City of Pacific Grove

Sewer System Asset Management Plan

HDR

May 2004

CITY OF PACIFIC GROVE
SEWER SYSTEM ASSET MANAGEMENT PLAN

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Executive Summary

The City of Pacific Grove engaged HDR Engineering, Inc. to prepare a Sewer System Asset Management Plan (SSAMP). The purpose of the SSAMP is to provide guidance to the City in the management of the City's sewer system assets. The sewer system assets include seven pump stations, 57 miles of gravity sewers, and one mile of pressure sewers.

Background

The City prepared a Sewer System Master Plan in calendar year 2000 that recommended replacement of the entire 58 mile sewer system over a period of 20 years.

The City replaced approximately two miles of its sewer system and many manholes at a cost of approximately $1.5 million between 2002 and 2004. The City's maintenance strategy was to clean its entire sewer system every eight months. In addition, the City completed television inspection of approximately 10 miles or 20% of its gravity sewers and it has plans to inspect another 18 miles of gravity sewers later this year. During this same period, the City implemented a program to control fats, oils, and grease from commercial sources. These efforts resulted in significant reduction in the frequency and severity of the City's sanitary sewer overflows.

The Central Coast Regional Water Quality Control Board has issued a requirement for the City, along with other sewer system operators in the Monterey Bay Area, to prepare a Sewer System Management Plan with the goal of reducing the frequency and severity of sanitary sewer overflows through the implementation of best management practices. These same requirements are either in place or being planned in the San Diego Bay Area, the Santa Ana River Basin, the San Francisco Bay Area, and a few agencies in the Central Valley and North Coast Regional Water Quality Control Boards. Broader application of these requirements in California is anticipated over the next two years.

The City has acted to increase its sewer service charge to provide additional funding for its sewer system. The sewer service charge will be increased 60% effective July 1, 2004. Future increases will be considered over the following two years with the goal of setting the July 1, 2006 sewer service charge at twice the current level.

The scope of work included evaluating maintenance practices, reviewing the condition of the sewer system where information was available, determining current wastewater flows, evaluating the capacity of the sewer system, identifying sewers with capacity and condition issues, developing a three year capital improvement program, and projecting sewer enterprise fund revenues and expenses. This SSAMP presents the results of the work. The recommended programs and activities will assist the City in complying with all current and reasonably anticipated regulations. Implementation of the recommendations included in the SSAMP will support achievement of the City's goals for its sewer system:

- Minimizing wet and dry weather sanitary sewer overflows,
- Providing an excellent level of service, and
- Protecting human health and the marine environment.

Findings

The City's current sewer cleaning strategy is to clean every gravity sewer on an eight month cycle and to clean problematic sewers on either a three or four month schedule. While this has been effective at reducing sanitary sewer overflows, some sewers are being cleaned too often and other sewers may not be cleaned often enough.

The City's sewer maintenance staff of three, one Maintenance Supervisor and two maintenance workers, is adequate to maintain the City's gravity sewer system assets.

The City's sewer cleaning equipment is adequate with the exception of the sewer rodding truck which should be replaced as soon as possible.

The seven City-owned pump stations that are operated and maintained under contract by the Monterey Regional Water Pollution Control Agency are well-operated and maintained and are in reasonably good condition. Two of the pump stations are in need of rehabilitation, minor modifications are required for support systems, and all pump stations will be provided with increased reliability with the purchase of spare pumps which will minimize downtime in the event of an equipment failure.

Wastewater flows were monitored at four locations and rainfall gauges were monitored at two locations between January 19 and March 19, 2004. The average flow during this period for days without rainfall was 1.71 million gallons per day. This equates to 210 to 380 gallons per day per connection depending on the area within the City. Four rainfall events occurred during this period with the largest one occurring on February 25, 2004. The peak wet weather flow was 3.28 million gallons per day. Analysis of the flow and rainfall data indicated that the City does not have a significant inflow problem and that increased flows due to infiltration is minor.

The capacity of key elements of the sewer system (approximately five miles of 8 inch and larger sewer) was evaluated for both current and projected future flows. Peak wet weather flows were projected to approximate the flows that would be associated with a storm that would occur once every ten years on the average with a duration of six hours (the approximate time of concentration or the time it takes for all areas of the collection system to attain peak flow during the rainfall event). Approximately 3,800 feet of sewers need to be upgraded to provide adequate capacity for current peak wet weather flow conditions. Future peak wet weather flows were projected by assuming that sewer service will be provided to all developable parcels and that 1,600 additional secondary housing units will be constructed. An additional 3,800 feet of sewers will need to be upgraded to provide adequate capacity for projected future peak wet weather flow conditions. The current and projected future capacity deficiencies are located in the older portions of the City and along the trunk sewer serving the Del Monte Park area. The capacity deficiencies are shown on Figure ES-1.

Data from historical smoke and dye testing to identify sources of inflow and infiltration were reviewed. It appears that the City has dealt or is dealing effectively with the few problems that were identified.

The data from the City's television inspection program was evaluated in an effort to characterize the condition of the sewer system. The television inspection data from 2002 and 2003 covers one third of the sewer system. The data is from the oldest portion of the City. A letter condition grade was assigned to each completed line segment: A (new or near new), B (minor deterioration), C (significant deterioration), D (severe deterioration), and F (failure imminent). Projecting the results of this one third sample over the entire collection system suggests that approximately 17% of the City's sewers are in condition D and 3% are in condition F. The sewers in condition D will need to be monitored and rehabilitated or replaced when conditions warrant. The City may choose to upgrade their condition using spot repairs where appropriate. Sewers that are in condition F will need to be replaced as soon as possible. A summary of the sewer condition assessment is contained in Table ES-1. The location of the condition D and F sewers are shown on Figure ES-1.

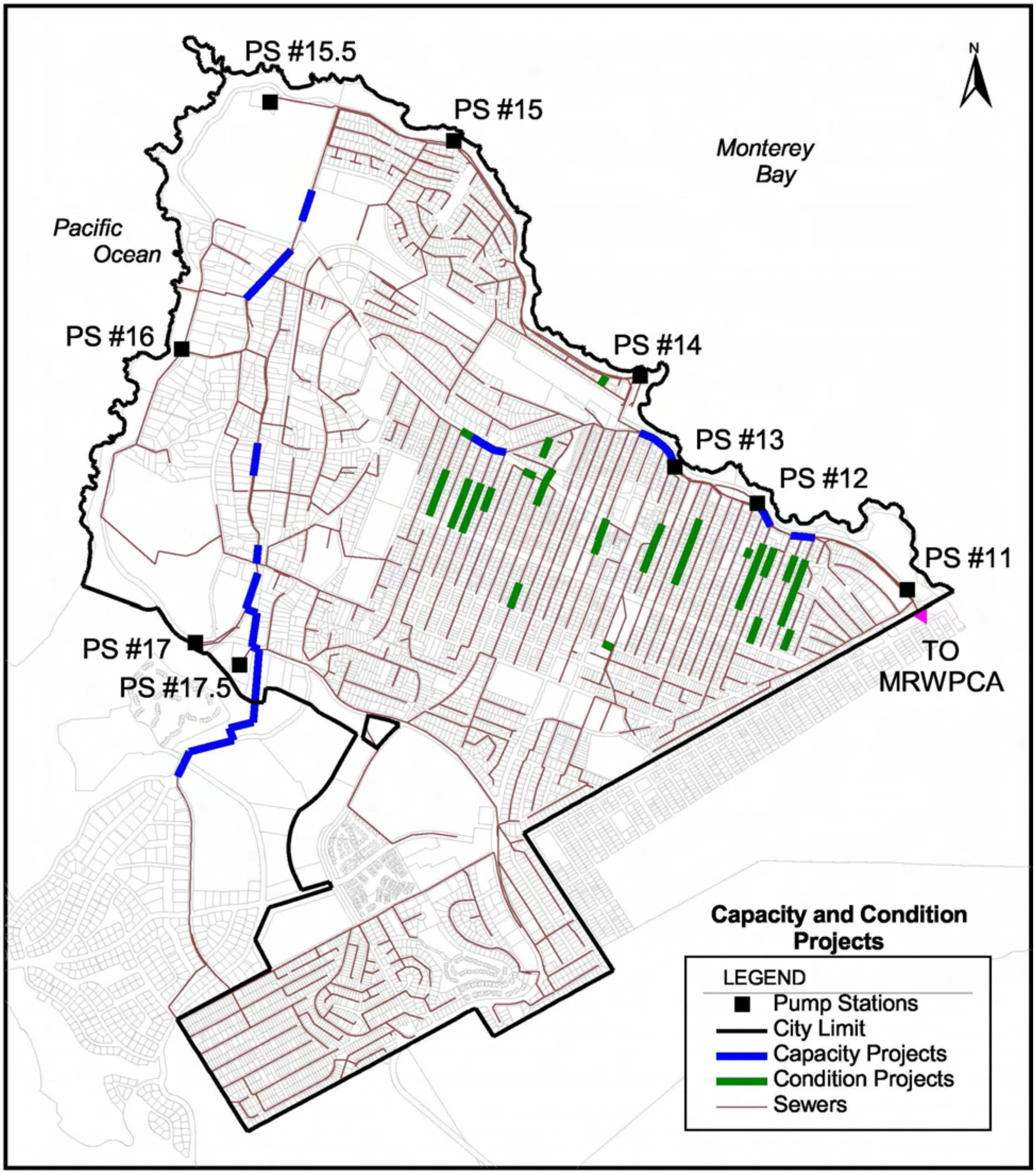
A model of the City's sewer enterprise fund was developed and revenues and expenses were projected. Sewer service charges were projected annually through 2010 and then by decade through 2100. The currently planned increases in the sewer service charge appear to be adequate in the near term.

Table ES-1 Summary of Sewer Condition Assessment

Condition Grade	Line Segments* Analyzed**	Length (feet)	Percentage of Total***	Length Extrapolated to Entire System (feet)
A	23	7,914	15%	45,879
B	58	18,342	35%	106,327
C	49	15,154	29%	87,847
D	30	8,598	17%	49,841
F	5	1,677	3%	9,724
Totals	**165**	**51,685**	**100%**	**299,619**

Notes:
*Line segment = manhole to manhole.
**2003 Replacement Projects have been eliminated from this table.
***By Length.

Figure ES-1: Capacity and Condition Projects



Recommendations

1. The City should consider changing its sewer cleaning strategy. Under the recommended strategy all gravity sewers would be cleaned every 60 months to determine whether conditions have changed that would warrant more frequent cleaning or other maintenance activity. Sewers with a history of problems would be cleaned at 2, 3, 6, 9, 12, or 36 month frequencies in order to prevent sanitary sewer overflows. This change should reduce the frequency of sanitary sewer overflows and it will free up labor that can be used for corrective maintenance.
2. The City should follow the Hydroflush Best Practices Manual recommendations for sewer cleaning.
3. The City should consider supporting its sewer system employees in obtaining certification from the California Water Environment Association's Technical Certification Program in Collection System Maintenance. This would entail preparing for and passing a written examination and annual participation in training events.
4. The City needs to implement a periodic force main inspection program. Force mains carry the flow from pump stations uphill to a gravity sewer. Force mains are vulnerable to damage from both internal and external corrosion. A force main failure could result in a significant sewage spill.
5. The City should complete a condition assessment of all of its manholes. The inspections can be conducted at the time the sewers are being cleaned. This activity should identify manholes that could cause problems prior to the time they fail.
6. The City should obtain the information tools needed to effectively manage its sewer system. These tools include a computerized maintenance management system (CMMS) and a geographical information system (GIS). The CMMS is used to plan and schedule work and to record the service history for individual line segments. The service history information is needed to make effective decisions regarding maintenance, repair, rehabilitation, or replacement. GIS is a tool that supports spatial analysis of the sewer system data and presents the results in a visual format that highlights localized problems.
7. The City should replace its truck-mounted rodder. Rodders are the most effective equipment for removing roots and hard grease accumulations from sewers. The City's existing rodder, due to its age, lacks the power and reliability that is needed.
8. The City should continue its condition assessment using television inspection until all of the gravity sewers have been inspected. This will identify sewers that are near failure and it will provide information needed to effectively manage the sewer system.
9. The City should eliminate intruding laterals from the gravity sewers. The intruding laterals reduce the capacity of the sewer, they interfere with sewer cleaning and inspection activities, and they provide a location where debris and foreign objects can accumulate to cause a sanitary sewer overflow.

10. The City should complete spot repairs where appropriate to reduce both maintenance activity and the potential for sanitary sewer overflows. The change in sewer cleaning strategy should free-up labor for this activity.
11. The City should implement the recommended three-year Capital Improvement Program. It is a prioritized list of capacity, condition, pump station, and other projects. It includes the replacement of 5,500 feet of gravity sewers, replacement of one pump station, rehabilitation of one pump station, purchase of spare pumps, and other miscellaneous projects at a total cost of $1.8 million (2004 dollars). The projects are planned for each of the three years with priority given to gravity sewers that are in poor condition, gravity sewers that lack capacity for current peak wet weather flows, and pump stations.
12. The City should continue with its plan to increase its sewer service charge on July 1, 2005 and again on July 1, 2006. The planned increases are needed to provide revenues that are adequate to meet the sewer system needs.
13. The City should review the SSAMP in three years to incorporate new information from maintenance activities and ongoing condition assessment and to prioritize identified and new capital projects for inclusion in the next three year Capital Improvement Program.

1 Introduction

The City commissioned HDR Engineering, Inc. to prepare a Sewer System Asset Management Plan (SSAMP). This section presents background information and describes the purpose and scope for this SSAMP.

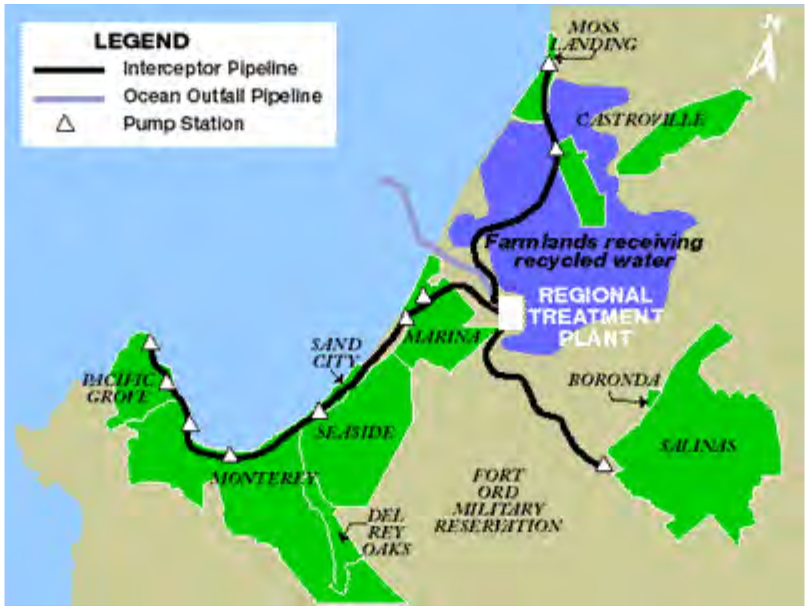
1.1 Background

Incorporated and chartered as a city on July 16, 1889 and April 22, 1927, respectively, the City of Pacific Grove (City) is located on the tip of the Monterey Peninsula of the Central California coast, approximately100 miles south of San Francisco (Figure 1-1). It is bounded on the north by Monterey Bay, on the east by Monterey, on the south by Pebble Beach, and on the west by the Pacific Ocean. The primarily residential community is 2.9 square miles in area and has a population of approximately 15,500. There is some commercial development, but very little industrial activity. The economy is primarily related to tourism, local services, and governmental functions. The City has a mild climate with an average annual mean temperature of 57 degrees Fahrenheit, rainfall of 19 inches, and humidity of 70 percent.

Figure 1-1: Location Map

The City provides sewer services for the residents. The City owns and operates the sewer collection system consisting of approximately 58 miles of pipelines (which vary in size from 4 to 18 inches in diameter), 900 manholes, and seven pump stations. An additional two pump stations that serve the City of Pacific Grove are owned by Monterey Regional Water Pollution Control Agency (MRWPCA). The collected wastewater is conveyed to the MRWPCA treatment plant by an interceptor pipeline that is located along the coast by the City's of Monterey, Seaside, and Marina. Figure 1-2 shows the MRWPCA interceptor serving the City of Pacific Grove and other MRWPCA facilities.

Figure 1-2: MRWPCA Facilities



1.2 Purpose

The purpose of the SSAMP is to provide guidance to the City in the operation, maintenance, and rehabilitation of the sewer assets of the community.

The objective of the SSAMP is to enable the City to achieve its goals:

- Eliminate both dry weather and wet weather sewer overflows
- Develop a sewer system that will provide excellent service and protect human health and the marine environment for future generations

Also, the recommended programs will achieve a level of service fully compliant with all current and reasonably anticipated regulations.

1.3 Scope of Work

The scope of work includes the following activities:

- System Evaluation
- Flow Monitoring
- Condition Assessment
- Inflow & Infiltration (I/I) Evaluation
- Operations & Maintenance (O&M) Program Evaluation
- Pump Station Evaluation
- Hydraulic Analysis

- Development of Recommended Capital and O&M Improvements
- Financial Analysis
- Final Report Preparation

1.4 Reference Material

The following documents were referenced in the preparation of this SSAMP:

- Summary Report on Capital Improvement Program for the Wastewater Collection System, Parsons Engineering Science, Inc., September 2000
- Inflow/Infiltration and Spill Prevention Program for City of Pacific Grove, City of Pacific Grove, April 2001
- Sewer Daily Reports (2003)
- Various Pump Station Data (MRWPCA)
- Smoke Testing Data (1997, 1999, 2000, and 2002)
- Closed-circuit video inspection data (2002 and 2003)
- City of Pacific Grove Municipal Code
- City of Pacific Grove Sewer Mapping information
- City of Pacific Grove Subdivision Map
- Various sewer system record drawings
- California Regional Water Quality Control Board, Central Coast Region, Waste Discharge Requirement Order No. R3-2002-0078 (Appendix A)
- NPDES Permit No. 97-83
- Stipulated Dismissal [Proposed] Consent Decree, Ecological Rights Foundation vs. the City of Pacific Grove

2 Collection System Facilities

This section presents the evaluation of the physical components of the sewer system.

2.1 Description of Existing Facilities

The sewer collection system consists of approximately 58 miles of pipelines (57 miles of gravity pipelines which vary in size from 4 to 18 inches in diameter (Table 2-1) and 1 mile of force mains). The majority of the sewers were built in the early 1900s. The predominant pipe material is clay pipe.

Table 2-1: Size Distribution of Gravity Sewers

Pipe Diameter (inches)	Length (feet)	Length (miles)	Percent of System (by length)
4	737	0.1	< 1%
6	242,136	45.9	81%
8	40,812	7.7	14%
10	822	0.2	< 1%
12	5,866	1.1	2%
15	9,246	1.8	3%
Totals	**299,619**	**56.7**	**100%**

There are nine pump stations (PS) located in the City's service area. The pump stations are either referred to by number (MRWPCA) or by name (City). In this SSAMP, the pump stations will be referenced by their number. Table 2-2 contains both the pump station number and names. All pump station are operated and maintained by MRWPCA. Seven are owned by the City and the two largest, PS #13 and #15, are owned by MRWPCA. Located downstream of the pump stations are 15,300 feet of force mains, of which 5,000 feet are owned and maintained by the City.

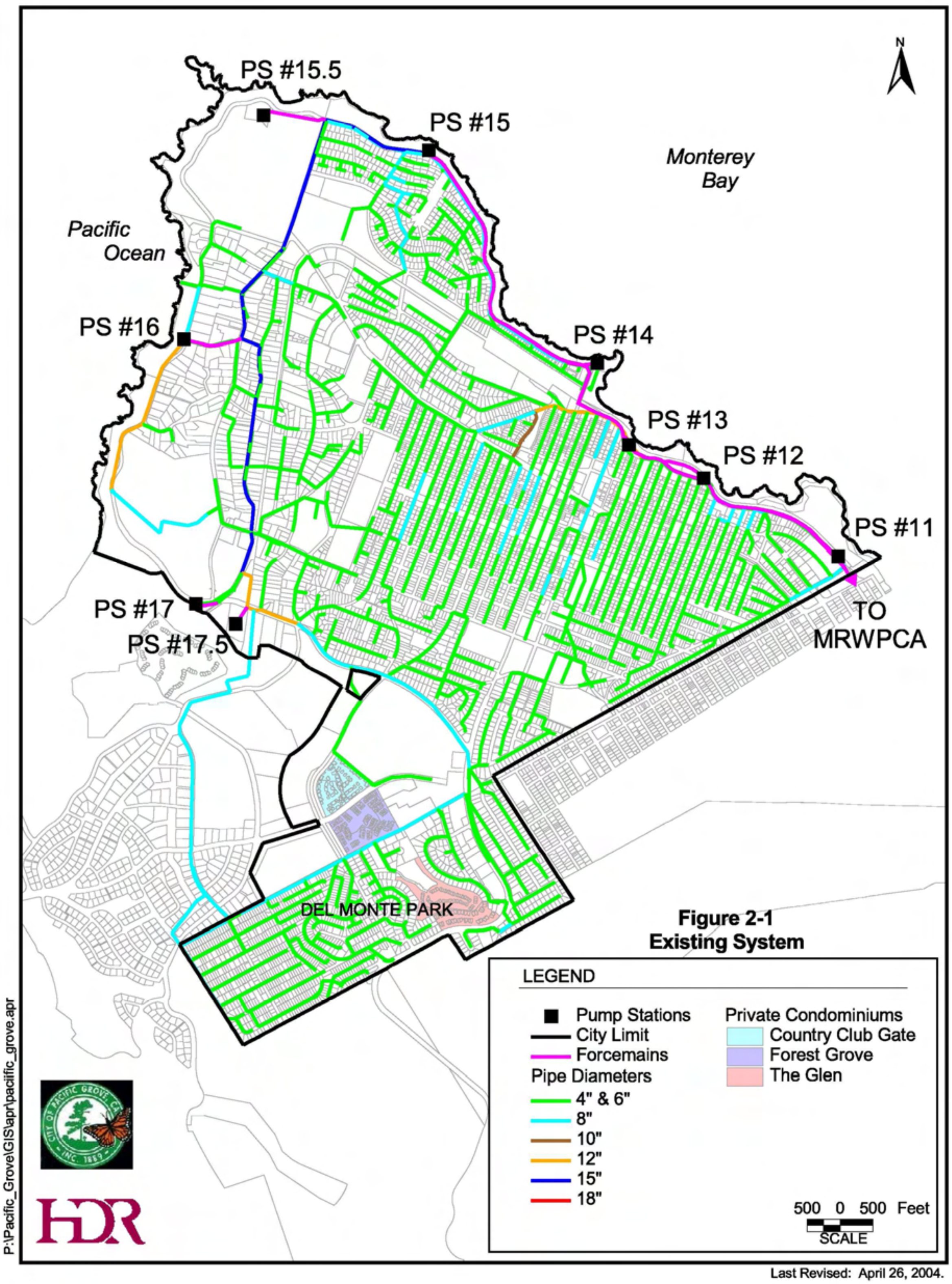
Maintenance access to the sewers is provided by 900 manholes and a number of structures such as clean outs and inspection holes. The collected wastewater is conveyed to the MRWPCA treatment plant for treatment, recycling, and disposal. Figure 2-1 graphically depicts the existing system.

Table 2-2: Pump Station Numbers and Names

Pump Station Number	Pump Station Name	Ownership	Capacity (gpm)
11	Eardley	City	500
12	9th Street	City	520
13	Fountain Avenue	MRWPCA	--
14	Lovers Point	City	80
15	Coral Street Station	MRWPCA	--
15.5	Crespi Pond	City	--
16	Arena	City	500
17	Beachcomber	City	50
18	17.5 or Russell Service Center	City	19

Note: The capacities of the pump stations are based on nameplate information and pump curves. It is recommended MRWPCA periodically conducts pump test to verify the capacities.

Figure 2-1: Existing Sewer System



2.2 Sewer Basins

The topography and sanitary sewer system layout for the City collection system can be divided into two regions: the West Side and the East Side. The East side can be further divided into three basins for a total of four basin areas.

Since the basin delineation follows the natural topography within the City, sewer flows are collected mostly by gravity. In each basin, all the developed parcels send wastewater to a sewer main, which gathers and conveys the flow until it leaves the basin through an "outlet". Basins 1 and 2 flow into PS #15. Basins 3 and 4 flow into PS #13. PS #15 and PS #13 are both owned by MRWPCA.

PS #18, PS #16, PS #15.5, and PS #14 flow to PS #15. The flow from PS #15 travels by force main directly to PS #13. PS #11 and PS #12 flow to PS #13. PS #13 conveys all the flows from the City to the WWTP.

Figure 2-2 presents the flow schematic and Figure 2-3 depicts the sewer basins.

Figure 2-2: Flow Schematic

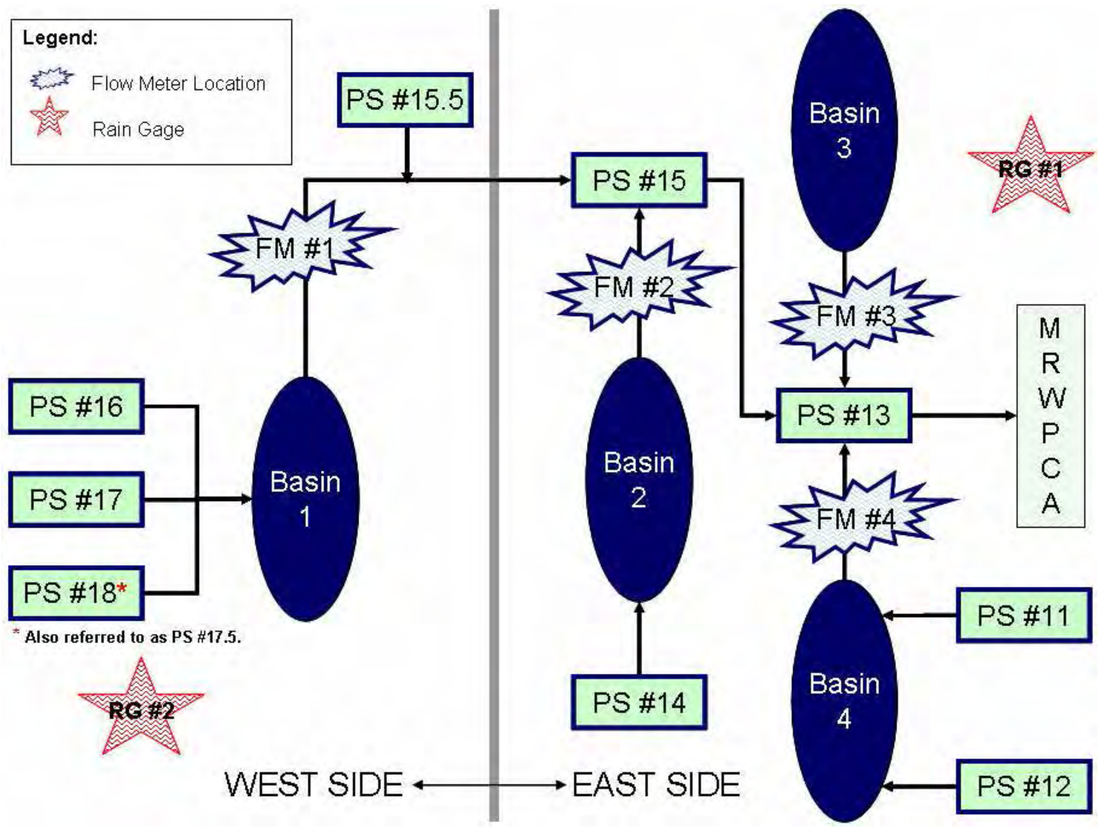
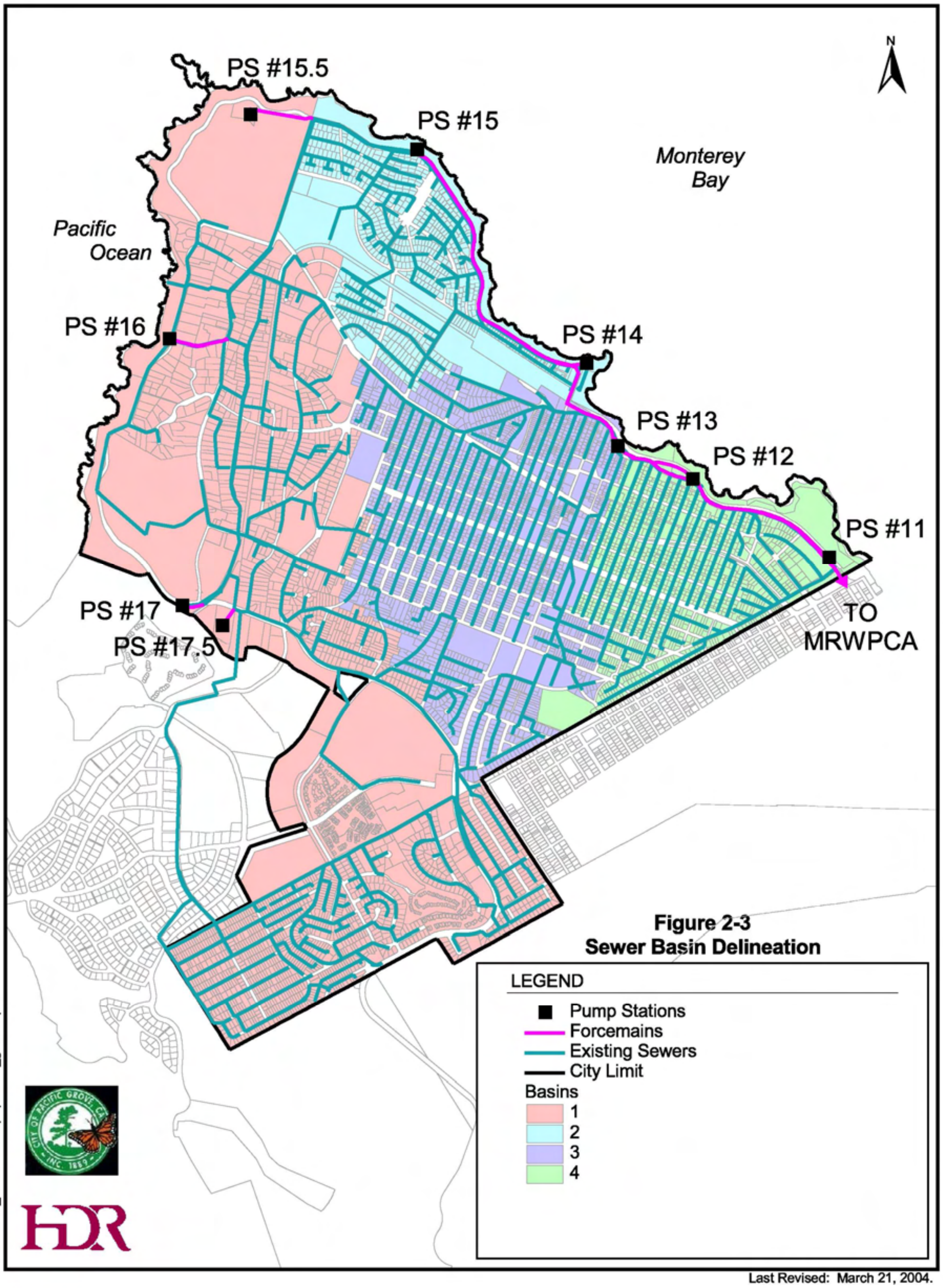


Figure 2-3: Sewer Basins



2.3 Land Use

2.3.1 Current Land Use

The City currently contains approximately 6,000 individual parcels. The predominant land use is single family residential. There are three private condominium complexes located in the southern portion of the City. They are known as County Club Gate, Forest Grove, and the Glen.

The main commercial areas are located at the following areas:

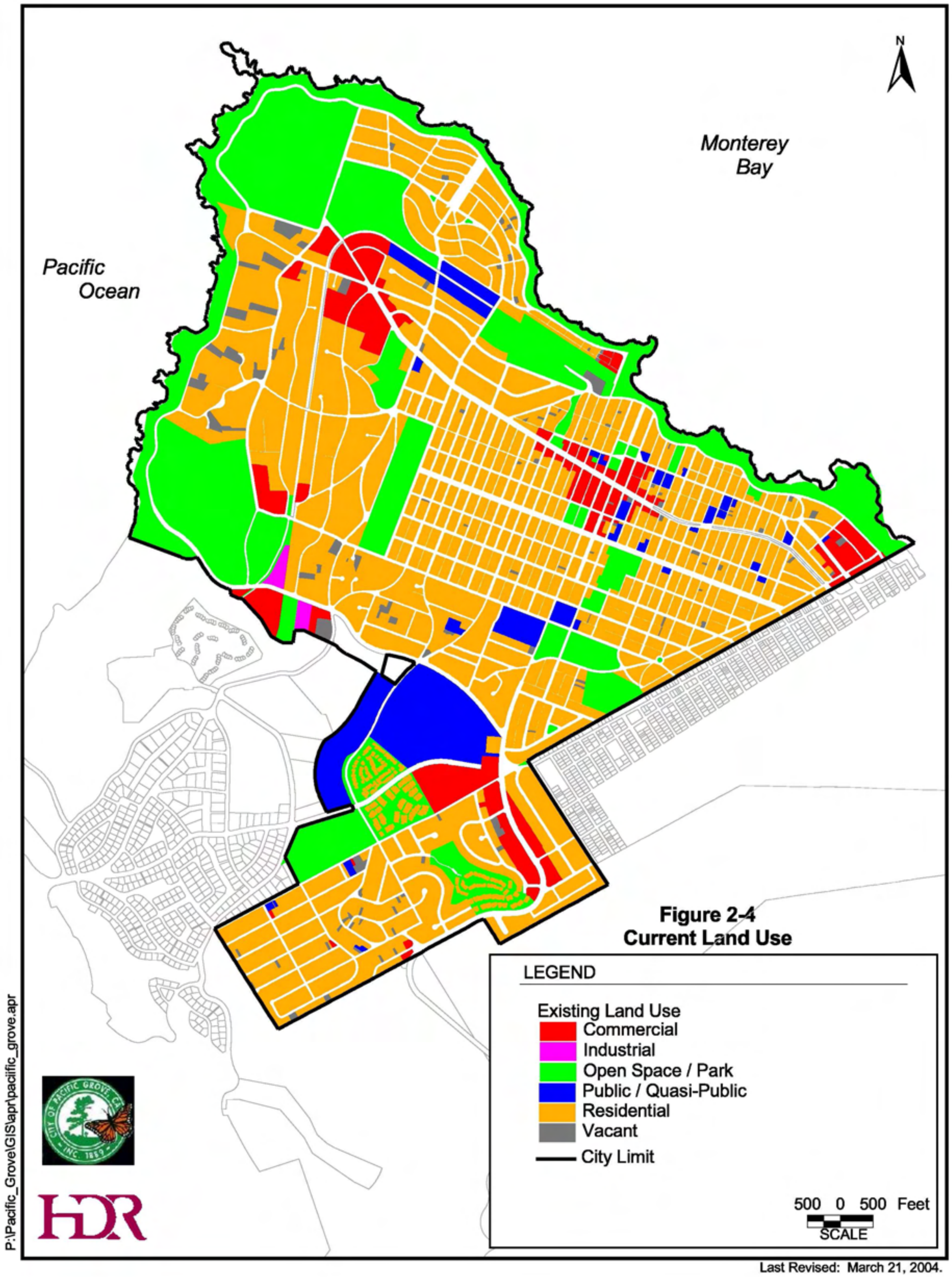
- Along Lighthouse Avenue from Cypress Avenue to 12th Street
- Lighthouse Avenue from Asilomar Avenue to Ridge Road
- Central Avenue between Eardley Avenue and Dewey Avenue
- An area in the Del Monte Park area.

Within the commercial areas, there are many restaurants, inns, and bed and breakfast establishments. In addition to open space, the City has many trails and pubic parks. Table 2-3 presents a summary of current land use. Figure 2-4 is a graphical representation of the current land use.

Table 2-3: Summary of Current and Buildout Land Use

Land Use	Existing		Buildout	
	Number of Parcels	Acres	Number of Parcels	Acres
Commercial	267	99	281	103
Industrial	2	5	2	5
Open Space / Park	80	415	80	415
Public / Quasi-Public	41	95	41	95
Residential	5,439	788	5,557	812
Vacant	132	28	0	0
Totals	**5,961**	**1,429**	**5,961**	**1,429**

Figure 2-4: Current Land Use



2.3.2 Buildout Land Use

The City is almost completely built out. Currently, there are 132 vacant parcels (28 acres) comprising 2 percent of the developable land.

The General Plan includes the addition of 2,000 secondary housing units. It is estimated that there are currently 400 secondary housing units in existence. Therefore, buildout may include 1,600 secondary housing units. A secondary residential unit is defined as a self-contained dwelling located on an existing single residential parcel with the following features:

- It's own entrance
- A cooking facility
- A bathroom

Secondary residences are seen as a way to meet the challenges of future housing needs, including affordable housing and housing for the aging population. The parcels where this development is feasible should be identified and monitored for future sewer capacity needs.

Development is restricted by the low number of developable parcels and the Monterey Peninsula's limited water supply. The Monterey Peninsula Water Management District allows existing homes with only one bathroom to add one additional bathroom. This change is not expected to have a material impact on the sewage generated.

The buildout land use is summarized in Table 2-3 with the current land use.

2.3.3 Annexation

Annexation last occurred in the 1950s-60s in the area know as Del Monte Park, located in the southern portion of the City in Basin 1. The City does not anticipate any future annexations.

3 Information Management Systems

The City does not currently have any automated information management systems for use in managing its collection system. Two tools are recommended to provide the information that is required to effectively manage the City's collection system: A Computerized Maintenance Management System (CMMS) and a Geographical Information System (GIS).

3.1 Geographical Information System

GIS provides the tool-of-choice for use in managing the data associated with collection system operations. GIS can be used to plan work, organize and analyze data, and prepare and present effective reports. As part of this project, the City's sewer mapping and inventory data has been built to be compatible with ESRI[1] GIS. The City should make provisions to continue to support and update the GIS information so that it can be used by City Staff in the future.

3.1.1 GIS Development

Geographical Information System (GIS) is a computer mapping system that links databases of geographically-based information to maps that display the information. Over the past decade, it is becoming one of the most powerful and commonly used asset management tools. In order to evaluate the sewer system performance and optimize operation and maintenance costs, a GIS system was developed based on the City's existing paper-based record information of the sewer system.

The sewer system was originally digitized into AutoCAD in 1994 from the 300-scale City record drawings. In 1999, the current base map was rebuilt using digital orthophotography (0.5 pixel, 100 scale). However, the sewer system had not been adjusted to fit the new land use. Specifically, the previous data had the following issues: sewers were not connected; sewers were not aligned with their corresponding structures; and some sewers were shown flowing in the wrong direction. Through the processes of registration, conversion, and update, the identified issues were resolved and used to build the GIS database. The steps used to build to the GIS are discussed in more detail below.

3.1.2 Building the GIS

Manhole locations observed from the orthophotography were digitized. The horizontal accuracy is within 0.7 feet. This method was applied to 50 to 70 percent of the system. For other circumstances (i.e. areas of poor visibility), the traveled way was bisected to create control points at the street intersections for each pipe segment. The sewer system utilities were then aligned with this control. Metadata, definitional data that provides information about or documentation of other data managed within an application, was assigned to each sewer (gravity and force mains) and structure (manholes, cleanouts, inspection holes, etc.).

[1] ERSI is a GIS and mapping software developer. Representative GIS products include ArcView, ArcInfo, etc.

The sewer system was tested in AutoCAD before processing in Arclnfo (GIS software). Coordinate errors such as dangles (undershoots and overshoots), pseudo-nodes, crossing objects (missing nodes), and clusters (topologically insignificant points, duplicate nodes) were eliminated. All systems were tested for continuity by executing flood trace analysis.

The system was checked for flow direction by conducting reverse-direction path trace analyses. This effectively tested the system by 'walking' upstream starting from the downstream manholes. Once the system passed the tests, the network topology was built in Arclnfo 8.3 and tested again for any coordinate errors. The resulting feature data set includes two feature classes: 1) line features representing sewers and 2) node features representing manholes, cleanouts, etc.

Each sewer is linked to its corresponding upstream and downstream manholes and the attribute table also contains information about the upstream and downstream manhole of a particular sewer. The attributes include pipe diameter, pipe age, manhole depth, invert elevations, rim elevation, land use, material, slope, roughness coefficient, etc. The attribute table was populated by text attributes in the AutoCAD drawings, check plots with City mark-ups, assessor parcel maps, as-built drawings, subdivision maps, and other source data provided by the City.

The GIS horizontal coordinates are in California State Plan NAD83[2] Zone IV and the vertical datum is in NAVD88[3]. It conforms to the Federal Geographic Data Committee (FGDC) standard. The metadata documentation is included in Appendix B.

3.1.3 Future GIS Maintenance and Update

The objective of a GIS is to compile a geographically located inventory of assets. It is common that the initial GIS contains missing information. Typically, a GIS project includes a surveying component in order to collect missing information (such as invert elevations and rim/ground elevations), verify pipe diameters, and confirm manhole locations. Missing data is denoted by a value of "–9" in the GIS attribute table. While the initial GIS is adequate for the purposes of developing the SSAMP, the City should conduct ongoing surveys as part of the Capital Improvement Program.

3.2 Computerized Maintenance Management System (CMMS)

A CMMS is an essential tool for planning and scheduling sewer maintenance work and for tracking the maintenance history of individual sewer line segments. The City should implement a CMMS for its collection system facilities (gravity sewers and structures).

[2] North American Datum of 1983

[3] North American Vertical Datum of 1988

MRWPCA is using a CMMS to plan and track the maintenance work on the City's pump stations. The City does not need to duplicate the information tracked by MRWPCA.

The primary functions of a CMMS are:

- Maintain service request and maintenance history information for each individual collection system asset.
- Produce and regularly update the maintenance schedule based on feedback information from the cleaning operation.
- Generate work orders.
- Generate reports that support data analysis and decision-making.
- Maintain condition assessment information for each individual collection system asset.
- Provide information on cost of O&M activities for each individual collection system asset.
- Provide documentation for use in regulatory compliance reporting.
- Indicate line segments or structures that may be candidates for replacement or rehabilitation under the capital improvement program.

The collection system CMMS that are applicable to small to medium size collection systems are listed in Table 3-1. The City has two favorable options: ICOMMM (ICOM[3]) and OASIS (Utility Software LLC).

Table 3-1: Comparison of CMMS Softwares

Software	Features	Cost
Azteca Cityworks	• Stand alone or server-based • Local hosting only • Scalable for any size collection system • Works as an extension of GIS • Options available for other City activities (e.g. streets, lights, etc.) • Nearest Client: City of San Mateo	$7,995 for first license
CASS WORKS	• Stand alone or server-based • Local hosting only • Designed for medium to large collection systems • Nearest Client: MRWPCA	$9,000 for one user

Software	Features	Cost
GBA Masterseries	• Stand alone or server-based • Local hosting only • Designed for medium to large collection systems • Cost for sewer module only (Options are available for other City activities) • Nearest Client: West Valley Sanitation District	$4,500 for first license
Hansen	• Web based • Local or remote hosting • Scalable for any size collection system • Options available for other City Activities (e.g. storm drains, streets, lighting, etc.) • Nearest Client: City of Monterey	$4,995 for first license (does not include configuration engineering costs)
ICOM^3	• Web-based • Local or remote hosting • Scalable for any size collection system • Offers remote IT and technical support • Integrated condition assessment and CIP management capability • Nearest Client:: Sausalito-Marin City Sanitary District	$3,000 for remote hosting
OASIS	• Stand alone or server-based • Local hosting only • Designed for small to medium collection systems • Data cannot be modified through GIS • Nearest Client: City of Paso Robles	$1,570 for first license

ICOM^3 has been introduced over the past couple of years. It is user friendly and reasonably priced. It is an integrated package that incorporates GIS, CMMS, Hydraulic Modeling Results, Condition Assessment, and CIP Management.

The primary advantage of ICOM^3 is that it offers remote hosting over the web. It also offers remote support for the software, data entry, and report generation. The City could receive the work orders, complete the daily work reports, and mail them to ICOM^3. ICOM^3 would enter the data, print the work orders, and generate reports which would be sent back to the City. The City would have access to the data and mapping information via the internet. According to the vendor, this software would not require a license for remote hosting. The estimated cost to the City would be the set-up fee of $3,000 and a monthly fee for remote hosting services of $1,500 per month. Data Integration and custom setup services would be provided at a fee of $100 per hour. Data entry costs would be $45 per hour. The data entry employees can enter an average of 50 to 60 cleaning inspection forms per hour.

OASIS is user-friendly and reasonably priced. It is a basic CMMS that employs the Microsoft Access database and it is designed for small to mid-sized collection system agencies. It is capable of storing inventory, operations, and maintenance information.

The OASIS data, in the form of Microsoft Access database, can be imported into most GIS applications, and is useful for administrative, planning, management, operating and maintenance functions related to the sewer systems. In addition to tracking maintenance work and developing capital projects, OASIS is an essential tool for preparing reports required for regulatory compliance.

The cost of purchasing one copy of OASIS is $1,570. Data conversion and setup is estimated to be an additional $5000 - $7000. A trial copy with basic system inventory data has been provided to the City as part of this SSAMP effort. Implementation of OASIS would require that the City staff take on the activities to operate and maintain the system on a stand-alone computer. The activities would include data entry, rescheduling, work order production, report production, data base administration, and arranging for software support.

4 Operations and Maintenance (O&M)

Effective O&M is the quickest and most cost-effective way to reduce the number and impact of SSOs. The goals of the O&M activities are to verify that sewers are not accumulating grease, roots, and/or debris that could cause SSOs and to remove those materials when they are present to prevent SSOs. The activities that are included are sewer cleaning and chemical root control.

The O&M activities that are associated with the City's pump stations and force mains are provided under contract with the MRWPCA and are addressed from a contract management perspective in this section.

This section describes the current O&M practices and presents the recommendations for improvement.

4.1 Gravity Sewers

The largest number of assets in a collection system are the gravity sewers. The following section will discuss the gravity sewer O&M.

4.1.1 Current Operation and Maintenance Practices

Current operations and maintenance practices are composed of the cleaning strategy, productivity, and work planning and tracking which are discussed below.

4.1.1.1 Sewer Cleaning Strategy

The City's current sewer cleaning strategy is to clean its entire gravity collection system once every 8 months and to clean problematic sewers more frequently. The Calendar Year 2003 sewer cleaning reports (Figure 4-1) show that the entire collection system was cleaned over an 8 month period and that approximately 7,600 feet of problematic sewers were cleaned on a 90-day cycle, and approximately 2,100 feet of problematic sewers were cleaned on a 120-day cycle.

4.1.1.2 Sewer Cleaning Productivity

The sewer cleaning crew averaged 11.4 production days per month during Calendar Year 2003 due to health-related issues. This equates to 1.4 FTEs (full time equivalents). The monthly cleaning production varied from the minimum of 12,077 feet in November to the maximum of 64,424 feet in April. The gross productivity averaged 173 feet cleaned per labor hour when both crew members were working. This is considered a reasonable level of productivity based on current work practices. The monthly data from the sewer cleaning daily reports is summarized in Table 4-1. The disadvantage of the aggressive cleaning schedule followed by the City is that most of the sewers may still be clean from the last maintenance effort.

Figure 4-1: Cleaning Cycle

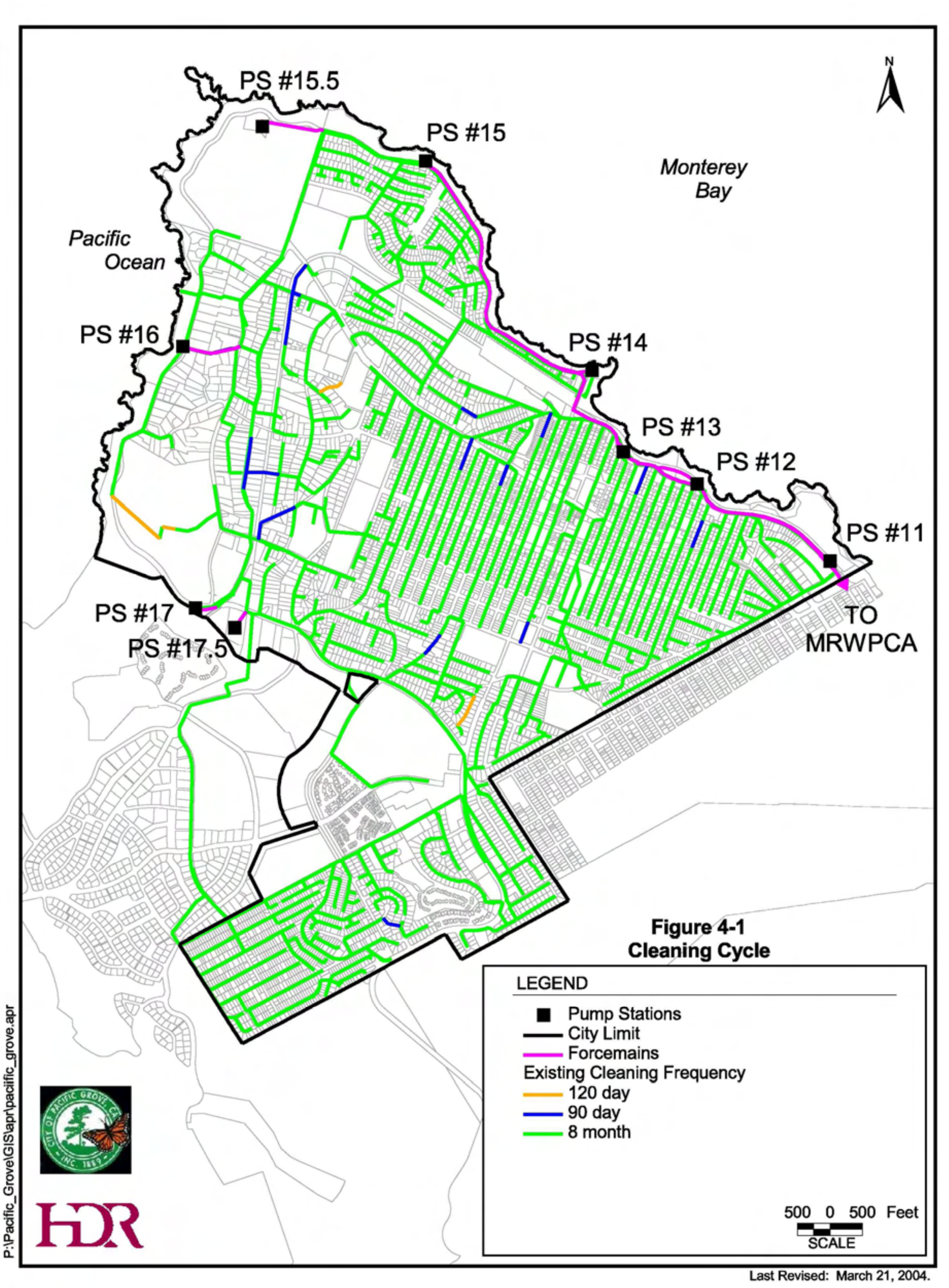


Table 4-1: 2003 Sewer Cleaning Daily Report Summary

Calendar Month	Monthly Cleaning Production (feet)	Average Cleaning Production (feet per day)	Number of Days Cleaning Per Month	Crew or Labor Hours Cleaning	Average Cleaning Production (feet per labor hour)
January	36,158	1,903	19	304	119
February	31,570	2,870	11	176	179
March	43,611	3,115	14	224	195
April	64,424	4,602	14	224	288
May	54,859	3,048	18	288	190
June	19,755	2,469	8	128	154
July	15,700	2,617	6	96	164
August	21,673	2,709	8	128	169
September	13,628	1,704	8	128	106
October	21,602	2,700	8	128	169
November	12,977	3,244	4	64	203
December	21,778	2,178	10	160	136
Average	**34,732**	**2,816**	**11.4**	**182**	**173**

4.1.1.3 Work Planning and Tracking

The sewer cleaning activities are currently planned and tracked by the Maintenance Supervisor based on experience. Work is assigned to the field crew verbally. At the end of each work day, the field crew completes a Daily Report to document the locations and length of sewers that have been cleaned. Typically, the cleaning follows the sewer basins; the crew starts work at the highest point in the basin and follows the flow downstream.

4.1.1.4 Sewer Cleaning Procedures

The sewer maintenance crew performs the following steps during cleaning:

1. Start cleaning at the upstream structure and work downstream using the Hydrovac.
2. Insert a three-prong fork in the outlet to the downstream manhole to capture roots.
3. Clean multiple sewer line segments during each setup.
4. Flush debris and grease downstream to the pump stations.
5. If sewer has heavy debris and/or grease, run it twice.
6. Remove debris from flat grade sewers using the vacuum.
7. Start the following day from where the work was completed.
8. Record completion of the sewer cleaning activity on the daily work report showing the line segments that were cleaned, the date, and lengths of the sewer line segments.

4.1.1.5 Chemical Root Control

The City currently uses chemical root control to minimize root intrusion problems in sewers that are difficult to access for maintenance (e.g. easement sewers, backyard sewers). The root control chemicals are applied once per year by a contractor. The current chemical used is Vaporooter and the current contractor is Pacific Sewer Maintenance. The current annual budget for this activity is $15,000.

4.1.2 Current Maintenance Organization

The O&M activity is managed by the Public Works Director/City Engineer. The O&M staff consists of one supervisor and two maintenance workers. The sewer O&M staff is assisted by other Public Works employees on as-needed basis.

The Maintenance Supervisor, in addition to supervising the field crew, is responsible for providing customer service, investigation of customer complaints, inspection of construction, enforcing City ordinances, coordinating with MRWCA regarding pump station O&M, coordinating with other City activities, procuring supplies and services, after-hours response to service requests, and maintaining records.

The maintenance workers are responsible for sewer cleaning, after-hours response to service requests, spill response and mitigation, and supporting other City activities. The City's spill response plan is included in Appendix C.

4.1.3 Optimized Maintenance Program

Based on HDR's experience, the following recommendations were developed for the City to optimize the sewer maintenance activities.

1. Clean sewers with a history of problems at a frequency of 2, 3, 6, 9, 12, or 36 months as required to prevent recurring stoppages. Record the results of each cleaning event using the results codes in Table 4-2. Table 4-3 recommends the initial cleaning frequency.
2. Clean all other sewers once every 60 months and record the results of the cleaning. Increase cleaning frequency when cleaning results dictate. Record the results of each cleaning event using the results codes in Table 4-2.
3. Sewer cleaning should follow the Best Practices Manual "Hydroflush Cleaning of Small-Diameter Sewers, February 2001, California Collection System Collaborative Benchmarking Group" (Appendix D). The two major changes that are recommended are:
   - Use a trap at each downstream manhole to prevent debris from being washed downstream until the volume and nature of the debris has been noted.
   - Use the vacuum to remove accumulated debris when the amount exceeds one gallon.

4. Conduct inspection of manhole/structure condition as part of the sewer cleaning activity until condition data has been collected for all manholes/structures. Appendix E contains more information about manhole inspection, rehabilitation, and replacement.
5. The Maintenance Supervisor should conduct random, periodic inspection of cleaning activities for quality assurance. It is recommended that the Maintenance Supervisor should inspect 4 to 10 cleaned line segments each month using the lateral camera. The sewer cleaning crew should be present and should assist in the inspection.
6. Establish a list of knowledge, skills, and abilities for the sewer cleaning crew and provide training in areas where deficiencies exist. Consider instituting the requirement that sewer cleaning crew members must obtain CWEA[4] Certificates in collection system maintenance.
7. Conduct a pilot scale project using experienced contractors to cut off protruding laterals to provide access for inspection and maintenance. If the pilot scale project is successful, continue the practice. If the pilot scale project is not successful, employ open cut methods to install a wye, and reconnect the lateral. Protruding laterals locations are contained in the CCTV inspection video and database.
8. Extend the chemical root control program to every 2 years to increase the number of sewers receiving chemical root control without increasing the City's annual budget. Increase the chemical root control budget to keep pace with inflation. Currently, chemical root control is performed annually and the budget is $15,000.
9. Enter all data collected into the CMMS and the GIS. Keep data current. Implement systems to ensure that the data is both current and correct.
10. Consider implementing an ordinance that would require privately owned and operated sewer systems that connect to the City to meet minimum condition and O&M requirements and to an appropriate response in the event of an SSO.
11. Consider implementing an ordinance that would require property owners to remove roots from their laterals that are growing into the City's sewer system.
12. Consider implementing an ordinance that would require contractors that remove roots from private laterals to employ methods that would contain and retrieve the root mass instead of allowing it to enter the City's sewer system where it may cause an SSO.
13. Hold a meeting with sewer cleaning and construction contractors in order to inform them of the SSAMP Program, lateral replacement program, and new ordinances.

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[4] California Water Environment Association (CWEA) administers competency certifications for wastewater personnel in the vocations of collection system maintenance, wastewater treatment plant maintenance, laboratory analysis, biosolids land application management, environmental compliance inspection, and industrial treatment plant operations. Information on certification is available at www.cwea.org.

Table 4-2: Sewer Cleaning Results Codes

Encountered Material	Clear	Light	Moderate	Heavy
Debris	**Code: CLR** No observable debris	**Code: DL** Minor amount of debris 15 minutes or less to clean 1 pass	**Code: DM** Less than 5 gallons of debris per line segment 15-30 minutes to clean 2-3 passes	**Code: DH** More than 5 gallons of debris per line segment More than 30 minutes to clean More than 4 passes Operator concern for future stoppage
Grease	**Code: CLR** No observable grease	**Code: GL** Minor amounts of grease 15 minutes or less to clean 1 pass	**Code; GM** Small “chunks” No “logs” 15-30 minutes to clean 2-3 passes	**Code: GH** Big “chunks” or “logs” More than 30 minutes to clean More than 4 passes Operator concern for future stoppage
Roots	**Code: CLR** No observable roots	**Code: RL** Minor amounts of roots 15 minutes or less to clean 1 pass	**Code: RM** Thin stringy roots No “clumps” 15-30 minutes to clean 2-3 passes	**Code: RH** Thick roots Large “clumps” More than 30 minutes to clean More than 4 passes Operator concern for future stoppage
Other (Pipe wall fragments, oil / dirt / rock, lost cleaning tool)	**Code: CLR** No observable materials	**Code: OL** Minor amounts of material	**Code: OM** Specify material Less than 1 gallon of material per line segment	**Code: OH** Specify material More than 1 gallon of material per line segment Operator concern for future stoppage
Recommended Action	**Continue current maintenance activity[1]**	**Schedule maintenance at 6-12 month frequency (6 month frequency for D Condition Lines, 9-12 month frequency for all other lines) Schedule CCTV[3]**	**Schedule maintenance at 6 month frequency[2] Schedule CCTV[3]**	**Schedule maintenance at 2-3 month frequency[2] Schedule CCTV[3]**

Notes:

1. After three consecutive “clear” observations increase maintenance frequency intervals, unless frequency is 60 months, as follows: B condition lines, 60 months; C condition lines, 36 months and then to 60 months for all C condition lines already on 36 month frequency interval; and D condition lines, 12 months.
2. Caution sewer cleaning crew to proceed with caution if materials listed under “Other” have been observed.
3. Schedule CCTV inspection to determine condition of sewer following observation of materials or conditions listed under “Other.”
4. This table adapted from Hydroflush Best Practices Manual, CWEA, 2001

Table 4-3: Recommended Initial Sewer Cleaning Frequencies

Condition Grade	Asset Management Action(s)
A	• Schedule and conduct proactive maintenance[2] on line segment at 60 month frequency. • Use feedback from proactive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 25 years. • No preventive maintenance[2] or repairs[4] warranted.
B	• Schedule and conduct proactive maintenance[2] on line segment at 60 month frequency. • Schedule line segment for more frequent preventive maintenance[2] if feedback from proactive maintenance[2] or SSO incidence indicates that more frequent line cleaning is needed to prevent SSO. • Use feedback from proactive/preventive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 15 years; adjust re-inspection frequency between 5 years and 15 years based on feedback from proactive/preventive maintenance. • No repairs[4] warranted.
C	• Schedule and conduct preventive maintenance[2] on line segment at an initial frequency of 12 months. Adjust preventive maintenance[2] frequency between 2 months and 36 months based on feedback from preventive maintenance: - Increase frequency for line segments with "moderate" or "heavy" results. - Maintain frequency for line segments with "light" results. - Decrease frequency to next frequency following 3 consecutive "clear" results. • Use feedback from preventive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 10 years; adjust frequency between 1 and 10 years based on feedback from proactive/preventive maintenance. • Schedule and apply chemical root control (if warranted). • Schedule and conduct repairs[4] if warranted to prevent SSO or reduce required maintenance. • Schedule and conduct line rehabilitation or replacement if warranted to prevent SSO or reduce required maintenance.
D	• Schedule and conduct preventive maintenance[2] on line segment at an initial frequency of 6 months. Adjust preventive maintenance[5] frequency between 2 months and 12 months based on feedback from preventive maintenance: • Increase frequency for line segments with "moderate" or "heavy" results. • Maintain frequency for line segments with "light" results. • Decrease frequency to next frequency following 3 consecutive "clear" results. • Use feedback from preventive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 5 years; adjust frequency between 1 and 5 years based on feedback from preventive maintenance. • Schedule and apply chemical root control (if warranted). • Schedule spot repairs[4] if warranted to prevent SSO or reduce required maintenance. • Place rehabilitation/replacement project for line segment on CIP for 5 years in future; adjust project schedule each year based on feedback from ongoing preventive maintenance and condition assessment. • Implement rehabilitation/replacement project based on adjusted schedule.

Condition Grade	Asset Management Action(s)
F	• Develop and implement site-specific contingency plan[6] to prevent or mitigate SSO in event of failure. • Schedule and conduct maintenance to prevent SSO. • Schedule and implement immediate spot repair, or rehabilitation/replacement project.

Notes:
1. Condition Grades are assigned based on defect codes and defect points (Appendix Q & R).
2. Proactive maintenance and preventive maintenance include sewer line cleaning and sewer line de-rooting and any other appropriate maintenance measures needed to clean and clear sewer lines. The feedback will follow the standards shown in the feedback matrix (Table 4-2).
3. The City will use Closed Circuit Television (CCTV) inspection as the default method for assessing the condition of its sewers. The City may employ an alternative sewer line inspection methodology in the future if such alternative methodology provides functionally equivalent information as CCTV inspection.
4. Defects that have been corrected by spot repairs can be eliminated from the line segment point total and the line segment can be reassigned a new condition grade if post-repair condition warrants reassignment.
5. Schedule spot repairs or other corrective actions to eliminate offset joints and/or protruding laterals when they interfere with maintenance or condition assessment activities.
6. Site-specific contingency plans should include consideration of containment, pump-around, soil stabilization, and/or frequent inspection.
7. Standard sewer maintenance frequencies will be 2 month, 3 month, 6 month, 12 month, 36 month, and 60 month.

4.1.4 Staffing and Equipment

Staffing and equipment recommendations are discussed below.

4.1.4.1 Projected Workload and Staffing

The projected workload and staffing under the recommended sewer cleaning program is shown in Table 4-4.

The recommended sewer cleaning program will reduce the sewer cleaning workload below that required by the current sewer cleaning strategy (i.e. clean the entire collection system every 8 months).

4.1.4.2 Organization Evaluation

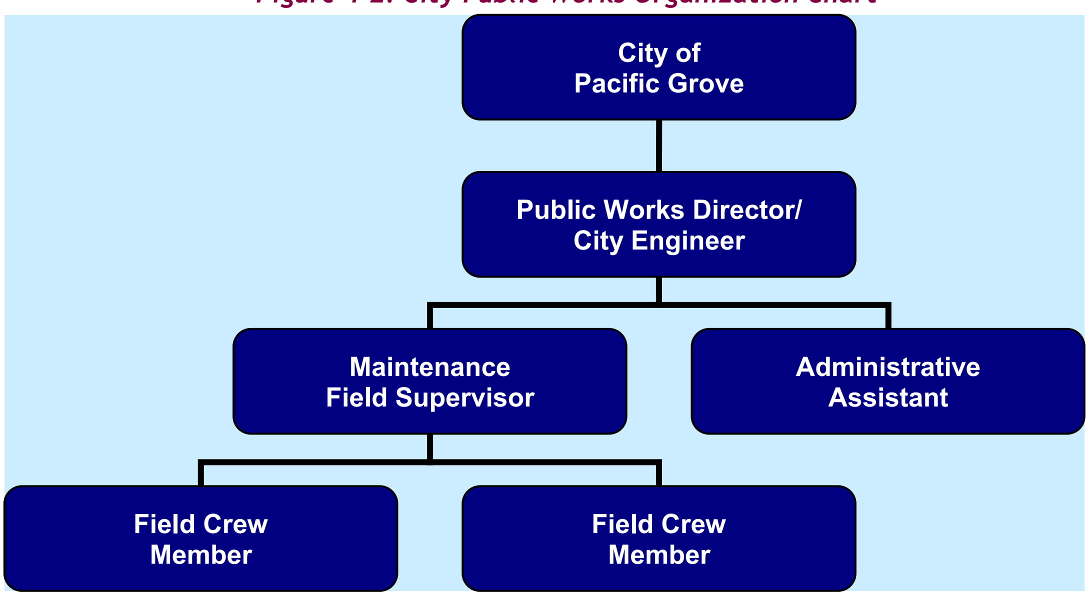
The City's current organizational chart is shown in Figure 4-2.

The current staff level is comparable to a similar sized collection systems and it is consistent with staffing benchmarks (20 to 40 miles of collection system per employee). By way of comparison, the *Seaside County Sanitation* District (SCSD) has 3 staff members (1 supervisor and 2 maintenance workers) for its 70 mile collection system.

Table 4-4: Projected Sewer Maintenance Workload and Staffing

Activity	Miles in Cleaning Program	Annual Workload (miles)	Annual Workload (ft)	Annual Labor Hours	FTEs at 1,700 hrs/yr
Proactive Cleaning					
60 month cycle	16.0	3.2	16,896	89	
Preventive Cleaning					
36 month cycle	22.0	7.3	38,720	215	
12 month	12.0	12.0	63,360	373	
9 month	2.0	2.7	14,045	83	
6 month	2.2	4.4	23,232	137	
3 month	1.4	5.6	29,568	174	
2 month	0.4	2.4	12,672	75	
Subtotal	56.0	37.6	198,493	1,146	0.7
Response to Service Requests (10/month @ 4 hours)				480	
Response to SSOs (1/month @ 6 hours)				72	
Subtotal				552	0.3
Totals				**1,698**	**1.0**

Figure 4-2: City Public Works Organization Chart



Based on HDR's experience, there is no need for additional staff. The recommendations for maintenance optimization and the provision of appropriate training and tools will enable the City to meet its needs with existing staff.

With a continuation of the City's CIP replacement program, and an expected reduction in the mileage of pipe in the high frequency cleaning cycles, additional time should become available to focus on spot repairs and further condition assessment work.

4.1.4.3 Equipment

The crew is provided with the following equipment to aid in their operation and maintenance activities:

- Combination Cleaner (Hydrovac)
  - This equipment was purchased in 2002 at the cost of approximately $250,000.
  - The estimated remaining service life is between 8 to 10 years
- High Velocity Cleaner (Jetter Truck)
  - This equipment was purchased in 1991.
  - This equipment is nearing the end of its service life.
- Mechanical Root Cleaner (Rodding Truck)
  - This equipment was purchased in 1958.
  - This equipment is beyond its service life and should be replaced.
- Other Equipment
  - Lateral camera
  - Hand rod
  - Portable generators

In order to optimize Equipment, the following is recommended:

- Replace the existing Rodding Truck which is at the end of useful life
- Purchase root cutters for the Hydrovac (e.g. chain flail or stiff cables)
- Maintain the Jetter Truck as a back-up for the Hydrovac.
- Purchase debris traps for use in 6 and 8 inch diameter pipe.

4.1.5 Maintenance Scheduling

Maintenance scheduling is composed of proactive cleaning and preventive cleaning. Proactive cleaning is recommended cleaning for all sewers except for those sewers that need more frequent cleaning because of roots, grease, etc. Cleaning frequency of sewers in the proactive cleaning program is every 60 months. Preventive cleaning frequencies will vary from 2 months to 36 months depending on the condition of the sewers. Cleaning frequencies for a particular sewer should be re-evaluated each time the sewer is cleaned based on the feedback matrix (Table 4-2).

4.1.5.1 Feedback Matrix

The recommended basis for setting sewer cleaning frequencies is the sewer cleaning feedback matrix. The feedback matrix was developed based on the Hydroflush Best Practices Manual (Appendix D). The information is presented in Table 4-2.

4.2 Pump Stations

The pump stations are operated and maintained by MRWPCA under an operations and maintenance agreement with the City.

MRWPCA operates and maintains a total of 27 pump stations. There are seven full time employees assigned to the pump station maintenance efforts. City crews provide basic support for pump station O&M activities such as wet well cleaning. MRWPCA provides all labor for routine operations inspections, minor repairs, and major upgrades to the pump stations.

The pump stations are largely below-ground type stations featuring a wet well, a valve pit, and above-ground electrical and control panels.

4.2.1 Current Operations and Maintenance Practices

The approach for the control system design is to automate the operations and monitoring of the stations to the greatest extent possible. MWRPCA is able to provide nearly continuous monitoring of a pump station and are able to dispatch their operators to address pump station problems.

The pump stations feature installed redundancy that provides additional protection. The first level of redundancy is the presence of dual pumps. In the event of a pump failure, due to clogging or other mechanical breakdown, the second pump is available to provide the necessary pumping. While there may have been times when both pumps are called into service, such as during peak flow events, the indications are that such occurrences are rare.

The stations are operated by local bubbler or float control that detects the station wet well level and initiates a pump start. The station may also be started through the SCADA system by remote command if necessary. Furthermore, the pumps may be started in the event of a control system failure by activating the “High-High” float that operates independently of the other controls. In the event of a High-High condition, the float activates the next available pump.

The pumps operate only a few hours each day. A summary of the total hours operated annually is presented in Table 4-5.

Table 4-5: Pump Station Annual Operating Hours

Pump Station	Total Pumping Time (Hrs)	Pumping Time (Hrs / Day)
PS #11	1,781	4.8
PS #12	2,064	5.7
PS #14	1,112	3.0
PS #15.5	233	0.6
PS #16	1,388	3.8
PS #17	152	0.4
PS #17.5	324	0.9

Maintenance activities provided by MRWPCA include basic housekeeping and pump/valve cleaning as needed. City crews periodically clean the wet wells. Recent maintenance and upgrade work was evident in the review of the control system and standby generator systems. Minor maintenance (Code 1) work is documented on the weekly route sheets and time is reported monthly. Major maintenance (Code 2) activities are reported by the MRWPCA on the quarterly cost statement to the City.

Based on the discussions with the field crews, the apparent responses to pump station failure modes include those listed on Table 4-6.

Table 4-6: Pump Station Failure Modes

Failure Mode	Response
Power Failure	Dispatch crew to investigate and provide backup power
High Wet Well (Alarm)	Dispatch crew to check station
Pump not pumping required flow	Remove clear debris from pumps and valves

4.2.1.1 Operations and Maintenance Documentation

The City staff does not have current documentation for the pump stations in their possession. The City staff was able to locate some of the maintenance manuals and other source documents, however, the inventory was not compete. It is not known if the level of documentation in the possession of MRWPCA is more complete. It is recommended that current documentation should be in the possession of the City even though primary operations and maintenance are being conducted by MRWPCA.

Considerable changes have occurred to the control systems and the mechanical equipment in some of the pump stations. MRWPCA has been upgrading the telemetry systems to their current SCADA standard, by adding in new remote terminal units, radios, and other equipment to provide data collection and alarming in a format compatible with the entire system.