SSO Reduction Plan

Prepared by the City of Pacifica

In Response to
California Regional Water Quality Control Board
San Francisco Bay Region
Cease and Desist Order No. R2-2011-0031

June 1, 2011

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List of Abbreviations

CCTV	Closed-Circuit Television
CDO	Cease and Desist Order
City	City of Pacifica
CIWQS	California Integrated Water Quality System
CMMS	Computerized Maintenance Management System
GIS	Geographic Information System
MH	Manhole
NASSCO	National Association of Sewer Service Companies
PACP	Pipeline Assessment Certification Program
QA/QC	Quality Assurance/Quality Control
SSMP	Sewer System Management Plan
SSO	Sanitary Sewer Overflow

1 Purpose

The SSO Reduction Plan is a required deliverable of Cease and Desist Order No. R2-2011-0031 (CDO). The CDO states as follows.

> *By June 1, 2011, the Discharger shall prepare an SSO Reduction Plan. The SSO Reduction Plan shall include (i) an analysis of historical SSOs (location, cause, maintenance history, and associated CCTV data), (ii) review of existing maintenance activities and practices, and (iii) recommendations for changes to sewer cleaning methods, tools, and schedules to reduce the frequency of SSOs to, at a minimum, the SSO Performance Standards specified in Section VI of this Order. By June 30, 2011, the Discharger shall implement the recommendations in the SSO Reduction Plan, and shall periodically review and revise the strategy implemented as appropriate and necessary to achieve, at a minimum, the SSO Performance standards specified in Section VI of this Order. Such review and revision shall be reported in the SSO Annual Reports and maybe also taken in conjunction and coordination with review and revision of the Discharger's Sanitary Sewer Management Plan (SSMP) that is required in the Sanitary Sewer Order and in Section VII of this Order.*

This SSO Reduction Plan will focus on reducing maintenance-related SSOs versus capacity-related SSOs. Solutions for addressing capacity-related SSOs are being developed as part of a Sewer Master Plan currently under development by RMC Water and Environment.

2 Analysis of Historical SSOs

2.1 Data Sources and Processing

The City analyzed 97 SSOs documented between May 31, 2007 and March 30, 2011. Data was downloaded from the California Integrated Water Quality System (CIWQS) SSO Reporting database and cross-checked with internal SSO reports. Based on the available data, the specific sewer mains, containing the blockage or overflow cause, were identified and linked to the City's geographical information system (GIS). Of these 97 SSOs, 5 SSOs were attributed to capacity issues resulting in sewer overflows during wet weather. The remainder of this analysis will focus on the 92 SSOs not caused by wet weather capacity issues.

2.2 Data Analysis and Findings

Analysis of the 92 SSOs not caused by wet weather capacity issues indicates 29 SSOs (32 percent) occurring due to problems in the lower laterals for which the City is responsible, and 63 SSOs (68 percent) occurring due to problems in sewer mains. The City is only responsible for a lower laterals when a cleanout is installed at the property line. Of the approximately 12,000 laterals in the City service areas, the City is responsible for approximately 2,950 lower laterals, which is approximately 25 percent of the lower laterals in the City. Table 1 includes a comparison of various statistics for sewer lateral versus sewer main SSOs. Figure 1 shows the locations of these SSOs by type and attributed cause.

Table 1: Comparison of Sewer Overflow Statistics*

Statistic Type	Lower Laterals	Mains	Total
Number of SSOs	29	63	92
Percentage of Total Number	31.5%	68.5%	100.0%
Total SSO Volume (gallons)	232	17,373	17,605
Percentage of Total SSO Volume	1.3%	98.7%	100.0%
Average SSO Volume (gallons)	8	276	191

*For 92 SSOs not caused by wet weather conditions and occurring between May 31, 2007 and March 30, 2011.

2.2.1 Lower Lateral Overflows

As Table 2-1 shows, although lower laterals contribute just over 31.5 percent of non-capacity-related SSOs when compared by number of SSOs, yet when compared by SSO volume, lower laterals account for less than 1.3 percent of SSO volume for non-capacity-related SSOs. When capacity-related SSOs are included in the comparison, the proportion of SSO volume released from lower laterals is 0.2 percent of the total SSO volume released between May 31, 2007 and March 30, 2011. This is due to the fact that almost all sewer lateral overflow events are caused by a blockage in the sewer lateral with the only source of sewage coming from the property connected to the lateral. These SSO events tend to be small and confined primarily to the property where the blockage occurred. Between May 31, 2007 and March 30, 2011, the City only experienced 29 sewer lateral SSOs with volumes ranging from 1 to 40 gallons spilled and an average SSO volume of 8 gallons. In contrast, the average SSO volume of non-capacity-related SSOs from the sewer mains was 276 gallons which means the average non-capacity-related mainline SSO between May 31, 2007 and March 30, 2011 spilled more volume than all 29 sewer lateral SSOs combined. For this reason, the remainder of this SSO Reduction Plan will focus entirely on proactive and preventive maintenance strategies to reduce sewer mainline SSOs. For the time being, the City will continue with a reactive maintenance approach to addressing sewer lateral SSOs.

2.2.2 Sewer Mainline Overflows

The City experienced 63 non-capacity-related sewer mainline SSOs between May, 31, 2007 and March 30, 2011. The majority of these sewer overflows are caused by root blockages in 6-inch sewer mains. The average volume of non-capacity-related SSOs is 276 gallons. If the one 8,000 gallon grease-related SSO is excluded, the average non-capacity-related SSO volume is 151 gallons.

The City has divided the sewer system into 17 separate districts, as shown in Figure 2. Analysis of SSOs within the districts indicates four districts with above average SSOs per unit length when compared to the average SSOs per unit length of the entire system. These four areas are designated by the following area codes in the GIS: F, LL1, SP, and V. 2 highlights the four districts with above average SSOs per unit length when compared to the average SSOs per unit length of the system overall.

Based on this analysis, annual cleaning of these targeted districts will be performed for all pipes without available CCTV inspection data or sewer cleaning findings. CCTV inspection data will include any maintenance-related defects identified during inspection. Sewer cleaning findings will consist of feedback from sewer cleaning crews indicating the type and severity of material found in a sewer pipe during sewer cleaning. For pipes in the targeted districts with CCTV data or cleaning findings, or once CCTV data or sewer cleaning findings are available, a condition-based maintenance schedule will be assigned.

3 Review of Existing Maintenance Activities and Practices

The City reviewed existing sewer maintenance activities and practices consisting of sewer cleaning, sewer inspection, and localized sewer repairs. The City currently performs all of the following sewer maintenance activities using City field crews.

- Reactive, preventive, and proactive maintenance through sewer cleaning by either hydroflushing or power rodding
- Reactive and systemwide CCTV inspection
- Localized sewer repairs

The primary maintenance activities resulting in SSO reduction are preventive and proactive maintenance and system-wide sewer inspection. These activities and associated practices are discussed further in the following subsections. Figure 3 shows the current preventive and proactive cleaning frequencies for sewer pipes in the system.

3.1 Reactive Maintenance and CCTV Inspection

The City routinely responds to service calls to reactively address sewer lateral and sewer mainline issues as identified by customers. A sewer cleaning crew will respond to service calls to validate the problem and determine the problem cause. In the case of a service call to respond to a sewer overflow, the sewer cleaning crew will address the blockage or issue, document the event in a sewer overflow report, and will create a follow-up work order for a CCTV crew to perform an inspection of the sewer pipe containing the blockage to support the City in determining an appropriate corrective action. In the case of a sewer lateral overflow, the City will respond similarly if the lateral has a cleanout at the property line. If the lateral does not have a cleanout at the property line, the City will check the upstream and downstream manhole of the adjacent sewer main and will clean the sewer main to prove the overflow was not caused by the City-owned main.

3.2 Preventive Maintenance

Preventive maintenance ("hot spot cleaning") is performed using hydroflushing or power rodding on sewer pipes with a history of maintenance issues. Approximately 27 percent of the City's sewer pipes are currently on a preventive maintenance schedule with 1.4 percent cleaned every 4 months, 17.6 percent cleaned every 6 months, and 7.9 percent cleaned annually. Approximately 24 percent of the preventive maintenance performed is accomplished using hydroflushing, 72 percent is accomplished using rodding, and the remainder is performed using a combination of both methods. Figure 3 identifies the current sewer cleaning frequencies for all pipes in the sewer system. In addition, the City has identified 22 lower laterals currently cleaned on either a 4-month or 6-month preventive maintenance schedule.

Hydroflushing is performed using a combination high velocity jetter/vacuum truck. The primary cleaning tools consist of a Warthog™ rotating nozzle for all-purpose cleaning of smaller pipes with roots, grease, and debris. Larger pipes with debris issues are cleaned using a C-Ray™ nozzle.

Rodding is performed using a truck-mounted power rodding machine. The primary tools utilized by rodding crews consist of an auger to advance through the pipe initially followed by concave root saw.

The City has a process for evaluating new sewer cleaning tools and technology prior to including as a standard tool available to field crews. New technology is piloted by a field crew, and field tests are performed to determine the effectiveness of the tool to support the City in performing sewer cleaning. The CCTV inspection crew supports the sewer cleaning crew in evaluating the effectiveness of new technology by performing CCTV inspection during the pilot testing to gather visual evidence of the effectiveness of the tool.

3.3 Proactive Maintenance

Proactive maintenance ("district maintenance") is performed by systematically cleaning areas in the system on a periodic and proactive basis. Proactive cleaning is currently performed every two years on all sewer pipes regardless of maintenance history with roughly 50 percent being performed using hydroflushing and 50 percent performed using power rodding.

3.4 System-wide Sewer Inspection

The City is currently performing system-wide sewer inspection to identify structural and maintenance issues within the sewer system. CCTV inspection is performed using conventional CCTV equipment and the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) inspection standard for documenting the results of the sewer pipe inspection. Inspection of the entire system will be completed by March 1, 2013.

3.5 Sewer Repair

The City will perform localized sewer repairs of critical defects using standard construction techniques to correct critical structural defects that create a high risk of structural failure or sewer overflow. Examples of critical defects includes pipe collapses, broken pipes, or holes in the pipe with soil visible or a visible void. The City also repairs lower laterals, for which the City is responsible, found to have significant structural defects.

3.6 Planned Improvements to Maintenance Activities and Practices

The City is currently performing many of the maintenance activities and practices required to reduce sewer overflows. The City is planning on enhancing the overall maintenance program by evaluating and adding chemical root control as an additional means to manage root growth in the sewer system and reduce root-related sewer overflows.

The City currently does not have processes and tools to support continual improvement of maintenance activities and practices. Tools and processes supporting continual improvement of a sewer maintenance program include:

- A computerized maintenance management system (CMMS) to support the planning, scheduling, and tracking of maintenance activities and to document field crew feedback to support asset maintenance decision-making.
- A process to collect data relating to the type and quantity of material found during sewer cleaning to support future maintenance frequency decisions.
- A process to measure and provide feedback to sewer cleaning crews on the quality of the sewer cleaning being performed.

Based on this review, the following actions are planned to improve sewer maintenance activities and practices.

1. The City will implement a CMMS to support planning and scheduling of sewer maintenance work orders, documentation of maintenance activities and outcomes, and reporting to support maintenance program management and decision-making. The City has completed purchase of the CMMS and will begin using it for maintenance and SSO-related activities by September 1, 2011.
2. The City will begin documenting the type and quantity of material found during sewer cleaning activities on September 1, 2011 with the implementation of the new CMMS. By September 1,

2011, the City will develop a guideline for consistent documentation of the type and quantity of material found and will train sewer cleaning crews on the new guideline. These observations will be collected for all sewer cleaning performed by individual manhole to manhole pipe segment and will be documented in the CMMS.

3. The City will develop and implement a sewer cleaning quality assurance and quality control (QA/QC) program for a minimum of 2 percent of the sewer cleaning performed. QA/QC will consist of performing CCTV inspection within 2 weeks of pipe cleaning. The City will implement an objective guideline for determining whether sewer cleaning performed passes or fails the cleaning quality review, based on 90 percent of the pipe cross-section being clear of grease, roots, sediment, debris, or obstructions. Based on the QA/QC results, the City will provide feedback to sewer cleaning crews to support modification of the sewer cleaning process, practices, techniques, and tools to improve sewer cleaning quality.
4. The City will continue the practice of evaluating new sewer cleaning tools to determine cleaning effectiveness prior to implementation as a standard tool available to field crews.

4 Recommendations for Changes to Sewer Cleaning Methods, Tools, and Schedules

This section includes recommended changes to sewer cleaning methods, tools, and maintenance schedules.

4.1 Recommended Changes to Cleaning Methods

The City currently employs hydroflushing and power rodding which are the two primary methods in the industry for performing sewer cleaning. In addition to these sewer cleaning methods, the City plans on employing chemical root control as an additional means to address root growth in pipes with root issues. The City will initially identify pipes with known chronic root issues and will hire a chemical root control contractor to apply root control chemicals on these pipes. The City plans on performing the second chemical treatment on pipes 12 months after the initial application and successive applications every 24 months thereafter. The City will begin implementation of the chemical root control program by October 30, 2011.

4.2 Recommended Changes to Cleaning Tools

The City is currently using state-of-the-art sewer cleaning tools to perform sewer cleaning. The City does not plan on changing sewer cleaning tools at this time. The City will continue the practice of evaluating new sewer cleaning tools to determine cleaning effectiveness prior to implementation as a standard tool available to field crews.

4.3 Recommended Changes to Maintenance Schedules

The City has reviewed available maintenance and CCTV inspection data and has identified changes to sewer maintenance schedules to focus the maintenance program on pipes with known maintenance issues and in areas with increased risk of sewer overflow. Maintenance and inspection data were analyzed by applying a 1 to 9 score to maintenance events and maintenance-related sewer defects, as indicated in Table 2.

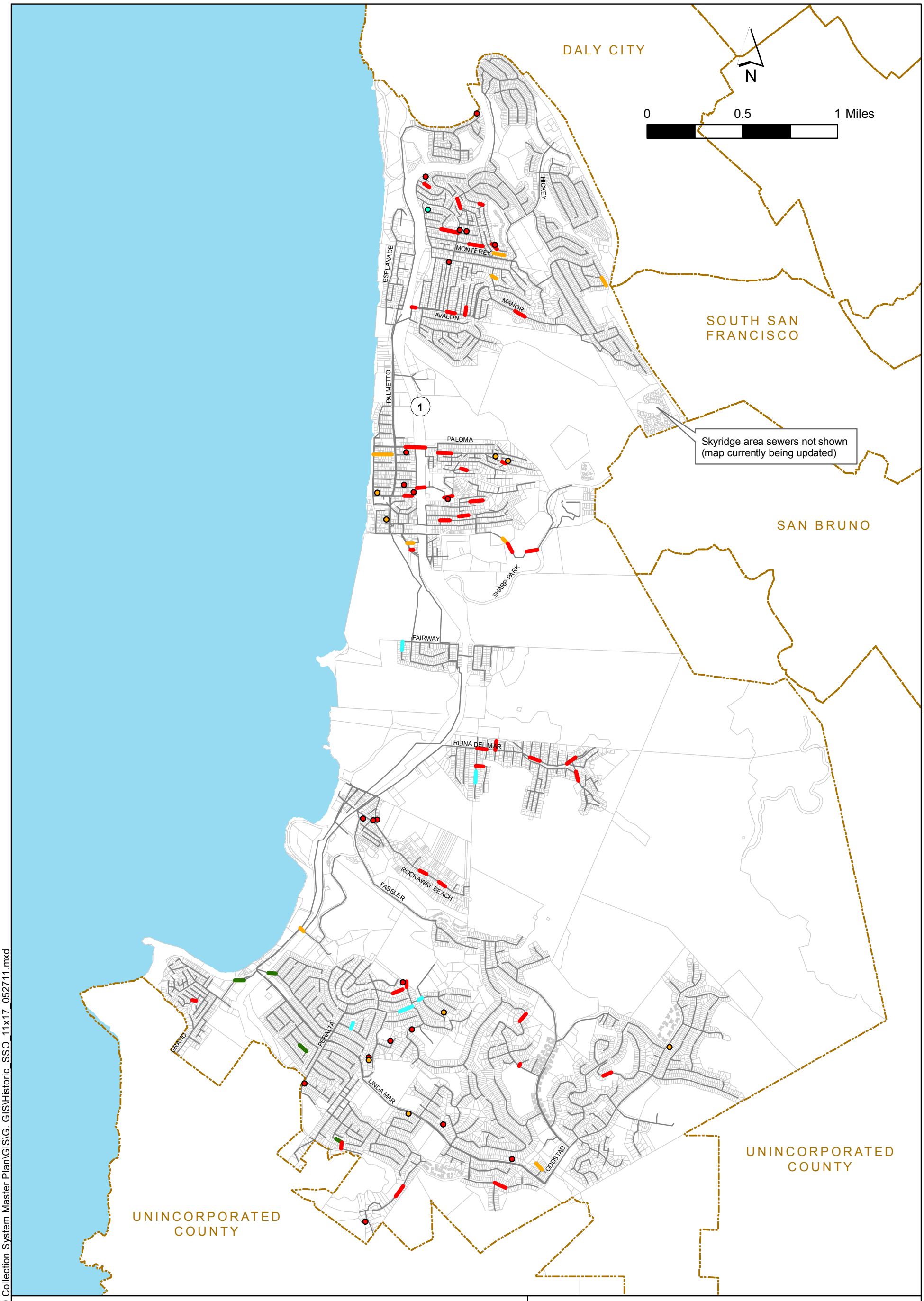
Table 2: Maintenance Scoring for Maintenance Events and Maintenance-Related Defects

Event of Defect Type	Example	Score
Sewer overflow	Non-capacity-related SSO event	9
Sewer stoppage	Stoppage call	7
Severe maintenance issue	Root ball; Obstructions greater than 30 percent of pipe cross-section	5
Moderate maintenance issue	Medium roots; Tap roots; Obstructions greater than 20 and less than 30 percent of pipe cross-section	3
Light or minor maintenance issue	Fine roots; Obstructions less than 20 percent of pipe cross-section	1

Both the maximum score and the sum of scores for all maintenance events and maintenance-related sewer defects, for the latest CCTV inspection, were calculated for each pipe. Using these scores, the following recommended changes to the maintenance schedules have been developed.

1. Created a hotspot cleaning schedule for pipes with CCTV inspection findings indicating maintenance issues.
    a. A 12-month cleaning schedule for pipes with light maintenance issues
    b. A 6-month cleaning schedule for pipes with heavy to moderate maintenance issues.
2. Increased the hotspot cleaning frequency for pipes with CCTV inspection findings indicating moderate to severe maintenance issues.
3. Increased the hotspot cleaning frequency for pipes with a combination of an SSO and CCTV data indicating maintenance issues.
4. Created a hotspot cleaning schedule for all pipes with a maintenance-related SSO and not currently on a hotspot schedule.
5. Created a 12-month cleaning schedule for all pipes in districts with above average SSOs per unit length (District F, LL1, SP, and V) that are not currently on a hotspot schedule and are currently without CCTV inspection findings analysis. Once CCTV inspection or sewer cleaning is performed the City will create a condition-based cleaning schedule based on either CCTV inspection findings or documented sewer cleaning findings.
6. Moved all pipes not on a hotspot schedule and in areas with below average SSOs per unit length to a 3-year cleaning schedule. Once CCTV inspection or sewer cleaning is performed, the City will create a condition-based cleaning schedule based on either CCTV inspection findings or documented sewer cleaning findings.
7. Moved all pipes not on a hotspot schedule, with CCTV inspection findings indicating no maintenance issues, and in areas with below average SSOs per unit length, to a 5-year cleaning schedule. If subsequent CCTV inspection or sewer cleaning findings indicate maintenance issues, the City will create a condition-based cleaning schedule based on either CCTV inspection findings or documented sewer cleaning findings.
8. Placed areas of new sewers (e.g., pipes constructed in the past 10 to 15 years, primarily of plastic materials) on a 10-year cleaning schedule.

Figure 4 shows the planned sewer cleaning frequencies for all pipes in the sewer system based on the recommended changes to the sewer cleaning schedules described above.



Legend

City Boundaries
Parcels
Pacifica Sewers

Lower Lateral SSOs
- Root intrusion
- Debris
- Other

Mainline SSOs
- Root intrusion
- Debris
- Grease deposition (FOG)
- Other

City of Pacifica
SSO Reduction Plan

Historical Non-Capacity Related SSOs (May 2007 - March 2011)

Figure 1

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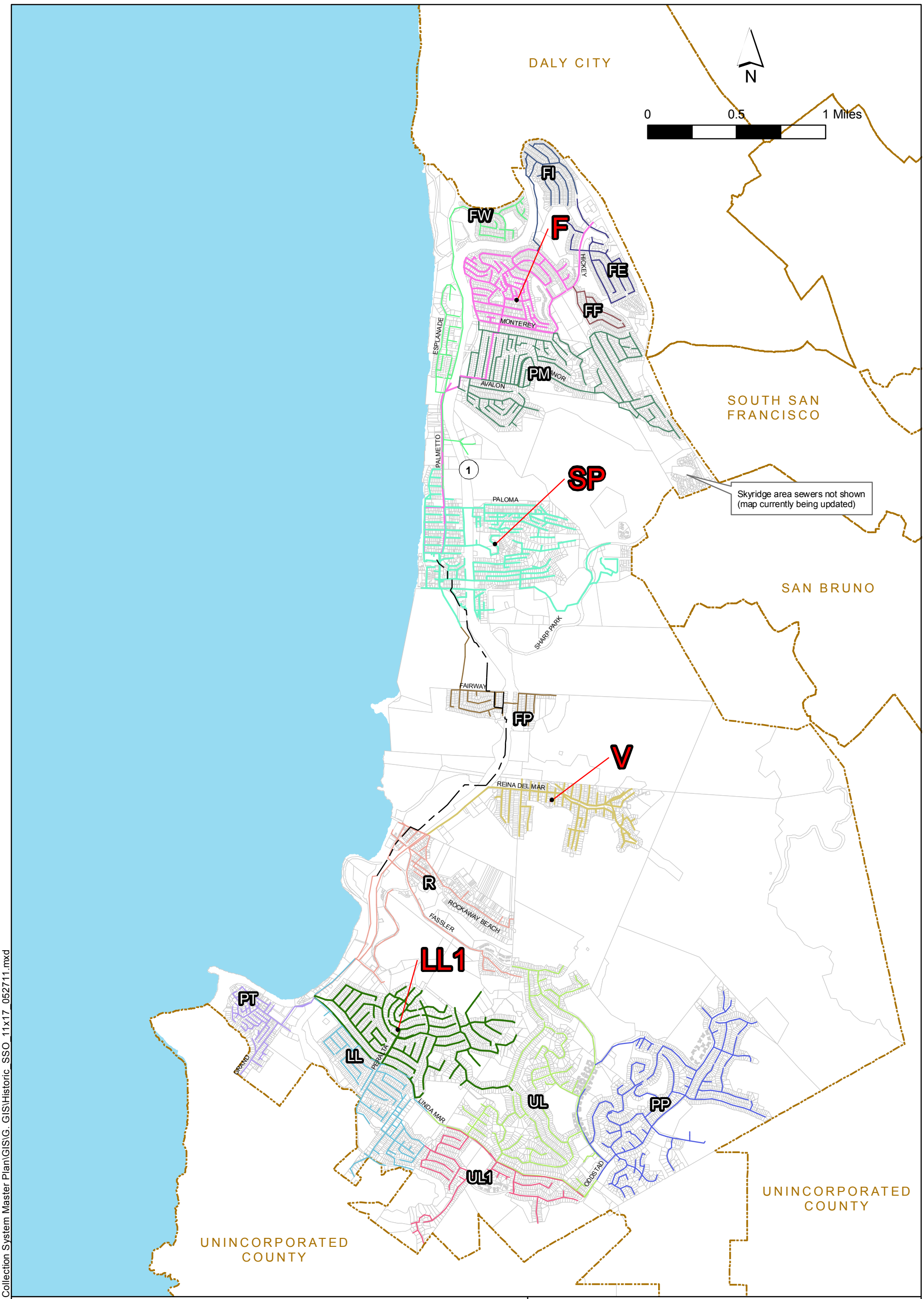

Legend

- City Boundaries
- Parcels
- Force Main
- SP Targeted Districts

Sewer Cleaning Districts

F, FE, FF, FI, FP, FW, LL, LL1, MP, PM, PP, PT, R, SP, UL, UL1, V

City of Pacifica
SSO Reduction Plan

Sewer Cleaning Districts

Figure 2

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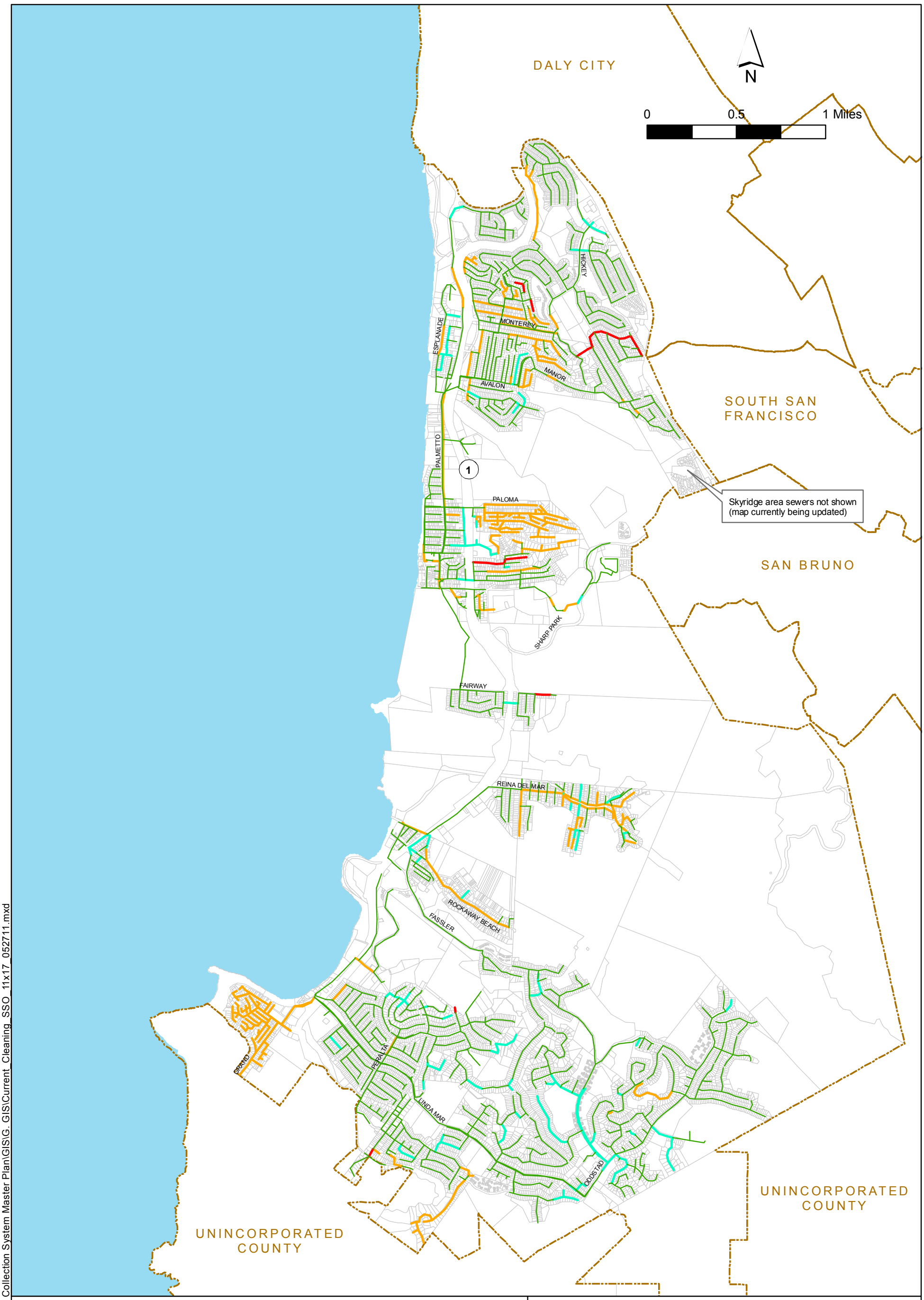

Legend

City Boundaries
Parcels

Hot Spots
4 months
6 months
12 months

District Maintenance
2 years

City of Pacifica
SSO Reduction Plan

Current Cleaning Frequencies

Figure 3

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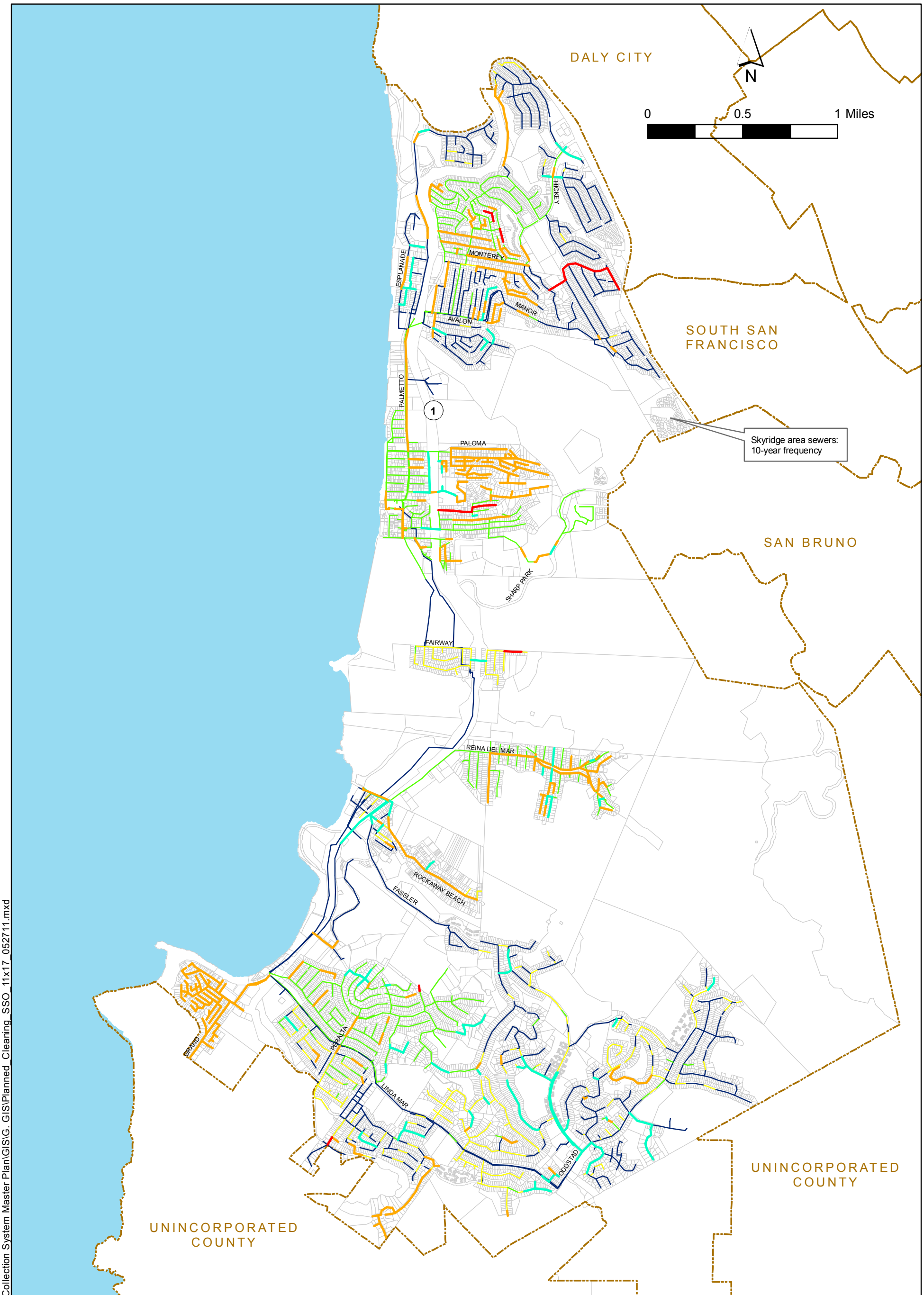

Legend

City Boundaries
Parcels

Hot Spots
- 4 months
- 6 months
- 12 months

District Maintenance
- 1 year
- 3 years
- 5 years

City of Pacifica
SSO Reduction Plan

Planned Cleaning Frequencies

Figure 4

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