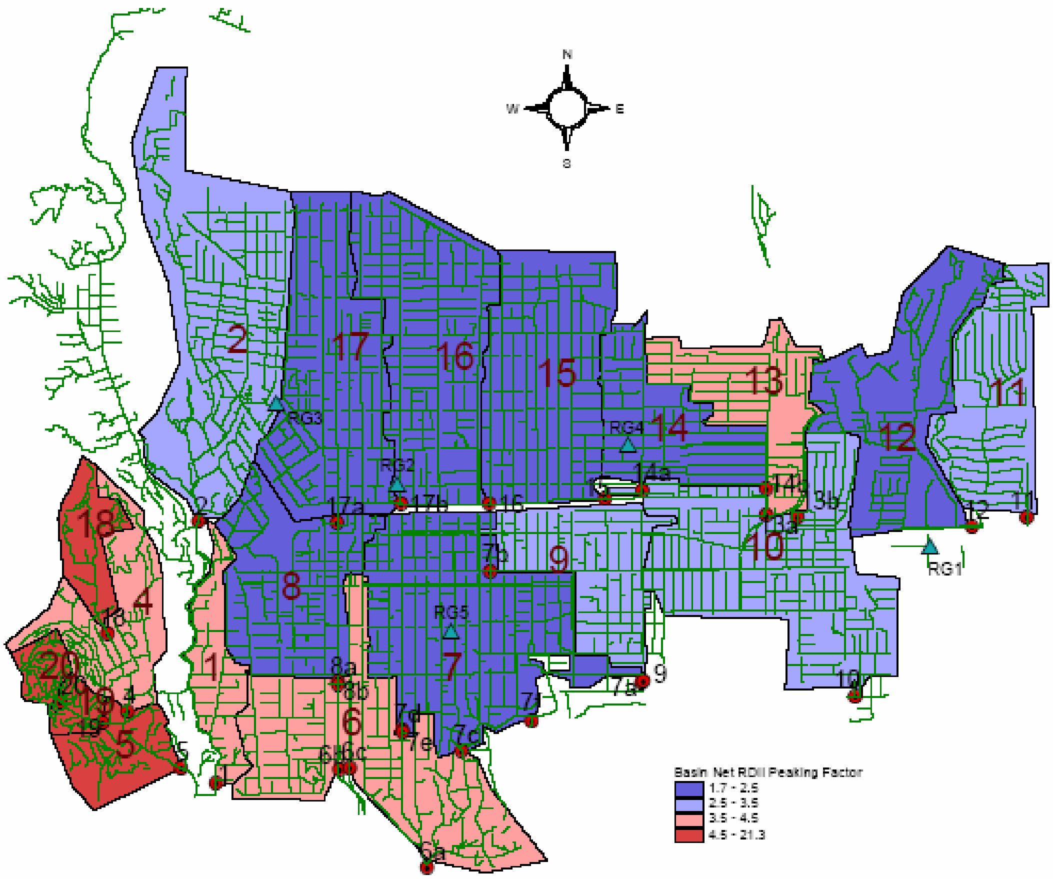
3.3.2.1 Pump Station Service Life History

Although both pump stations are over 50 years old, both were refurbished with new pumps recently. Busch Gardens was upgraded in 1999, while Rosemont was upgraded in 2004. The data from these upgrades is included in Appendix B.

3.3.2.2 Pump Station Known Problems

The Busch Garden Pump Station building is wooden and rapidly deteriorating.

Figure 3-12: City of Pasadena I&I Flow Monitoring Results by Basin



Section 4: Operations and Maintenance

Continued inspection, maintenance and rehabilitation of the wastewater collection and pumping system are integral components of a utility operation and are required to extend the useful life of infrastructure facilities and prevent system failures. Since chronic pump station failures and sewer pipeline and manhole blockages can lead to incidents of sewage spillage and property damage, regular, proactive maintenance must be performed to limit the City of Pasadena's liability from system backups into private property and to protect the environment from overflows and spillage.

During the preparation of this master plan, the City's Operations and Maintenance (O&M) activities were reviewed to assess potential procedural conflicts and/or inadequacies and develop an appropriate O&M program. This section presents an overview of the existing procedures, staffing, and budget for this activity and recommends operational, staffing, financial and data management improvements.

4.1 Existing O&M Resources and Procedures

4.1.1 Existing Staff, Organization, and Equipment

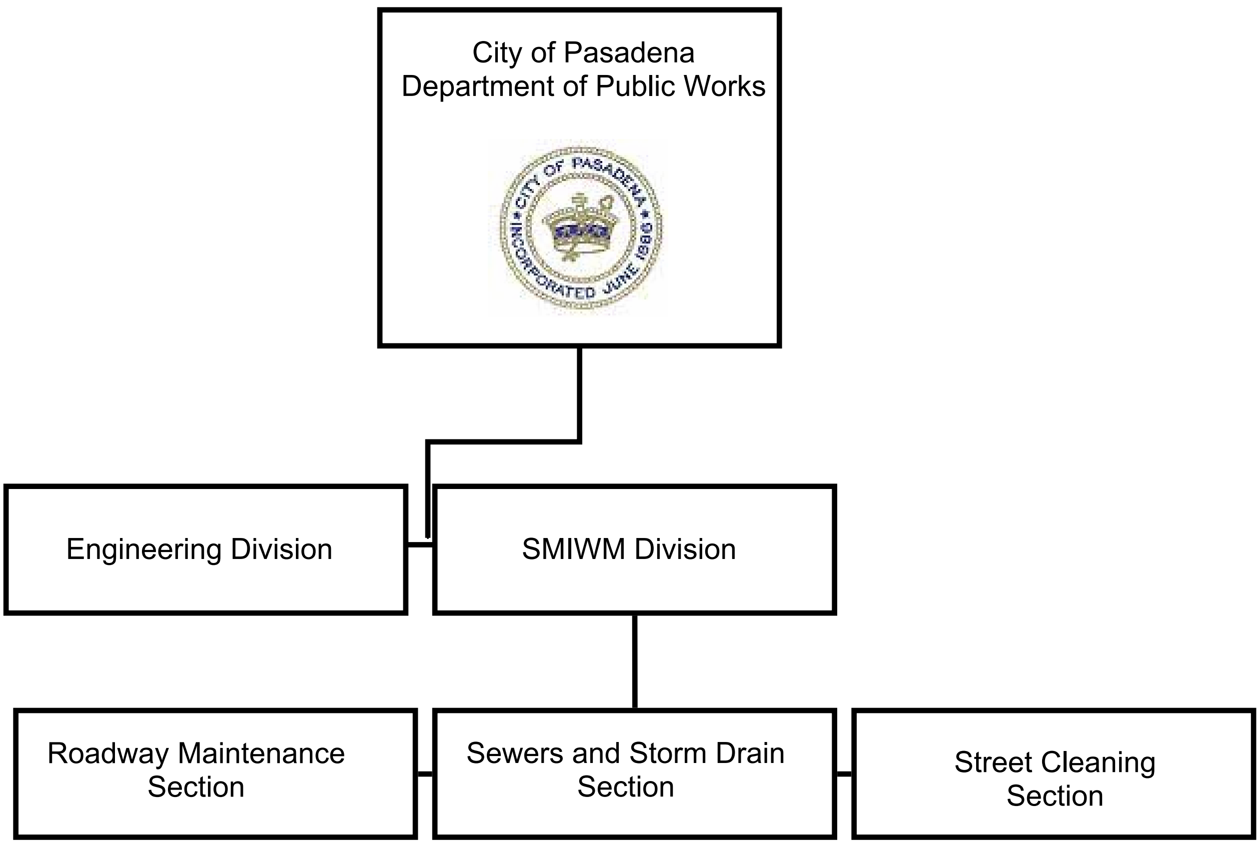
The City of Pasadena Public Works Street Maintenance & Integrated Waste Management (SMIWM) Division is responsible for the operation and maintenance of all City-owned sewer and storm drainage collection and pumping facilities. In general, the costs associated with the Sewer and Storm Drain section of SMIWM are borne by the City of Pasadena's Sewer Fund.

The Sewer and Storm Drain section currently comprises one supervisor overseeing 11 staff. Staff members are rotated among teams performing the following activities:

- Three (3) two-person teams provide crews for routine sewer line maintenance
- One (1) two-person team performs trash removal in catch basins and storm drains
- One (1) two-person team performs fast food and high pedestrian area maintenance
- One (1) person performs inspection on sewer users with a high likelihood of contributing fats, oils and greases (FOG) into City-owned sewer lines

The Sewer and Storm Drain section of the SMIWM utilize jet cleaning trucks and vactor units in the performance of their day-to-day duties. The organization and its place within the City of Pasadena are shown in Figure 4-1.

Figure 1: SMIWM Organization Chart



The level of effort for collection system and pumping system maintenance was estimated based on discussions with City staff. The current maintenance activities associated with the City's collection system and pumping system are described below.

4.1.2 Existing Pipe Line Operation and Maintenance Procedures

Routine sewer line maintenance within the City of Pasadena is performed by three (3) two-person crews operating two jet trucks and one combination truck. The City is divided into 17 maintenance areas that the crews maintain sequentially. It is the goal of the Sewer and Storm Drain section to clean each maintenance area once annually, but the diversion of manpower for emergency and auxiliary activities generally prevents this from occurring. Under ideal conditions, one crew is programmed to clean approximately 4,000 linear feet per day (lf/day) of line over flat terrain and 3,000 lf/day in hilly areas. These cleaning rates reflect an operationally efficient staff as the production rates are slightly higher than the typical 2,000 to 3,000 lf/day values generally used by many other wastewater utilities.

Deviations from ideal conditions include non-standard manhole geometries, difficult easement access to manholes and service points, and the resolution of other field problems. Because the City does not own equipment suitable for cleaning locations that are inaccessible to vehicular equipment, sewer operation crews must manually drag and carry jet flushing hose equipment through private property and hand feed the cleaning hose to the sewer manhole access point. This manual operation requires a full sewer crew, is an unsanitary activity, increases the risk of field staff injuries and property damage, is an inefficient use of staff and prevents them from performing their routine duties in an efficient manner, and results in an unpleasant experience for both City staff and the City's property owners.

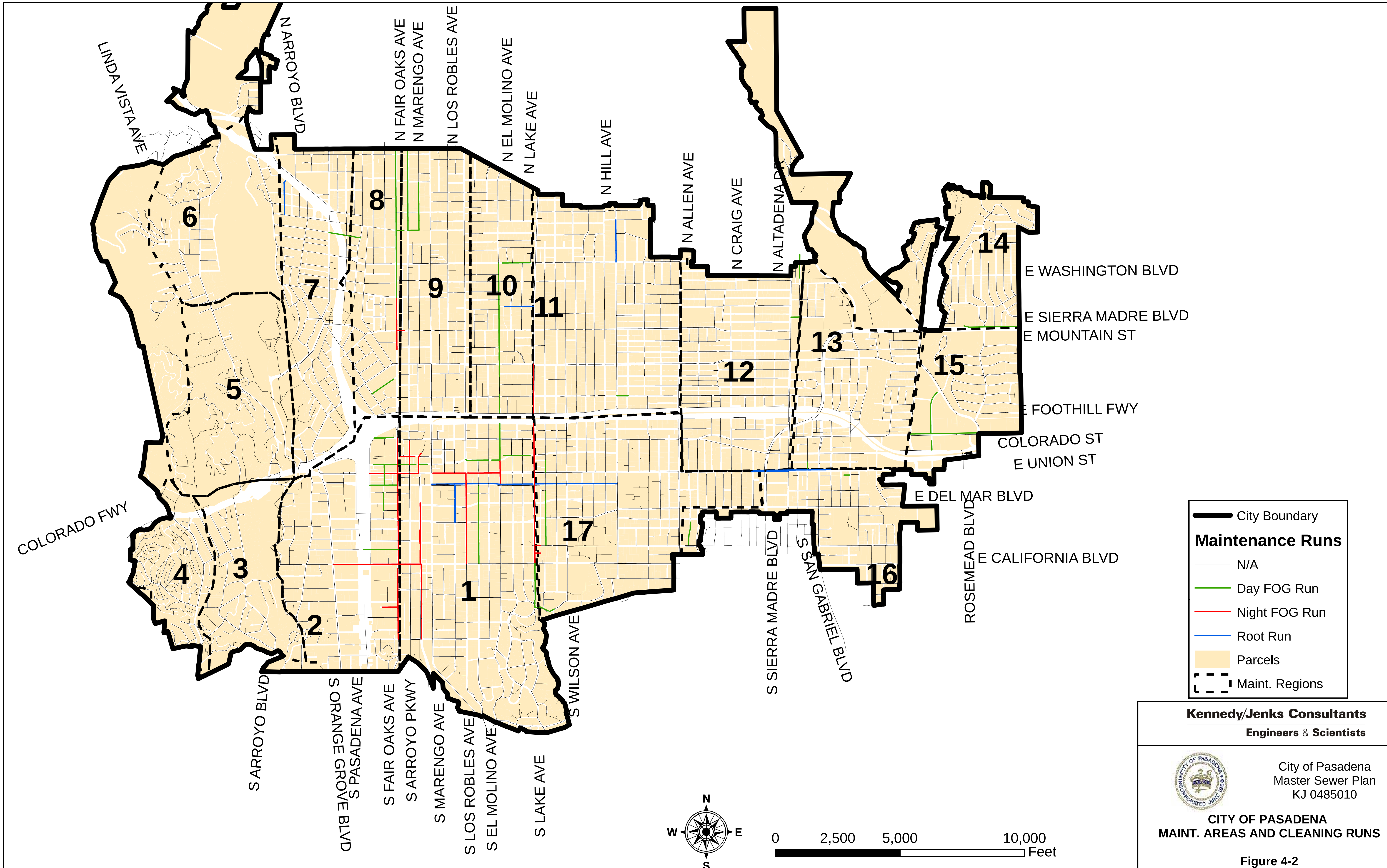
In addition to the performance of annual maintenance of the City's maintenance service areas, specific cleaning routes are performed to alleviate known operational and maintenance problems within the City's sewer lines. These specific cleaning routes cover areas that are impacted from known root intrusion and FOG discharges. Currently, the FOG cleaning route is performed every two to three months and totals approximately 90,000 linear feet. Similarly, the root cleaning route is performed every three months and totals approximately 7,000 feet. The root route is being expanded to 17,000 feet based on the recurring needs of several additional problem areas. Figure 4-2 shows the City's maintenance areas, existing FOG routes, and existing root routes. The FOG and tree root intrusion areas comprise approximately 6% of the City's sewer pipeline facilities.

Prevention of insect and vector infestation within the City's sewer lines is performed by a chemical dosing program. The program is handled by an outside firm under contract to the City. Three thousand manholes are dosed per year with the understanding of a two-year chemical residual following each treatment.

In addition to these ongoing cleaning and maintenance activities, the City's SMIWM Division supports the assessment of sewer pipeline condition through video inspection services. Currently, the City co-owns its TV equipment with two other agencies under a tri-city arrangement. Overall equipment maintenance responsibility is provided by the City of Glendale. The equipment is rotated among the three agencies on a quarterly basis. As such, each agency uses the equipment for three months per year. Accordingly, every three years, each agency receives a six-month allocation, and uses the equipment during the first and fourth quarter of the year.

Based on discussions with City staff, the goal of the video inspection program is to televise the entire wastewater collection system approximately every five to seven years, with an increased frequency of up to once per year for very old facilities or areas of specific concern. Unfortunately, because of the short duration that the equipment is available under the tri-city ownership arrangement, City O&M staff is not able to use the equipment enough to have adequate efficiency or staff to meet the City's video inspection goal. Current production values indicate that City sewer crews have difficulty attaining the 1,500 to 2,000-feet-per-day typical industry criteria under the existing arrangement.

Given the need to obtain a city-wide condition assessment of the sewer system, the City has contracted the video inspection work to an outside vendor over the last several years. The City has encumbered approximately $400,000 per year over the last 5 years to attain a city-wide assessment. This assessment is expected to be completed in FY 2008. Based on discussions with City staff, the tri-city arrangement is not meeting the goals of any of the three cities. As such, this arrangement is being discontinued and provisions for an ongoing video inspection program by other means are underway. As part of routine operations and maintenance, the City tracks sewer overflows and backups. Results of this tracking can be found in Appendix C.



City of Pasadena
Master Sewer Plan
KJ 0485010

CITY OF PASADENA
MAINT. AREAS AND CLEANING RUNS

Figure 4-2

4.1.3 Existing Pump Station Procedures

As described in Section 3 of this master sewer plan, the City of Pasadena owns and operates two sewer pump stations. Routine maintenance and repair of these pump stations is contracted by the City of Pasadena to Multi-Tec, Inc. Multi-Tec keeps a regular maintenance and replacement schedule for the pump station equipment, pumps, and motors. Sewer and storm drain section staff monitor the pump stations to assure that they are operating properly on a day-to-day basis. In addition, City staff uses the combination truck to regularly clean the wet wells of the pump stations.

Section 3 lists several existing conditions at the City's pump stations that will require repair or retrofitting. Budgets for such repairs are presented in Section 7 of this report. When put into effect, these improvements will reduce the amount of City staff time required at the pump stations.

4.1.4 Existing Staff, Equipment and Budget

As previously discussed, the City's Sewer and Storm Drain Section is staffed with 11 field personnel, one supervisor, and supporting vehicles and equipment. The sewer lift stations are maintained through an ongoing contract with Multi-Tec, Inc., and supporting management and engineering services and activities are provided from other in-house City personnel. The costs of these services that are segregated in the FY 2005-06 budget for sewer services are reflected in the following categories.

- Personnel - $620,852
- Supplies and Services - $196,763
- Internal Service Charges - $131,672
- Total Budgeted Costs - $1,167,473
- Abatements - $218,186
- Total Budgeted Costs - $1,167,473

4.2 Recommended Procedures

4.2.1 Recommended Operational Procedures

The SMIWM Division's ongoing operation and maintenance program is well defined and appears to be appropriated with the desired level of service as defined in the goals and objectives. Based on a review of the City's existing sewer system programs/procedures, recommendations are provided to support long-range operations and maintenance support. This support is recommended to minimize the City's exposure to property damage liability and to provide environmental compliance.

The deficiencies identified during the conduct of this study generally appear to be associated with the level of staffing that is necessary to meet the prescribed service standards. As such, the recommended O&M program procedures generally reflect the existing procedures of the SMIWM Section. These procedures are summarized as follows:

CITY OF PASADENA
PREVENTATIVE MAINTENANCE PROGRAM

I. GENERAL INSPECTIONS

A. All Sewer Lines and Manholes (Semi-annually)

1. Ring and cover is sealed to manhole and level with adjacent pavement
2. Settlements over wastewater lines
3. Manhole interior for leakage
4. Flow conditions, surcharging or high water marks
5. Stoppages or restrictions
6. Presence of vermin or rodents
7. Indications of non-domestic sewage or industrial wastes
8. Odors

B. Pump Stations (Twice per Week)

1. Ongoing maintenance of the City's sewer pump stations is provided by Multi-Tec, Inc.
2. Facility inspection daily to assure operational performance.

II.CLEANING

A. Sewer Lines

1. Scheduled (Annually or quarterly) based on previously recommended priorities and frequencies
2. Unscheduled - Based on inspections or emergency situations

B. Pump Stations (Monthly)

1. Clean wet wells with Vactor truck and wash down walls

III. OTHER FUNCTIONS

A. Complaints and Emergencies

1. Provide a phone number that residents can use to report complaints and emergencies, 24 hour a day, 365 days a year.
2. Provide immediate response to emergency conditions and take corrective action.
3. Respond to general complaints within a 24 hour period. Take corrective action as required.

B. Videotape Inspections

1. Perform video inspections of lines immediately following scheduled line cleaning operations.
2. Obtain a new system-wide assessment every five to seven years.
3. Maintain an inventory of deficiencies and replacements in GIS.

C. General Facilities Remediation

1. Repair sewer line
2. Perform routine pump station maintenance such as painting and mechanical repairs as required.

D. Vermin and Rodent Control

1. Provided by Outside Contractor.

E. FOG Control Program

1. Expand FOG program to include additional corrective action and enforcement procedures.

4.2.2 Recommended Maintenance Procedures

As previously discussed, the SMIWM Division provides ongoing O&M of the City's sewer and storm drainage systems. The appropriate level of O&M-related staffing activities are derived herein based on industry standard production/efficiency values and utility O&M program goals. The staffing requirements associated with this section are derived as follows:

4.2.2.1 Routine Sewer Pipeline Cleaning

Sewer pipeline cleaning is an important element of a utility. The typical production values used to budget for this O&M activity reflects that a full-time two-man crew can clean 2,000 to 3,000 feet of a collection system per day, assuming that major problems are not encountered. The City currently completes 3,000 to 4,000 feet per day in ideal situations, depending on the service area.

To assess the staffing requirements of this important O&M elements, estimated production standards are correlated with the City's 1.7 million linear feet of pipelines, 17,000 feet of tree root areas, and 90,000 feet of pipelines with excessive grease. Using the cleaning production criteria of 3,200 feet per day, it would take approximately 641 crew days to clean the system annually and to clean the root and FOG areas quarterly.

While the estimated time requirements represent average production rates and efficiencies, these values do not include the excess time associated with resolving field problems, field staff assignment adjustments for special events, and allowances for employee benefits (e.g., holidays, vacation, sick leave). Accordingly, program schedules for these activities are developed by factoring in a 15 percent allowance for the resolution of field problems, a 5% allowance for support of special events, and a 20 percent allowance for employee benefits. The resulting implications for sewer staffing requirements are shown in Table 4-1.

Table 4-1: Recommended Sewer Crew Staffing

Description	Linear Feet
Base Cleaning Program	1,731,568
Additional Root Areas	51,000
Additional FOG Areas	270,000
Total Annual Cleaning	2,052,568
Typical Cleaning Rate (lf/day)	3,200
Crew Days Required to Meet Goal	641
<u>Staffing Assessment</u>	
Days Available/Year/Crew	260
Allowance for Benefits (20%)	52
Allowance for Field Resolution (15%)	39
Allowance for Special Events (5%)	13
Net Annual Available Days/Crew	156
Number of Crews to Meet Goal	4.11

As shown, to accomplish the pipeline cleaning activities in conformance with the City's annual cleaning goal would require four two-man crews to annually clean the full sewer system and clean the high maintenance areas quarterly. Based on the program activities and maintenance goals of the SMIWM, it is recommended that one additional full-time crew be assigned to routine sewer line maintenance.

While the value shown in Table 4-1 reflects the need for slightly greater than 4 crews, it is recommended to increase staff by one crew at this time, and monitor the production time attained during the next fiscal year. Based on the performance in FY 06-07, it may be necessary to add an additional crew to meet the City's goals, and utilize the excess labor in other overall sewer and storm water program activities.

To equip this crew with appropriate equipment, it is also recommended that the City purchase a new vactor/hydro combo unit and an easement machine to improve easement access and eliminate the manual hand feeding of the cleaning equipment at access points not found in public right-of-ways. The cost of the combo unit is approximately $320,000, while the easement machine for cleaning purposes costs approximately $50,000.

4.2.2.2 Routine Sewer Video Inspection Program

As previously discussed, the goal of the video inspection program is to video inspect the entire wastewater collection system approximately every five to seven years, with an increased frequency of up to once per year for very old facilities or areas of specific concern. In accordance with these criteria, an assessment of the video inspection program alternatives was derived to ascertain the appropriate approach for ongoing video inspection services.

The assessment of staffing requirements was performed in a similar manner to the cleaning program. Applying a typical video inspection production rate of 2,000 feet per day to the City's 1.7 million linear feet of pipelines reflects that approximately 866 crew days will be required to video the City's base system. Applying the previously derived allowances for available days per crew, the City could video inspect its system with one crew in approximately 5.5 years.

While the estimated time requirements represent average production rates and efficiencies, these values do not include the excess time associated with annual inspection of older facilities and areas of concern. For comparison purposes, if an additional 300,000 feet is used as an annual requirement for areas of concern and problem areas, the City time required to inspect the system would increase to approximately 6.6 years, still within the seven year program goal.

The results of the staffing assessment and an evaluation of the cost effectiveness of purchasing the necessary equipment and performing the associated services in-house versus the cost of continuing with ongoing contractual services is shown in Table 4-2. As shown, the cost to purchase this equipment and utilize in-house services is more cost effective than the use of outside contractual services under the five to seven year program. Accordingly, in addition to the increase in dedicated sewer maintenance services personnel for pipeline cleaning, it is also recommended that the City purchase the necessary camera truck for approximately $250,000, and hire and train an additional sewer crew to operate and maintain this equipment.

Table 4-2: Cost Comparison For In-house vs. Contract Sewer Video Inspection

Description	Linear Feet
Base Video Program	1,731,568
Additional Root Areas	-
Additional Age/Material Areas	-
Total Annual Video	1,731,568
Typical Video Rate (lf/day)	2,000
Crew Days Required to Meet Goal	866
Staffing Assessment	
Days Available/Year/Crew	260
Allowance for Benefits (20%)	52
Allowance for Field Resolution (15%)	39
Allowance for Special Events (5%)	13
Net Annual Available Days/Crew	156
Crews Required to Meet Goal	5.55
Video Inspection Service Alternatives Evaluation	
In-house Cost	
City labor (@ $140,000/yr, 5 years)	$700,000
Equipment Cost	$200,000
Total 5-Year Cost	$900,000
Annual Cost	$180,000
Contracted Cost ($0.90/ft)	$1,558,411
Annualized Cost (7-years)	$222,630
Annualized Cost (5-years)	$311,682

4.2.2.3 Recommended O&M Staffing and Equipment

In accordance with the assessment and recommendations derived herein, the City of Pasadena should budget for additional personnel and related equipment. The staffing and equipment elements required to implement the sewer system O&M program goals are summarized as follows:

- One new Sewer Maintenance Field Crew (2 – SMWs) - $140,000
- One new Video Inspection Field Crew (2 – SMWs) - $140,000
- One CNG Vactor/Hydro combination unit – $320,000
- One Easement Machine – $50,000
- One Camera Truck - $250,000
- Safety equipment (two crews) - $20,000 ($10,000 each).

In addition to these staffing and equipment recommendations, it is important to note that the City has embraced the need to provide dedicated staffing to these important City services to preserve and evaluate the useful life of these underground assets. Dedicated and committed staff should be assigned and trained to meet the demands of these services so that the life expectancy of these facilities can be attained. Should the City's proactive operation and maintenance program continue to fall short of the program goals, unidentified failure of sewer pipelines may occur. The cost of this activity will manifest itself in the early retirement of the City's assets and the increased potential for sanitary sewer overflows.

It is further recommended that the City evaluate the performance of the Sewer and Storm Drain Section related to the performance of the cleaning and video inspection goals. While two new crews are proposed to be added, overall performance of section activities should be contrasted with prescribed goals on an annual basis to ascertain if additional staffing and equipment is required.

Section 5: Wastewater Flows and Design Criteria

This section outlines the development of sewer flows and design criteria used to evaluate the City of Pasadena's sewer system. These parameters are based primarily on information provided by the City of Pasadena, other surrounding municipalities, and engineering standard practices. The data developed and evaluated herein was used to establish flow rates for various types of land use within the City. It subsequently provides support for the calibration of the sewer system hydraulic model, and the projection of future sewer system flows within the City of Pasadena's service area. The future sewer flows are used in subsequent sections to evaluate the adequacy of existing collection/pumping system facilities and to identify the need for additional facilities to meet future loading conditions.

5.1 Estimation of Sewer Flows

In the recent decade, the City of Pasadena has experienced increased population growth and a continued trend of redevelopment. To develop current wastewater loads and loading factors, flow estimates were prepared using data received from various sources and correlated to develop appropriate wastewater flows to be used in this study. The sources and results of this analysis are discussed in the following sections.

5.1.1 Temporary Flow Monitoring Program

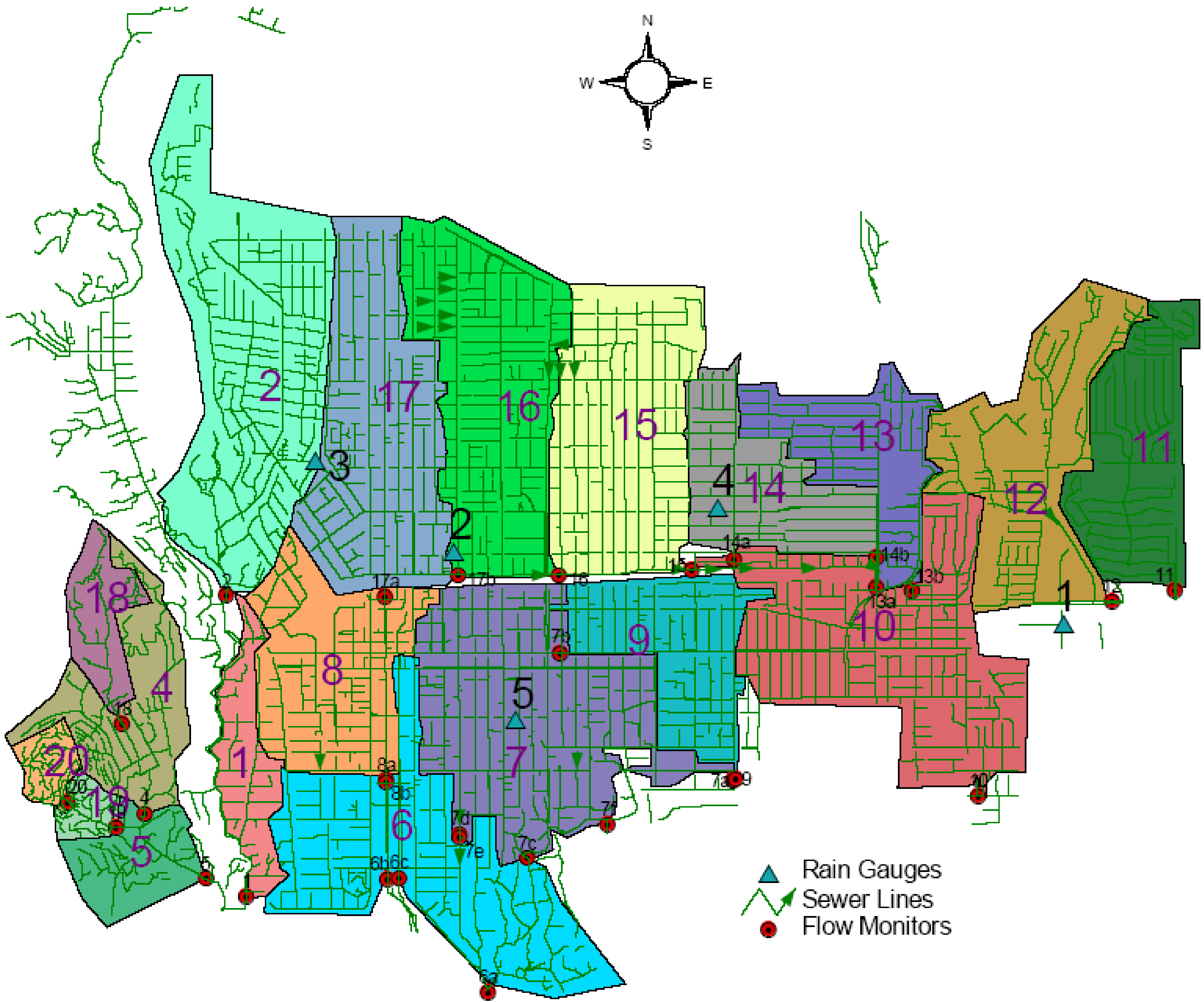
To provide a comprehensive assessment of sewer flow within the City of Pasadena, an extensive flow monitoring program was planned and conducted by KJ in association with ADS Environmental, Inc. (ADS). There were two primary objectives of the temporary flow monitoring program: 1) establish average and peak sewer values at key locations within the system for calibration of the computerized hydraulic model, including land use loading factors 2) obtain measured data during the rainy winter season to evaluate the impact of wet-weather conditions on sewer system flows.

5.1.1.1 Temporary Flow Monitoring Plan

Based on the above-mentioned prescribed purposes, a flow monitoring plan was prepared using the newly-created GIS data, as described in Section 3. Monitor points were selected such that flow basins created by those points were hydraulically isolated from each other. As a result of the relatively large number of manholes with flow splits within the City of Pasadena's downtown areas, multiple monitor points were often required to capture all of the flow from a given basin.

Ultimately, 30 monitors were placed to divide the City into 20 basins. The components of the flow monitoring plan are shown in Figure 5-1. The specific locations of the temporary flow monitors are given in Table 5-1. The basic properties of each basin, including approximate number of linear feet of pipe and number of acres contained in each basin, as well as the "basin arithmetic" required to isolate each basin, are shown in Table 5-2. The relationship of the monitoring sites to the derived basins is graphically in Figure 5-2.

Each monitor site was chosen and then field-tested by ADS personnel. Field tests were done to ensure that the site was both accessible for proper meter location and hydraulically stable enough to provide accurate, consistent results. In order to most efficiently capture all sewer flow generated within the City of Pasadena, some flow monitors were placed in LACSD and San Marino sewer lines. In such cases, appropriate personnel from these agencies were called upon to help with monitor installation. In addition to the 30 flow monitors, ADS field personnel installed five rain gauges on City of Pasadena-owned locations. These rain gauges divide the City in appropriate rainfall basins for the rainfall dependant inflow and infiltration (RDII) portion of the study. The locations of rain gauges are shown on Figure 5-1. The flow monitors and rain gauges captured data between February 16 and March 23, 2005.



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FLOW MONITORING PLAN COMPONENTS

Figure 5-1

Table 5-2: City of Pasadena Temporary Flow Monitoring Study Monitor Locations

Site Name	Manhole No.	Measured Pipe Diameter	Address
PAS GRA01	1602-123	9.88	1215 S. GRAND AVE.
PAS ARR02	1507-114	16.25	360 N. ARROYO.IN GRASS S. OF AQUATIC CTR.
PAS LAG04	1404-244	11.75	575 LAGUNA
PAS LAG05	1502-109	14.75	1107 LAGUNA
PAS LOS06A	N/A	18.38	1860 LOS ROBLES S. OF MISSION ST.
PAS RAY06B	N/A	15.50	85 E. State ST., E. OF TRACKS
RAYO6C	1702-106	30.00	S.W. Corner of Glenarm @ S. Arroyo Pkwy.
PAS COLO7B	1906-109	11.63	INTERSECTION: COLORADO @ MENTOR AVE.
HIL07C	N/A	15.25	1100 Hillcrest (@Wentworth Ave.), Pasadena., CA
ROB07D	1803-112	18.00	894 Los Robles, Pasadena., CA
ROB07E	1803-114	8.38	915 Los Robles (N.of Alpine), Pasadena, CA
ROS07F	2003-108	16.00	855 Rosalind@Driveway, Pasadena., CA
PAS RAY08A	1704-126	15.25	620 RAYMOND N. OF PICO ST.
RAY08B	1704-131	16.50	Raymond @Pico St. (intersection), Pasadena., CA
PAS ALL09A	N/A	15.25	ALLEN AVE. (Btwn Lombardy and Orlando)
PAS ALL09B	N/A	11.75	ALLEN AVE. (Btwn Lombardy and Orlando)
PAS LOM10	N/A	27.00	3105 LOMBARDY @ SYDNEY ST.
PAS MIC11	2607-101	8.00	MICHILLINDA 287'N. OF FOOTHILL BLVD.
PAS F0012	N/A	23.25	3601E. FOOTHILL BLVD. (IN SIDEWALK NEXT TO LIGHT POLE)
PAS ALT13A	2307-113	7.38	300 N. ALTADENA S. OF 210 W IN MEDIAN
PAS VIN13B	2307-123	8.38	2689 Mataro (in Vine Alley)
PAS ALL14A	2108-146	8.00	436 N. ALLEN @WAGNER
PAS ALT14B	2308-150	18.50	433 N. ALTADENA S. OF VILLA
PAS MAP15	2108-167	41.38	MAPLE @SIERRA BONITA N. OF FWY 210
PAS MAP16	1908-158	29.88	MAPLE @MENTOR
PAS RAY17A	1707-112	15.00	RAYMOND AVE. @CHESTNUT
PAS MAP17B	N/A	26.88	MAPLE ST. @N. EUCLID ST.
PAS ANN18	1405-133	8.00	96 ANNANDALE S. OF COLORADO
PAS LAL19	1403-124	8.25	1339 LA LOMA
PAS LAL20	1404-214	8.13	1587 LA LOMA (AT JUNNIPER)
PAS RG01	Rain Gauge		180 N. HALSTEAD ST.
PAS RG02	Rain Gauge		Villa Street (at Villa Park)
PAS RG03	Rain Gauge		225-349 W MOUNTAIN ST.
PAS RG04	Rain Gauge		DUNHAM ST. ALLEY
PAS RG05	Rain Gauge		541 OAK KNOLL AVE, (IN ALLEY)

Table 5-3: City of Pasadena Temporary Flow Monitoring Basin Summary Information

BASIN INFORMATION SUMMARY				
Basin	Associated Meters	Upstream Meters	Basin Piping (linear Feet)	Basin Area (Acres)
1	1		31,711	251
2	2		143,102	1,272
4	4	18	50,899	427
5	5	4, 19	24,900	243
6	6a, 6b, 6c	8a, 8b, 7c, 7d, 7e	128,502	970
6a*	6a	7c, 7e	53,285	464
6c*	6c	8a, 7d	54,906	370
7	7a,7b,7c,7d,7e,7f		201,975	1,094
8	8a, 8b	17a	92,921	648
8a*	8a	17a	75,000	518
9	9	7b	75,880	485
10	10	13a, 13b, 14a, 14b	166,654	1,098
11	11		70,873	572
12	12		78,577	782
13	13a, 13b		64,593	450
14	14a, 14b		67,444	467
15	15	16	113,833	864
16	16	17b	139,686	930
17	17a, 17b		122,929	890
18	18		17,147	192
19	19	20	15,009	70
20	20		18,920	85

5.1.1.2 Temporary Flow Monitoring Results

Sewer flow and rainfall data was captured at 15-minute intervals throughout the study period. The raw flow and rainfall data was developed into base infiltration (BI), average dry weather flow (ADWF), peak dry weather flow (PDWF), and peak wet weather flow (PWWF) factors for each monitor and basin. A full description of this process and its results can be found in Volume 2 of this Master Sewer Plan. The flow factors relevant to the sewer system hydraulic model are discussed in more detail below.

In general, the flow monitoring study found the City of Pasadena's sewer collection system to be reasonably tight with respect to I&I. However, the study did find some individual basins with both high BI and RDII values. These basins include portions of the downtown areas and the Laguna area west of Arroyo Seco. The City is aware of and has ongoing investigation programs in place for these areas of high infiltration. In addition, specific pipeline improvements are made in Section 7 of this report that ameliorate capacity insufficiencies caused by high infiltration.

5.1.2 Base Infiltration

Base infiltration was calculated from monitor data as described in Volume 2 of this Master Sewer Plan. Base infiltration factors were developed on a per-basin basis by dividing the base infiltration flow rate by the linear footage of pipe in the basin. Table 5-3 gives the results of this calculation.

Table 5-4: Basin Base Infiltration (BI) Factors

Basin	BI (gpd/lf)
01	1.55
02	1.41
04	2.89
05	0.07
06	6.74
07	2.67
08	4.61
09	1.8
10	0.88
11	0.94
12	5.66
13	0.31
14	1.12
15	1.53
16	2.11
17	2.62
18	2.49
19	2.03
20	0.72

5.1.3 Existing Average Dry Weather Flow Development

Exisiting average dry weather flow factors in the City of Pasadena were developed integrating GIS, water billing, and flow monitoring data available during this Master Sewer Plan. Average water billing data from January, February, and March 2005 were applied to each parcel within the City of Pasadena. Return-to-sewer ratios were applied to each parcel. These ratios were adjusted to achieve calibration at each of the 30 flow monitors utilized throughout the City. Table 5-4 shows the results of this process assembled by Master Plan Zone Classification.

In the course of the parcel-level sewer flow development, investigation of high water users was made to increase the accuracy of the spatial location of these important accounts. Appendix D contains the tables developed for high water users within the City of Pasadena.

5.1.4 Future Average Dry Weather Flow Development

When the growth in units and net building square footage as described in Section 2 are applied to flows, future ADWF shows a 24% increase from existing. This value corresponds consistently to the ultimate growth indicated in the City's Water Master Plan (MWH, 2005). Table 5-5 shows these values.

Table 5-5: City of Pasadena Existing ADWF by MP Zone Classification

	Master Sewer Plan Zone	Acreage	Acreage %	Net Building Square Footage	Dwelling Units	Existing ADWF (gpd)	Existing ADWF per acre (gpd/ac)	Existing ADWF per DU (gpd/du)
Residential	RS1	71	0.60%	0	43	8,322	118	194
	RS2	1,125	9.57%	0	1,216	358,344	319	295
	RS4	1,187	10.10%	0	3,428	1,553,207	1,309	453
	RS6	2,932	24.96%	0	16,455	3,878,911	1,323	236
	RM12	390	3.32%	0	4,292	948,836	2,431	221
	RM16	346	2.95%	0	4,286	914,085	2,641	213
	RM16-1	69	0.58%	0	801	234,285	3,419	292
	RM16-2	22	0.19%	0	584	103,312	4,637	177
	RM32	335	2.85%	0	7,126	1,283,641	3,832	180
	RM48	132	1.12%	0	3,967	570,283	4,335	144
	CG-RES	13	0.11%	0	104	18,756	1,483	180
	CO-RES	13	0.11%	0	275	39,471	3,064	144
	CL-RES	23	0.19%	0	260	56,085	2,468	216
	PS-RES	61	0.52%	0	433	95,339	1,572	220
	CD-RES	148	1.26%	0	5,713	1,058,730	7,130	185
	ECSP-RES	4	0.03%	0	38	19,858	5,251	523
	EPSP-RES	9	0.07%	0	120	21,659	2,530	180
	FGSP-RES	30	0.25%	0	508	124,494	4,214	245
	PD-RES	103	0.88%	0	1,443	165,035	1,599	114
	WGSP-RES	2	0.02%	0	22	362	149	16
Non-Residential	CG-NON	94	0.80%	1,994,329	442	121,502	1,298	
	CO-NON	18	0.16%	313,054	11	14,646	795	
	CL-NON	116	0.99%	4,171,679	87	305,815	2,639	
	PS-NON	730	6.21%	5,166,245	258	242,297	332	
	CD-NON	394	3.36%	16,766,826	1,124	1,543,661	3,914	
	ECSP-NON	123	1.05%	3,311,155	740	206,904	1,685	
	EPSP-NON	238	2.03%	7,007,541	57	283,746	1,191	
	FGSP-NON	95	0.81%	1,633,141	84	237,840	2,493	
	PD-NON	175	1.49%	2,712,604	326	179,257	1,022	
	WGSP-NON	57	0.48%	818,265	10	31,278	553	
	IG	88	0.75%	1,725,010	36	201,652	2,280	
	OS	2,350	20.01%	77,462	6	23,527	10	
	Unclassified	255	2.17%	0	123	0	0	
	Total	**11,747**	**100.00%**	**45,697,311**	**54,418**	**14,845,141**	**1,264**	

Table 5-6: City of Pasadena Future ADWF by MP Zone Classification

	Master Sewer Plan Zone	Acreage	Existing ADWF (gpd)	Future ADWF (gpd)	Percent Increase (%)
Residential	RS1	71	8,322	17,422	109.35%
	RS2	1,125	358,344	474,382	32.38%
	RS4	1,187	1,553,207	1,577,261	1.55%
	RS6	2,932	3,878,911	3,926,019	1.21%
	RM12	390	948,836	1,076,752	13.48%
	RM16	346	914,085	1,038,501	13.61%
	RM16-1	69	234,285	266,961	13.95%
	RM16-2	22	103,312	114,642	10.97%
	RM32	335	1,283,641	1,503,463	17.12%
	RM48	132	570,283	675,882	18.52%
	CG-RES	13	18,756	18,904	0.79%
	CO-RES	13	39,471	50,169	27.10%
	CL-RES	23	56,085	59,380	5.88%
	PS-RES	61	95,339	100,967	5.90%
	CD-RES	148	1,058,730	1,751,054	65.39%
	ECSP-RES	4	19,858	22,802	14.83%
	EPSP-RES	9	21,659	28,579	31.95%
	FGSP-RES	30	124,494	142,626	14.56%
	PD-RES	103	165,035	179,776	8.93%
	WGSP-RES	2	362	8,126	2145.00%
Non-Residential	CG-NON	94	121,502	134,814	10.96%
	CO-NON	18	14,646	26,504	80.97%
	CL-NON	116	305,815	356,896	16.70%
	PS-NON	730	242,297	377,732	55.90%
	CD-NON	394	1,543,661	2,550,341	65.21%
	ECSP-NON	123	206,904	330,178	59.58%
	EPSP-NON	238	283,746	520,378	83.40%
	FGSP-NON	95	237,840	262,890	10.53%
	PD-NON	175	179,257	223,914	24.91%
	WGSP-NON	57	31,278	164,716	426.61%
	IG	88	201,652	392,447	94.62%
	OS	2,350	23,527	40,320	71.38%
	Unclassified	255	0	0	
	Total	**11,747**	**14,845,141**	**18,414,798**	**24.05%**

5.1.5 Sewer Flow Peak Factors

As described above, average flows entering the sewer collection system are assessed by correlating land use types with associated flow generation factors that have been calibrated to flows measured during a flow monitoring program. However, further determination of the adequacy of the wastewater system is based upon the ability of the system to convey peak wastewater flows. Peak flows include both peak dry weather and peak wet weather flows. The development of the peak factors that relate average flows to peak flows within the City of Pasadena is described below.

5.1.5.1 Peak Dry Weather Flow Factors

Peak dry weather flow results from the natural patterns of sewer system usage indicated in typical residential and non-residential dischargers to the sewer system. These patterns result in a diurnal discharge curve for each user; the combination of these diurnal discharge curves developed throughout a sewer basin result in a characteristic diurnal flow curve at the monitor that measures the flow in that basin.

The City of Pasadena's Temporary Flow Monitoring Study developed a characteristic diurnal curve at each monitor. These curves were developed by averaging the flows for days deemed "dry" according the rainfall data captured by the five rain gauges monitored as part of the study. The dry day monitor diurnal curves can be found in Appendix B of Volume 2. For each monitor, the peak flow value shown on the diurnal curve was compared to the average dry flow value measured at the given monitor. The ratio of these values provides the average peak dry weather flow factor experienced in the basin drained by the monitor. These factors are shown in Table 5-6.

Table 5-7: Peak Dry Weather Flow Factors

Basin	PDWF Peak Factor
0	1.5
1	1.6
2	1.65
4	1.32
5	1.51
6	1.41
6a	1.41
6b	1.48
6c	1.39
7	1.53
7a	1.45
7b	1.45
7c	1.74
7d	1.70
7e	1.71
7f	1.40
8	1.46
8a	1.37
8b	1.87
9	1.55
10	1.56
11	1.61
12	1.54
13	1.98
13a	2.82
13b	1.98
14	1.83
14a	1.96
14b	1.81
15	1.55
16	1.50
17	1.46
17a	1.34
17b	1.48
18	1.58
19	2.85
20	1.64

5.1.5.2 Peak Wet Weather Flow Factors

Peak wet weather flow factors measure a sewer collection system's response to Rain Dependent Inflow and Infiltration (RDII). Such precipitation enters the sewer collection system through inflow (direct connections such as manhole covers and illegal storm connections) and infiltration (broken and cracked pipes and leaky joints). The amount of RDII that enters a sewer collection system during any given wet weather event depends both on the total amount of precipitation that falls over the collection system and on the "leakiness" of that collection system.

Thus, quantification of peak wet weather flow factors for a given sewer collection system requires the integration of two elements: the identification of a "design" amount of precipitation ("design storm") to use in the calculations, and the calculation of the amount of precipitation from the design storm that will enter the sewer collection system. The selection of a design storm is a process that combines the analysis of probabilistic risk of a given storm to the collection system (in terms of surcharge and/or flooding) with the balancing factor of the economic consequences of over designing the collection system. The calculation of flow entering the collection system is made using baseline factors established during the temporary wet weather flow monitoring study.

The City of Pasadena chose as a design storm a precipitation event with a 5-year recurrence interval. Statistically, there is a 20% chance any given year that a storm of this intensity will take place. The intensity and recurrence interval of the storm were determined from the *Precipitation-Frequency Atlas of the Western United States* (NOAA Atlas 2, Volume XI. 1973). The intensity of the 5 year design storm corresponds to 1.15 inches per hour sustained for 1 hour, or 0.67 inches per hour sustained for 6 hours.

The City of Pasadena Temporary Flow Monitoring Study calculates the response of the City's collection system to precipitation on a basin by basin basis. As described in Section 3 of this Master Sewer Plan, some basins within the City showed significantly more response to precipitation. This response was quantified by normalizing the amount of precipitation entering a basin by the amount of sewer pipe in the basin. The result is a wet weather flow factor, calculated in gpd/linear foot of pipe, which describes the amount of precipitation entering a specific area of the collection system. As described in Volume 2 of this study, Storm 2 captured during the temporary flow monitoring period was classified as a 5-year storm. The basin by basin response of the City's sewer collection system to Storm 2 was normalized by linear feet of pipe in each basin. Table 5-7 shows each basin's normalized response (Peak Wet Weather Flow Factor) to the 5-year design storm.

Table 5-8: City of Pasadena Peak Wet Weather Flow Factors

Basin	PWWF (gpd/lf)
1	51.71
2	15.51
4	23.57
5	5.62
6	52.69
7	10.99
8	3.69
9	11.05
10	5.28
11	7.05
12	7.63
13	0.92
14	0.59
15	5.97
16	11.88
17	5.85
18	68.81
19	27.98
20	9.51

5.2 Sewer System Design/Capacity Criteria

In analyzing a sewer collection system, it is necessary to derive standards regarding the amount of flow that may be efficiently conveyed by any given component: gravity main, pump station, force main. At the time of collection system design and/or evaluation, there is often some uncertainty as to future development patterns within the area to be served. To deal with this uncertainty, provision is usually made for some extra capacity to allow for the possibility of actual system flows being slightly higher than the anticipated flows. The following sections describe the design/capacity criteria used on the evaluation of the City of Pasadena Sewer Collection System as part of this Master Sewer Plan.

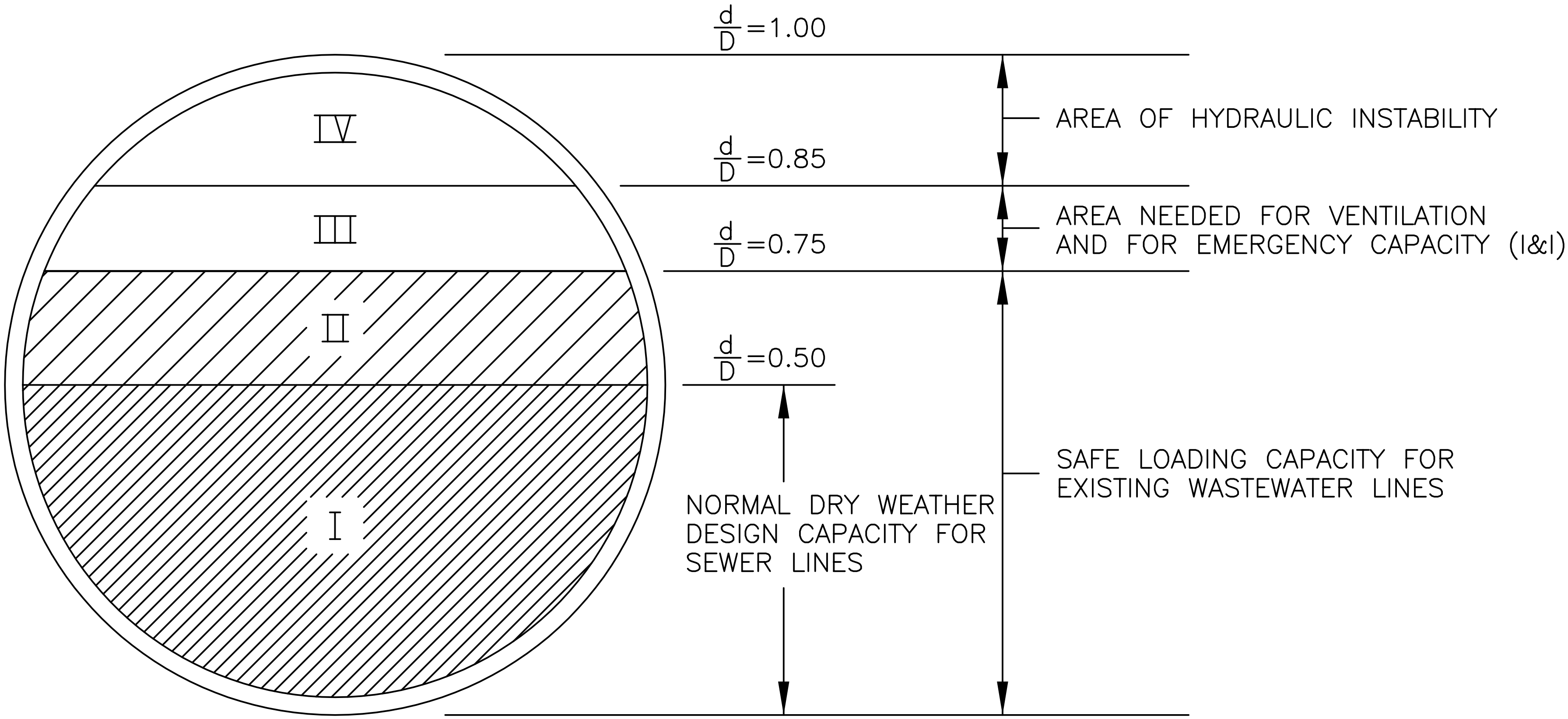
5.2.1 Gravity Pipeline Design Criteria

5.2.1.1 Capacity

Figure 5-2 shows a typical cross section of a sewer pipeline. The National Clay Pipe Institute (NCPI) recommends that smaller pipelines (8" and smaller) be designed to flow at levels not exceeding half-full (d/D=0.50) during peak conditions, as shown in Zone I on Figure 5-2. For larger pipelines, the tributary area is larger. Local deviation from design wastewater flows tend to balance one another for larger areas, resulting in a closer correlation of actual and design wastewater flows. Consequently, the NCPI recommends that these larger wastewater pipelines should be designed for a d/D not to exceed 0.75.

In analyzing existing wastewater pipelines, it is usually unnecessary to allow for a large factor of safety. This is because tributary areas are largely built out, future development patterns are relatively certain, and flow rates can be obtained by flow monitoring these facilities. Therefore, the wastewater pipelines may be flowing at levels above a design d/D of 0.50 and still be operating satisfactorily.

Zone III of Figure 5-2 has been reserved to handle emergency flows such as I&I beyond that planned for in a design storm and to provide for ventilation within the pipe. Zone IV should not be considered a component of the pipeline capacity. At a depth to diameter ratio of 0.82, the wastewater pipeline capacity is the same as it would be if it were flowing full (d/D=1.00), because the additional area of flow is counteracted by the added friction between the top (soffit) of the wastewater pipeline and the fluid. Maximum capacity of a pipeline occurs at d/D=0.93.



TYPICAL PIPELINE LOADING CONDITIONS

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Master Sewer Plan

TYPICAL PIPELINE LOADING CONDITIONS

K/J 0485010

Figure 5-2

As discussed above, the City of Pasadena's sewer collection system shows varying dry weather peak factors and varying response to wet weather (wet weather peak factors). As a result, in some areas of the City, peak dry weather flow controls capacity as described above, and in other areas peak wet weather flow is the controlling factor. Because of this, the City of Pasadena requires design and capacity factors that incorporate both flow scenarios. The following describes the City of Pasadena's design and capacity factors:

- A pipe shall be considered to have insufficient operational capacity if the modeled PWWF in this pipe results in d/D >= 0.75

- A pipe shall be considered to have insufficient operational capacity if the modeled PDWF in this pipe results in d/D >= :

  - 0.67 for all pipes greater than or equal to 15" in diameter
  - 0.60 for all pipes 12" in diameter
  - 0.55 for all pipes 10" in diameter
  - 0.50 for all pipes less than or equal to 8" in diameter

- All pipes evaluated to have insufficient operational capacity will be designed to a d/D=0.50 for the PDWF scenario and to a d/D=0.67 for the PWWF scenario

5.2.1.2 Minimum Velocity

From an operational perspective, a minimum peak flow velocity of 2.0 fps at PDWF is desirable to adequately scour the pipeline and prevent significant solids deposition. Pipelines in the system that do not develop adequate cleansing velocity (flat pipelines, low spots, or pipelines with low flow) should be given priority status in the City of Pasadena's pipeline cleaning program.

5.2.2 Pump Station and Force Main Design Criteria

The evaluation of a wastewater pump station is based on two primary criteria. These criteria include the ability of the pump station to reliably pump the PWWF and wet well adequacy for pump cycling.

5.2.2.1 Capacity

The design pump capacity requirement is consistent with methodology used in the collection system model. A pump station will be considered over capacity if it cannot pump the PWWF with one pump out of service and the remaining pumps operating at 75% of the station's rated capacity. The remaining 25% capacity is allocated for I&I predicted for the 5-year design storm, reserve capacity contingency, and variation in wastewater flow. Standby power provisions are also an integral element of the pump station reliability.

In addition to the pump station capacity and wet well cycling considerations, the force mains in the City's system should be managed to conform to maximum velocity criteria. Based on discussions with City staff, the design criteria used for these facilities in this study is a maximum of 8 feet per second.

5.2.2.2 Cycling

Wet well adequacy is analyzed in terms of maximum pump cycles per hour. A typical pump motor is designed for a maximum of six starts or cycles per hour. If the motor is started more than six times in an hour, it may overheat the motor starters, causing them to wear prematurely and fail. The maximum number of cycles per hour corresponds to the minimum cycle time, which is calculated using the pumping rate, the wet well dimensions, and the pump on/off control points. The cross-sectional area of the wet well and the pump control points determine the operational wet well volume. For example, when the wastewater in the wet well reaches the pump's upper control point, the pump turns on and draws down the wet well wastewater level. When the wastewater level reaches the pump's lower control point, the pump turns off and the wet well begins to refill.

The time between pump starts is the cycle time. The minimum cycle time occurs when the flow rate into the wet well is half the pumping rate. Under these conditions, the water level in the wet well rises between pump control points in x minutes, would be pumped down in x minutes, and the cycle time would be 2x minutes.

Section 6: Sewer System Evaluation

This section evaluates the City of Pasadena's existing sewer collection system's ability to convey existing peak dry and peak wet weather flows from current land uses; and future peak dry and peak wet weather flows associated with redevelopment and new development of vacant lands in accordance with City planning projections, as discussed above.

6.1 Overview

The wastewater collection system was evaluated for existing and future conditions using a hydraulic model called H20Map Sewer, a computer simulation model developed by MWH Soft, Inc. The model is developed using the physical system information obtained from the City's newly-created GIS and further reconciled through the conduct of this study. Land use type and flow tributary to system manholes are then linked, and average flows are calculated using the general and specific flow generation criteria presented in Section 5. Collection pipelines and pump stations are evaluated based on their ability to convey the projected peak dry and peak wet weather flow.

Although the City of Pasadena's pump stations are included in the wastewater hydraulic model for connectivity, they are not evaluated by the hydraulic model. Both the Rosemont and Busch Garden Pump Stations are evaluated separately, using the flow information developed in the model and data collected in the field. Potential hydraulic concerns or deficiencies within the existing system are identified under current and future flow conditions and recommendations are provided for the potential remediation of these facilities.

As discussed, a system-wide design capacity contingency is established in the model to provide flexibility for variations in flows and to accommodate future redevelopment projects. The concept of a capacity contingency is a common consideration to account for the undefined size and location of future redevelopment projects and should provide flexibility for redevelopment within the City. Actual redevelopment projects should be evaluated by the City of Pasadena on a case-by case basis. As such, some especially large or high density projects may require specific capacity improvements to provide adequate service.

6.2 Collection System Evaluation

An integral component of the collection system evaluation is the use and development of a sewer system hydraulic model. The model used for the City's system was H20Map Sewer. The program transforms physical system information, flow generation criteria, and analytical criteria into a mathematical model that simulates hydraulic conditions in the sewer system. H20Map Sewer is a dynamic computer model that simulates the hydraulic conditions of the gravity flow collection system. Flows are loaded into the model at each manhole and are summed along each flow path. In addition, the model calculates the capacity of each pipeline within the system and compares the pipeline capacity with the calculated flow to identify potentially hydraulically deficient conditions and to size possible future improvements.

The construction of a hydraulic model in H20Map Sewer requires the development and integration of two separate system elements. These elements include the sewer facility data files and the sewer flow loading data file. H20Map Sewer is designed to read the appropriate characteristics of each system file, integrate the unique linkage among the data elements, and develop the hydraulic simulation of the wastewater conveyed throughout the collection system. Each of these modeling data files are discussed in the following sections.

6.2.1 Sewer Facilities Data Sets

The facility data file is comprised of the physical elements of the sewer system to be modeled. Physical elements include pipeline diameter, roughness, length, slope, and invert elevations in the collection system, and operations data for the pump station. In H20Map Sewer, these physical elements are stored spatially in native shapefile format. The non-spatial attributes are stored in a linked H20Map Sewer (.hsw file). As previously discussed, these physical elements were imported from pipeline and manhole GIS shapefiles. The shapefiles were developed from the GIS development portion of this project, described in Section 3.

Because the number of physical elements (pipelines and manholes) in the City of Pasadena's system fell well within the limits of what could be computed efficiently by H20Map Sewer 9000 link version, every pipeline within the City of Pasadena's system (excluding laterals) was included and simulated in the hydraulic model. Developing the model in this manner provided for a highly accurate model, because wastewater flows were loaded into the model near their actual physical location of connection, rather than being aggregated into manholes on a downstream trunk line.

6.2.2 Sewer Model Loading Data Files

The H20Map Sewer hydraulic modeling platform loads base and peak dry weather flow at the manholes throughout the modeled system. The loading data files consist of a Microsoft Excel spreadsheet that lists the ID number of each manhole in the system and the wastewater load to be assigned to that manhole in the model.

The base infiltration (BI), developed as part of the flow monitoring program as described in Section 5, was assigned in the model to specific pipes based upon basin location. GIS analysis was used to assign a basin identifier to each sewer line within the City's system, thereby applying the appropriate basin BI factor to each pipeline. This factor, when multiplied by the total length of the pipe, produces the total amount of inflow and infiltration experienced by the pipe under peak wet weather conditions. Thus, unlike average and peak dry weather loadings, which were assigned to system manholes, the BI loads were assigned to each sewer pipeline within the City's system.

The ADWF load assigned to each manhole in the Excel file is calculated using spatial relationship functions in the GIS. As discussed in Section 5, the wastewater load for each parcel in the City was calculated using water billing records, return-to-sewer ratios, and flow monitoring calibration adjustment factors. The load from each parcel was then assigned to the nearest manhole using GIS spatial analysis tools. A visual manual review of spatial data and lateral locations was subsequently performed to correct those parcels which were not loaded to the correct area through the automated assignment routine. Several loads were added to the model separate from this GIS-based process. These loads include flow from the Rose Bowl, which has a unique loading pattern.

Peak dry weather loads in the City of Pasadena were calculated by multiplying the base average loads by the dry weather peak factors developed during the flow monitoring program. The applicable peak factors were based on the unique basin characteristics, as described in Section 5. A GIS overlay analysis was used to assign each manhole in the City's system to a basin. The appropriate and relevant peak factor was subsequently applied to the average dry weather load at each manhole, resulting in a peak load to incorporate in the hydraulic model.

The flow monitoring program was also used to develop peak wet weather flow factors for the wastewater loading data files. As described in Section 5, the wet weather flow monitoring program was used to calculate an inflow and infiltration value based upon linear feet of sewer line. Since the inflow and infiltration value was developed per basin, GIS analysis was used to assign a basin to each sewer line within the City's system, thereby applying the appropriate basin inflow and infiltration factor to each pipeline. This factor, when multiplied by the total length of the pipe, produces the total amount of inflow and infiltration experienced by the pipe under peak wet weather conditions. Thus, unlike average and peak dry weather loadings, which were assigned to system manholes, the peak wet weather loads were assigned to each sewer pipeline within the City's system. As such, the wet weather modeling simulations have flows based on peak dry weather loads assigned to manholes and peak wet weather loads assigned to pipelines.

6.2.3 Hydraulic Modeling Scenarios

Six separate scenarios were run to assess the capacity of the City of Pasadena sewer collection system:

- Existing Average Dry Weather Flow (ADWF)
- Existing Peak Dry Weather Flow (PDWF)
- Existing Peak Wet Weather Flow (PWWF)
- Future Average Dry Weather Flow (ADWF)
- Future Peak Dry Weather Flow (PDWF)
- Future Peak Wet Weather Flow (PWWF)

As described in Section 5, the future scenarios correspond to flows projected to the planning horizon of the City of Pasadena Comprehensive General Plan.

6.2.4 Hydraulic Model Calibration

Hydraulic model calibration is the process by which BI, ADWF, PDWF, and PWWF factors, as well as model connectivity and physical characteristics are adjusted such that modeled flow under the various scenarios matches measured flows recorded during the flow monitoring study. Results that are well-calibrated for existing flow scenarios indicate that the hydraulic model represents field conditions to a high degree of accuracy. Such a model will give accurate output as future scenarios are run and will provide meaningful results to "what-if" development questions that arise as the sewer collection system is developed and grows. Table 6-1 shows the City of Pasadena Hydraulic Model calibrated under existing ADWF and existing PDWF to within 5% of flow at each of the 30 flow monitors utilized throughout the temporary flow monitoring program.

Table 6-2 shows PWWF calibration for the hydraulic model. As described above, the PWWF factors developed for the hydraulic model were developed for a 5-year design storm. Storm 2, as documented in the temporary flow monitoring program in Volume Two of this Master Sewer Plan, was classified as a 5-year storm. Thus, PWWF calibration was checked by comparing modeled PWWF to measured flows for this storm. Such a comparison is bound to be less precisely correlated than ADWF and PDWF comparisons because of the unique nature of storms and the statistical nature of the design storm concept, but reasonable calibration should show that the appropriate PWWF factors were chosen and accurately input into the model.

Table 6-1: City of Pasadena Existing ADWF and PDWF Calibration Tables

	Average Dry			Peak Dry			
Monitor	**Average Dry Flow from Model**	**Average Dry Flow from Monitor**	**% Difference**	**Peak Dry Flow from Model**	**Peak Dry Flow from Monitor**	**% Difference**	
	(mgd)	**(mgd)**		**(mgd)**	**(mgd)**		
01	0.151	0.1496	101.0%	0.242	0.239	101.12%	
02	1.239	1.2957	95.6%	2.036	2.138	95.23%	
04	0.340	0.3549	95.8%	0.471	0.468	100.55%	
05	0.489	0.5141	95.1%	0.777	0.776	100.09%	
09	0.850	0.8462	100.4%	1.354	1.312	103.23%	
06a	2.852	2.8536	99.9%	4.146	4.024	103.04%	
06b	0.582	0.5555	104.8%	0.856	0.820	104.40%	
06c	2.619	2.5091	104.4%	3.798	3.638	104.39%	
07a	1.108	1.1025	100.5%	1.586	1.640	96.71%	
07b	0.104	0.1014	102.6%	0.209	0.210	99.56%	
07c	0.110	0.1089	101.0%	0.193	0.201	95.80%	
07d	0.926	0.9144	101.3%	1.567	1.550	101.11%	
07e	0.035	0.0351	99.6%	0.061	0.060	101.49%	
07f	0.796	0.8000	99.5%	1.174	1.220	96.23%	
08a	1.083	1.0435	103.8%	1.379	1.424	96.82%	
08b	0.254	0.2429	104.6%	0.464	0.454	102.14%	
10	1.313	1.3457	97.6%	2.088	2.099	99.46%	
11	0.484	0.4656	104.0%	0.782	0.750	104.32%	
12	2.924	2.9236	100.0%	4.504	4.502	100.04%	
13a	0.019	0.0186	102.2%	0.053	0.052	101.12%	
13b	0.057	0.0554	102.9%	0.109	0.110	99.40%	
14a	0.079	0.0764	103.3%	0.153	0.150	102.12%	
14b	0.487	0.4962	98.1%	0.888	0.898	98.87%	
15	4.654	4.8145	96.7%	7.192	7.463	96.37%	
16	3.392	3.2401	104.7%	5.001	4.860	102.90%	
17a	0.241	0.2317	104.0%	0.316	0.311	101.76%	
17b	1.679	1.6533	101.6%	2.428	2.447	99.23%	
18	0.071	0.0726	97.8%	0.112	0.115	97.61%	
19	0.083	0.0806	102.9%	0.197	0.206	95.79%	
20	0.029	0.0292	99.4%	0.048	0.048	100.32%	

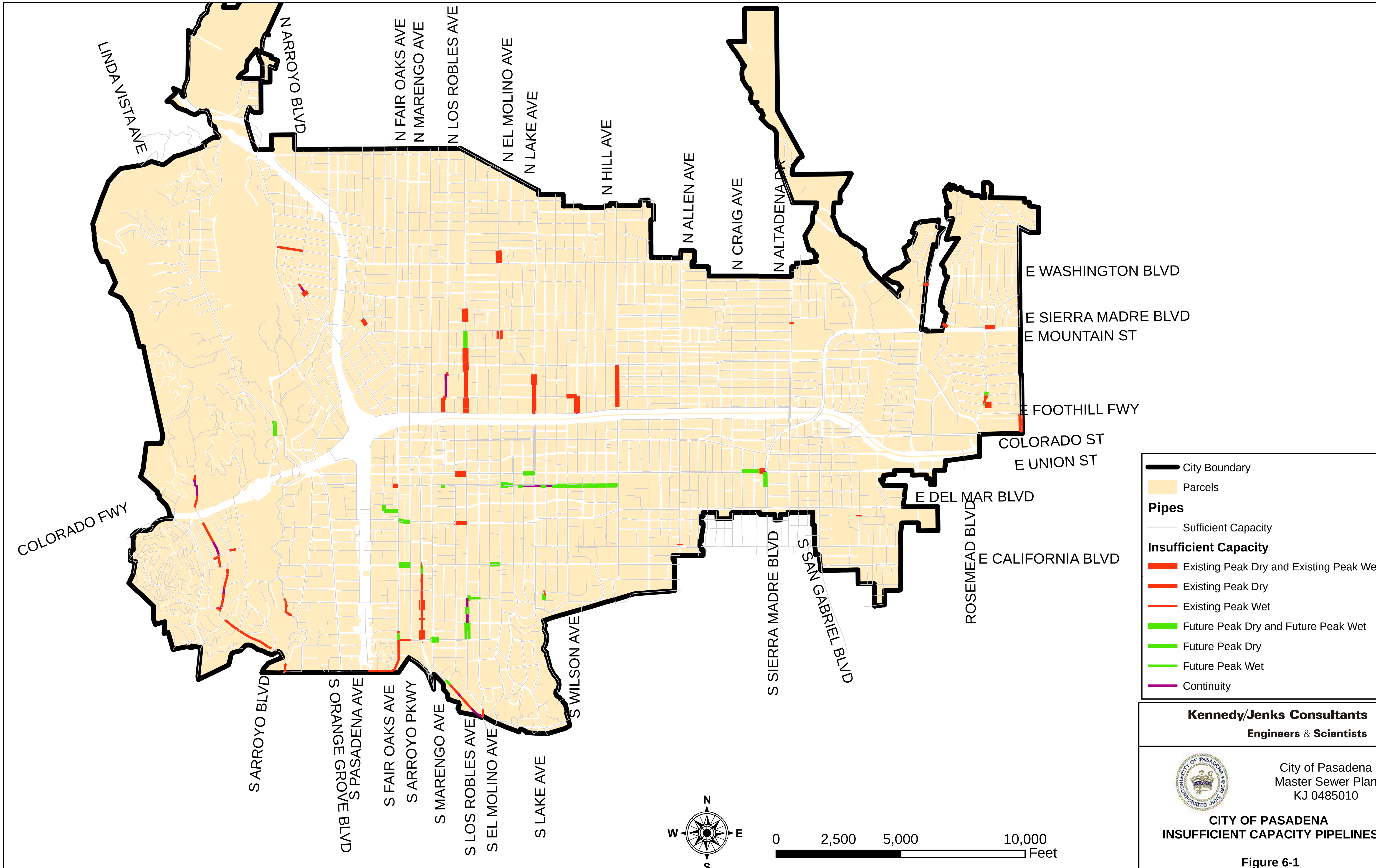
Table 6-2: City of Pasadena PWWF Calibration

Monitor	PWWF Monitor (mgd)	PWWF Model (mgd)
1	0.65	1.01
2	3.70	3.94
4	2.43	2.56
5	3.05	3.39
6a	7.25	9.99
6b	1.55	2.42
6c	7.01	7.34
7a	2.34	1.88
7b	0.25	0.26
7c	0.67	0.33
7d	2.39	2.13
7e	0.34	0.23
7f	1.70	1.76
8a	2.09	2.06
8b	0.42	0.48
9	1.86	2.00
10	2.38	2.73
11	1.02	1.20
12	4.83	4.70
13a	0.06	0.04
13b	0.14	0.12
14a	0.17	0.15
14b	0.98	0.83
15	8.45	9.41
16	5.58	6.74
17a	0.34	0.39
17b	2.62	2.82
18	1.63	1.18
19	0.72	0.66
20	0.16	0.11

6.3 Collection System Capacity Insufficiencies

Based upon the output from the sewer collection system model for the City of Pasadena, pipes with insufficient capacity were identified for the six scenarios identified above. Neither of the ADWF scenarios, existing or future, showed such lack of hydraulic capacity. This fact indicates that the capacity of the collection system has been fundamentally maintained during the City's growth and development. Nonetheless, the lack of capacity during the remaining four scenarios requires CIP improvements that should be undertaken to lower the probability of hydraulic failure under PDWF or PWWF. The CIP will be discussed in Section 7.

Figure 6-1 shows the pipes identified with insufficient capacity. The color coding indicates the scenario(s) under which the insufficient capacity has been identified. Because no sewer loads were reduced in any future scenarios, any pipes identified in a given existing scenario will have equal or worse insufficient capacity under the corresponding future scenario. A more detailed version of this map is included in 34”x44” format as an attachment to this document. Table 6-3 lists all of the identified pipe reaches shown in Figure 6-1.



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CITY OF PASADENA
INSUFFICIENT CAPACITY PIPELINES

Figure 6-1

TABLE 6-3: CITY OF PASADENA PIPELINES WITH INSUFFICIENT CAPACITY

Facility ID	From ID	To ID	From Location	To Location	Diameter (in)	Length (ft)
14061042	1406-115	1406-119	150 PATRICIAN WAY	1 N SAN RAFAEL AVE	8	235
14061051	1406-120	1406-123	1 N SAN RAFAEL AVE	126 PATRICIAN WAY	8	381
14061052	1406-119	1406-120	1 N SAN RAFAEL AVE	1 N SAN RAFAEL AVE	8	60
14061041	1406-111	1406-115	170 PATRICIAN WAY	150 PATRICIAN WAY	8	205
14061049	1406-126	1406-128	122 PATRICIAN WAY	52 PATRICIAN WAY	8	326
14061050	1406-123	1406-126	126 PATRICIAN WAY	122 PATRICIAN WAY	8	163
14051031	1405-180	1405-196	234 ANNANDALE RD	272 ANNANDALE RD	8	279
14051032	1405-168	1405-180	186 ANNANDALE RD	234 ANNANDALE RD	8	280
14041142	1405-196	1404-106	272 ANNANDALE RD	NITHSDALE RD & GLEN SUMMER RD	8	80
14041143	1404-106	1404-108	NITHSDALE RD & GLEN SUMMER RD	NITHSDALE RD & GLEN SUMMER RD	8	5
14041144	1404-119	1404-141	326 GLEN SUMMER RD	326 GLEN SUMMER RD	8	294
14041145	1404-108	1404-119	NITHSDALE RD & GLEN SUMMER RD	326 GLEN SUMMER RD	8	145
14041146	1404-116	1404-106	NITHSDALE RD & GLEN SUMMER RD	NITHSDALE RD & GLEN SUMMER RD	8	227
14051026	F89171	1405-133	GRADE BREAK	96 ANNANDALE RD	8	268
14051029	1405-133	1405-150	96 ANNANDALE RD	142 ANNANDALE RD	8	280
14051033	1405-150	1405-168	142 ANNANDALE RD	186 ANNANDALE RD	8	280
14051046	1405-120	F89171	48 ANNANDALE RD	GRADE BREAK	8	48
15051007	1505-156	1505-162	1034 NITHSDALE RD	NITHSDALE RD & SAN MIGUEL RD	8	279
14031001	1403-122	1403-130	660 LAGUNA RD	LA LOMA RD & LAGUNA RD	15	50
14041010	1404-244	1403-102	575 LAGUNA RD	LA LOMA RD & LAGUNA RD	12	39
14041153	1504-148	1404-225	LAGUNITA ROAD & LAGUNA ROAD	560 LAGUNA RD	10	214
14031079	1403-125	1403-130	1257 LA LOMA RD	LA LOMA RD & LAGUNA RD	10	150
14031085	1403-102	1403-122	LA LOMA RD & LAGUNA RD	660 LAGUNA RD	10	335
14031098	1403-130	1403-140	LA LOMA RD & LAGUNA RD	680 LAGUNA RD	15	106
14041152	1404-225	1404-244	560 LAGUNA RD	575 LAGUNA RD	10	210
15041001	F89151	1504-129	GRADE BREAK	462 LAGUNA RD	10	203
15041002	1504-122	F89151	430 LAGUNA RD	GRADE BREAK	12	8
15041011	1504-121	1504-122	407 LAGUNA RD	430 LAGUNA RD	12	55
15041012	1504-117	1504-121	377 LAGUNA RD	407 LAGUNA RD	12	163
15041029	1504-133	1504-148	455 LAGUNA RD	LAGUNITA ROAD & LAGUNA ROAD	10	288
15041030	1504-129	1504-133	462 LAGUNA RD	455 LAGUNA RD	10	80
15031068	1503-162	1503-164	1000 LAGUNA RD	1020 LAGUNA RD	15	161
15021003	F89148	F89149	GRADE BREAK	GRADE BREAK	16	17
15021001	F89150	1502-104	GRADE BREAK	GRADE BREAK	15	2
15021002	1502-104	F89148	GRADE BREAK	GRADE BREAK	15	38
15021004	F89149	1502-109	GRADE BREAK	1107 LAGUNA RD	15	120
15021007	1502-112	F89176	LAGUNA RD & SAN RAFAEL AVE	GRADE BREAK	10	14
15021008	F89146	1502-112	GRADE BREAK	LAGUNA RD & SAN RAFAEL AVE	15	4
15021025	1502-117	1502-118	ARROYO BLVD & SAN RAFAEL AVE	1240 S ARROYO BLVD	14	118
15021026	1502-118	1502-119	1240 S ARROYO BLVD	1260 S ARROYO BLVD	14	187
15021027	1502-119	1502-122	1260 S ARROYO BLVD	ARROYO DR, 68 FT S/O COLUMBIA ST	14	110
15021029	1503-164	F89150	1020 LAGUNA RD	GRADE BREAK	15	159
15031005	1504-164	1503-103	802 S ARROYO BLVD	BELLEFONTAINE ST & ARROYO BLVD	8	173
15031010	1503-115	1503-121	880 S ARROYO BLVD	888 S ARROYO BLVD	10	286
15031011	1503-107	1503-115	850 S ARROYO BLVD	880 S ARROYO BLVD	10	260
15031012	1503-103	1503-107	BELLEFONTAINE ST & ARROYO BLVD	850 S ARROYO BLVD	10	132
15031065	1503-155	1503-159	GRADE BREAK	GRADE BREAK	15	284
15031066	1503-159	1503-161	GRADE BREAK	GRADE BREAK	15	212
15031067	1503-161	1503-162	GRADE BREAK	1000 LAGUNA RD	15	222
15031069	1503-143	1503-146	LAGUNA RD & ELLINGTON LN	LAGUNA RD & SAN REMO RD	10	135
15031070	1503-141	1503-143	800 LAGUNA RD	LAGUNA RD & ELLINGTON LN	10	150
15031071	1503-146	1503-155	LAGUNA RD & SAN REMO RD	GRADE BREAK	10	255
15031072	1503-135	1503-141	780 LAGUNA RD	800 LAGUNA RD	10	175
15031073	1503-132	1503-135	748 LAGUNA RD	780 LAGUNA RD	10	175
15031074	1503-131	1503-132	LAGUNA RD & BURLEIGH DR	748 LAGUNA RD	10	108
15111004	1511-103	1611-116	686 W WASHINGTON BLVD	643 W WASHINGTON BLVD	8	264
15111005	1511-101	1511-103	730 W WASHINGTON BLVD	686 W WASHINGTON BLVD	8	263
15111006	1511-100	1511-101	WASHINGTON BLVD & ARROYO BLVD	730 W WASHINGTON BLVD	8	260
16111080	1611-116	1611-118	643 W WASHINGTON BLVD	WASHINGTON BLVD & FOREST AVE	8	263
16101088	1610-106	1610-112	1144 FOREST AVE	1140 FOREST AVE	10	185
16101092	1611-176	1610-106	1165 FOREST AVE	1144 FOREST AVE	10	182
17101019	1710-160	1710-162	POPLAR LN & SUNSET AVE	SUNSET AVE, 22 FT S/E POPLAR LN	8	20
17101020	1610-159	1710-160	SUNSET AVE, 78 FT S/O GLORIETA ST	POPLAR LN & SUNSET AVE	8	269
18081066	1808-111	1808-131	589 N GARFIELD AVE	VILLA ST & GARFIELD AVE	8	500
18081067	1809-179	1808-111	PARKE ST & GARFIELD AVE	589 N GARFIELD AVE	8	440
18081063	1808-131	1808-132	VILLA ST & GARFIELD AVE	VILLA ST & GARFIELD AVE	8	108
18081064	1808-141	1808-151	417 N GARFIELD AVE	MAPLE ST & GARFIELD AVE	8	178
18081065	1808-132	1808-141	VILLA ST & GARFIELD AVE	417 N GARFIELD AVE	8	412
18091020	1809-178	1809-179	PARKE ST & GARFIELD AVE	PARKE ST & GARFIELD AVE	8	116
18081026	1808-144	1808-153	409 N LOS ROBLES AVE	389 N LOS ROBLES AVE	8	167
18081057	1808-128	1808-144	VILLA ST & LOS ROBLES AVE	409 N LOS ROBLES AVE	8	441
18091050	1809-159	1809-174	715 N LOS ROBLES AVE	650 N LOS ROBLES AVE	8	350
18091064	1809-145	1809-159	ASHTABULA ST & LOS ROBLES AVE	715 N LOS ROBLES AVE	8	383
18091065	1809-139	1809-145	BUCKEYE ST & LOS ROBLES AVE	ASHTABULA ST & LOS ROBLES AVE	8	199
18081058	1809-174	1808-105	650 N LOS ROBLES AVE	590 N LOS ROBLES AVE	8	350
18081059	1808-116	1808-128	540 N LOS ROBLES AVE	VILLA ST & LOS ROBLES AVE	8	350
18081060	1808-105	1808-116	590 N LOS ROBLES AVE	540 N LOS ROBLES AVE	8	350
18091066	1809-134	1809-139	BUCKEYE ST & LOS ROBLES AVE	BUCKEYE ST & LOS ROBLES AVE	8	42
18091067	1809-125	1809-134	808 N LOS ROBLES AVE	BUCKEYE ST & LOS ROBLES AVE	8	323
18091076	1809-112	1809-125	MOUNTAIN ST & LOS ROBLES AVE	808 N LOS ROBLES AVE	8	324
18101028	1810-125	1810-133	1033 N LOS ROBLES AVE	ADENA ST & LOS ROBLES AVE	8	391
18101029	1810-119	1810-125	JACKSON ST & LOS ROBLES AVE	1033 N LOS ROBLES AVE	8	144
18091032	1809-105	1809-126	MOUNTAIN ST & EL MOLINO AVE	864 N EL MOLINO AVE	8	346
18091010	1809-126	1809-128	864 N EL MOLINO AVE	851 N EL MOLINO AVE	8	7
18081036	1808-134	1808-135	EL MOLINO AVE, 40FT S/0 VILLA ST	EL MOLINO AVE, 56FT S/0 VILLA ST	12	16
19081001	1908-152	1908-156	MAPLE ST & LAKE AVE	MAPLE ST & LAKE AVE	8	20
19081060	1909-177	1908-112	620 N LAKE AVE	SANTA BARBARA ST & LAKE AVE	8	424
20081011	2008-152	2008-154	381 MAR VISTA AVE	MAPLE ST & MAR VISTA AVE	8	28
19091009	1909-163	1909-164	698 N WILSON AVE	ORANGE GROVE BLVD & WILSON AVE	8	4
20081028	2008-141	2008-152	411 MAR VISTA AVE	381 MAR VISTA AVE	8	219
20081049	2008-133	2008-141	435 MAR VISTA AVE	411 MAR VISTA AVE	8	151
20081050	2008-129	2008-133	VILLA ST & MAR VISTA AVE	435 MAR VISTA AVE	8	289
19081037	1908-122	2008-129	VILLA ST & WILSON AVE	VILLA ST & MAR VISTA AVE	8	416
20081054	2008-128	2008-134	VILLA ST & HILL AVE	429 N HILL AVE	8	331
20081053	2008-134	2008-140	429 N HILL AVE	409 HILL AVE	8	95
20081055	2008-104	2008-116	609 N HILL AVE	HILL AVE & MONTE VISTA ST	8	401
20081059	2008-116	2008-128	HILL AVE & MONTE VISTA ST	VILLA ST & HILL AVE	8	400
20091022	2009-139	2008-104	ORANGE GROVE BLVD & HILL AVE	609 N HILL AVE	8	467
17061058	1706-159	1706-157	GREEN ST & MILLS PL	GREEN ST & FAIR OAKS AVE	10	219
17051057	1705-103	1705-102	44 ORANGE PL	ORANGE PL & FAIR OAKS AVE	8	300
17051058	1705-104	1705-103	ORANGE PL & DE LACEY AVE	44 ORANGE PL	8	280
17051085	1705-125	1705-126	DEL MAR BLVD, 234 FT E/O FAIR OAKS AVE	DEL MAR BLVD & RAYMOND AVE	8	239
17051087	1705-120	1705-125	DEL MAR BLVD & FAIR OAKS AVE	DEL MAR BLVD, 234 FT E/O FAIR OAKS AVE	8	243
17061026	1706-182	1705-104	VALLEY ST & DE LACEY AVE	ORANGE PL & DE LACEY AVE	8	265
17041017	1704-113	1704-115	CALIFORNIA BLVD, 246 FT W/O RAYMOND AVE	CALIFORNIA BLVD & RAYMOND AVE	8	246
17041018	1704-109	1704-113	CALIFORNIA BLVD & FAIR OAKS AVE	CALIFORNIA BLVD, 246 FT W/O RAYMOND AVE	8	224
17031029	1703-126	1703-131	900 S ARROYO PKWY	900 S ARROYO PKWY	8	63
17041035	1704-112	1704-111	CALIFORNIA BLVD & ARROYO PKWY	CALIFORNIA BLVD & ARROYO PKWY	8	26
17031002	1703-100	1703-116	812 S ARROYO PKWY	850 S ARROYO PKWY	8	400

TABLE 6-3: CITY OF PASADENA PIPELINES WITH INSUFFICIENT CAPACITY

Facility ID	From ID	To ID	From Location	To Location	Diameter (in)	Length (ft)
17031032	1703-142	1703-153	990 S ARROYO PKWY	1030 S ARROYO PKWY	8	180
17031034	1703-153	1703-157	1030 S ARROYO PKWY	GLENARM ST & ARROYO PKWY	8	200
17031028	1703-116	1703-126	850 S ARROYO PKWY	900 S ARROYO PKWY	8	337
17031031	1703-131	1703-142	900 S ARROYO PKWY	990 S ARROYO PKWY	8	420
17031015	1703-173	1703-175	GLENARM ST & ARROYO PKWY	GLENARM ST & ARROYO PKWY	18	21
17041059	1704-160	1703-100	FILLMORE ST & ARROYO PKWY	812 S ARROYO PKWY	8	378
17041054	1704-130	1704-151	PICO ST & ARROYO PKWY	ARROYO PKWY, 322 FT N/O FILLMORE ST	8	338
17041056	1704-151	1704-160	ARROYO PKWY, 322 FT N/O FILLMORE ST	FILLMORE ST & ARROYO PKWY	8	322
17041058	1704-111	1704-130	CALIFORNIA BLVD & ARROYO PKWY	PICO ST & ARROYO PKWY	8	363
18031005	1803-143	1703-156	245 E GLENARM ST	181 E GLENARM ST	21	288
17031073	1703-148	1703-152	1017 S FAIR OAKS AVE	1017 S FAIR OAKS AVE	10	19
17031092	1703-168	1703-165	FAIR OAKS AVE & GLENARM ST	35 E GLENARM ST	12	245
17021020	1702-144	1702-132	35/37 COLUMBIA ST	1199 S FAIR OAKS AVE	10	404
17021050	1702-122	1702-117	FAIR OAKS AVE & STATE ST	GRACE TER & FAIR OAKS AVE	10	90
17021051	1702-132	1702-122	1199 S FAIR OAKS AVE	FAIR OAKS AVE & STATE ST	10	120
17021060	1702-117	1702-108	GRACE TER & FAIR OAKS AVE	1129 S FAIR OAKS AVE	10	194
17021061	1702-150	1702-144	35 COLUMBIA ST	35/37 COLUMBIA ST	10	137
17021063	1702-146	1702-147	COLUMBIA ST & PASADENA AVE	COLUMBIA ST & AVOCA AVE	10	360
17021064	1702-147	1702-148	COLUMBIA ST & AVOCA AVE	87 COLUMBIA ST	10	289
17021065	1702-148	1702-149	87 COLUMBIA ST	COLUMBIA ST & GRACE DR	10	166
17021066	1702-149	1702-150	COLUMBIA ST & GRACE DR	35 COLUMBIA ST	10	120
17031007	1703-165	1703-164	35 E GLENARM ST	GLENARM ST & RAYMOND AVE	12	250
17031072	1703-143	1703-148	FAIR OAKS AVE & ARLINGTON DR	1017 S FAIR OAKS AVE	10	86
17031074	1702-108	1703-168	1129 S FAIR OAKS AVE	FAIR OAKS AVE & GLENARM ST	10	400
17031071	1703-152	1703-168	1017 S FAIR OAKS AVE	FAIR OAKS AVE & GLENARM ST	10	264
18031001	1803-112	1803-118	894 LOS ROBLES AVE	ALPINE ST & LOS ROBLES AVE	18	344
18031024	1804-166	1803-105	FILLMORE ST & LOS ROBLES AVE	844 S LOS ROBLES AVE	18	329
18031002	1803-118	1803-134	ALPINE ST & LOS ROBLES AVE	1000 S LOS ROBLES AVE	18	339
18031026	1803-134	1803-136	1000 S LOS ROBLES AVE	GLENARM ST & LOS ROBLES AVE	18	323
18041058	1804-164	1804-166	FILLMORE ST, 134 FT E/O LOS ROBLES AVE	FILLMORE ST & LOS ROBLES AVE	18	133
18041003	1804-161	1804-164	FILLMORE ST, 40 FT E/O OAKLAND AVE	FILLMORE ST, 134 FT E/O LOS ROBLES AVE	18	395
18031025	1803-105	1803-112	844 S LOS ROBLES AVE	894 LOS ROBLES AVE	18	305
18041009	1804-111	1804-115	CALIFORNIA BLVD & EL MOLINO AVE	CALIFORNIA BLVD & EL MOLINO AVE	8	10
18041038	1804-112	1804-111	CALIFORNIA BLVD & MADISON AVE	CALIFORNIA BLVD & EL MOLINO AVE	10	421
19041018	1904-160	1904-162	CORNELL RD & MENTOR AVE	CORNELL RD & MENTOR AVE	8	53
19041026	1904-162	1903-101	CORNELL RD & MENTOR AVE	DALE DR & MENTOR AVE	10	276
18011027	1801-119	1801-121	1504 S MARENGO AVE	1530 S MARENGO AVE	8	201
18011028	1801-116	1801-119	1500 S MARENGO AVE	1504 S MARENGO AVE	8	155
18011032	1801-101	1801-105	1390 S MARENGO AVE	1420 S MARENGO AVE	8	130
18011037	1801-121	1801-124	1530 S MARENGO AVE	1540 S LOS ROBLES AVE	8	231
18011026	1801-117	1801-124	1508 S LOS ROBLES AVE	1540 S LOS ROBLES AVE	8	315
18011029	1801-113	1801-116	1470 S MARENGO AVE	1500 S MARENGO AVE	8	215
18011030	1801-110	1801-113	1444 S MARENGO AVE	1470 S MARENGO AVE	8	214
18011031	1801-105	1801-110	1420 S MARENGO AVE	1444 S MARENGO AVE	8	215
18011033	1802-154	1801-101	1360 S MARENGO AVE	1390 S MARENGO AVE	8	250
18021041	1802-149	1802-154	1340 S MARENGO AVE	1360 S MARENGO AVE	8	250
18021042	1802-146	1802-149	MARENGO AVE & EUCLID AVE	1340 S MARENGO AVE	8	250
19061080	1806-136	1906-139	GREEN ST & EL MOLINO AVE	689 E GREEN ST	12	291
19061005	1906-139	1906-138	689 E GREEN ST	GREEN ST & OAK KNOLL AVE	12	203
19061065	1906-150	1906-149	GREEN ST & MENTOR AVE	960 E GREEN ST	8	244
19061067	1906-152	1906-151	GREEN ST & LAKE AVE	914 E GREEN ST	8	245
19061073	1906-153	1906-152	840 E GREEN ST	GREEN ST & LAKE AVE	8	255
19061074	1906-154	1906-153	GREEN ST & HUDSON AVE	840 E GREEN ST	8	202
19061053	1906-147	1906-146	1030 E GREEN ST	GREEN ST & WILSON AVE	8	208
19061054	1906-148	1906-147	GREEN ST & CATALINA AVE	1030 E GREEN ST	8	201
19061058	1906-146	2006-143	GREEN ST & WILSON AVE	1130 E GREEN ST	8	307
19061064	1906-149	1906-148	960 E GREEN ST	GREEN ST & CATALINA AVE	8	210
19061066	1906-151	1906-150	914 E GREEN ST	GREEN ST & MENTOR AVE	8	207
19061075	1906-155	1906-154	740 E GREEN ST	GREEN ST & HUDSON AVE	8	219
20061012	2006-140	2006-139	1218 E GREEN ST	GREEN ST & CHESTER AVE	8	226
20061076	2006-135	2006-134	GREEN ST, 245 FT E/O HOLLISTON AVE	GREEN ST & HILL AVE	8	222
20061078	2006-136	2006-135	GREEN ST & HOLLISTON AVE	GREEN ST, 245 FT E/O HOLLISTON AVE	8	248
20061081	2006-138	2006-136	1304 E GREEN ST	GREEN ST & HOLLISTON AVE	8	271
20061083	2006-139	2006-138	GREEN ST & CHESTER AVE	1304 E GREEN ST	8	215
20061086	2006-141	2006-140	GREEN ST & MICHIGAN AVE	1218 E GREEN ST	8	206
20061087	2006-143	2006-141	1130 E GREEN ST	GREEN ST & MICHIGAN AVE	8	327
22061081	2206-106	2206-105	COLORADO BLVD, 230 FT E/O ROOSEVELT AVE	COLORADO BLVD & SIERRA MADRE BLVD	8	225
22061048	2206-132	2206-135	37 S SIERRA MADRE BLVD	45 S SIERRA MADRE BLVD	8	133
22061049	2206-135	2206-143	45 S SIERRA MADRE BLVD	111 S SIERRA MADRE BLVD	8	250
22061082	2206-107	2206-106	COLORADO BLVD & ROOSEVELT AVE	COLORADO BLVD, 230 FT E/O ROOSEVELT AVE	8	230
22061083	2206-108	2206-107	COLORADO BLVD, 233 FT W/O ROOSEVELT AVE	COLORADO BLVD & ROOSEVELT AVE	8	234
22061084	2206-109	2206-108	COLORADO BLVD & GRAND OAKS AVE	COLORADO BLVD, 233 FT W/O ROOSEVELT AVE	8	243
22061046	2206-105	2206-117	COLORADO BLVD & SIERRA MADRE BLVD	COLORADO BLVD & SIERRA MADRE BLVD	8	55
22061047	2206-117	2206-132	COLORADO BLVD & SIERRA MADRE BLVD	37 S SIERRA MADRE BLVD	8	208
21051037	2105-148	2105-149	ALLEN AVE, 97 FT N/O SAN PASQUAL ST	ALLEN AVE, 50 FT N/O SAN PASQUAL ST	12	48
21041003	2104-104	2104-105	HOMET RD & ALLEN AVE	HOMET RD & ALLEN AVE	8	7
23101089	2310-166	2310-173	DUDLEY ST & ALTADENA DR	ALTADENA DR, 77 FT W/O DUDLEY ST	8	81
25101043	2510-147	2510-148	3745 E SIERRA MADRE BLVD	SIERRA MADRE BLVD & HASTINGS RANCH DR	8	210
26101033	2610-129	2510-147	SIERRA MADRE BLVD & MEDFORD RD	3745 E SIERRA MADRE BLVD	8	204
25081011	2508-141	2508-140	3725 HAMPTON RD	3725 HAMPTON RD	8	257
25081036	2508-130	2508-138	HASTINGS RANCH DR, 109.8 FT S/O NEWHAVEN RD	HAMPTON RD & HASTINGS RANCH DR	8	258
25081037	2508-127	2508-130	NEWHAVEN RD & HASTINGS RANCH DR	HASTINGS RANCH DR, 109.8 FT S/O NEWHAVEN RD	8	110
25081035	2508-138	2508-141	HAMPTON RD & HASTINGS RANCH DR	3725 HAMPTON RD	8	65
25081038	2508-121	2508-127	HASTINGS RANCH DR, 148 FT N/O NEWHAVEN RD	NEWHAVEN RD & HASTINGS RANCH DR	8	148
26071002	2607-101	2607-102	MICHILLINDA AVE, 287 FT N/O FOOTHILL BLVD	FOOTHILL BLVD & MICHILLINDA AVE	8	248
26071003	2608-132	2607-101	MICHILLINDA AVE, 231 FT S/O MAYFAIR DR	MICHILLINDA AVE, 287 FT N/O FOOTHILL BLVD	8	288
26081025	2608-129	2608-132	MAYFAIR DR & MICHILLINDA AVE	MICHILLINDA AVE, 231 FT S/O MAYFAIR DR	8	231
18111049	1811-111	1811-123	RIO GRANDE ST & EL MOLINO AVE	WASHINGTON BLVD & EL MOLINO AVE	8	515
18061086	1806-118	1806-119	COLORADO BLVD & COLORADO BLVD	COLORADO BLVD & LOS ROBLES AVE	8	456
18051043	1805-121	1805-120	DE MAR BLVD & EUCLID AVE	DE MAR BLVD & LOS ROBLES AVE	8	462
19061089	1906-115	1906-114	COLORADO BLVD & HUDSON AVE	COLORADO BLVD & LAKE AVE	8	470
15071049	1507-103	1507-112	361 LINDA VISTA AVE	333 LINDA VISTA AVE	8	240
15071050	1507-112	1507-120	333 LINDA VISTA AVE	320 LINDA VISTA AVE	8	200
15071051	1507-120	1507-135	320 LINDA VISTA AVE	310 LINDA VISTA AVE	8	155
18061072	F89223	1806-149	GRADE BREAK	300 E GREEN ST	8	160
TOTAL						**44,860**

6.4 Pump Station Evaluation

As described in Section 3, the pumps in both pump stations serving the City of Pasadena were recently replaced under the supervision of City Staff. Due to this, hydraulic evaluation of the pump stations was not performed. However concerns identified by City staff, such as the lack of stand by power and the deteriorating condition of the physical plant at the lift station, were incorporated into the CIP developed as part of this Master Sewer Plan. The CIP is included below in Section 7.

Section 7: Sewer System Improvement Costs

This section incorporates the findings of the previous sections and outlines the estimated costs of the potential collection system and pumping station improvements. The identified improvements are subsequently prioritized into a capital improvement program based on the assessment of facility condition and the hydraulic analysis under current and future loading conditions. The potential capital improvement costs of the identified facilities, prioritized schedules, and general assumptions are contained herein.

Sewer system improvements are generally established based on two distinct categories: facility condition and hydraulic adequacy. Facility condition improvements are required to upgrade/improve aging facilities and are corrected by replacement or repair-related rehabilitation activities. Potential hydraulic improvements are identified to accommodate the current and projected flows within the City of Pasadena's sewer collection system. The identification of these improvements is based primarily on the results of the computerized hydraulic model discussed in Section 6, and the evaluation criteria discussed in Section 5. The costs of the recommended collection system capital improvements are separated into these two categories and discussed in the subsequent portions of this section.

7.1 Creation of Capital Improvement Projects (CIP)

CIP for the collection system were developed by grouping the pipes identified in Section 6 into geographic clusters, or projects. While the nature of the projects was determined primarily by the number of identified pipes in close geographic proximity to each other, relatively similar size was maintained for each of the projects. In addition to the pipes identified in Section 6, "continuity pipes" were identified and included in the projects. These are pipes that should be considered for upsizing because upstream and downstream pipes are being upsized to greater diameter, creating areas of inconsistency for maintenance purposes. The final determination of the status of continuity pipes should be made on a project-by-project basis after field inspection of the condition and hydraulics of the pipes in question.

7.2 Project Prioritization

Individual pipes showing insufficient capacity were prioritized using two factors: the scenario(s) under which the insufficiency was identified, and the material of the insufficient pipe. Projects were prioritized according to the highest priority pipe included in the project. Continuity pipes were given no priority. Pipes were prioritized from 1 (highest priority) to 5 (lowest priority) using the following criteria:

- Pipes identified under both Existing PDWF and PWWF were prioritized higher than those identified under only Existing PDWF, which were prioritized higher than those identified under only Existing PWWF.
- Pipes identified under future scenarios were prioritized in the same hierarchy as above, but under all pipes identified in existing scenarios.
- Non-VCP pipes were prioritized higher than VCP pipes because of the shorter useful life estimated for non-VCP pipes.

7.3 Sewer Collection System Pipeline Unit Costs

Sewer collection system pipeline unit costs were developed based upon costs compiled from recent projects in the City of Pasadena and were checked against neighboring locales and industry values. These unit costs are displayed in Table 7-1. They apply to new and replacement construction completed in place under normal working conditions.

Table 7-1: Sewer Collection Pipeline Budgetary Unit Costs (2005 Cost Basis)

Pipe Diameter (in)	Unit Cost
8	$249
10	$276
12	$301
15	$334
18	$364
21	$391
24	$417
27	$441
30	$463

Note: Construction costs are approximately 65% of the budgetary costs.

7.4 Pump Station Unit Costs

Engineer's estimates of probable costs were developed for a back-up generator at Rosemont Pump Station and a back-up generator/building replacement at Busch Gardens Lift Station. These estimates are included as Table 7-2 and Table 7-3, respectively.

Table 7-2: Engineer's Estimate of Probable Cost – Rosemont Lift Station

Item No.	Description	Quantity	Unit	Unit Price	Subtotal	Source
1	75 kW Diesel Generator	1	Each	$ 26,000	$ 26,000	2005 RS Means Pg 861
2	System Electrical Upgrade and Installation	100%	Lump Sum		$ 17,000	2005 RS Means Pg 861
3	Reinforced Concrete Slab	100%	Lump Sum		$ 5,000	Olsen Construction
	-					
	Subtotal Construction Cost				$ 48,000	
	Contingency			20%	$ 9,600	
	Contractor OH&P			20%	$ 9,600	
	Total Construction Cost				$ 67,200	
	Engineering Design & Admin				$ 5,000	
	Total Capital Cost				**$ 72,200**	

Table 7-3: Engineer's Estimate of Probable Cost – Busch Garden Lift Station

Item No.	Description	Quantity	Unit	Unit Price	Subtotal	Source
1	75 kW Diesel Generator	1	Each	$ 26,000	$ 26,000	2005 RS Means Pg 861
2	System Electrical Upgrade and Installation	100%	Lump Sum		$ 17,000	2005 RS Means Pg 861
3	Reinforced Concrete Slab	100%	Lump sum		$ 5,000	Olsen Construction
4	Rigid Frame Pre-Engineered Steel Build.	200	SF	$ 8	$ 1,520	2005 RS Means Pg 474
5	Double Leaf Doors	1	Each	$ 500	$ 500	2005 RS Means Pg 475
6	Aluminum Roof Hatch	1	Each	$ 650	$ 650	2005 RS Means Pg 268
7	Aluminum Dome Roof Fan	1	Each	$ 250	$ 250	2005 RS Means Pg 729
	-					
	Subtotal Construction Cost				$ 50,930	
	Contingency			20%	$ 10,185	
	Contractor OH&P			20%	$ 10,185	
	Estimated Total Construction Cost				$ 71,300	
	Engineering Design & Admin				$ 5,000	
	Total Capital Cost				**$ 76,300**	

7.5 Prioritized Capital Improvement Program

Table 7-4 displays the prioritized sewer collection system pipeline CIP. As can be seen in this table, all pipes identified in Section 6 are replaced according to the design criteria laid out in the same section. Replacement diameter and resulting d/D ratio mitigation are shown as well. A 24x36" plot of these projects in included under cover of this Master Sewer Plan in Appendix E.

TABLE 7-4: CITY OF PASADENA PIPELINES WITH INSUFFICIENT CAPACITY

Facility ID	From ID	To ID	From Location	To Location	Diameter (in)	Length (ft)	Project	Priority	Replacement Diamter (in)	Unit Cost	Replacement Cost	Material	Classification	Analysis EXAD d/D	Analysis EXPD d/D	Analysis EXPW d/D	Analysis FUAD d/D	Analysis FUPD d/D	Analysis FUPW d/D	Replacement EXPD DIA (in)	Replacement EXPD d/D	Replacement EXPW DIA (in)	Replacement EXPW d/D	Replacement FUPD DIA (in)	Replacement FUPD d/D	Replacement FUPW DIA (in)	Replacement FUPW d/D
14061042	1406-115	1406-119	150 PATRICIAN WAY	1 N SAN RAFAEL AVE	8	235	1	4	12	$301	$70,645	VCP	Continuity	0.15	0.19	0.67	0.16	0.21	0.68	0	0.00	0	0.00	0	0.00	0	0.00
14061051	1406-120	1406-123	1 N SAN RAFAEL AVE	126 PATRICIAN WAY	8	381	1	4	12	$301	$114,621	VCP	Continuity	0.15	0.18	0.65	0.16	0.20	0.66	0	0.00	0	0.00	0	0.00	0	0.00
14061052	1406-119	1406-120	1 N SAN RAFAEL AVE	1 N SAN RAFAEL AVE	8	60	1	4	12	$301	$18,060	VCP	Continuity	0.12	0.15	0.50	0.13	0.16	0.50	0	0.00	0	0.00	0	0.00	0	0.00
14061041	1406-111	1406-115	170 PATRICIAN WAY	150 PATRICIAN WAY	8	205	1	4	12	$301	$61,735	VCP	EXPW	0.19	0.24	1.00	0.21	0.27	1.00	0	0.00	12	0.44	0	0.00	12	0.45
14061049	1406-126	1406-128	122 PATRICIAN WAY	52 PATRICIAN WAY	8	326	1	4	12	$301	$98,186	VCP	EXPW	0.18	0.22	1.00	0.19	0.24	1.00	0	0.00	12	0.41	0	0.00	12	0.41
14061050	1406-123	1406-126	126 PATRICIAN WAY	122 PATRICIAN WAY	8	163	1	4	15	$334	$54,375	VCP	EXPW	0.25	0.32	1.00	0.27	0.35	1.00	0	0.00	15	0.43	0	0.00	15	0.44
14051031	1405-180	1405-196	234 ANNANDALE RD	272 ANNANDALE RD	8	279	2	4	10	$276	$76,866	VCP	Continuity	0.14	0.18	0.58	0.15	0.19	0.59	0	0.00	0	0.00	0	0.00	0	0.00
14051032	1405-168	1405-180	186 ANNANDALE RD	234 ANNANDALE RD	8	280	2	4	10	$276	$77,142	VCP	Continuity	0.16	0.19	0.68	0.17	0.21	0.69	0	0.00	0	0.00	0	0.00	0	0.00
14041142	1405-196	1404-106	272 ANNANDALE RD	NITHSDALE RD & GLEN SUMMER RD	8	80	2	4	10	$276	$22,080	VCP	EXPW	0.17	0.21	0.75	0.18	0.23	0.77	0	0.00	10	0.48	0	0.00	10	0.49
14041143	1404-106	1404-108	NITHSDALE RD & GLEN SUMMER RD	NITHSDALE RD & GLEN SUMMER RD	8	5	2	4	12	$301	$1,565	VCP	EXPW	0.25	0.30	1.00	0.26	0.32	1.00	0	0.00	12	0.44	0	0.00	12	0.45
14041144	1404-119	1404-141	326 GLEN SUMMER RD	326 GLEN SUMMER RD	8	294	2	4	15	$334	$98,263	VCP	EXPW	0.36	0.43	1.00	0.37	0.46	1.00	0	0.00	15	0.46	0	0.00	15	0.47
14041145	1404-108	1404-119	NITHSDALE RD & GLEN SUMMER RD	326 GLEN SUMMER RD	8	145	2	4	12	$301	$43,705	VCP	EXPW	0.27	0.32	1.00	0.28	0.34	1.00	0	0.00	12	0.47	0	0.00	12	0.48
14041146	1404-116	1404-106	NITHSDALE RD & GLEN SUMMER RD	NITHSDALE RD & GLEN SUMMER RD	8	227	2	4	10	$276	$62,597	VCP	EXPW	0.29	0.34	0.76	0.30	0.35	0.77	0	0.00	10	0.48	0	0.00	10	0.49
14051026	F89171	1405-133	GRADE BREAK	96 ANNANDALE RD	8	268	2	4	12	$301	$80,758	VCP	EXPW	0.18	0.22	1.00	0.19	0.24	1.00	0	0.00	12	0.41	0	0.00	12	0.42
14051029	1405-133	1405-150	96 ANNANDALE RD	142 ANNANDALE RD	8	280	2	4	12	$301	$84,160	VCP	EXPW	0.17	0.21	1.00	0.18	0.23	1.00	0	0.00	12	0.39	0	0.00	12	0.39
14051033	1405-150	1405-168	142 ANNANDALE RD	186 ANNANDALE RD	8	280	2	4	12	$301	$84,340	VCP	EXPW	0.17	0.22	1.00	0.19	0.24	1.00	0	0.00	12	0.39	0	0.00	12	0.39
14051046	1405-120	F89171	48 ANNANDALE RD	GRADE BREAK	8	48	2	4	12	$301	$14,298	VCP	EXPW	0.18	0.22	1.00	0.19	0.24	1.00	0	0.00	12	0.41	0	0.00	12	0.42
15051006	1505-151	1505-156	NITHSDALE RD	NITHSDALE RD	8	282	2	4	12	$301	$84,882	VCP	EXPW														
15051100	1505-156	1505-162	1034 NITHSDALE RD	NITHSDALE RD & SAN MIGUEL RD	8	279	2	4	12	$301	$83,979	VCP	EXPW	0.30	0.35	1.00	0.31	0.36	1.00	0	0.00	12	0.41	0	0.00	12	0.41
14031001	1403-122	1403-130	660 LAGUNA RD	LA LOMA RD & LAGUNA RD	15	50	3	4	18	$364	$18,200	VCP	Continuity	0.17	0.20	0.47	0.17	0.20	0.47	0	0.00	0	0.00	0	0.00	0	0.00
14041010	1404-244	1403-102	575 LAGUNA RD	LA LOMA RD & LAGUNA RD	12	39	3	4	15	$334	$13,026	VCP	Continuity	0.21	0.25	0.63	0.22	0.26	0.64	0	0.00	0	0.00	0	0.00	0	0.00
14041153	1504-148	1404-225	LAGUNITA ROAD & LAGUNA ROAD	560 LAGUNA RD	10	214	3	4	15	$334	$71,610	VCP	Continuity	0.22	0.26	0.68	0.23	0.27	0.69	0	0.00	0	0.00	0	0.00	0	0.00
14031079	1403-125	1403-130	1257 LA LOMA RD	LA LOMA RD & LAGUNA RD	10	150	3	4	15	$334	$50,200	VCP	EXPW	0.26	0.39	1.00	0.27	0.42	1.00	0	0.00	15	0.39	0	0.00	15	0.40
14031085	1403-102	1403-122	LA LOMA RD & LAGUNA RD	660 LAGUNA RD	10	335	3	4	15	$334	$111,890	VCP	EXPW	0.26	0.31	1.00	0.27	0.32	1.00	0	0.00	15	0.41	0	0.00	15	0.42
14031098	1403-130	1403-140	LA LOMA RD & LAGUNA RD	680 LAGUNA RD	15	106	3	4	21	$391	$41,446	VCP	EXPW	0.27	0.34	1.00	0.28	0.36	1.00	0	0.00	21	0.47	0	0.00	21	0.48
14041152	1404-225	1404-244	560 LAGUNA RD	575 LAGUNA RD	10	210	3	4	15	$334	$70,006	VCP	EXPW	0.26	0.31	1.00	0.27	0.32	1.00	0	0.00	15	0.41	0	0.00	15	0.42
15041001	F89151	1504-129	GRADE BREAK	462 LAGUNA RD	10	203	3	4	18	$364	$73,856	VCP	EXPW	0.32	0.38	1.00	0.33	0.40	1.00	0	0.00	18	0.40	0	0.00	18	0.40
15041002	1504-122	F89151	430 LAGUNA RD	GRADE BREAK	12	8	3	4	15	$334	$2,672	VCP	EXPW	0.24	0.28	0.77	0.25	0.29	0.78	0	0.00	15	0.49	0	0.00	15	0.49
15041011	1504-121	1504-122	407 LAGUNA RD	430 LAGUNA RD	12	55	3	4	18	$364	$20,020	VCP	EXPW	0.26	0.31	1.00	0.27	0.33	1.00	0	0.00	18	0.42	0	0.00	18	0.42
15041012	1504-117	1504-121	377 LAGUNA RD	407 LAGUNA RD	12	163	3	4	15	$334	$54,475	VCP	EXPW	0.24	0.28	0.76	0.24	0.29	0.77	0	0.00	15	0.49	0	0.00	15	0.49
15041029	1504-133	1504-148	455 LAGUNA RD	LAGUNITA ROAD & LAGUNA ROAD	10	288	3	4	18	$364	$104,941	VCP	EXPW	0.32	0.38	1.00	0.33	0.40	1.00	0	0.00	18	0.39	0	0.00	18	0.40
15041030	1504-129	1504-133	462 LAGUNA RD	455 LAGUNA RD	10	80	3	4	18	$364	$28,974	VCP	EXPW	0.32	0.38	1.00	0.33	0.40	1.00	0	0.00	18	0.39	0	0.00	18	0.39
15031068	1503-162	1503-164	1000 LAGUNA RD	1020 LAGUNA RD	15	161	4	4	24	$417	$67,262	CIP	EXPW	0.29	0.38	1.00	0.30	0.39	1.00	0	0.00	21	0.50	0	0.00	24	0.41
15021003	F89148	F89149	GRADE BREAK	GRADE BREAK	16	17	4	4	21	$391	$6,647	DIP	EXPW	0.26	0.33	1.00	0.27	0.35	1.00	0	0.00	21	0.49	0	0.00	21	0.50
15021001	F89150	1502-104	GRADE BREAK	GRADE BREAK	15	2	4	4	21	$391	$782	VCP	EXPW	0.29	0.36	1.00	0.30	0.38	1.00	0	0.00	21	0.48	0	0.00	21	0.49
15021002	1502-104	F89148	GRADE BREAK	GRADE BREAK	15	38	4	4	24	$417	$15,846	VCP	EXPW	0.29	0.38	1.00	0.30	0.39	1.00	0	0.00	21	0.50	0	0.00	24	0.41
15021004	F89149	1502-109	GRADE BREAK	1107 LAGUNA RD	15	120	4	4	24	$417	$50,040	VCP	EXPW	0.29	0.37	1.00	0.30	0.39	1.00	0	0.00	21	0.50	0	0.00	24	0.41
15021007	1502-112	F89176	LAGUNA RD & SAN RAFAEL AVE	GRADE BREAK	10	14	4	4	15	$334	$4,676	VCP	EXPW	0.26	0.33	0.82	0.27	0.34	1.00	0	0.00	15	0.39	0	0.00	15	0.39
15021008	F89146	1502-112	GRADE BREAK	LAGUNA RD & SAN RAFAEL AVE	15	4	4	4	21	$391	$1,369	VCP	EXPW	0.25	0.32	0.77	0.26	0.33	0.79	0	0.00	21	0.41	0	0.00	21	0.42
15021025	1502-117	1502-118	ARROYO BLVD & SAN RAFAEL AVE	1240 S ARROYO BLVD	14	118	4	4	21	$391	$46,255	VCP	EXPW	0.30	0.39	1.00	0.31	0.41	1.00	0	0.00	21	0.45	0	0.00	21	0.46
15021026	1502-118	1502-119	1240 S ARROYO BLVD	1260 S ARROYO BLVD	14	187	4	4	21	$391	$73,000	VCP	EXPW	0.31	0.40	1.00	0.32	0.42	1.00	0	0.00	21	0.46	0	0.00	21	0.47
15021027	1502-119	1502-122	1260 S ARROYO BLVD	ARROYO DR, 68 FT S/O COLUMBIA ST	14	110	4	4	21	$391	$42,815	VCP	EXPW	0.30	0.38	1.00	0.31	0.40	1.00	0	0.00	21	0.44	0	0.00	21	0.45
15021029	1503-164	F89150	1020 LAGUNA RD	GRADE BREAK	15	159	4	4	21	$391	$62,013	VCP	EXPW	0.28	0.36	1.00	0.29	0.38	1.00	0	0.00	21	0.48	0	0.00	21	0.49
15031005	1504-164	1503-103	802 S ARROYO BLVD	BELLEFONTAINE ST & ARROYO BLVD	8	173	4	4	15	$334	$57,882	VCP	EXPW	0.34	0.44	1.00	0.37	0.49	1.00	0	0.00	15	0.37	0	0.00	15	0.38
15031010	1503-115	1503-121	880 S ARROYO BLVD	888 S ARROYO BLVD	10	286	4	4	18	$364	$103,995	VCP	EXPW	0.37	0.48	1.00	0.40	0.52	1.00	0	0.00	18	0.41	0	0.00	18	0.42
15031011	1503-107	1503-115	850 S ARROYO BLVD	880 S ARROYO BLVD	10	260	4	4	18	$364	$94,640	VCP	EXPW	0.37	0.49	1.00	0.40	0.53	1.00	0	0.00	18	0.42	0	0.00	18	0.42
15031012	1503-103	1503-107	BELLEFONTAINE ST & ARROYO BLVD	850 S ARROYO BLVD	10	132	4	4	15	$334	$44,021	VCP	EXPW	0.28	0.36	1.00	0.30	0.39	1.00	0	0.00	15	0.40	0	0.00	15	0.41
15031065	1503-155	1503-159	GRADE BREAK	GRADE BREAK	15	284	4	4	21	$391	$110,888	VCP	EXPW	0.26	0.33	1.00	0.27	0.35	1.00	0	0.00	21	0.44	0	0.00	21	0.45
15031066	1503-159	1503-161	GRADE BREAK	GRADE BREAK	15	212	4	4	24	$417	$88,529	VCP	EXPW	0.31	0.40	1.00	0.32	0.42	1.00	0	0.00	24	0.43	0	0.00	24	0.44
15031067	1503-161	1503-162	GRADE BREAK	1000 LAGUNA RD	15	222	4	4	21	$391	$86,646	VCP	EXPW	0.28	0.35	1.00	0.29	0.37	1.00	0	0.00	21	0.47	0	0.00	21	0.47
15031069	1503-143	1503-146	LAGUNA RD & ELLINGTON LN	LAGUNA RD & SAN REMO RD	10	135	4	4	15	$334	$45,123	VCP	EXPW	0.31	0.39	1.00	0.32	0.41	1.00	0	0.00	15	0.48	0	0.00	15	0.49
15031070	1503-141	1503-143	800 LAGUNA RD	LAGUNA RD & ELLINGTON LN	10	150	4	4	15	$334	$50,133	VCP	EXPW	0.30	0.38	1.00	0.31	0.40	1.00	0	0.00	15	0.47	0	0.00	15	0.47
15031071	1503-146	1503-155	LAGUNA RD & SAN REMO RD	GRADE BREAK	10	255	4	4	15	$334	$85,304	VCP	EXPW	0.31	0.39	1.00	0.32	0.41	1.00	0	0.00	15	0.48	0	0.00	15	0.48
15031072	1503-135	1503-141	780 LAGUNA RD	800 LAGUNA RD	10	175	4	4	15	$334	$58,383	VCP	EXPW	0.30	0.38	1.00	0.31	0.40	1.00	0	0.00	15	0.47	0	0.00	15	0.48
15031073	1503-132	1503-135	748 LAGUNA RD	780 LAGUNA RD	10	175	4	4	15	$334	$58,517	VCP	EXPW	0.30	0.38	1.00	0.31	0.40	1.00	0	0.00	15	0.47	0	0.00	15	0.47
15031074	1503-131	1503-132	LAGUNA RD & BURLEIGH DR	748 LAGUNA RD	10	108	4	4	15	$334	$36,206	VCP	EXPW	0.30	0.38	1.00	0.31	0.40	1.00	0	0.00	15	0.47	0	0.00	15	0.48
15111004	1511-103	1611-116	686 W WASHINGTON BLVD	643 W WASHINGTON BLVD	8	264	5	2	12	$301	$79,494	VCP	EXPW	0.46	0.64	1.00	0.46	0.64	1.00	10	0.44	12	0.41	10	0.45	12	0.41
15111005	1511-101	1511-103	730 W WASHINGTON BLVD	686 W WASHINGTON BLVD	8	263	5	2	12	$301	$79,133	VCP	EXPW	0.45	0.63	1.00	0.45	0.63	1.00	10	0.44	12	0.40	10	0.44	12	0.41
15111006	1511-100	1511-101	WASHINGTON BLVD & ARROYO BLVD	730 W WASHINGTON BLVD	8	260	5	2	12	$301	$78,320	VCP	EXPW	0.45	0.62	1.00	0.45	0.63	1.00	10	0.44	12	0.40	10	0.44	12	0.40
16111080	1611-116	1611-118	643 W WASHINGTON BLVD	WASHINGTON BLVD & FOREST AVE	8	263	5	2	12	$301	$79,223	VCP	EXPW	0.46	0.64	1.00	0.46	0.64	1.00	10	0.44	12	0.41	10	0.45	12	0.41
16101088	1610-106	1610-112	1144 FOREST AVE	1140 FOREST AVE	10	185	6	2	15	$334	$61,790	VCP	Continuity	0.39	0.53	0.74	0.39	0.53	0.74	0	0.00	0	0.00	0	0.00	0	0.00
16101092	1611-176	1610-106	1165 FOREST AVE	1144 FOREST AVE	10	182	6	2	15	$334	$60,922	VCP	EXPW	0.40	0.54	0.76	0.40	0.54	0.77	0	0.00	15	0.37	0	0.00	15	0.37
17101019	1710-160	1710-162	POPLAR LN & SUNSET AVE	SUNSET AVE, 22 FT S/E POPLAR LN	8	20	7	3	10	$276	$5,396	VCP	EXPD	0.41	0.51	0.57	0.44	0.54	0.60	10	0.36	0	0.00	10	0.39	0	0.00
17101020	1610-159	1710-160	SUNSET AVE, 78 FT S/O GLORIETA ST	POPLAR LN & SUNSET AVE	8	269	7	3	10	$276	$74,368	VCP	EXPD	0.42	0.52	0.59	0.45	0.56	0.63	10	0.37	0	0.00	10	0.40	0	0.00
18081066	1808-111	1808-131	589 N GARFIELD AVE	VILLA ST & GARFIELD AVE	8	500	8	3	10	$276	$138,000	VCP	Continuity	0.37	0.46	0.49	0.40	0.50	0.53	0	0.00	0	0.00	0	0.00	0	0.00
18081067	1809-179	1808-111	PARKE ST & GARFIELD AVE	589 N GARFIELD AVE	8	440	8	3	10	$276	$121,330	VCP	Continuity	0.37	0.46	0.49	0.39	0.49	0.52	0	0.00	0	0.00	0	0.00	0	0.00
18081063	1808-131	1808-132	VILLA ST & GARFIELD AVE	VILLA ST & GARFIELD AVE	8	108	8	3	10	$276	$29,863	VCP	EXPD	0.46	0.58	0.63	0.49	0.64	0.68	10	0.41	0	0.00	10	0.44	0	0.00
18081064	1808-141	1808-151	417 N GARFIELD AVE	MAPLE ST & GARFIELD AVE	8	178	8	3	10	$276	$49,140	VCP	EXPD	0.43	0.54	0.58	0.46	0.59	0.62	10	0.39	0	0.00	10	0.41	0	0.00
18081065	1808-132	1808-141	VILLA ST & GARFIELD AVE	417 N GARFIELD AVE	8	412	8	3	10	$276	$113,602	VCP	EXPD	0.41	0.52	0.55	0.44	0.56	0.59	10	0.37	0	0.00	10	0.40	0	0.00
18091020	1809-178	1809-179	PARKE ST & GARFIELD AVE	PARKE ST & GARFIELD AVE	8	116	8	2	10	$276	$32,016	VCP	EXPD	0.43	0.54	0.58	0.45	0.58	0.61	10	0.39	0	0.00	10	0.41	0	0.00
18081026	1808-144	1808-153	409 N LOS ROBLES AVE	389 N LOS ROBLES AVE	8	167	9	2	12	$301	$50,362	VCP	EXPD & EXPW	0.56	0.71	1.00	0.58	0.76	1.00	10	0.48	12	0.42	12	0.39	12	0.43
18081057	1808-128	1808-144	VILLA ST & LOS ROBLES AVE	409 N LOS ROBLES AVE	8	441	9	2	12	$301	$132,771	VCP	EXPD & EXPW	0.54	0.68	1.00	0.57	0.73	1.00	10	0.47	12	0.41	10	0.49	12	0.42
18091050	1809-159	1809-174	715 N LOS ROBLES AVE	650 N LOS ROBLES AVE	8	350	9	2	12	$301	$105,350	VCP	EXPD & EXPW	0.54	0.68	1.00	0.57	0.73	1.00	10	0.47	12	0.41	10	0.49	12	0.42
18091064	1809-145	1809-159	ASHTABULA ST & LOS ROBLES AVE	715 N LOS ROBLES AVE	8	383	9	2	12	$301	$115,163	VCP	EXPD & EXPW	0.54	0.68	1.00	0.57	0.72	1.00	10	0.47	12	0.41	10	0.49	12	0.42
18091065	1809-139	1809-145	BUCKEYE ST & LOS ROBLES AVE	ASHTABULA ST & LOS ROBLES AVE	8	199	9	2	12	$301	$60,019	VCP	EXPD & EXPW	0.49	0.60	0.77	0.51	0.63	0.80	10	0.42	10	0.49	10	0.44	12	0.38
18081058	1809-174	1808-105	650 N LOS ROBLES AVE	590 N LOS ROBLES AVE	8	350	9	2	10	$276	$96,545	VCP	EXPD	0.46	0.57	0.71	0.49	0.60	0.74	10	0.40	0	0.00	10	0.42	0	0.00
18081059	1808-116	1808-128	540 N LOS ROBLES AVE	VILLA ST & LOS ROBLES AVE	8	350	9	2	10	$276	$96,545	VCP	EXPD	0.46	0.57	0.70	0.48	0.60	0.74	10	0.40	0	0.00	10	0.42	0	0.00
18081060	1808-105	1808-116	590 N LOS ROBLES AVE	540 N LOS ROBLES AVE	8	350	9	2	10	$276	$96,655	VCP	EXPD	0.45	0.56	0.69	0.48	0.59	0.72	10	0.40	0	0.00	10	0.42	0	0.00
18091066	1809-134	1809-139	BUCKEYE ST & LOS ROBLES AVE	BUCKEYE ST & LOS ROBLES AVE	8	42	9	2	10	$276	$11,592	VCP	FUPD	0.40	0.49	0.60	0.42	0.51	0.61	0	0.00	0	0.00	10	0.37	0	0.00
18091067	1809-125	1809-134	808 N LOS ROBLES AVE	BUCKEYE ST & LOS ROBLES AVE	8	323	9	2	10	$276	$89,093	VCP	FUPD	0.40	0.48	0.59	0.42	0.50	0.61	0	0.00	0	0.00	10	0.36	0	0.00
18091076	1809-112	1809-125	MOUNTAIN ST & LOS ROBLES AVE	808 N LOS ROBLES AVE	8	324	9	2	10	$276	$89,314	VCP	FUPD	0.41	0.50	0.61	0.43	0.52	0.63	10	0.36	0	0.00	10	0.37	0	0.00
18101028	1810-125	1810-133	1033 N LOS ROBLES AVE	ADENA ST & LOS ROBLES AVE	8	391	10	2	15	$334	$130,728	VCP	EXPD & EXPW	0.62	1.00	1.00	0.65	1.00	1.00	12	0.41	15	0.37	12	0.43	15	0.38
18101029	1810-119	1810-125	JACKSON ST & LOS ROBLES AVE	1033 N LOS ROBLES AVE	8	144	10	2	15	$334	$47,929	VCP	EXPD & EXPW	0.61	1.00	1.00	0.65	1.00	1.00	12	0.41	15	0.36	12	0.43	15	0.37
18091032	1809-105	1809-126	MOUNTAIN ST & EL MOLINO AVE	864 N EL MOLINO AVE	8	346	11	2	15	$334	$115,564	VCP	EXPD & EXPW	0.59	0.78	1.00	0.61	1.00	1.00	12	0.39	15	0.37	12	0.40	15	0.37
18091010	1809-126	1809-128	864 N EL MOLINO AVE	851 N EL MOLINO AVE	8	7	11	2	12	$301	$2,098	VCP	EXPD & EXPW	0.49	0.62	1.00	0.50	0.64	1.00	10	0.43	12	0.43	10	0.45	12	0.43
18081036	1808-134	1808-135	EL MOLINO AVE, 40FT S/0 VILLA ST	EL MOLINO AVE, 56FT S/0 VILLA ST	12	16	11	2	15	$334	$5,397	VCP	EXPW	0.39	0.50	0.74	0.41	0.52	0.77	0	0.00	0	0.00	0	0.00	15	0.49
19081001	1908-152	1908-156	MAPLE ST & LAKE AVE	MAPLE ST & LAKE AVE	8	20	12	2	12	$301	$5,912	VCP	Continuity	0.20	0.25	0.30	0.22	0.27	0.32	0	0.00	0	0.00	0	0.00	0	0.00
19081060	1909-177	1908-112	620 N LAKE AVE	SANTA BARBARA ST & LAKE AVE	8	424	12	2	12	$301	$127,744	VCP	EXPD & EXPW	0.55	0.73	1.00	0.60	1.00	1.00	10	0.49	12	0.45	12	0.41	12	0.47
20081011	2008-152	2008-154	381 MAR VISTA AVE	MAPLE ST & MAR VISTA AVE	8	28	13	2	12	$301	$8,314	VCP	Continuity	0.26	0.34	0.38	0.26	0.35	0.39	0	0.00	0	0.00	0	0.00	0	0.00
19091009	1909-163	1909-164	698 N WILSON AVE	ORANGE GROVE BLVD & WILSON AVE	8	4	13	2	15	$334	$1,336	VCP	EXPD & EXPW	1.00	1.00	1.00	1.00	1.00	1.00	24	0.48	27	0.44	24	0.48	27	0.44
20081028	2008-141	2008-152	411 MAR VISTA AVE	381 MAR VISTA AVE	8	219	13	2	15	$334	$73,190	VCP	EXPD & EXPW	0.64	1.00	1.00	0.66	1.00	1.00	12	0.46	12	0.49	12	0.47	15	0.36
20081049	2008-133	2008-141	435 MAR VISTA AVE	411 MAR VISTA AVE	8	151	13	2	12	$301	$45,301	VCP	EXPD & EXPW	0.60	1.00	1.00	0.62	1.00	1.00	12	0.44	12	0.47	12	0.45	12	0.48
20081050	2008-129	2008-133	VILLA ST & MAR VISTA AVE	435 MAR VISTA AVE	8	289	13	2	12	$301	$86,929	VCP	EXPD & EXPW	0.47	0.66	0.78	0.48	0.69	1.00	10	0.46	10	0.49	10	0.47	12	0.39
19081037	1908-122	2008-129	VILLA ST & WILSON AVE	VILLA ST & MAR VISTA AVE	8	416	13	2	10	$276	$114,899	VCP	EXPD	0.40	0.55	0.63	0.41	0.57	0.65	10	0.39	0	0.00	10	0.40	0	0.00
20081054	2008-128	2008-134	VILLA ST & HILL AVE	429 N HILL AVE	8	331	14	3	10	$276	$91,384	VCP	EXPD	0.46	0.64	0.74	0.47	0.67	0.77	10	0.45	0	0.00	10	0.46	10	0.49
20081053	2008-134	2008-140	429 N HILL AVE	409 HILL AVE	8	95	14	3	10	$276	$26,243	VCP	EXPD	0.43	0.60	0.68	0.44	0.62	0.70	10	0.42	0	0.00	10	0.43	0	0.00
20081055	2008-104	2008-116	609 N HILL AVE	HILL AVE & MONTE VISTA ST	8	401	14	3	10	$276	$110,538	VCP	EXPD	0.38	0.52	0.58	0.39	0.54	0.60	10	0.37	0	0.00	10	0.38	0	0.00
20081059	2008-116	2008-128	HILL AVE & MONTE VISTA ST	VILLA ST & HILL AVE	8	400	14	3	10	$276	$110,400	VCP	EXPD	0.38	0.53	0.59	0.40	0.55	0.61	10	0.38	0	0.00	10	0.39	0	0.00
20091022	2009-139	2008-104	ORANGE GROVE BLVD & HILL AVE	609 N HILL AVE	8	467	14	3	10	$276	$128,975	VCP	EXPD	0.37	0.50	0.56	0.38	0.52	0.58	0	0.00	0	0.00	10	0.37	0	0.00
17061058	1706-159	1706-157	GREEN ST & MILLS PL	GREEN ST & FAIR OAKS AVE	10	219	15	3	12	$301	$65,769	VCP	EXPD	0.45	0.56	0.58	0.50	0.62	0.64	12	0.42	0	0.00	12	0.46	0	0.00
17051057	1705-103	1705-102	44 ORANGE PL	ORANGE PL & FAIR OAKS AVE	8	300	16	6	10	$276	$82,717	VCP	FUPD	0.10	0.12	0.14	0.44	0.62	0.63	0	0.00	0	0.00	10	0.43	0	0.00
17051058	1705-104	1705-103	ORANGE PL & DE LACEY AVE	44 ORANGE PL	8	280	16	6	10	$276	$77,363	VCP	FUPD	0.10	0.11	0.13	0.43	0.60	0.61	0	0.00	0	0.00	10	0.42	0	0.00
17051085	1705-125	1705-126	DEL MAR BLVD, 234 FT E/O FAIR OAKS AVE	DEL MAR BLVD & RAYMOND AVE	8	239	16	6	10	$276	$66,074	VCP	FUPD	0.27	0.33	0.34	0.44	0.58	0.59	0	0.00	0	0.00	10	0.41	0	0.00
17051087	1705-120	1705-125	DEL MAR BLVD & FAIR OAKS AVE	DEL MAR BLVD, 234 FT E/O FAIR OAKS AVE	8	243	16	6	10	$276	$67,203	VCP	FUPD	0.27	0.32	0.33	0.43	0.55	0.56	0	0.00	0	0.00	10	0.39	0	0.00
17061026	1706-182	1705-104	VALLEY ST & DE LACEY AVE	ORANGE PL & DE LACEY AVE	8	265	16	6	10	$276	$73,140	VCP	FUPD	0.09	0.10	0.12	0.42	0.58	0.59	0	0.00	0	0.00	10	0.41	0	0.00
17041017	1704-113	1704-115	CALIFORNIA BLVD, 246 FT W/O RAYMOND AVE	CALIFORNIA BLVD & RAYMOND AVE	8	246	17	6	10	$276	$67,979	VCP	FUPD & FUPW	0.39	0.46	0.50	0.56	0.74	0.79	0	0.00	0	0.00	10	0.50	10	0.50
17041018	1704-109	1704-113	CALIFORNIA BLVD & FAIR OAKS AVE	CALIFORNIA BLVD, 246 FT W/O RAYMOND AVE	8	224	17	6	12	$301	$67,274	VCP	FUPD & FUPW	0.39	0.47	0.51	0.58	0.78	1.00	0	0.00	0	0.00	12	0.39	12	0.39
17031029	1703-126	1703-131	900 S ARROYO PKWY	900 S ARROYO PKWY	8	63	18	2	15	$334	$21,109	VCP	EXPD & EXPW	0.52	0.63	1.00	0.65	1.00	1.00	10	0.44	15	0.45	12	0.41	15	0.49

TABLE 7-4: CITY OF PASADENA PIPELINES WITH INSUFFICIENT CAPACITY

Facility ID	From ID	To ID	From Location	To Location	Diameter (in)	Length (ft)	Project	Priority	Replacement Diamter (in)	Unit Cost	Replacement Cost	Material	Classification	Analysis EXAD d/D	Analysis EXPD d/D	Analysis EXPW d/D	Analysis FUAD d/D	Analysis FUPD d/D	Analysis FUPW d/D	Replacement EXPD DIA (in)	Replacement EXPD d/D	Replacement EXPW DIA (in)	Replacement EXPW d/D	Replacement FUPD DIA (in)	Replacement FUPD d/D	Replacement FUPW DIA (in)	Replacement FUPW d/D
17041035	1704-112	1704-111	CALIFORNIA BLVD & ARROYO PKWY	CALIFORNIA BLVD & ARROYO PKWY	8	26	18	2	15	$334	$8,784	VCP	EXPD & EXPW	0.51	0.62	1.00	0.63	1.00	1.00	10	0.43	15	0.39	12	0.41	15	0.43
17031002	1703-100	1703-116	812 S ARROYO PKWY	850 S ARROYO PKWY	8	400	18	2	15	$334	$133,600	VCP	EXPD & EXPW	0.42	0.50	1.00	0.52	0.64	1.00	10	0.36	15	0.37	10	0.44	15	0.39
17031032	1703-142	1703-153	990 S ARROYO PKWY	1030 S ARROYO PKWY	8	180	18	2	15	$334	$60,053	VCP	EXPD & EXPW	0.42	0.50	1.00	0.52	0.64	1.00	10	0.36	15	0.38	10	0.44	15	0.40
17031034	1703-153	1703-157	1030 S ARROYO PKWY	GLENARM ST & ARROYO PKWY	8	200	18	2	15	$334	$66,800	VCP	EXPD & EXPW	0.42	0.50	1.00	0.52	0.64	1.00	10	0.36	15	0.38	10	0.44	15	0.41
17031028	1703-116	1703-126	850 S ARROYO PKWY	900 S ARROYO PKWY	8	337	18	2	15	$334	$112,491	VCP	EXPW	0.42	0.50	1.00	0.51	0.63	1.00	0	0.00	15	0.37	10	0.44	15	0.39
17031031	1703-131	1703-142	900 S ARROYO PKWY	990 S ARROYO PKWY	8	420	18	2	15	$334	$140,347	VCP	EXPW	0.41	0.49	1.00	0.50	0.61	1.00	0	0.00	15	0.37	10	0.43	15	0.39
17031015	1703-173	1703-175	GLENARM ST & ARROYO PKWY	GLENARM ST & ARROYO PKWY	18	21	18	2	30	$463	$9,630	VCP	EXPD & EXPW	0.55	1.00	1.00	0.66	1.00	1.00	24	0.48	27	0.46	27	0.47	30	0.44
17041059	1704-160	1703-100	FILLMORE ST & ARROYO PKWY	812 S ARROYO PKWY	8	378	18	2	12	$301	$113,718	VCP	EXPW	0.35	0.41	1.00	0.43	0.51	1.00	0	0.00	12	0.42	10	0.37	12	0.45
17041054	1704-130	1704-151	PICO ST & ARROYO PKWY	ARROYO PKWY, 322 FT N/O FILLMORE ST	8	338	18	2	12	$301	$101,738	VCP	EXPW	0.32	0.38	0.78	0.39	0.47	1.00	0	0.00	10	0.49	0	0.00	12	0.40
17041056	1704-151	1704-160	ARROYO PKWY, 322 FT N/O FILLMORE ST	FILLMORE ST & ARROYO PKWY	8	322	18	2	12	$301	$96,982	VCP	EXPW	0.32	0.38	0.79	0.39	0.47	1.00	0	0.00	10	0.50	0	0.00	12	0.41
17041058	1704-111	1704-130	CALIFORNIA BLVD & ARROYO PKWY	PICO ST & ARROYO PKWY	8	363	18	2	12	$301	$109,143	VCP	FUPW	0.31	0.37	0.72	0.38	0.45	1.00	0	0.00	0	0.00	0	0.00	12	0.39
18031005	1803-143	1703-156	245 E GLENARM ST	181 E GLENARM ST	21	288	19	5	27	$441	$126,964	VCP	FUPD & FUPW	0.42	0.56	0.69	0.48	0.69	1.00	0	0.00	0	0.00	27	0.45	27	0.49
17031073	1703-148	1703-152	1017 S FAIR OAKS AVE	1017 S FAIR OAKS AVE	10	19	20	4	15	$334	$6,346	VCP	Continuity	0.29	0.34	0.64	0.32	0.38	0.68	0	0.00	0	0.00	0	0.00	0	0.00
17031092	1703-168	1703-165	FAIR OAKS AVE & GLENARM ST	35 E GLENARM ST	12	245	20	4	21	$391	$95,756	VCP	EXPW	0.46	0.55	1.00	0.50	0.61	1.00	0	0.00	21	0.47	15	0.43	21	0.48
17021020	1702-144	1702-132	35/37 COLUMBIA ST	1199 S FAIR OAKS AVE	10	404	20	4	15	$334	$134,836	VCP	EXPW	0.36	0.42	1.00	0.38	0.44	1.00	0	0.00	15	0.48	0	0.00	15	0.49
17021050	1702-122	1702-117	FAIR OAKS AVE & STATE ST	GRACE TER & FAIR OAKS AVE	10	90	20	4	18	$364	$32,906	VCP	EXPW	0.43	0.51	1.00	0.46	0.54	1.00	0	0.00	18	0.44	0	0.00	18	0.45
17021051	1702-132	1702-122	1199 S FAIR OAKS AVE	FAIR OAKS AVE & STATE ST	10	120	20	4	15	$334	$40,113	VCP	EXPW	0.33	0.39	1.00	0.35	0.41	1.00	0	0.00	15	0.45	0	0.00	15	0.45
17021060	1702-117	1702-108	GRACE TER & FAIR OAKS AVE	1129 S FAIR OAKS AVE	10	194	20	4	18	$364	$70,543	VCP	EXPW	0.38	0.44	1.00	0.40	0.47	1.00	0	0.00	18	0.39	0	0.00	18	0.40
17021061	1702-150	1702-144	35 COLUMBIA ST	35/37 COLUMBIA ST	10	137	20	4	15	$334	$45,691	VCP	EXPW	0.32	0.38	1.00	0.34	0.39	1.00	0	0.00	15	0.43	0	0.00	15	0.43
17021063	1702-146	1702-147	COLUMBIA ST & PASADENA AVE	COLUMBIA ST & AVOCA AVE	10	360	20	4	15	$334	$120,240	VCP	EXPW	0.33	0.38	1.00	0.35	0.41	1.00	0	0.00	15	0.42	0	0.00	15	0.43
17021064	1702-147	1702-148	COLUMBIA ST & AVOCA AVE	87 COLUMBIA ST	10	289	20	4	15	$334	$96,426	VCP	EXPW	0.36	0.42	1.00	0.37	0.44	1.00	0	0.00	15	0.47	0	0.00	15	0.48
17021065	1702-148	1702-149	87 COLUMBIA ST	COLUMBIA ST & GRACE DR	10	166	20	4	15	$334	$55,477	VCP	EXPW	0.35	0.40	1.00	0.36	0.43	1.00	0	0.00	15	0.46	0	0.00	15	0.46
17021066	1702-149	1702-150	COLUMBIA ST & GRACE DR	35 COLUMBIA ST	10	120	20	4	15	$334	$39,946	VCP	EXPW	0.34	0.40	1.00	0.36	0.42	1.00	0	0.00	15	0.46	0	0.00	15	0.46
17031007	1703-165	1703-164	35 E GLENARM ST	GLENARM ST & RAYMOND AVE	12	250	20	4	21	$391	$97,750	VCP	EXPW	0.44	0.52	1.00	0.48	0.58	1.00	0	0.00	21	0.45	0	0.00	21	0.47
17031072	1703-143	1703-148	FAIR OAKS AVE & ARLINGTON DR	1017 S FAIR OAKS AVE	10	86	20	4	15	$334	$28,624	VCP	EXPW	0.32	0.38	0.77	0.37	0.44	1.00	0	0.00	15	0.37	0	0.00	15	0.39
17031074	1702-108	1703-168	1129 S FAIR OAKS AVE	FAIR OAKS AVE & GLENARM ST	10	400	20	4	18	$364	$145,527	VCP	EXPW	0.38	0.44	1.00	0.40	0.47	1.00	0	0.00	18	0.39	0	0.00	18	0.40
17031071	1703-152	1703-168	1017 S FAIR OAKS AVE	FAIR OAKS AVE & GLENARM ST	10	264	20	4	15	$334	$88,276	VCP	FUPW	0.31	0.37	0.74	0.36	0.42	0.80	0	0.00	0	0.00	0	0.00	15	0.38
18031001	1803-112	1803-118	894 LOS ROBLES AVE	ALPINE ST & LOS ROBLES AVE	18	344	21	5	21	$391	$134,309	VCP	Continuity	0.40	0.54	0.60	0.46	0.66	0.72	0	0.00	0	0.00	0	0.00	0	0.00
18031024	1804-166	1803-105	FILLMORE ST & LOS ROBLES AVE	844 S LOS ROBLES AVE	18	329	21	5	21	$391	$128,795	VCP	Continuity	0.40	0.54	0.60	0.46	0.66	0.72	0	0.00	0	0.00	0	0.00	0	0.00
18031002	1803-118	1803-134	ALPINE ST & LOS ROBLES AVE	1000 S LOS ROBLES AVE	18	339	21	5	24	$417	$141,488	VCP	FUPD & FUPW	0.41	0.56	0.62	0.48	0.68	0.76	0	0.00	0	0.00	24	0.43	24	0.44
18031026	1803-134	1803-136	1000 S LOS ROBLES AVE	GLENARM ST & LOS ROBLES AVE	18	323	21	5	24	$417	$134,566	VCP	FUPD & FUPW	0.41	0.55	0.62	0.47	0.68	0.75	0	0.00	0	0.00	24	0.42	0	0.00
18041058	1804-164	1804-166	FILLMORE ST, 134 FT E/O LOS ROBLES AVE	FILLMORE ST & LOS ROBLES AVE	18	133	21	5	24	$417	$55,628	VCP	FUPD & FUPW	0.42	0.56	0.64	0.49	0.69	0.78	0	0.00	0	0.00	24	0.43	24	0.45
18041003	1804-161	1804-164	FILLMORE ST, 40 FT E/O OAKLAND AVE	FILLMORE ST, 134 FT E/O LOS ROBLES AVE	18	395	21	5	24	$417	$164,548	VCP	FUPW	0.41	0.54	0.62	0.48	0.67	0.75	0	0.00	0	0.00	0	0.00	24	0.44
18031025	1803-105	1803-112	844 S LOS ROBLES AVE	894 LOS ROBLES AVE	18	305	21	5	24	$417	$127,143	VCP	FUPD	0.40	0.55	0.61	0.47	0.67	0.74	0	0.00	0	0.00	24	0.42	0	0.00
18041009	1804-111	1804-115	CALIFORNIA BLVD & EL MOLINO AVE	CALIFORNIA BLVD & EL MOLINO AVE	8	10	22	6	10	$276	$2,760	VCP	FUPD	0.33	0.45	0.49	0.41	0.56	0.61	0	0.00	0	0.00	10	0.40	0	0.00
18041038	1804-112	1804-111	CALIFORNIA BLVD & MADISON AVE	CALIFORNIA BLVD & EL MOLINO AVE	10	421	22	6	12	$301	$126,816	VCP	FUPD	0.33	0.44	0.49	0.40	0.55	0.60	0	0.00	0	0.00	12	0.42	0	0.00
19041018	1904-160	1904-162	CORNELL RD & MENTOR AVE	CORNELL RD & MENTOR AVE	8	53	23	6	30	$463	$24,446	VCP	EXPD & EXPW	1.00	1.00	1.00	1.00	1.00	1.00	18	0.43	21	0.44	30	0.46	30	0.48
19041026	1904-162	1903-101	CORNELL RD & MENTOR AVE	DALE DR & MENTOR AVE	10	276	23	6	12	$301	$83,106	VCP	FUPD	0.21	0.26	0.35	0.43	0.58	0.64	0	0.00	0	0.00	12	0.43	0	0.00
18011027	1801-119	1801-121	1504 S MARENGO AVE	1530 S MARENGO AVE	8	201	24	4	12	$301	$60,381	VCP	Continuity	0.14	0.16	0.35	0.16	0.19	0.37	0	0.00	0	0.00	0	0.00	0	0.00
18011028	1801-116	1801-119	1500 S MARENGO AVE	1504 S MARENGO AVE	8	155	24	4	12	$301	$46,685	VCP	Continuity	0.15	0.17	0.38	0.17	0.20	0.40	0	0.00	0	0.00	0	0.00	0	0.00
18011032	1801-101	1801-105	1390 S MARENGO AVE	1420 S MARENGO AVE	8	130	24	4	12	$301	$39,040	VCP	Continuity	0.14	0.16	0.35	0.16	0.19	0.37	0	0.00	0	0.00	0	0.00	0	0.00
18011037	1801-121	1801-124	1530 S MARENGO AVE	1540 S LOS ROBLES AVE	8	231	24	4	12	$301	$69,531	VCP	Continuity	0.15	0.17	0.38	0.17	0.20	0.39	0	0.00	0	0.00	0	0.00	0	0.00
18011026	1801-117	1801-124	1508 S LOS ROBLES AVE	1540 S LOS ROBLES AVE	8	315	24	4	12	$301	$94,785	VCP	EXPW	0.30	0.30	0.77	0.31	0.32	0.80	0	0.00	10	0.49	0	0.00	12	0.38
18011029	1801-113	1801-116	1470 S MARENGO AVE	1500 S MARENGO AVE	8	215	24	4	12	$301	$64,835	VCP	EXPW	0.26	0.30	0.77	0.30	0.35	1.00	0	0.00	10	0.49	0	0.00	12	0.39
18011030	1801-110	1801-113	1444 S MARENGO AVE	1470 S MARENGO AVE	8	214	24	4	12	$301	$64,534	VCP	EXPW	0.27	0.31	0.81	0.31	0.37	1.00	0	0.00	12	0.38	0	0.00	12	0.40
18011031	1801-105	1801-110	1420 S MARENGO AVE	1444 S MARENGO AVE	8	215	24	4	12	$301	$64,625	VCP	EXPW	0.26	0.31	0.79	0.31	0.36	1.00	0	0.00	10	0.50	0	0.00	12	0.39
18011033	1802-154	1801-101	1360 S MARENGO AVE	1390 S MARENGO AVE	8	250	24	4	12	$301	$75,280	VCP	EXPW	0.27	0.31	0.79	0.31	0.37	1.00	0	0.00	10	0.50	0	0.00	12	0.39
18021041	1802-149	1802-154	1340 S MARENGO AVE	1360 S MARENGO AVE	8	250	24	4	12	$301	$75,250	VCP	EXPW	0.26	0.31	0.75	0.30	0.36	0.81	0	0.00	10	0.48	0	0.00	12	0.38
18021042	1802-146	1802-149	MARENGO AVE & EUCLID AVE	1340 S MARENGO AVE	8	250	24	4	10	$276	$68,917	VCP	FUPW	0.26	0.30	0.74	0.30	0.36	0.79	0	0.00	0	0.00	0	0.00	10	0.50
19061080	1806-136	1906-139	GREEN ST & EL MOLINO AVE	689 E GREEN ST	12	291	25	5	15	$334	$97,027	VCP	FUPD & FUPW	0.40	0.53	0.60	0.49	0.70	0.78	0	0.00	0	0.00	15	0.48	15	0.49
19061005	1906-139	1906-138	689 E GREEN ST	GREEN ST & OAK KNOLL AVE	12	203	25	5	15	$334	$67,869	VCP	FUPD	0.39	0.51	0.57	0.47	0.66	0.73	0	0.00	0	0.00	15	0.46	0	0.00
19061065	1906-150	1906-149	GREEN ST & MENTOR AVE	960 E GREEN ST	8	244	26	6	10	$276	$67,344	VCP	Continuity	0.20	0.23	0.28	0.38	0.49	0.53	0	0.00	0	0.00	0	0.00	0	0.00
19061067	1906-152	1906-151	GREEN ST & LAKE AVE	914 E GREEN ST	8	245	26	6	10	$276	$67,565	VCP	Continuity	0.19	0.23	0.28	0.38	0.49	0.53	0	0.00	0	0.00	0	0.00	0	0.00
19061073	1906-153	1906-152	840 E GREEN ST	GREEN ST & LAKE AVE	8	255	26	6	10	$276	$70,352	VCP	Continuity	0.14	0.16	0.19	0.28	0.35	0.37	0	0.00	0	0.00	0	0.00	0	0.00
19061074	1906-154	1906-153	GREEN ST & HUDSON AVE	840 E GREEN ST	8	202	26	6	10	$276	$55,669	VCP	Continuity	0.13	0.15	0.18	0.26	0.33	0.35	0	0.00	0	0.00	0	0.00	0	0.00
19061053	1906-147	1906-146	1030 E GREEN ST	GREEN ST & WILSON AVE	8	208	26	6	10	$276	$57,298	VCP	FUPD	0.21	0.24	0.31	0.41	0.53	0.58	0	0.00	0	0.00	10	0.38	0	0.00
19061054	1906-148	1906-147	GREEN ST & CATALINA AVE	1030 E GREEN ST	8	201	26	6	10	$276	$55,476	VCP	FUPD	0.21	0.25	0.31	0.42	0.54	0.59	0	0.00	0	0.00	10	0.39	0	0.00
19061058	1906-146	2006-143	GREEN ST & WILSON AVE	1130 E GREEN ST	8	307	26	6	10	$276	$84,815	VCP	FUPD	0.21	0.25	0.31	0.41	0.53	0.57	0	0.00	0	0.00	10	0.38	0	0.00
19061064	1906-149	1906-148	960 E GREEN ST	GREEN ST & CATALINA AVE	8	210	26	6	10	$276	$57,960	VCP	FUPD	0.22	0.26	0.32	0.44	0.57	0.62	0	0.00	0	0.00	10	0.40	0	0.00
19061066	1906-151	1906-150	914 E GREEN ST	GREEN ST & MENTOR AVE	8	207	26	6	10	$276	$57,132	VCP	FUPD	0.20	0.23	0.28	0.39	0.51	0.54	0	0.00	0	0.00	10	0.36	0	0.00
19061075	1906-155	1906-154	740 E GREEN ST	GREEN ST & HUDSON AVE	8	219	26	6	10	$276	$90,554	VCP	FUPD	0.21	0.24	0.29	0.44	0.58	0.62	0	0.00	0	0.00	10	0.41	0	0.00
20061012	2006-140	2006-139	1218 E GREEN ST	GREEN ST & CHESTER AVE	8	226	26	6	10	$276	$62,238	VCP	FUPD	0.22	0.25	0.33	0.41	0.53	0.58	0	0.00	0	0.00	10	0.38	0	0.00
20061076	2006-135	2006-134	GREEN ST, 245 FT E/O HOLLISTON AVE	GREEN ST & HILL AVE	8	222	26	6	10	$276	$61,327	VCP	FUPD	0.23	0.27	0.36	0.44	0.56	0.63	0	0.00	0	0.00	10	0.40	0	0.00
20061078	2006-136	2006-135	GREEN ST & HOLLISTON AVE	GREEN ST, 245 FT E/O HOLLISTON AVE	8	248	26	6	10	$276	$68,310	VCP	FUPD	0.26	0.30	0.40	0.49	0.65	0.73	0	0.00	0	0.00	10	0.45	0	0.00
20061081	2006-138	2006-136	1304 E GREEN ST	GREEN ST & HOLLISTON AVE	8	271	26	6	10	$276	$74,713	VCP	FUPD	0.23	0.26	0.35	0.43	0.55	0.61	0	0.00	0	0.00	10	0.39	0	0.00
20061083	2006-139	2006-138	GREEN ST & CHESTER AVE	1304 E GREEN ST	8	215	26	6	10	$276	$59,368	VCP	FUPD	0.23	0.26	0.34	0.42	0.55	0.61	0	0.00	0	0.00	10	0.39	0	0.00
20061086	2006-141	2006-140	GREEN ST & MICHIGAN AVE	1218 E GREEN ST	8	206	26	6	10	$276	$56,911	VCP	FUPD	0.22	0.26	0.33	0.42	0.54	0.60	0	0.00	0	0.00	10	0.39	0	0.00
20061087	2006-143	2006-141	1130 E GREEN ST	GREEN ST & MICHIGAN AVE	8	327	26	6	10	$276	$90,280	VCP	FUPD	0.21	0.25	0.32	0.40	0.52	0.57	0	0.00	0	0.00	10	0.37	0	0.00
22061081	2206-106	2206-105	COLORADO BLVD, 230 FT E/O ROOSEVELT AVE	COLORADO BLVD & SIERRA MADRE BLVD	8	225	27	1	12	$301	$67,635	CP	EXPD & EXPW	0.56	0.79	1.00	0.63	1.00	1.00	12	0.39	12	0.41	12	0.43	12	0.44
22061048	2206-132	2206-135	37 S SIERRA MADRE BLVD	45 S SIERRA MADRE BLVD	8	133	27	1	10	$276	$36,625	CP	FUPD	0.36	0.46	0.51	0.40	0.52	0.57	0	0.00	0	0.00	10	0.36	0	0.00
22061049	2206-135	2206-143	45 S SIERRA MADRE BLVD	111 S SIERRA MADRE BLVD	8	250	27	1	10	$276	$69,083	CP	FUPD	0.35	0.45	0.51	0.39	0.51	0.56	0	0.00	0	0.00	8	0.50	0	0.00
22061082	2206-107	2206-106	COLORADO BLVD & ROOSEVELT AVE	COLORADO BLVD, 230 FT E/O ROOSEVELT AVE	8	230	27	1	10	$276	$63,397	CP	FUPD	0.35	0.46	0.50	0.39	0.51	0.55	0	0.00	0	0.00	8	0.50	0	0.00
22061083	2206-108	2206-107	COLORADO BLVD, 233 FT W/O ROOSEVELT AVE	COLORADO BLVD & ROOSEVELT AVE	8	234	27	1	10	$276	$64,474	CP	FUPD	0.38	0.49	0.54	0.42	0.55	0.60	0	0.00	0	0.00	10	0.38	0	0.00
22061084	2206-109	2206-108	COLORADO BLVD & GRAND OAKS AVE	COLORADO BLVD, 233 FT W/O ROOSEVELT AVE	8	243	27	1	10	$276	$67,096	CP	FUPD	0.36	0.46	0.51	0.40	0.52	0.56	0	0.00	0	0.00	10	0.36	0	0.00
22061046	2206-105	2206-117	COLORADO BLVD & SIERRA MADRE BLVD	COLORADO BLVD & SIERRA MADRE BLVD	8	55	27	1	10	$276	$15,180	VCP	Continuity	0.31	0.40	0.44	0.35	0.45	0.48	0	0.00	0	0.00	0	0.00	0	0.00
22061047	2206-117	2206-132	COLORADO BLVD & SIERRA MADRE BLVD	37 S SIERRA MADRE BLVD	8	208	27	1	10	$276	$57,270	VCP	FUPD	0.41	0.54	0.60	0.46	0.61	0.68	10	0.38	0	0.00	10	0.43	0	0.00
21051037	2105-148	2105-149	ALLEN AVE, 97 FT N/O SAN PASQUAL ST	ALLEN AVE, 50 FT N/O SAN PASQUAL ST	12	48	28	1	21	$391	$18,690	CP	EXPD & EXPW	0.59	0.80	1.00	0.65	1.00	1.00	18	0.39	21	0.41	18	0.42	21	0.43
21041003	2104-104	2104-105	HOMET RD & ALLEN AVE	HOMET RD & ALLEN AVE	8	7	28	1	21	$391	$2,737	VCP	EXPD & EXPW	1.00	1.00	1.00	1.00	1.00	1.00	18	0.45	21	0.43	21	0.41	21	0.48
23101089	2310-166	2310-173	DUDLEY ST & ALTADENA DR	ALTADENA DR, 77 FT W/O DUDLEY ST	8	81	29	3	10	$276	$22,273	VCP	EXPD	0.38	0.56	0.58	0.39	0.57	0.59	10	0.40	0	0.00	10	0.41	0	0.00
25101043	2510-147	2510-148	3745 E SIERRA MADRE BLVD	SIERRA MADRE BLVD & HASTINGS RANCH DR	8	210	30	3	10	$276	$57,932	VCP	EXPD	0.41	0.55	0.73	0.43	0.57	0.76	10	0.39	0	0.00	10	0.40	10	0.49
26101033	2610-129	2510-147	SIERRA MADRE BLVD & MEDFORD RD	3745 E SIERRA MADRE BLVD	8	204	30	3	10	$276	$56,276	VCP	EXPD	0.42	0.55	0.73	0.43	0.57	0.76	10	0.39	0	0.00	10	0.40	10	0.49
25081011	2508-141	2508-140	3725 HAMPTON RD	3725 HAMPTON RD	8	257	31	2	12	$301	$77,297	VCP	EXPD & EXPW	0.48	0.65	1.00	0.49	0.66	1.00	10	0.45	12	0.42	10	0.46	12	0.43
25081036	2508-130	2508-138	HASTINGS RANCH DR, 109.8 FT S/O NEWHAVEN RD	HAMPTON RD & HASTINGS RANCH DR	8	258	31	2	10	$276	$71,070	VCP	EXPW	0.41	0.55	0.74	0.42	0.56	0.76	10	0.39	0	0.00	10	0.40	10	0.48
25081037	2508-127	2508-130	NEWHAVEN RD & HASTINGS RANCH DR	HASTINGS RANCH DR, 109.8 FT S/O NEWHAVEN RD	8	110	31	2	10	$276	$30,305	VCP	EXPD	0.39	0.51	0.68	0.39	0.52	0.69	10	0.36	0	0.00	10	0.37	0	0.00
25081035	2508-138	2508-141	HAMPTON RD & HASTINGS RANCH DR	3725 HAMPTON RD	8	65	31	2	10	$276	$17,912	VCP	FUPD	0.38	0.50	0.66	0.39	0.51	0.67	0	0.00	0	0.00	10	0.36	0	0.00
25081038	2508-121	2508-127	HASTINGS RANCH DR, 148 FT N/O NEWHAVEN RD	NEWHAVEN RD & HASTINGS RANCH DR	8	148	31	2	10	$276	$40,820	VCP	FUPD	0.38	0.50	0.66	0.39	0.51	0.67	0	0.00	0	0.00	10	0.36	0	0.00
26071002	2607-101	2607-102	MICHILLINDA AVE, 287 FT N/O FOOTHILL BLVD	FOOTHILL BLVD & MICHILLINDA AVE	8	248	32	3	10	$276	$68,393	VCP	EXPD	0.39	0.51	0.67	0.40	0.52	0.68	10	0.36	0	0.00	10	0.37	0	0.00
26071003	2608-132	2607-101	MICHILLINDA AVE, 231 FT S/O MAYFAIR DR	MICHILLINDA AVE, 287 FT N/O FOOTHILL BLVD	8	288	32	3	10	$276	$79,598	VCP	EXPD	0.39	0.51	0.67	0.39	0.52	0.68	10	0.36	0	0.00	10	0.37	0	0.00
26081025	2608-129	2608-132	MAYFAIR DR & MICHILLINDA AVE	MICHILLINDA AVE, 231 FT S/O MAYFAIR DR	8	231	32	3	10	$276	$63,811	VCP	EXPD	0.39	0.51	0.67	0.39	0.52	0.68	10	0.36	0	0.00	10	0.37	0	0.00
18111049	1811-111	1811-123	RIO GRANDE ST & EL MOLINO AVE	WASHINGTON BLVD & EL MOLINO AVE	8	515	33	2	12	$301	$154,865	VCP	EXPD & EXPW	0.50	0.62	1.00	0.51	0.65	1.00	10	0.43	12	0.45	10	0.45	12	0.46
18061086	1806-118	1806-119	COLORADO BLVD & COLORADO BLVD	COLORADO BLVD & LOS ROBLES AVE	8	456	34	2	12	$301	$137,316	VCP	EXPD & EXPW	0.54	0.79	1.00	0.65	1.00	1.00	12	0.40	12	0.41	12	0.47	12	0.47
18051043	1805-121	1805-120	DE MAR BLVD & EUCLID AVE	DE MAR BLVD & LOS ROBLES AVE	8	462	35	3	10	$276	$127,512	VCP	EXPD	0.39	0.53	0.58	0.46	0.66	0.71	10	0.38	0	0.00	10	0.45	0	0.00
19061089	1906-115	1906-114	COLORADO BLVD & HUDSON AVE	COLORADO BLVD & LAKE AVE	8	470	36	6	10	$276	$129,692	VCP	FUPD	0.30	0.38	0.48	0.44	0.58	0.67	0	0.00	0	0.00	10	0.41	0	0.00
15071049	1507-103	1507-112	361 LINDA VISTA AVE	333 LINDA VISTA AVE	8	240	37	6	10	$276	$66,240	VCP	FUPD	0.39	0.49	0.49	0.45	0.58	0.58	0	0.00	0	0.00	10	0.41	0	0.00
15071050	1507-112	1507-120	333 LINDA VISTA AVE	320 LINDA VISTA AVE	8	200	37	6	10	$276	$55,200	VCP	FUPD	0.40	0.50	0.50	0.46	0.59	0.59	0	0.00	0	0.00	10	0.41	0	0.00
15071051	1507-120	1507-135	320 LINDA VISTA AVE	310 LINDA VISTA AVE	8	155	37	6	10	$276	$42,780	VCP	FUPD	0.39	0.49	0.49	0.45	0.58	0.58	0	0.00	0	0.00	10	0.41	0	0.00
18061072	F89223	1806-149	GRADE BREAK	300 E GREEN ST	8	160	38	6	10	$276	$44,243	VCP	FUPD	0.17	0.20	0.20	0.44	0.59	0.59	0	0.00	0	0.00	10	0.42	0	0.00
TOTAL						**45,142**					**$14,001,280**																

7.6 Sewer Facility Charge Evaluation

As authorized by Government Code Section 66013 various municipal code sections, the City has recently begun to utilize this charge mechanism to recover the costs of new development's impact on sewer system capacity. The purpose of this charge is to assure that future customers pay their fair share of the costs of the system's capacity for existing facilities and new facilities to be constructed in the future that are of benefit to the customer paying this charge. As such, a Sewer Facility Charge equitably distributes facility costs to future users based on their demands on the sewer system. The assets that are used to collect and pump the City's sewage are the basis for the costs of capacity in the system.

In recognition of the need to remain current and integrate the new Master Plan costs of system capacity, the City desires to develop an appropriate Sewer Facility Charge. This section is intended to update the current cost of system capacity, reflect these costs in the development of this charge, and document the charge in conformance with the requirements of Government Code Section 66000 et seq.

7.6.1 Regulatory Requirements

The regulations that govern the charges discussed herein generally fall into two areas: compliance with State government codes and adherence to City ordinances. These are discussed as follows:

Government Code Sections 66013, 66016, 66022 and 66023 are the primary government code sections applicable to the development and recovery of capacity charges. The focus of these sections is summarized below:

The City must establish that the capacity charge does not exceed the estimated reasonable cost of capacity in facilities in existence or to be constructed for the benefit of the customer charged.

The capacity charge revenues must be segregated from operating and maintenance funds and deposited in a separate fund.

The City may only expend the revenues for the purpose for which the charges were collected.

In summary, these sections of Government Code suggest that the basis for a capacity charge be consistent with new development's impact on the cost of capacity in the City's sewer system.

In addition to the State requirements, local Municipal Code generally provides additional clarity in the administration of this charge. As discussed with City staff, there currently is no code to address the development, administration or use of this charge and its related funds. As such, should the City desire to adopt the Sewer Facility Charge derived herein, additional Municipal Code modifications will be required.

7.6.2 Calculation Methodology

Sewer Facility Charges are used by many public agencies to finance utility system improvements that result from growth pressures identified during planning for future growth. There are two basic methodologies in common usage to develop the fees: incremental and capacity buy-in. Some agencies, due to their special or unique circumstances, policies or local requirements, may create a combination or variation of the basic methods.

7.6.2.1 Incremental Method

The incremental method is the most common approach used to develop sewer facility charges, particularly in communities with a potential for significant additional growth (in either area or density). This method identifies the cost of future facilities required to meet the projected demands of the identified growth. Costs related to unutilized existing system capacity and remedial system improvements are not included in the analysis. These costs are unitized by using the projected number of new units over the study period to create a charge/new unit.

The Capital Improvement Program and the future incremental demands based on growth projections of the General Plan serve as basis for this method.

7.6.2.2 Capacity Buy-In Method

The capacity buy-in method is based on the average investment in the utility system by the current customers. It identifies the value of the unutilized capacity of the system by dividing the value of the fixed assets by the current demand on the system. The valuation of the fixed assets process should be based on a supportable methodology that may be subject to modification to insure fairness to future customers from special liabilities of the current customers.

Since the capacity buy-in method does not require a capital improvement program, this simple and straightforward methodology can be readily evaluated and updated.

7.6.2.3 Combination or Hybrid Methods

It is not uncommon to see elements of both methods integrated or combined in the development of capacity charges. The critical factor is the documentation of a clear nexus between the identified program costs and the beneficial users. To insure conformance with statutory requirements, nexus studies should include a legal review prior to adoption.

7.6.2.4 Recommended Method

Several criteria were considered in selecting the method for developing the Sewer Facility Charge for the City including:

- A documented nexus between the cost of the capacity and the proposed updated fees;
- Compliance with statutory requirements;
- Provides equity between new and existing customers;
- Generally conforms with current cost allocation policies; and
- Facilitates public understanding and acceptance.

While all of the methodologies satisfy the statutory requirements, the hybrid method is most applicable because of the recently updated information available in the General Plan that clearly documents the cost/benefit relationship of the City's significant future growth with the facilities required to meet the demands of that growth integrated in the General Plan. The methodology selected was confirmed by City staff to be the most consistent with the City's needs and goals.

7.6.2.5 Development of Sewer Facility Charges

In accordance with the subscribed methodology, proposed charges were derived by developing a value of the City's sewer system, and unitizing this value by dividing by the ultimate system demands. The system value was developed based on an estimate of the replacement cost new less depreciation (RCNLD) of the sewer pipelines in the City's GIS, and adding the new capital improvements identified in the Master Plan to meet the ultimate demands. The resulting findings are summarized in Table 7-5.

Table 7-5: Development of Proposed Sewer Facility Charge

Description	Units
System Demand and Usage Criteria	
Ultimate Annual Demand (mgd)	18.71
Current Demand (mgd)	14.90
Incremental New Demand (mgd)	3.81
Cost of Capacity	
Net New Cash Improvements	$14,001,280
Net Book Value of Assets	$101,692,640
Capacity Buy In Approach	
Costs (Net New CIP + Assets)	$115,693,920
Ultimate Demand gpd	18,710,000
Sewer Facility Charge ($/gpd)	$6.19
Sewer Facility Charge ($/unit)*	$1,534
Current Capacity Charge (gpd)	$6.00
Estimated SFR Charge/Unit*	$1,500
*Unit is 250 gpd	

As shown, the resulting value of the City's sewer system was estimated to be $6.19 per gallon per day. This value is comparable to the current charge that is assessed to allow new development to connect without paying for the cost of total pipeline replacement.

To assure that growth pays its fair share, the City should consider the adoption of the revised cost of service for new connections. Moreover, the City should consider reviewing this charge periodically and escalating the charge on an annual basis to generally preserve the current relationship of costs and charges. This approach is also utilized by the City for the sewer use fee.

7.7 Sewer Use Fee Evaluation

In a manner similar to the conduct of the Sewer Facility Charge evaluation, an assessment of the City's sewer costs and associated sewer use fee revenues was performed. The purpose of this evaluation is to quantify the implications of implementing the Master Sewer Plan findings on current rates and charges. A discussion of the City's sewer system costs and fees is provided in the following sections.

7.7.1 Economic Nature of Utility Operations

Public utility operations, such as the City's sewer utility, provide a service to a community which is primarily essential to public health and protection of the environment. Utility operations differ from other types of business entities in that they are highly capital intensive. This means that a large amount of capital investment is required to operate a utility compared to most other businesses.

A large amount of capital is required to fund a utility system. This capital cost, combined with operating labor, insurance and other costs of operation which do not vary with volume of sewage discharged, means that the vast majority of the costs of a sewer system are fixed. Fixed costs are incurred whether or not customers use water/discharge sewage, and are associated with providing the availability of service. Usually the long-term costs for a sewer system are at least 50 percent of total expenditures. A smaller proportion of a utility's cost is variable, and changes with the volume of sewage discharged (i.e. the cost of power for lift stations, etc.). Due to the large amount of capital required to build and operate a sewer system, sewer utilities are generally monopolies in their service areas.

7.7.2 Historical Sewer System Fees and Revenues

As authorized by Chapter 4.52 of the Pasadena Municipal Code, the City charges a sewer use fee to recover the costs of providing sewer service. The charge is administered based on the quantity of water used by each customer in hundred cubic feet (Hcf). Residential properties also have a maximum level per year to acknowledge the quantity of exterior seasonal water usage. This chapter was first adopted in 1967 and has been modified periodically per City Ordinance. The fee has been kept reasonably current by indexing this charge with local Consumer Price Indexes (CPI) and annually increasing the sewer use fee accordingly. A summary of the City's historical sewer use fee over the last few years is shown in Table 7-6.

Table 7-6: Historical Sewer Use Fees

Description	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
$/Hcf - homes served by Code	$0.17	$0.18	$0.18	$0.18	$0.19
Maximum per year	$80.27	$82.42	$85.35	$86.99	$90.34
$/Hcf - homes not served by Code	$0.21	$0.22	$0.22	$0.23	$0.24
Minimum per month	$6.65	$6.83	$7.08	$7.21	$7.49
$/Hcf - all other sources	$0.30	$0.31	$0.32	$0.33	$0.34
Approximate Percent Increase	3.60%	2.68%	3.55%	1.92%	3.85%

Source: City of Pasadena

As shown, the sewer fee has increased from 1.92% to 3.85% over the last five years. This increase represents approximately $0.01 per 100 cubic fee (Hcf) per year to keep pace with inflation, while the maximum charge per year has been increasing approximately $1.65 to $3.35 per year. The sewer use fee has historically generated approximately $2.6 to 2.9 million per year. The budgeted revenue to be generated by this fee in FY 2005-06 is $2,942,762.

7.7.3 Projected Sewer System Revenue Requirements

An assessment of the City's future revenue requirements can be focused in the projection of several key areas. These areas are customer growth, operation and maintenance costs, and capital-related expenditures. These interdependent factors are incorporated in the City's budget and are cornerstone elements of the revenue projection provided herein.

7.7.3.1 Customer Growth and Demand

As derived in Section 5, future flows are projected to increase by approximately 3.8 mgd in the City's ultimate build-out scenario. This ultimate demand represents the additional impact on the sewer system and also represents the level of additional services that will be paying the sewer use fee over the long range planning period. Conservatively unitizing this value on an annual basis is used to predict the magnitude of additional customers that will be paying the sewer use fee and will be subject to the Sewer Facility Charge. The results of this growth assessment analysis and discussion with City staff are shown in Table 7-7.

Table 7-7: Historical Sewer Use Fees

Description	Units
System Demand and Usage Criteria	
Ultimate Annual Demand (mgd)	18.71
Current Demand (mgd)	14.90
Incremental New Demand (mgd)	3.81
Estimated Growth Period (Years)	20
Estimated New Growth/Year (mgd)	0.19
Growth Adjustment Factor	50%
Planning Value - Growth/Year (mgd)	0.10

As shown, growth and redevelopment is conservatively projected to generate an additional 0.1 mgd or 100,000 gallons per day in Pasadena. This conservatively growth variable will be incorporated in the estimation of additional sewer use and capital facility charge revenues in subsequent sections.

7.7.3.2 Operating Expense Projection

The City budgets and manages its operation and maintenance (O&M) expenses by categorizing service activities into several functional budgetary categories. For cost projection purposes, these categories are segregated into four major cost elements. These are personnel, supplies and services, internal service charges and abatements.

Operating expenses were projected by combining the FY 05-06 budgeted costs in the defined categories with the recommended increase in O&M staffing costs developed in Section 4. These costs were subsequently escalated based on a 2.7% to 3.0% annual inflation factor. Accordingly, the base FY 2005-06 operating budget of $1.17 million is projected to increase to $1.46 million in FY 2006-07 to account for the additional staffing, and reach approximately $1.7 million by the FY 2011-12 planning period.

7.7.3.3 Capital Improvement Requirements

As previously derived, the City's sewer system is in need of additional capital expenditures to remediate identified system improvements. These improvements are for known pipeline and manhole repairs, collection system capacity deficiencies, pump station improvements, new O&M equipment, and additional funds to provide for the ongoing reinvestment in aging infrastructure. These capital improvements are integral elements of the City's projected revenue requirements and integrated in the sewer rate and revenue plan derived herein. Based upon discussions with City staff, sewer rates should fund approximately $1 million per year in capacity related improvements.

7.7.3.4 Projected Sewer Revenue Plan

The projected revenue plan is developed to compare the sewer utility's revenues with revenue requirements for the six-year study period. The financial projection is based on the estimated change in customer demands, the projected O&M expenses, the inclusion of the comprehensive capital improvement program, and discussions with City staff.

It should be noted that in the development of the projected plan, there are several key elements that were discussed with City staff that required specific direction. These key elements are as follows:

- New O&M staffing and equipment costs should begin in FY 2007.
    - Video Inspection contractual services cost of $400,000 per year should continue in FY 2007 for one additional year.

- Debt should not be used to meet capital improvement requirements.
- Rates should fund approximately $1 million per year in capacity related improvements.
- Ongoing capital repair/replacements should be funded at the rate of annual depreciation. Funds should be accrued in addition to the specified pipeline/manhole repair projects.
- If a substantial increase in rates is required, it should occur in year one to meet the plan requirements. Subsequent increases should generally be limited to CPI adjustments.

The results of the City's sewer system revenue plan are shown in Table 7-8.

Table 7-8: Projected Revenues and Expenses

Description	Budgeted FY2006	Projected FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
Sewer Fund Revenues							
Sewer Use Charges	$2,942,762	$4,728,038	$4,891,734	$5,060,885	$5,235,668	$5,426,736	$5,624,549
Investment Earnings (Sewer - 62.8% of total) (1)	$74,240	$63,847	$53,631	$50,413	$50,413	$50,413	$50,413
Sewer Facility Charge Revenues	$0	$619,000	$628,285	$637,709	$647,275	$656,984	$666,839
Total Sewer Fund Revenue	$3,017,002	$5,410,884	$5,573,650	$5,749,008	$5,933,356	$6,134,133	$6,341,801
Operating Expenses (1)							
Personnel	$827,803	$852,637	$878,216	$904,563	$931,700	$959,651	$988,440
Supplies and Services	$262,351	$267,598	$272,950	$278,409	$283,977	$292,496	$301,271
Internal Service Charges	$175,562	$179,073	$184,445	$189,979	$195,678	$201,549	$207,595
Subtotal - Sewer Expenses (75%)	$949,287	$974,481	$1,001,709	$1,029,713	$1,058,516	$1,090,272	$1,122,980
Abatements	$218,186	$224,732	$231,474	$238,418	$245,570	$252,937	$260,526
New Sewer O&M Costs (2)		$260,000	$267,280	$274,764	$282,457	$290,931	$299,659
Total Operating Expenses	$1,167,473	$1,459,213	$1,500,462	$1,542,894	$1,586,544	$1,634,140	$1,683,164
Net Revenue	$1,849,529	$3,951,671	$4,073,188	$4,206,113	$4,346,812	$4,499,993	$4,658,637
Capital Expenditures							
Pipeline/Manhole Repair Projects (1)	$450,000	$400,000	$400,000	$400,000	$160,000	$165,000	$170,000
Annual Video Inspection Services	$400,000	$400,000	$0	$0	$0	$0	$0
Capacity Improvement Projects (3)	$151,000	$449,226	$874,255	$943,408	$940,348	$974,395	$1,572,818
Pump Station Improvement Costs (4)		$76,300	$72,200	$0	$0	$0	$0
New O&M Equipment Costs		$520,000	$0	$0	$0	$0	$0
Annual Capital Repair/Replacement Funding		$2,750,000	$2,791,250	$2,833,119	$2,875,616	$2,918,750	$2,962,531
Total Capital Expenditures(5)	$1,001,000	$4,595,526	$4,137,705	$4,176,527	$3,975,964	$4,058,145	$4,705,349
Capital Financing							
Proposed Debt Issuance							
Financing Expenses							
Net Change in Funds Avail. After Capital Activit	$848,529	($643,855)	($64,517)	$29,587	$370,848	$441,848	($46,713)
Beginning Cash Balance	$3,094,428	$3,942,957	$3,299,103	$3,234,586	$3,264,173	$3,635,021	$4,076,869
Ending Cash Balance	**$3,942,957**	**$3,299,103**	**$3,234,586**	**$3,264,173**	**$3,635,021**	**$4,076,869**	**$4,030,156**
Cumulative Capital Replacement Fund Reserve(5)		$2,750,000	$5,541,250	$8,374,369	$11,249,984	$14,168,734	$17,131,265
Basis for Projected Sewer Revenues							
Percent Rate Increase		**60.0%**					
CPI Indexed Rate Increase			2.8%	2.8%	2.8%	3.0%	3.0%
Estimated New Demand/Year (MGD)		0.10	0.10	0.10	0.10	0.10	0.10
Cumulative Estimated Demand/Year (MGD)	14.90	15.00	15.10	15.20	15.30	15.40	15.50
Percent Annual Increase in Demand		0.67%	0.66%	0.66%	0.65%	0.65%	0.65%
Capital Facility Charge ($/gpd)		$6.19	$6.28	$6.38	$6.47	$6.57	$6.67
Capital Facility Charge Increase (ENRCCI)		0.0%	1.5%	1.5%	1.5%	1.5%	1.5%
Percent Operational Cost Increase (CPI)		2.7%	2.8%	2.8%	2.8%	3.0%	3.0%

(1) Source: City staff provided projected investment earnings,base operating expenses, and pipeline/manhole repair project cost through FY 2010.
(2) Estimated new sewer O&M costs provided in Section 4.
(3) Collection system capacity improvements are scheduled at approximately $1 million/year. Priority 1, 2, and 3 are funded by the end of FY 2012.
(4) Pump station improvements are scheduled to be completed in a two-year period; Busch Garden followed by Rosemont.
(5) Specific Capital Repair and Replacement Projects are being prepared by City Staff. As they projects are prepared, the CCFR balance will decrease.

As shown, the revenue plan proposes a substantial increase in revenues over the six-year planning period to fund the identified obligations and maintain a comparable level of sewer fund balance. The plan includes the adoption of an initial rate increase to implement the Master Sewer Plan findings for hydraulic improvements and the need to provide the funds necessary for capital reinvestment of aging infrastructure. The initial increase is projected at approximately 60%. When no specific user charge increase is recommended, user fees are scheduled to increase at the same rate as the projected operational cost increase, in accordance with the City's Municipal Code.

In contrast, the plan clearly shows that the $3 million per year generated by current rates will be inadequate to meet the identified financial obligations. Accordingly, without additional funds, the cash balance of the City's sewer fund is projected to be depleted in FY 2008.

7.7.4 Proposed Sewer Fees and Charges

As developed herein, the City's sewer system is in need of additional funds to meet the goals and objectives outlined in the Sewer Master Plan. The revenue plan reflects the need to substantially increase revenues and the City's directive is to provide for an initial increase to meet this need. The resulting fees associated with the proposed rates are shown in Table 7-9.

Table 7-9: Proposed Sewer Fees and Administrative Findings

Description	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
$/Hcf - homes served by Code	$0.19	$0.30	$0.31	$0.32	$0.33	$0.34	$0.35
Maximum per year	$90.34	$144.54	$148.59	$152.75	$157.03	$161.74	$166.59
$/Hcf - homes not served by Code	$0.24	$0.38	$0.39	$0.41	$0.42	$0.43	$0.44
Minimum per month	$7.49	$11.98	$12.32	$12.66	$13.02	$13.41	$13.81
$/Hcf - all other sources	$0.34	$0.54	$0.56	$0.57	$0.59	$0.61	$0.63
Projected Percent Increase	3.85%	60.00%	2.80%	2.80%	2.80%	3.00%	3.00%

As shown in Table 7-9, the proposed rates are designed to infuse the sewer fund with additional revenues to meet current and projected costs. While the initial increase of 60% may appear to be a substantial percentage, it represents an increase of only $0.11/Hcf of water used for a typical City resident. Moreover, this increase represents a maximum per month increase of only $4.52, which is approximately $0.15/day.

In addition to the financial findings and recommendations provided herein, it is further recommended the City consider a more formal segregation of the sanitary sewer and storm drain sewer funds as specified in Chapter 4.52 of the City's Municipal Code. Pursuant to the data reviewed during the conduct of the sewer revenue plan, it appears that sanitary sewer and storm drain sewer costs are commingled, and only separated by estimated percentages. In consideration of the requirements of Proposition 218, the City may desire to either establish separate funds for these activities or, at a minimum, establish distinct object codes for each related activity within the same fund. Proceeding in this manner would provide a more distinct nexus between costs and benefits and may provide additional administrative conformance with current government code.

References

City of Pasadena Water Master Plan, MWH 2005.

City of Pasadena Comprehensive General Plan, Amended to Year 2000.