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Exhibit Number	:	
Commissioner	:	Michael Picker
Administrative Law Judge	:	Rafael Lirag
ORA Witnesses	:	Jenny Au; Pat Ma

OFFICE OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

ORA Rebuttal Testimony

PHASE II – WATER QUALITY ISSUES IN THE CITY OF GARDENA

Golden State Water Company
Test Year 2016 General Rate Case
A.14-07-006

San Francisco, California
August 24, 2015

MEMORANDUM

This Rebuttal Testimony is prepared by Jenny Au and Pat Ma of the *Office of Ratepayer Advocates (ORA) - Water Branch,* and under the general supervision of Program Manager Danilo Sanchez, and Program & Project Supervisor Lisa Bilir. The witnesses' Statements of Qualifications are in Chapter 11 of this proceeding's Exhibit ORA-1, ORA's Company-Wide Report on the Results of Operations. Shanna Foley and Kerriann Sheppard serve as ORA legal counsels in this proceeding.

ORA Rebuttal Testimony

Phase II – Water Quality Issues in the City of Gardena

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Phase II – Water Quality Issues in the City of Gardena

A. INTRODUCTION & BRIEF PROCEDURAL HISTORY

ORA in its water quality testimony in GSWC's General Rate Case Application 14-07-006 presented findings related to what has been described as "black water" incidents in early 2015 in the City of Gardena ("Gardena"). These incidents involved customer complaints of "*blackened tap water*" coming from residential plumbing fixtures at 14093 Gramercy Place in Gardena and a similar water quality issue in another residence across the street from that address.[1] ORA also learned that multiple customers have filed complaints with the City of Gardena related to the quality of water received from Golden State Water Company (GSWC or Golden State).[2]

Although GSWC considered the discolored water discovered at 14903 Gramercy Place an "isolated event,"[3] the Mayor of the City of Gardena, Paul Tanaka, in his January 29, 2015 letter to the Commission and the U.S. Environmental Protection Agency, indicated that there is a long-standing water quality issue in Gardena affecting many residents.[4] Based on this and other findings presented in its water quality testimony, ORA requested that the Commission open a second phase in this proceeding for GSWC to address customers' concerns regarding the quality

[1] Exhibit ORA-8 at page 54, line 7 to page 58, line 2; *see* Figure 8-A at page 57.

[2] Exhibit ORA-8 at page 57, line 3.

[3] Nutting Testimony, Attachments – Volume 2, Attachment 8 at page 1 (GSWC Written Statement – Jan 2015).

[4] Exhibit ORA-8 at page 56, line 10 to line 12.

of water in Gardena to ensure that the "black water" problem is properly and timely resolved, and to identify and address operational deficiencies, if any.[5]

The assigned Administrative Law Judge granted ORA's request for a Phase II and directed GSWC to serve additional testimony on this issue. This rebuttal testimony is ORA's response to GSWC's Phase II testimony submitted on July 24, 2015.

ORA's recommendations presented herein are based on its review of the July 24, 2015 direct testimony of GSWC witnesses Katherine Nutting and Robert McVicker (numbered by GSWC as Exhibit GS-165[6] and GS-166, respectively, and herein referred to as "Nutting Testimony" and "McVicker Phase II Testimony") and additional information received through follow-up communications with GSWC. ORA also bases its recommendations on information received from the staff of the State Water Resources Control Board (SWRCB), as well as data requests, exhibits and hearing transcripts from this proceeding.

B. KEY RECOMMENDATIONS

(1) ORA recommends that the Commission afford no weight to the pipeline replacement information submitted in GSWC's McVicker Phase II Testimony. GSWC asserts that the water quality issues in the Gardena area relate to aesthetic effects such as discoloration and odor, rather than any unsafe levels of contamination or exceedance of any Maximum Contaminant Levels (MCLs).[7] The McVicker Phase II Testimony's

[5] Exhibit ORA-8 at page 58, line 18 to line 21.

[6] GSWC submitted a public and a confidential version of Exhibit 165's Attachment 16 – Example of UDF Plan.

[7] Nutting Testimony at page 4, line 19 to page 5, line 2.

various references to catastrophic failures at best has minimal relevance in addressing the Gardena water quality issues, and at worst presents misleading information.

(2) ORA also recommends a number of reporting requirements, described in detail in **Section C.4.d** of this report, to facilitate the Commission's monitoring of GSWC's compliance with the SWRCB's directives and to ensure that actions taken or to be taken by GSWC are adequate and cost-effective in addressing the Gardena water quality issues.

C. DISCUSSION

1. Water Quality Incidents at the Gramercy Place Locations

The Nutting Testimony concludes that the water quality complaint from the 14903 Gramercy Place customer location is resolved and describes in detail the water quality issues and the actions taken by GSWC to address the issues at the two Gramercy Place locations.[8]

A significant development appears to be GSWC's determination that the customers' service lines were tapped off of the water main near two 45-degree fittings and that the locations of these service line taps could increase the possibility of discolored water entering the customers' water supply, and GSWC's subsequent relocation of the service lines to connect them to the water main on Gramercy Place in mid-March 2015.[9] GSWC however states that it "did not determine the specific cause of the incident" and "did not discover a likely event that would have created a reverse flow or any other mechanism that could disturb the material in the pipes."[10]

[8] Nutting Testimony at page 17, line 15 to page 24, line 9.

[9] Nutting Testimony at page 23, line 16 to page 24, line 7.

[10] Nutting Testimony at page 22, line 13 to line 15.

GSWC also presents monthly data on the number of water quality complaints from its customers in Gardena from July 2014 to February 2015.[11] ORA requested additional data for March 2015 to July 2015. Table 1 below presents the data on water quality complaints from Gardena customers, as provided by GSWC to ORA in August 2015.

Table 1: Customer Complaints from the City of Gardena[12]

Month / Year	Number of Water Quality Complaints in the City of Gardena
July 2014	12
August 2014	35
September 2014	13
October 2014	36
November 2014	7
December 2014	30
January 2015	33
February 2015	46
March 2015	12
April 2015	13
May 2015	24
June 2015	15
July 2015	2

It is difficult to form a definitive conclusion based on the above data. ORA notes however that the number of complaints from the most recent five months (March to July 2015) is noticeably lower than the number of complaints from the prior five months (October 2014 to February 2015).

[11] Nutting Testimony at page 18, line 1 to line 11.

[12] July 2014 to February 2015 data from Nutting Testimony at page 18; March 2015 to July 2015 data from August 21, 2015 email response from Jenny Darney-Lane of GSWC to Pat Ma of ORA.

2. Investigation by the State Water Resources Control Board's Office of Enforcement

ORA contacted the SWRCB's Office of Enforcement on August 12, 2015 and was informed that there is an on-going investigation regarding the Gardena water quality issues. According to the Office of Enforcement, the investigation of this type is expected to result in an Inspection Report that will include findings of concerns and deficiencies, if any. If violations are found based on findings in the Inspection Report, they will be communicated to the utility via a Notice of Violation letter; the utility would be required to respond to the Notice in writing. ORA was not able obtain information on the expected issuance date and timeframe of the Inspection Report.

3. Letter from the State Water Resources Control Board's Division of Drinking Water

On August 18, 2015, SWRCB's Division of Drinking Water (DDW) issued a letter addressing GSWC's Final Incident Report submitted to DDW on March 19, 2015, and GSWC's Operation and Maintenance Plan submitted on March 31, 2015. DDW specifies that GSWC shall respond in writing to the letter's italicized comments within 30 days (by September 17, 2015).[13]

DDW's italicized comments/requirements to which GSWC must respond are listed by subject area below; please refer to the August 18, 2015 letter included as **Appendix A** of this report for additional discussions leading to the italicized comments/requirements (to highlight the letter's italicized comments, they are italicized *and* underlined herein):

(1) Reporting of customer complaints

> "On February 19, 2015, the Company provided DDW with approximately 105 customer complaint investigation reports for the period June 2014 to January 2015…DDW finds the complaint investigation report form adequate in documenting conditions found at customer complaint locations. However, the submitted

[13] August 18, 2015 Letter from Sutida Bergquist, P.E. of DDW-Central District to Kate Nutting of GSWC at page 2.

documents did not include a full address of the customer, specifically the name of the cities or the unincorporated areas with water quality area. *In the future, all customer complaint investigation reports submitted to DDW must include a full address, the name of the city or unincorporated area, along with the water quality area*.

"…Both DDW and the Company need to understand the number of water quality complaints for each individual city and/or unincorporated are. *Therefore, the Company must modify the water quality complaint report to include the complete address and water quality area location for each complaint, and* submit these to [the DDW] office by the 10th of each month."[14]

(2) Update of infrastructure improvements, including those discussed in the GSWC Final Incident Report

"DDW requests an update of infrastructure improvements for the City of Gardena – including those as discussed in the [Final Incident] Report:

- "Replacing some or all of older 4-inch cast iron main on 149th Street
- "Evaluating possible replacement of the east-west trending to the north and south of 149th Street in Gramercy Area
- "Relocation of the two service lines, at the 14903 Gramercy Place and at 2007 W 149th Street (across from 14903 Gramercy Place) from the main on 149th Street to the main on Gramercy Place to improve water quality
- "6.4 miles of water main will be replaced in the City of Gardena from 2015-2017 (Gardena has total of 110 miles of water main). *Please provide details including timeline schedules for engineering and construction deadlines for each project in the update. Please also provide the same detail information for the remaining 22 miles water main proposed replacements in the Southwest system*
- "2015-2017 Southwest Capital Improvement Projects – (Enclosure 3) *please add date of completion and include the project table with the monthly report due to DDW by the 10th of each month until complete.*

[14] *Id.* at page 3.

- *"Summary of table of the Gardena water main (110 miles) with information on their location, material, size, age, break history, condition, flushing activity, and indication of dead-end.*

- "…There are 510 dead-ends in the Southwest system. For at least the past five years, the Company has been conducting dead-end flushing every 2 years. The Capital Project showed only one dead-end will be looped during 2015 and 2017. *The Company should consider eliminating more dead-ends to improve water quality in low flow areas."*[15]

(3) Water quality and the Operation and Maintenance Plan (OMP)

"The Company OMP does not include any in place action plan or procedure to investigate or respond to elevated color and odor results at the routine sample sites. *The OM Plan shall incorporate this element. In the event that Turbidity, Color, or Odor exceeds the [Secondary Maximum Contaminant Level] at the routine sampling sites, the Company shall notify DDW within 24 hours, and prepare and submit an incident investigation report to DDW within 30 days of the exceedance. At a mimimum, the report shall include any incidents of hydrant flushing, water main breaks, new main tie-in or treatment plant upset, as well as customer complaints in the affected areas.*"[16]

(4) Customer notification of flushing activities and the OMP

"In the OMP, the Company Flushing Program Implementation states, 'Flushing may occur during off-peak hours to minimize disturbance to the system, especially in areas with sediment deposition. If flushing is scheduled during normal working hours, it may be beneficial to give residents prior notice, especially if colored water is anticipated…' The Company did not follow the OMP in providing residents with prior notice as the OMP suggested.

"*The OMP shall incorporate public notification procedures and methods. Public notification shall include the different methods used by the Company and approved by DDW to notify customers prior to all flushing events schedule or in the OMP. The Company should develop and strive towards a 'Zero' goal of allowing undesired*

[15] *Id.* at page 3 to page 4.

[16] *Id*. at page 4 to page 5.

materials to enter homeowner or business plumbing, as well as developing and striving towards a 100 percent goal of customer notification."

"UDF [unidirectional flushing] creates a disturbance of system biofilm, which is suspected to harbor pathogenic microorganisms. *The Company shall provide DDW with an evaluation, or feasibility report of the actual effectiveness of implementing the chosen notification methods, such as postcards, door advertisements, letters, robocalls and web postings that would promptly pre-notify customers of any flushing, piping or other remediation activities that may affect water quality or cause any inconvenience to residents. For web based notification, the Company shall provide the number of internet visitor hits or views of the Southwest flushing activities page specific for each water quality area.*

"*Any Company internet based customer public notification system shall include complete and comprehensive information on how a customer may file a water complaint with the State Water Resources Control Board, and the California Public Utilities Commissions* [sic]. *The Company shall provide DDW with monthly updates of customer numbers receiving e-mailed public notification*.

"Review by DDW of the OMP is ongoing. DDW may have additional comments of the OMP."[17]

(5) Pipeline Flushing

"DDW agrees that routine UDF would be a preferred method over conventional flushing, and that UDF is an essential and effective preventative maintenance procedure in removing accumulated material that has built up over time, including manganese. The Company began implementing the unidirectional flushing method in 2010. Occasionally, the Compnay has returned to previously flushed water quality areas (WQAs), indicating UDF would be on-going and labor intensive. Figure 3 of the Report indicates that 11 out of 18 WQAs have been flushed by UDF. As of the Report date, there are still seven system areas yet to be flushed since 2010. Many distribution operator training manuals recommend entire system flushing, at least, annually as ongoing preventative maintenance. *DDW recommends that the Company properly and appropriately perform UDF in an ongoing basis which is an essential preventative maintenance task, to ensure that the best possible quality water is delivered in the Southwest system*.

[17] *Id.* at page 5.

"Another essential preventative maintenance task is dead-end water main flushing, to eliminate stagnant water in low flow areas resulting in color and odor complaints. According to the OMP, the Company indicates that all dead-ends are flushed on a schedule based on circumstance and need of each area, but no less than annually. However, for several years, the Company has reported dead-ends being flushed every two years. *The Company shall flush each system dead-end once each year, and include with the monthly report the ID numbers of dead-ends flushed*."[18]

(6) Cessation of SeaQuest™ Addition

"The Company submitted a permit application requesting cessation of SeaQuest™ treatment because the Company determined the source water was non-corrosive, and UDF would be a more effective tool for controlling biofilm… The Company and DDW agreed to withdraw SeaQuest™, area by area, where UDF has been completed. The Company recently informed DDW that one water quality area continues SeaQuest™ addition. *DDW highly recommends that, as soon as possible, the Company performs appropriate flushing of this remaining area so SeaQuest™ is completely withdrawn from the system*."[19]

(7) Revisions to and Submittal of Bacteriological Sample Siting Plan

"DDW reviewed the Bacteriological Sampling Siting Plan (BSSP) submitted on May 7, 2015. The Company proposed BSSP has not been approved by DDW, which has determined that *the Company shall modify the proposed BSSP by returning to the previous number of 55 sampling sites*… For DDW and the Company to have a better understanding of the general-physical water quality of the Southwest service area, *the Company shall include monitoring and reporting of Turbidity, Color Odor, and Iron and Manganese at all 55 sites. The Company shall revise BSSP and submit to DDW within 30 days*."[20]

[18] *Id.* at page 5 to page 6.

[19] *Id.* at page 6.

[20] *Id.* at page 6.

(8) Biofilm Study

> "The Company conducted a biofilm study in the Southwest system (circa 2011). The results showed the presence of numerous microorganisms, including amoeba. *DDW requests additional information on the laboratory, the method used, and whether speciation of the amoeba, as well as any other discovered microbes, was done to determine pathogenic probability*."[21]

4. Nutting Testimony: Water Quality Issues and GSWC's Actions in Gardena and the Southwest System

Most of GSWC's Nutting Testimony describes water quality issues and actions that GSWC has taken in the past several years to address long-standing issues in the Southwest system.

a. Implementation of the 2007 Study's Recommendations

Among its efforts to address long-standing water quality issues in the Southwest system, GSWC engaged CH2MHILL to conduct two studies - in 1996 and 2007.[22] The last study issued in July 2007 is titled *Southwest System Water Quality Study* ("*2007 Study*"). This discussion focuses on the *2007 Study* recommendations primarily because it is the more recent study.

The *2007 Study* presents recommendations grouped into Phase 1 and Phase 2, with Phase 2 to be implemented after Phase 1 only if necessary, and describes the recommended phased approach as follows (specific recommendations are shown in **Table 2**):

> To help GSWC deal with the challenges that they face in the Southwest System, this study has developed the following recommendations. The recommendations have been categorized into two phases. The Phase 1 improvements should be implemented immediately, since they have been identified to provide the greatest benefit for the cost and are expected to mitigate the water quality problems associated with a low disinfectant residual in the distribution system. The Phase 2 improvements are only

[21] *Id*. at page 6.

[22] Nutting Testimony at page 7, line 22 to page 8, line 9.

> recommended if the Phase 1 improvements fall short of the desired objective and low disinfectant residuals continue to be observed in portions of the system. The Phase 2 improvements should not be considered until after the Phase 1 improvements have been operational long enough to determine the effectiveness of the improvements. Additional improvements, such as replacing unlined metal pipe, could help improve water quality, but were not considered cost effective on their own.[23]

GSWC's Nutting Testimony describes several steps taken in regard to changes in operations and in infrastructure in response to the *2007 Study*'s recommended improvements. It is unclear from the testimony however whether all recommendations were implemented, when they were implemented and if they were not implemented, why not. It is also unclear if GSWC undertook the recommended phased approach and assessed the results of Phase 1 improvements as recommended by the study prior to implementing Phase 2. Thus, ORA requested a status update from GSWC on the *2007 Study*'s recommendations. **Table 2** below presents the recommended improvements and corresponding status updates.

[23] Nutting Testimony, Attachments – Volume 1, *2007 Study* in Attachment 1, page 17 to page 18 (emphasis added).

Table 2: Status Update of the *2007 Study*'s Recommended Improvements

Recommendations from 2007 Southwest System Water Quality Study[24]	Status Update[25]
The Phase 1 improvements should be implemented immediately, since they have been identified to provide the greatest benefit for the cost and are expected to mitigate the water quality problems associated with a low disinfectant residual in the distribution system.	
(1-1) Implement operational modifications to exercise the water storage tanks. The water stored in these reservoirs needs to be flushed through the tanks regularly to minimize water age. The costs associated with this recommendation are mainly operational costs and are difficult to quantify. Nevertheless, there should be an increased cost associated with exercising the storage tanks.	GSWC reports that it already operated its tanks in the Southwest system in a manner that minimizes water ages as much as possible prior to 2007, but made refinements following the 2007 Study's recommendations and evaluated the refinements on a regular basis. GSWC explains that the set points at which each tank draws and fills are programmed in Supervisory Control and Data Acquisition (SCADA) and the extent to which each tank "turns over" can be determined through SCADA. GSWC does not currently have a written procedure documenting this practice.
(1-2) Convert all of the groundwater sources to automated chloramine disinfection. This cost will include costs for new capital facilities at those sites that do not already have chloramination disinfection. Those costs are included in the estimated costs presented in Table ES-5 of the 2007 study.	This status update applies to Recommendations 1-2 and 1-3. GSWC reports that it has implemented this recommendation, as described in Nutting Testimony on page 10 – Chemical Process

[24]Nutting Testimony, Attachments – Volume 1, *2007 Study* in Attachment 1, pages 18-19. (emphasis added).

[25] August 13, 2015 phone conversation between ORA and GSWC, and follow-up emails between Pat Ma of ORA and Jenny Darney-Lane and Matt Winslow of GSWC.

Recommendations from 2007 Southwest System Water Quality Study[24]	Status Update[25]
(1-3) Construct disinfection system control upgrades at the groundwater well sites. The costs for this recommendation include the cost of new capital facilities, as well as increased operational costs with the addition of ammonia to the chlorine. The estimated capital costs for the 11 well sites that were considered the most critical total about $2.869 million (in January 2007 dollars).	Control Improvements section. GSWC explains that the automation was installed at the wells between 2007 and 2012, with high priority given to wells that were most highly impacted.
(1-4) Shock chlorination is recommended for biofilm control and removal. Shock chlorination is recommended in the areas of the system where biofilm has been identified and is expected to be performed on an annual basis as needed. The additional costs, if any, for this recommendation were considered negligible.	GSWC explains that it does not believe this is a main way to control biofilm, although GSWC has implemented some form of "shock chlorination" and described it on pages 30-31 of Nutting Testimony. GSWC reports that "shock chlorination" was proven effective when performed in the Water Quality Area 2, but the company has not found the treatment as effective in other areas due to the nature of those areas' water supply mix (purchased water/well water).
(1-5) Periodic flushing when required. Even with improved control systems, some portions of the distribution system may still require flushing. These will typically be dead-ends at cul-de-sac streets and other locations where the pipelines do not loop. With the implementation of the other recommendations, it is expected that less flushing will be required. Therefore, the cost of this recommendation should be less than GSWC's existing costs.	GSWC states that it has implemented flushing as described in Nutting Testimony on pages 11-14, and 24-25. GSWC further explains that it started unidirectional flushing in 2010 in the Southwest system, and does not have a multi-year schedule. GSWC generally determines which areas to do next based water quality issues that arise. GSWC reports that it also performs dead-end flushing.
The Phase 2 improvements should not be considered until after the Phase 1 improvements have been operational long enough to determine the effectiveness of the improvements.	
(2-1) Modify the operation of selected imported water connections and/or between pressure zones (adjustment PRV settings) to expand MWD	GSWC reports that it did not make specific effort to alter settings at the MWD (Metropolitan Water District)

Recommendations from 2007 Southwest System Water Quality Study[24]	Status Update[25]
imported water into areas with longer water ages (detention times). The objective of this recommendation is to force groundwater into portions of the distribution system where it is consumed quicker to minimize water age. If the Metropolitan supplies are balanced with connections in other parts of the system there should be little or no cost associated with this improvement.	interconnections as a result of this recommendation. GSWC also states that it has made adjustments to the MWD interconnections periodically in response to pressure and/or water quality concerns in the distribution system. GSWC states that the company altered the settings at MWD interconnections at times during 2015 in an effort to increase the amount of imported water in the Gardena area where there was an increase in customer complaints.
(2-2) Increase the use of the imported MWD water source within the Southwest System during specified times of the year. The higher cost of imported water seems to make this recommendation unattractive. However, if GSWC can increase its groundwater use in other systems with better groundwater quality, then GSWC may actually be able to reduce its overall costs by increasing the well production at locations where less treatment is required.	GSWC reports that it has not implemented this recommendation at this time because of cost considerations, but may examine it as part of the water quality analysis described in McVicker Testimony on pages 7-8.
(2-3) Installation of mixing systems in the system water storage tanks. Mixers can be used to continuously blend the water in the storage tank with incoming water. This creates a condition called continuously mixed flow, and is very good at minimizing water age in the reservoir while also increasing the longevity of the disinfectant residual. The design of mixers (including the type, size, and quantity) will be specific to each storage tank. Since mixers are not recommended at this time, construction cost estimates were not developed.	GSWC reports that a tank mixing system has been ordered for the Chadron tank and is expected to be installed within the next month (September 2015). Per GSWC, mixers are being planned for the Wadsworth and Gardena Heights tanks and expected to be installed by the end of year (2015).
(2-4) Construction of re-chlorination stations in the distribution system. Re-chlorination stations are disinfection facilities that are located within the distribution system as opposed to being	GSWC explains that this option can increase risks and is complicated. It can also increase cost due to additional facilities required and additional chemicals costs.

Recommendations from 2007 Southwest System Water Quality Study[24]	Status Update[25]
located at the sources of supply. These facilities are used to replenish the disinfectant that has been consumed while traveling through the system. Re-chlorination stations can be constructed at a tank site, or elsewhere within the distribution system along pipelines, to boost the disinfectant residual if it becomes too low. Since these facilities are not recommended at this time, construction cost estimates were not developed.	GSWC does not considered this option high in priority as other remedies such as unidirectional flushing have proven to be effective.

As shown in the status updates above, GSWC implemented a number of recommendations presented in the *2007 Study*. Some were not implemented for various reasons as described in the table. GSWC did not have a formal "post-Phase 1" assessment and at this time generally focuses its efforts on unidirectional flushing activities (in addition to other options described in Nutting Testimony).[26]

b. Recent activities

GSWC explains that one of the significant activities undertaken by GSWC starting in 2010 is the unidirectional flushing or UDF program. GSWC performed unidirectional flushing in in Southwest system's Water Quality Area 5 (WQA 5) [27] and Gramercy Area in the December 2014 to February 2015 period. As part of this process, GSWC also identified problems in the distribution systems that require repairs and modifications, described below.

Closed and broken closed gate valves – GSWC reports that in the process of implementing unidirectional flushing in the Gardena/Gramercy areas, its "operators came across a number of

[26] Ibid.

[27] One of the system's 18 WQAs, and where the 14903 Gardena Place incidents occurred.

gate valves that were either inadvertently closed or broken closed," and as a result GSWC replaced 27 gate valves, 15 of which were broken closed, in the impacted area in the first five months of 2015.[28] As GSWC explains, closed gate valves can restrict water flow and lead to an increase in water age in the distribution system, which in turn can cause discolored water and/or odor.[29]

Dead-end pipe segment – GSWC also reports discovery of a segment of the cast iron main on Gramercy Place that was not needed for water service but created a dead-end.[30] After determining that this dead-end segment could contribute to high water age in that area and the color and odor issues that customers had been experiencing, GSWC disconnected and abandoned the segment in March 2015.[31]

c. Consideration of additional solutions

The Nutting Testimony also describes a number of solutions under consideration that have the potential to improve water quality. Most notable are: swabbing or pigging of existing pipelines to remove sediments, biofilm, accumulated precipitates and heavy tuberculation,[32] and disinfection process enhancements at GSWC's wells to address the chloramine degradation issue.[33]

[28] Nutting Testimony at page 26, line 1 to line 9.

[29] Nutting Testimony at page 26, line 14 to line 18.

[30] Nutting Testimony at page 26, line 20 to line 23.

[31] Nutting Testimony at page 26, line 23 to page 27, line 2.

[32] Nutting Testimony at page 31, line 18 to page 32, line 12.

[33] Nutting Testimony at page 33, line 4 to line 6.

d. ORA's reporting recommendations

Based on the above findings, ORA recommends the following:

Reporting requirements for the next rate case filing – The Rate Case Plan in its Minimum Data Requirements (MDRs) already requires that Class A utilities such as GSWC submit copies of SWRCB/DDW water quality citations, last inspection reports, and letters of violation in each general rate case application.[34] The MDRs also specifies that the utility provides information on "all actions taken to comply with the [SWRCB/DDW] requests" and "[r]ecommend additional water quality requirements, tests, conditions, protocols, etc. that may be needed in the future to assure water quality and safety, including costs and enforcement."[35] The MDR responses related to water quality in the Southwest system and Gardena area should be incorporated in the enhanced reporting requirement recommended by ORA below.

The Commission's mission is to "serve the public interest by protecting consumers and ensuring the provision of safe, reliable utility service and infrastructure at reasonable rates, with a commitment to environmental enhancement and a healthy California economy."[36] To ensure that GSWC *adequately* and *cost-effectively* addresses water quality issues in Gardena and in the larger Southwest service area, ORA recommends that the Commission require GSWC to include in its next general rate case's *proposed application* and *application* a comprehensive report that at the minimum covers the following as related to the water quality issues discussed herein:

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[34] D.07-05-062, Attachment 1 at page A-30 – MDR #II.G. 5 to 6. Note that while the MDRs refer to the California Department of Health Services ("CDPH") reports, the CDPH is a predecessor of the California Department of Public Health whose Drinking Water Program is now the State Water Resources Control Board's (SWRCB's) Division of Drinking Water (DDW).

[35] D.07-05-062, Attachment 1 at page A-30 – MDR #II.G. 7 and 10.

[36] http://www.cpuc.ca.gov/puc/, accessed on August 22, 2015.

(1) Detailed description of actions *taken* in response to the SWRCB's directives (such as the DDW's August 18, 2015 letter) and the resulting costs and benefits. GSWC should be required to include cost and benefit analysis of alternatives considered, justification for action proposed, and estimated impacts on ratepayers' rates.

(2) Detailed description of actions *proposed* in response to the SWRCB's directives and the expected costs and benefits. GSWC should be required to include cost and benefit analysis of alternatives considered, justification for action proposed, and estimated impacts on ratepayers' rates.

(3) Detailed description of actions *taken* to address water quality issues that are not in direct response to the SWRCB's directives and the resulting costs and benefits of those actions. GSWC should be required to include cost and benefit analysis of alternatives considered, justification for action proposed, and estimated impacts on ratepayers' rates.

(4) Detailed description of actions *proposed* to be taken to address water quality issues that are not in direct response to the SWRCB's directives and the resulting costs and benefits of those actions. GSWC should be required to include cost and benefit analysis of alternatives considered, justification for action proposed, and estimated impacts on ratepayers' rates.

(5) Findings regarding options described in GSWC's Nutting Testimony such as swabbing/pigging of existing pipelines and disinfection process enhancements at GSWC's wells.

(6) Status update on the *2007 Study* recommendations presented in a similar format as **Table 2** above but accompanied by a detailed explanation and documentation.

Reporting requirements from now through the next general rate case period – To monitor GSWC's progress in addressing water quality issues in Gardena and in the larger Southwest service area, ORA recommends that the Commission require GSWC to provide the Commission's Division of Water and Audits and ORA's Water Branch an electronic copy of the SWRCB's Inspection Reports, Notices of Violation and any other directives (such as the DDW's August 18, 2015 letter) related to the Southwest system within *seven* days of receipt of the

document by GSWC. GSWC should also be required to provide the Commission's Division of Water and Audits and ORA's Water Branch an electronic copy of all subsequent correspondences including periodic reports associated with said Inspection Reports/Notices/directives, also within *seven* days of receipt/issuance of the document by GSWC. This reporting requirement should remain effective through the next rate case cycle to provide the Commission up-to-date information in its review of GSWC's capital budget requests in the next general rate case.

5. McVicker Phase II Testimony: Pipeline Replacements

The McVicker Phase II Testimony presents information on the age and life expectancy of the Southwest system's cast iron and steel pipelines, and on capital projects proposed in the current rate case and contemplated for the future that purportedly would improve water quality in the City of Gardena.

Age and life expectancy of the Southwest system's cast iron and steel pipelines – The McVicker Phase II Testimony in support of its recommended additional actions describes the Southwest system's steel and cast iron pipelines as follows:

> Over 46% of the pipeline in the Southwest system is cast iron or steel pipe that is between 40 and 80 years. Steel pipe is expected to last between 48 and 68 years, and cast iron pipe is expected to last between 58 and 87 years.

Although the testimony does not provide a citation, ORA assumes the information is taken from Exhibit GS-69 – GSWC's July 2014 Pipeline Management Program report. It appears that the above presentation of age and life expectancies is intended to support GSWC's pipeline replacement requests. However, presenting one combined age range of cast iron and steel types and contrasting it with the each type's life expectancy can lead to misinterpretation. This presentation of the data does not allow the reader sufficient information to compare and contrast the age data of each pipeline type against that type's life expectancy data.

A more specific, useful, and unbiased way of presenting the age and life expectancy data is by pipeline type. Table 3 below uses information from GSWC's Pipeline Management Program report and presents by pipeline type the average age, the range for short- and long-service life expectancy and also the proportion of each type relative to the system total (in length).[37]

Table 3: GSWC Southwest system – Cast Iron and Steel Pipeline Data

Pipe Type	Cast Iron	Steel
Proportion to total system	50.14%	3.45%
Short Service Life Expectancy	58-76 years	48-62 years
Long Service Life Expectancy	76-87 years	63-68 years
Average age	58 years	49 years

The following observations regarding these two pipe types in the Southwest system can be made from data presented in Table 3 above:

- For *cast iron* pipelines, the average age is nine years below the mid-point of the Short Service Life Expectancy (a pessimistic expectation in terms of how long this type is expected to last), and 24 years below the mid-point of the Long Service Life Expectancy (an optimistic view).
- For *steel* pipelines, which make up less than 4% of the total system in length, the average age is six years below the mid-point of Short Service Life Expectancy and nearly 17 years below the mid-point Long Service Life Expectancy.

GSWC's inappropriate warnings of catastrophic failures – The McVicker Phase II Testimony recycles GSWC's dramatic warnings of the consequences of rejecting its pipeline replacement requests. GSWC cites a recommendation on the U.S. drinking water infrastructure - "we will

[37] Exhibit GS-69 at page 8-111 to page 8-112; numbers of years for age and life expectancy are based on visual inspection of graphical information (bar graphs) presented in these pages.

have to face the need to 'catch up' with past deferred investments, and the more we delay the harder the job will be when the day of reckoning comes."[38] GSWC also refers to some unspecified "media coverage of some rather dramatic infrastructure failures" experienced by the Los Angeles Department of Water and Power (LADWP).[39] GSWC has already used another over-the-top example of "catastrophic" events in its Rebuttal Testimony and Brief in this proceeding - the LADWP's "101 blowouts" in the summer of 2009.[40] This type of information can be misleading and is not useful in making sound engineering and ratemaking decisions, as explained below.

USC Study of the LADWP's 101 Blowouts – In describing the LADWP's summer 2009 blowouts, GSWC cited a 2010 University of Southern California study titled *Expert Review of Water System Pipeline Breaks in the City of Los Angeles during Summer 2009* ("*USC Study*").[41] GSWC paints this picture of "catastrophic" failures in its efforts to justify the overly aggressive pipeline replacement budget requested in this rate case (nearly 50% more than the amount authorized in the last rate case[42]). However, it neglected to include significant, relevant information from any study of this type - the findings and recommendations.

The findings by the "Investigation Team" presented in the Executive Summary of the *USC Study* are as follows:

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[38] McVicker Phase II Testimony at page 4, line 18 to page 5, line 4, citing the American Water Works Association's article (emphasis added).

[39] McVicker Phase II Testimony at page 4, line 10 to line 12 (emphasis added).

[40] Exhibit GS-129 at page 8, line 13 to line 15; GSWC Opening Brief at page 44 (emphasis added).

[41] Exhibit GS-129 at p. 8, footnote 4 ("Expert Review of Water System Pipeline Breaks in the City of Los Angeles During Summer 2009." University of Southern California, April 9, 2010. http://cee.usc.edu/assets/014/68397.pdf)

[42] ORA Opening Brief at page 94.

> The Investigation Team's findings reveal a connection between the City's water-rationing program and the increase in pipe breaks during the summer of 2009, especially with cast iron pipes,.[sic] At various locations in the LADWP water distribution system, the water pressure dropped significantly on Mondays and Thursdays after the beginning of the water rationing program on June 1, 2009. Those water pressure drops on these days were caused by an increased water flow during the watering of lawns. As a result, the cyclic levels of water pressure increased and accelerated the metal fatigue failures of aged and corroded cast iron pipes.
>
> These findings conclude that that the sudden changes of water pressure in the system, attributable to the water-rationing program, had a negative impact on cast iron pipes with lower fatigue resistance (i.e. especially corroded cast iron pipes).[43]

The Investigation Team's corresponding recommendations are as follows:

- For the summer of 2010, the Investigation Team recommends avoiding abrupt variations in water pressure as much as possible. To avoid increased levels of water main breaks, it is recommended that LADWP alters its existing water-rationing program so that it evenly distributes the variations of water pressure over time, and avoids sudden drops of water pressure. For instance, LADWP could devise water rationing so that properties with odd and even street numbers engage in watering lawns on different days. This solution would reduce sudden drops of water pressure and would impose less stress on corroded cast iron pipelines.
- Starting in 2010, the Investigation Team recommends that LADWP invests in research aimed at:
  - exploring and further refining our understanding of the factors affecting pipeline failure
  - developing tools that better quantify, understand, and predict system failures
  - improving risk-based asset management of LADWP facilities
- The Investigation Team also recommends that LADWP considers:
  - a more efficient pipe replacement program as part of its asset management plan, and improved field inspection techniques

[43] *USC Study* at page iv (emphasis added).

- an aggressive pipeline replacement program that reduces the effects of aging and increased vulnerability over the long term[44]

In other words, the *USC Study* finds a connection between the LADWP's water-rationing program and the increase in pipe breaks during the summer of 2009. The *USC Study* provides a corresponding recommendation to modify the program to avoid the pressure variations caused by customers' usage pattern that resulted from the program and consequently to avoid the repeat of the summer of 2009's "101 blowouts." Presumably, GSWC as a responsible water system operator would consider this finding in its own implementation of water conservation and rationing programs to avoid the "101 blowouts" problem.

Further, the *USC Study* does not rush into recommending aggressive pipeline replacements. Instead, the study presents a comprehensive, multi-faceted approach to manage pipeline infrastructure, only listing pipeline replacements last as a recommendation for the LADWP to consider. As shown, GSWC presented only a partial picture of this *USC Study*. GSWC should have provided the Commission with a more complete picture, with proper context and relevant findings and recommendations.

GSWC's inappropriate comparison with the LADWP – In addition to using the LADWP's summer 2009 blowout information without providing full context and presenting unsourced declarations about the LADWP's "dramatic infrastructure failures," GSWC also makes broad assertions about how the LADWP and GSWC systems are similar (e.g., in age).[45] Because GSWC highlights the need to replace cast iron pipelines as a way to address the Gardena water quality issues,[46] it is necessary to examine the two systems' similarities, if any, relative to cast

[44] *USC Study* at page iv to page v (emphasis added).

[45] McVicker Phase II Testimony at page 4, line 12 to line 13.

[46] McVicker Phase II Testimony at page 5, line 6 to line 11.

iron mains. The purpose of this examination is to determine the validity and relevance of GSWC's comparison.

GSWC does not provide evidence to support its assertion that the two systems are similar in age. However, based on data from GSWC's previously submitted testimony in this proceeding, it is clear that the two systems' proportion of cast iron to total mains are not similar. Of the LADWP's 7,100 miles of water mains, 70% is cast iron.[47] In contrast, only 42% of GSWC's Region 2 mains is cast iron and only 50% of GSWC's mains in the Southwest system is cast iron.[48] These differences are not insignificant; therefore, GSWC's repeated assertions about the similarity of its systems to the LADWP's system without supporting evidence should be given little weight.

GSWC's inappropriate basis for recommending cast iron pipeline replacement – As ORA previously stated, the McVicker Phase II Testimony promotes replacement of cast iron pipelines as a way to combat the water quality issues in Gardena.[49] GSWC asserts that "[t]his has long been recognized by the water industry both in terms of biofilm accumulation, tubercle formation…"[50] Again, GSWC is not presenting the full array of options provided by its own consultant CH2MHILL, which prepared the 1996 and 2007 studies addressing water quality issues in the Southwest system.[51] The CH2MHILL *1996 Study*'s "Future Improvements" section confirms that the Southwest system's "cast iron pipes are susceptible to biofilm growth," but also

[47] Exhibit GS-69 at page 3-2.

[48] Exhibit GS-69, Table 4.6 at page 4-4 to page 4-5. For Region 2, 42% = 375.7 in cast iron miles / 880.8 in total miles; for Southwest system, 50% = 220.0 in cast iron miles / 437.8 in total miles.

[49] McVicker Phase II Testimony at page 5, line 6 to line 11.

[50] McVicker Phase II Testimony at page 5, line 9 to line 10.

[51] Nutting Testimony at page 7, line 22 to page 8, line 9.

specifies that "cast iron pipes need to be replaced or cleaned and lined to prevent biofilm growth."[52] GSWC should not be too eager to replace its cast iron pipelines and disregard options presented by its own consultant (e.g., cleaning and lining existing pipes). Until and unless GSWC makes a concerted effort to identify such options, perform quantitative costs and benefits, and present the results for the Commission's review, its recommendation to replace cast iron pipes as the way to combat water quality issues in Gardena should be given no weight.

Project requested in this GRC – The McVicker Phase II Testimony lists pipeline replacement projects totaling nearly $18 million that purportedly will address replacement and water quality needs.[53] ORA already addressed the requests for these projects in its Phase I Testimony, Opening Brief, and Reply Brief and will not repeat the discussion again here. It is worth noting however that the pipelines GSWC proposed in this general rate case are *not* in the Gramercy Place area.[54]

"Proposed Future Projects" – The McVicker Phase II Testimony also presents a long list of "proposed future" pipeline replacement and other projects,[55] but does not present any information on how these projects would *successfully* and *cost-effectively* alleviate the issues that prompted the establishment of Phase II in this proceeding. Pipeline replacement's c*ost-effectiveness* is a concern already raised by GSWC's consultant who performed the *2007 Study*, which issues the following specific caution:

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[52] Nutting Testimony, Attachments – Volume 1, Attachment 1 at page 6-2 in the 1996 Study (emphasis added).

[53] McVicker Phase II Testimony at page 5, line 13 to page 7, line 3.

[54] Exhibit ORA-33 – Agenda and map of Southwest Capital Projects – 2008 to 2017, provided at the Division of Drinking Water and GSWC February 19, 2015 meeting; Exhibit ORA-34 – "Map of area in Gardena impacted with black water;" Hearing Transcript Vol. 9 at page 764, line 26 to page 772, line 5.

[55] McVicker Phase II Testimony at page 7 to page 12.

> Additional improvements, such as replacing unlined metal pipe, could help improve water quality, but were not considered cost effective on their own.[56]

In addition, as described earlier, the CH2MHILL *1996 Study* recommends other options for existing cast iron pipelines such as cleaning and lining. The Commission should give little weight to this laundry list of "proposed future" projects, totaling over $21 million,[57] as GSWC has not presented any evidence that these projects will successfully and cost-effectively solve the Gardena water quality problems. Moreover, it is not reasonable for GSWC to presume that on-going and contemplated operation and maintenance activities (e.g., unidirectional flushing; dead-end flushing; swabbing/pigging) described in GSWC's Nutting Testimony and the DDW's August 18, 2015 letter would not adequately address the Gardena water quality issues that took place in early 2015.

One of the "proposed future projects" of note is yet another study on the Southwest system's water quality for a cost of $250,000 (in 2015 dollars).[58] While claiming the need to obtain a consultant's input and recommendations on this matter, GSWC curiously speculates that such analysis could result in a recommendation to add "wellhead treatment projects" and asserts that such an "analysis will show that when compared to the cost of water associated with purchased water only, these facilities will provide a much greater benefit to our customers."[59] GSWC then inexplicably presents a half-year cost of $6 million in purchased water as if it is uncontroverted evidence supporting the conclusions and recommendations that it supposedly seeks from the

[56] Nutting Testimony, Attachments – Volume 1, 2007 Study in Attachment 1, 2007 Study at page 18 (emphasis added).

[57] Total costs from projects listed on page 7 to page 12; cost estimates are expressed variously in 2015, 2016 or 2017 dollars.

[58] McVicker Phase II Testimony at page 7, line 20 to page 8, line 8.

[59] McVicker Phase II Testimony at page 8, line 2 to line 6 (emphasis added).

"proposed future" study.[60] This type of conclusory statement regarding what the study would show seems to suggest that GSWC has already determined this study's results and that the study could be manipulated to produce these pre-determined results in order to support its future rate case's capital budget requests. This is yet another reason why the Commission should give little weight to the "proposed future" capital projects presented in the McVicker Phase II Testimony.

D. CONCLUSION

One, as explained above, ORA recommends that the Commission afford no weight to the pipeline replacement information submitted in GSWC's McVicker Phase II Testimony. This testimony at best has minimal relevance in addressing the water quality issues in Gardena, and at worst presents misleading information.

Two, the SWRCB's Office of Enforcement and Division of Drinking Water are reviewing the Gardena water quality issues and will be issuing/have issued their respective findings and directives to GSWC. ORA recommends reporting requirements, described in detail above, to facilitate the Commission's monitoring of GSWC's compliance with those directives and to ensure that actions taken or to be taken by GSWC are adequate and cost-effective in addressing the water quality issues in Gardena and in the larger Southwest system.

[60] McVicker Phase II Testimony at page 8, line 6 to line 8.

ORA Rebuttal Testimony

Phase II – Water Quality Issues in the City of Gardena

APPENDIX A

August 18, 2015 Letter
from the State Water Resources Control Board's Division of Drinking Water to
Golden State Water Company regarding Gardena Colored Water Incident

August 18, 2015 letter includes one ATTACHMENT (Complaint Summary) and three ENCLOSURES (Final Incident Report; Water System Operation and Maintenance Plan; Baumann Memo).

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

August 18, 2015

Ms. Kate Nutting
General Manager
Golden State Water Company-Southwest
1600 W Redondo Beach Blvd
Gardena, CA 90247

SYSTEM 1910155 – GOLDEN STATE WATER COMPANY, GARDENA COLORED WATER INCIDENT

Dear Ms. Nutting,

The State Water Resources Control Board - Division of Drinking Water (DDW) appreciates the Golden State Water Company – Southwest System (Company) March 19, 2015 submittal of the Final Incident Report (Report), investigating water quality complaint incidents of color and odor in the City of Gardena (Gardena). Also, the Company submitted the Operation and Maintenance Plan (OMP) on March 31, 2015. Both documents were prepared at DDW request, and are included as enclosures to this letter.

According to DDW records, the Company provides water services to the Cities of Lawndale and Gardena, portions of the Cities of Hawthorne, Inglewood, Compton, Carson, and the following unincorporated areas of Los Angeles County: Lennox, Athens, and Del Aire. The Company currently serves a population of 271,677 through 51,015 service connections. The service connections include 36,866 single-family residential, 9,515 multi-family, 4,770 commercial/institutional, 102 industrial and 193 landscape irrigation connections. The Company operates 14 local groundwater wells; a distribution system consisting of 463 miles of pipeline (110 miles in Gardena), storage tanks, pumping stations, etc. The Company operates three Iron and Manganese (Fe/Mn) removal treatment systems, one of which is designed to remove hydrogen sulfide (an odor causing compound). In addition, the Company also operates a hydrogen sulfide oxidation treatment system at one other well site. In 2014, the Company reported 9,339.9 million gallons (MG) of water supplied to the Southwest system. While local groundwater accounted for 56.5% (5,276.3 MG) of the supply, 44.5% (4,063.6 MG) was supplemented with the imported water purchased from the West Basin MWD and the Central Basin MWD. The Company routinely monitors its sources and distribution system for various constituents to fulfill the federal and state regulatory requirements, as well as for operational purposes. The Company is not a public agency, and is an investor-owned utility that is also under regulation by the California Public Utility Commission.

The following are DDW comments. The Company shall address all italicized comments in writing.

Gardena Incident Report

In general, the Report did not address water quality complaints for the entire City of Gardena service area but rather for a specific complaint incident at 14903 Gramercy Place (Gramercy) on January 21, 2015, as titled on the subject line of the Report. DDW also received complaints from other areas in Gardena that were also investigated by the Company but were not included in this report. The Report notes that the Company was unable to determine the cause of the January 21, 2015, black colored water at Gramercy. The Company investigation concluded that there were no incidents of hydrant flushing, water main breaks, or new main tie-ins in this area around this time.

The Company did submit one of the Gramercy incident water filters, apparently installed at the home's hot water heater influent, for laboratory analysis. DDW was later informed by Company letter that the lab report was also provided to the Gramercy customer on March 4, 2015. Although the Company mentioned having the results in a February 2015 meeting, the laboratory report is dated March 2, 2015. The Company stated that colored water incidents in the area are related to the presence of sediments, minerals, iron, manganese, and biofilm in the water mains.

Following the Gramercy January 21, 2015 incident, the Company issued a January 27, 2015 written statement about water quality in Gardena. The statement noted the incident to be an extreme case of discolored water. Also, the statement noted that possible causes for the odor and discolored water were due to pipe sediments, including minerals, corrosion byproducts, and iron and manganese metals that are known to accumulate in older cast iron and steel water mains. On January 29, 2015, the Company issued an update that included the statement, "When these materials are stirred by increased water velocity in the pipes, they can be pushed from the mains into home plumbing systems."

Customer Complaints

On February 19, 2015, the Company provided DDW with approximately 105 customer complaint investigation reports for the period June 2014 to January 2015. There were three reports for incidents at Gramercy. The January 21, 2015 Gramercy incident report also indicates visiting "2207." The map shows 2207 149th Street across from the Gramercy incident location. The Company did not submit a customer complaint investigation report for January 21, 2015 at 2207 149th Street. Investigation reports were completed by Company water quality investigators, and nearly all were reviewed by the water systems superintendent (D. Bartleson), a State certified level D3 water system distribution operator. The investigation report is a standard Company form containing customer's contact information, complaint details, and conditions observed/action taken by water quality investigators. Most of the complaint investigation reports were for color and odor complaints. Approximately 30 investigation reports indicated that color and odor problems were observed at the hose bibs. Color and odor complaints were often described by the investigators to be black/brown and having a smell of "rotten-egg", "sewer", etc. Company investigators noted very low chlorine residuals in most of those cases. Some reports mentioned biofilm was observed at the hose bib. Corrective actions were typically main flushing using nearby fire hydrant and/or the water lines inside the customer home or business. Three investigation reports indicated complaint locations were near water piping main dead-ends. Some reports indicated there were point-of-entry devices used at the customer's location. DDW finds the complaint investigation report form adequate in documenting conditions found at customer complaint locations. However, the submitted documents did not include a full address of the customer, specifically the name of the cities or

unincorporated areas with water quality area. *In the future, all customer complaint investigation reports submitted to DDW must include a full address, the name of the city or unincorporated area, along with the water quality area.*

The Company also provided a number of complaints received for July 2014 to April 2015 that indicate water quality complaints in Gardena have been proportionally much higher in comparison to the rest of the Southwest system. Gardena complaints accounted for over two-thirds of the total system complaints in October 2014, December 2014, January 2015, February 2015, and April 2015. A summary of the Company provided complaint data is shown in Attachment 1. The Company did not submit data prior to July 2014 specific to the City of Gardena. Both DDW and the Company need to understand the number of water quality complaints for each individual city and/or unincorporated area. *Therefore, the Company must modify the water quality complaint report to include the complete address and water quality area location for each complaint, and* submit these to our office by the 10th of each month.

On February 12, 2015, the Company provided water quality information to the public at the Gardena Community Meeting, which included solutions to resolve water quality problems in Gardena. The Company short term solution includes localized flushing to improve water quality and decrease odor and water discoloration. The Company long-term solution is performing water main unidirectional flushing (UDF) to remove accumulated material as well as replace deteriorated mains.

DDW recognizes that while localized flushing or "spot" flushing is necessary to resolve a customer complaint, existing pipeline preventative maintenance should include routine annual UDF, or other options to prevent material accumulations in water mains. Based on a document presented to DDW, the Company performed UDF on nearly half of the system in early 2015, using additional outside manpower. However, since 2010, the Company has yet to totally flush the complete system.

Infrastructure Improvements

DDW requests an update of infrastructure improvements for the City of Gardena – including those as discussed in the Report:

- Replacing some or all older 4-inch cast iron main on 149th Street
- Evaluating possible replacement of the east-west trending to the north and south of 149th Street in Gramercy area
- Relocation of the two service lines, at the 14903 Gramercy Place and at 2007 W 149th Street (across from 14903 Gramercy Place) from the main on 149th Street to the main on Gramercy Place to improve the water quality
- 6.4 miles of water main will be replaced in the City of Gardena from 2015-2017 (Gardena has total of 110 miles of water main). *Please provide details including timeline schedules for engineering and construction deadlines for each project in the update. Please also provide same detail information for the remaining 22 miles of water main proposed replacements in the Southwest system*
- 2015-2017 Southwest Capital Improvement Projects – (Enclosure 3) *please add date of completion and include the project table with the monthly report due to DDW by the 10th of each month until complete.*
- *Summary table of the Gardena water main (110 miles) with information on their location, material, size, age, break history, condition, flushing activity, and indication of dead-end.*

In 2014, the Company reported 307 water mains and 500 service connection breaks/leaks due to a weather/temperature change, pipe material and the age of the pipe and meters. There was no water outage in the service area reported in 2014. There are 510 dead-ends in the Southwest system. For at least the past five years, the Company has been conducting dead-end flushing every 2 years. The Capital Project showed only one dead-end will be looped during 2015 and 2017. *The Company should consider eliminating more dead-ends to improve water quality in low flow areas.*

Water Quality

The Report contained laboratory results of the five sampling locations representative of the water quality at Gramercy during the month of January and February 2015. The sample results showed Total Coliform and *E-Coli* to be absent with turbidity levels less than the maximum of 5 NTUs. However, some of the color and odor results were equal or above the maximum of 15 color units (CU) and 3 threshold odor number units (TON) shown on the table below.

Date	Color, CU (Color Units- 15 max)				
	SW2 (Area 6)	SW21 (Area 4)	SW22 (Area 4)	SW47 (Area 5)	SW48 (Area 5)
1/6/2015			15		
1/13/2015			15		
1/21/2015		30	15		
2/3/2015			15		
2/24/2015			15		
	Odor, TON Units (Threshold Odor Number- 3 max)				
2/3/2015		67			
2/10/2015		4			
1/27/2015				3	

While bacteriological standards (Total Coliform and *E-Coli*) are health-based, Turbidity, Color, and Odor are secondary drinking water standards based on consumer acceptance. Federal guidance for secondary standards indicate that Color above 15 CUs would be a visible tint, and for an Odor above 3 TON would be observed as a rotten-egg, musty or chemical smell. According to the lab data, customers in Areas 4, 5, and 6 may have experienced extreme color and/or odor problems.

As mentioned in your report, a presence of manganese (Mn) in the water can cause colored water. According to the Company submitted monthly monitoring reports for 2013 and 2014, manganese was detected sporadically at SW2 and SW48 and some was found to be elevated, as high as 240 µg/L. At SW22, Mn was consistently detected during that period ranging from 20 µg/L to 38 µg/L. Other Southwest System areas with the highest levels of Mn were at SW20 located in Area 6 with 4700 µg/L and 7400 µg/L reported from samples taken on September 10, 2013, and September 17, 2013, respectively. As you are aware, Mn may have an adverse impact on public health. Currently, USEPA has a manganese health advisory level of 1000 µg/L for one-day maximum exposure. According to the data, the Company has exceeded this advisory level at SW20 for a period of time in September 2013.

The Company OMP does not include any in place action plan or procedure to investigate or respond to elevated color and odor results at the routine sample sites. *The OM Plan shall incorporate this element. In the event that Turbidity, Color, or Odor exceeds the SMCL at the routine sampling sites, the Company shall notify DDW within 24 hours, and prepare and submit an incident investigation report to DDW within 30 days of the exceedance. At a minimum, the report shall include any*

incidents of hydrant flushing, water main breaks, new main tie-in or treatment plant upset, as well as customer complaints in the affected areas.

Customer Notification of Flushing Activities

DDW appreciates that the Company began notifying customers of flushing activities upon DDW request. In the OMP, the Company Flushing Program Implementation states, "Flushing may occur during off-peak hours to minimize disturbance to the system, especially in areas with sediment deposition. If flushing is scheduled during normal working hours, it may be beneficial to give residents prior notice, especially if colored water is anticipated..." The Company did not follow the OMP in providing residents with prior notice as the OMP suggested.

The OMP shall incorporate public notification procedures and methods. Public notification shall include the different methods used by the Company and approved by DDW to notify customers prior to all flushing events scheduled or in the OMP. The Company should develop and strive towards a "Zero" goal of allowing undesired materials to enter homeowner or business plumbing, as well as developing and striving towards a 100 percent goal of customer notification.

UDF creates a disturbance of system biofilm, which is suspected to harbor pathogenic microorganisms. *The Company shall provide DDW with an evaluation, or feasibility report of the actual effectiveness of implementing the chosen notification methods, such as postcards, door advertisements, letters, robocalls, and web postings that would promptly pre-notify customers of any flushing, piping or other remediation activities that may affect water quality or cause any inconvenience to residents. For web based notification, the Company shall provide the number of internet visitor hits or views of the Southwest flushing activities page specific for each water quality area.*

Any Company internet based customer public notification system shall include complete and comprehensive information on how a customer may file a water complaint with the State Water Resources Control Board, and the California Public Utilities Commissions. The Company shall provide DDW with monthly updates of customer numbers receiving e-mailed public notification.

Review by DDW of the OMP is ongoing. DDW may have additional comments of the OMP.

Pipeline Flushing

DDW agrees that routine UDF would be a preferred method over conventional flushing, and that UDF is an essential and effective preventative maintenance procedure in removing accumulated material that has built up over time, including manganese. The Company began implementing the unidirectional flushing method in 2010. Occasionally, the Company has returned to previously flushed water quality areas (WQAs), indicating UDF would be on-going and labor intensive. Figure 3 of the Report indicates that 11 out of 18 WQAs have been flushed by UDF. As of the Report date, there are still seven system areas yet to be flushed since 2010. Many distribution operator training manuals recommend entire system flushing, at least, annually as ongoing preventative maintenance. *DDW recommends that the Company properly and appropriately perform UDF in an ongoing basis which is an essential preventative maintenance task, to ensure that the best possible quality water is delivered in the Southwest system.*

Another essential preventative maintenance task is dead-end water main flushing, to eliminate stagnant water in low flow areas resulting in color and odor complaints. According to the OMP, the Company indicates that all dead-ends are flushed on a schedule based on circumstance and need of each area, but no less than annually. However, for several years, the Company has reported dead-ends being flushed every two years. *The Company shall flush each system dead-end once each year, and include with the monthly report the ID numbers of dead-ends flushed.*

SeaQuest™ Addition

The Company submitted a permit application requesting cessation of SeaQuest™ treatment because the Company determined the source water was non-corrosive, and UDF would be a more effective tool for controlling biofilm. The Department of Health Service - Drinking Water Program (DDW's predecessor) permitted use of SeaQuest™ addition, following a long multiple benefits demonstration period. As mentioned in the Report, DDW has concern with discontinuation of SeaQuest™, which has been in place for over fifteen years. Consequently, we requested assistance from Dr. Frank Bauman, retired annuitant and former Chief of the State Department of Health Services - Sanitation and Radiation Laboratories, to conduct an evaluation. Dr. Bauman's memorandum, dated September 24, 2012, is included as an Enclosure. Dr. Bauman provided information showing the system continues to experience severe biofilm problems, but made a recommendation to allow for withdrawal of SeaQuest™. However, Dr. Bauman's memo also warned of biofilm sloughing, and emphasized the importance of appropriate flushing and proper customer notification. The Company and DDW agreed to withdraw SeaQuest™, area by area, where UDF has been completed. The Company recently informed DDW that one water quality area continues SeaQuest™ addition. *DDW highly recommends that, as soon as possible, the Company performs appropriate flushing of this remaining area so SeaQuest™ is completely withdrawn from the system.*

Distribution System Monitoring, Bacteriological Sample Siting Plan

DDW reviewed the Bacteriological Sample Siting Plan (BSSP) submitted on May 7, 2015. The Company proposed BSSP has not been approved by DDW, which has determined that *the Company shall modify the proposed BSSP by returning to the previous number of 55 sample sites.* In recent years, although the number of service connections has stayed relatively the same, the Company has used census methods in estimating population which shows a significant population increase from approximately 170,000 to 270,000. Also, the Company has also incorporated additional pressure zones. For DDW and the Company to have a better understanding of the general-physical water quality of the Southwest service area, *the Company shall include monitoring and reporting of Turbidity, Color, Odor, and Iron and Manganese at all 55 sites. The Company shall revise BSSP and submit to DDW within 30 days.*

Biofilm Study

The Company conducted a biofilm study in the Southwest system (circa 2011). The results showed the presence of numerous microorganisms, including amoeba. *DDW requests additional information on the laboratory, the method used, and whether speciation of the amoeba, as well as any other discovered microbes, was done to determine pathogenic probability.*

Within 30 days, please respond to all above italicized comments in writing. The safety and protection of public health is our responsibility. As you are aware, Section 106.3 of the California Water Code sets forth a policy for the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes. We appreciate your cooperation in adhering to this policy and any questions concerning this letter may be addressed to the undersigned or Jim Willis at (818) 551-2031.

Sincerely,

Sutida Bergquist, P.E.
District Engineer-Central District
Division of Drinking Water

Enclosures

ATTACHMENTS (1):

- Complaint Summary

ENCLOSURES (3):

- Final Incident Report,
- Water System Operation and Maintenance Plan,
- Baumann Memo

Attachment 1: Complaint Summary of GSWC Submitted Data

Month, Year	Number of Water Quality Complaints in Entire System	Number of Water Quality Complaints in the City of Gardena	Percentage of Water Quality Complaints in the City of Gardena
July 2014	26	12	46.2
August 2014	52	35	67.3
September 2014	29	13	44.8
October 2014	46	36	78.3
November 2014	17	7	41.1
December 2014	39	30	76.9
January 2015	40	33	82.5
February 2015	58	46	79.3
March 2015	20	12	60.0
April 2015	17	13	76.5

CC: Hon. Michael D. Antonovich, Mayor of the Board, Supervisor-Fifth District
Hon. Hilda L. Solis, Los Angeles County Supervisor-First District
Hon. Mark Ridley-Thomas, Los Angeles County Supervisor-Second District
Hon. Sheila Kuehls, Los Angeles County Supervisor-Third District
Hon. Don Knabe, Los Angeles County Supervisor-Fourth District
County of Los Angeles Board of Supervisors
Kenneth Hahn Hall of Administration
500 West Temple Street, Room 383
Los Angeles, CA 90012

Mailing List (Via Email Only)

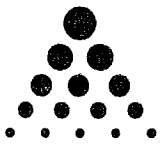
Mayor Paul K. Tanaka, the City of Gardena
Ms. Corine Li, U.S. EPA Region 9, Water Division
Ms. Jenny Au, CPUC - ORA
Mr. Angelo Bellomo, Director of Environmental Health
Mr. Carlos Borja, Chief Cross Connection Control
Mr. William Gedney, Vice President Asset Management
Mr. Dawn White, Water Quality Manager
Mr. Kurt Souza, P.E., SWRCB-DDW Acting Deputy Chief

BCC: Chris Carrigan
Matthew Bufflenben
Central-GSWC/SW, 1910155
Reading
Region
Jim Willis

DDW Comment on GSWC Incident Report and OM Plan (1910155)-2015
SB/JW

ENCLOSURES

1. Final Incident Report
2. Water System Operation and Maintenance Plan
3. Baumann Memo



Golden State
Water Company
A Subsidiary of American States Water Company

March 19, 2015

Sutida Bergquist, P.E.
District Engineer
State Water Resources Control Board
Division of Drinking Water
500 North Central Avenue, Suite 500
Glendale, CA 91203

Subject: Final Incident Report
Water Quality Complaint on January 21, 2015 at
14903 Gramercy Place, Gardena, California

Dear Ms. Bergquist:

Golden State Water Company (Golden State Water) submits this *Final Incident Report* regarding the actions taken by Golden State Water in response to a water quality complaint on January 21, 2015 at 14903 Gramercy Place in Gardena, California as requested by the Division of Drinking Water (DDW) in your February 23, 2015 letter.

Description of Water Quality Complaint

On the evening of January 21, 2015 Golden State Water Company (Golden State Water) received a complaint of dirty water at the residence located at 14903 South Gramercy Place in Gardena, California. The surrounding neighborhood of this address is referred to as the "Gramercy area" in this document. A distribution operator responded to the complaint when it was received. When the operator arrived at the customer's residence, the water was reported by the customer to have mostly cleared. The operator conducted an initial water quality investigation. No other customers contacted Golden State Water to report discolored water that evening; however the customer at 14903 Gramercy Place told our operator that their neighbor across the street (2007 W 149th St.) was having a similar issue. The operator also visited that residence and observed some discolored water in the sink and toilet.

A report dated February 9, 2015 describing the incident and Golden State Water's investigation was submitted to the DDW and is included as an attachment. Colored water incidents in this area are related to the presence of sediments, minerals, iron, manganese and biofilm in the water mains.

This was a temporary occurrence and the water serving the customer is clear.

Water Quality Complaints - Background

In July and August of 2014 Golden State Water observed an increase in water quality complaints and a corresponding decrease in chlorine residual in portions of the City of Gardena. The trend of water quality complaints within the City of Gardena are summarized in the following table:

14401 Chadron Avenue, Hawthorne, CA 90250
Tel: (310) 263-4141 Fax: (310) 263-4144

Month – Year	Number of Water Quality Complaints in the City of Gardena
July 2014	12
August 2014	35
September 2014	13
October 2014	36
November 2014	7
December 2014	30
January 2015	33
February 2015	46

As shown in the table, water quality complaints increased and decreased over several months during the second half of 2014 in portions of the City of Gardena. Flushing activities are discussed below. Even though complaints increased in February 2015, based on our observations, the water quality in the area was improving throughout the month. The increased number of complaints in February 2015 is likely attributable to greater customer awareness. Golden State Water has been encouraging customers to report any adverse water quality so that we can address the underlying causes. Although we always encourage our customers to report all water quality issues, our recent statements in the media and during public meetings appear to have had the desired affect and customers are likely reporting water quality complaints that they would not have previously reported.

The nominal water flow patterns in portions of WQAs 4, 5, 6, and 7 are complex necessitating a complicated order of UDF activities. As noted below, UDF activities in most WQAs were not completed until mid to late February. Additionally, UDF in WQA 6 will not be completed until the middle of March 2015 and water flowing out from this area is one likely source of water quality complaints. Golden State Water continues to monitor water quality in these areas to maintain a comprehensive understanding of the water quality conditions.

Overall, as UDF is completed in each WQA, the frequency of water quality complaints decreases.

Flushing Activities in Gardena

Golden State Water began unidirectional flushing in Water Quality Area (WQA) 5 on December 17, 2015. The complaint referenced above was located in WQA 5.

On January 28, 2015, UDF efforts were increased. Two separate UDF crews flushing two separate portions of the system working in two shifts each began working simultaneously. UDF was conducted from approximately 7:00 am to 10:00 pm until February 18, 2015 when the UDF schedule was changed to 10:00 pm to 2:00 pm, maintaining two separate UDF crews. After UDF of WQAs 2, 4, 5, and portions of 6 and 7, the second UDF crew was discontinued. UDF activities continue to date with one crew in two shifts flushing from 10:00 pm to 2:00 pm. The portion of the water system where UDF was completed since December 17, 2015 is shown in Green on Figure 3.

UDF consists of isolating a particular pipe section or loop, typically through closing appropriate valves and creating a single-direction flow which increases the maximum possible flushing velocity in the water main. UDF always progresses from a clean source and already flushed pipes systematically toward the end of the area to be flushed and generally follows the normal direction of water flow in the distribution system. Extensive planning and the use of a hydraulic model are critical for UDF. Following the normal

water flow direction in the distribution system from a water source can necessitate completing UDF in large portions of the distribution system in order to complete UDF in one specific target area.

It was determined that conducting UDF of the Gramercy area against normal water flow would be advantageous because flushing with the normal flow direction of water would require UDF of other large portions of the distribution system first. The plan was to complete UDF in this area twice, once against normal water flow and once with normal water flow to ensure a successful outcome. This plan was completed successfully and the outcome of UDF in this area was satisfactory.

A timeline of WQAs flushed by UDF is provided below:

Area	Begin Date	End Date
WQA 2	November 6, 2014	February 6, 2015
WQA 4	February 6, 2015	February 21, 2015
WQA 5	December 17, 2015	February 25, 2015
Portion of WQA 6	February 16, 2015	February 20, 2015
WQA 6	February 25, 2015	Anticipated March 18, 2015
Portion of WQA 7	February 2, 2015	February 26, 2015
Gramercy Area	January 30, 2015	February 2, 2015
Gramercy Area	February 23, 2015	February 25, 2015

Customer Communications

Golden State Water issued a written statement regarding water quality reports in Gardena on January 27, 2015 with updated statements on January 28 and 29, 2015 (attached). An additional statement regarding water quality in the City of Gardena and our efforts to address water quality complaints was posted to our website on February 5, 2015 (attached). A letter regarding water quality dated January 30, 3015 to all our customers located in the City of Gardena (included as an attachment).

Golden State Water began placing door hangers on the premises of customers in the immediate vicinity of unidirectional flushing activities on February 5. An example of the door hanger is provided as an attachment. The first set of postcards was mailed on Monday February 9, 2015. Door hangers were placed until our customers received the postcards on approximately Wednesday February 11, 2015.

On February 20, 2015 we launched a webpage on our website dedicated to flushing in the Southwest District (gswater.com/flushing-southwest). The schedule on the webpage is updated daily with the general location of flushing activities for that day. Flushing postcards are mailed prior to beginning UDF in a specific geographic area. The flushing postcards include the URL of the flushing webpage. An example of the flushing postcard and the webpage are included as attachments.

On February 19, 2015 Golden State Water held a community meeting in Gardena, California. The meeting included a 20 minutes presentation (attached) and an hour and a half long question and answer session.

Over the past six weeks following media coverage of the Complaint Kate Nutting, General Manager of the Southwest District has engaged in numerous media interviews.

Water Quality Monitoring

Golden State Water conducts bacteriological sampling of our 43 dedicated sample stations on a weekly basis. Additionally, water samples from 21 of these sample stations are analyzed weekly for turbidity, color, and odor. The sample results of weekly samples for January and February for the six sample stations located nearest to the Gramercy area are summarized in the attached tables. No samples have been present for total coliform or *E.* coli during this time frame.

On February 4, 2015, a sample was collected from the front hose bib at the location the Complaint. The sample was absent for total coliform and *E.* coli. The lab report for this sample was previously provided to DDW.

Over the past several weeks Golden State Water has conducted multiple water quality canvases across WQAs 2, 3, 4, 5, 6, and 7 to assess the effectiveness of UDF as it was completed in these areas and maintain our comprehensive understanding of water quality in these areas. During each canvass, water from approximately 80 fire hydrants (discharged at a low flow rate) was measured for total chlorine residual and observations of color and odor were noted. Detectable chlorine residual was measured in all but one of the approximately 240 separate measurements taken. Mild color and odor was observed in the water from a few of the fire hydrants, primarily in WQAs 2 and 4. The cause of the color and odor in WQA 4 is likely due to influence from portions of WQA 6 where UDF is not yet completed. The cause of color and odor post-UDF in WQA 2 is currently under investigation.

Lower than desired chlorine residuals were observed in a few localized areas and the cause of these residuals is either under investigation or due to influence from areas were UDF has not been recently completed but is either planned or underway.

In the Gramercy area, water quality is routinely monitored and detectable chlorine residual has been routinely observed in the neighborhood. A table summarizing the chlorine residual measurements and operator observations of color and odor are provided in the attached table. To date, routine monitoring in the Gramercy area has yielded water that is clear and odorless.

Water quality canvasses in WQAs 2, 3, 4, 5, 6, and 7 will continue periodically as needed to maintain our comprehensive understanding of water quality in these areas and assist in developing a more proactive and less reactive UDF schedule.

Infrastructure Improvement

After a review of the as-built drawings of the intersection of 149th Street and Gramercy Place, Golden State Water traced the location of the service line for 14903 Gramercy Place. It was determined that the service line was tapped off of the water main near two 45-degree fittings and that this location of the service line tap could increase the possibility of discolored water entering the customer's service. On January 29, 2015 Golden State Water discussed the relocation of the service line tap from the main on 149th Street to the main on Gramercy Place. The customer communicated to Golden State Water several times that they did not want their service line moved even though it would not affect their property in any way. Golden State Water engaged the customer multiple times to explain the rationale for moving the service line. We preferred not to relocate the service line without the buy-in of the customer; however this is Golden State Water property and relocating the service line was determined to be beneficial to water quality. This was discussed in the February 19, 2015 meeting with the DDW and the DDW supported relocating the service line. Ultimately after every good faith effort was made with the customer we moved forward with relocating the service line. The customer was informed that we would be

relocating the service. The customer indicated they understood the rational and ultimately agreed. The service line tap location was relocated from the water main on 149th Street to the water main on Gramercy Place the week of March 9, 2015.

The service line serving the customer located at 2007 W 149th Street (across the street from 14903 Gramercy Place) was tapped in a similar location as the service for 14903 Gramercy Place. The customer at 2007 W 149th Street has also experienced discolored water. It was determined that relocating this service would be beneficial to water quality and Golden State Water discussed this with the customer on January 29, 2015. The service line serving this customer was relocated from the water main on 149th Street to the water main on Gramercy Place the week of March 12, 2015.

At this time Golden State Water Company is considering the replacement of some or all of the older 4-inch cast iron main on 149th Street. Golden State Water is also evaluating the east-west trending 4-inch cast iron mains to the north and south of 149th Street in this neighborhood for possible replacement.

Additional capital improvements relating to water main replacement based on water quality in addition to other factors are being evaluated across the Southwest District.

SeaQuest™ Addition and Discontinuance

The Southwest system experiences customer complaints due to taste, odor, color and particles in the water. Golden State Water began phasing-in sequestering agent (polyphosphate; SeaQuest™) addition to groundwater and surface water connections in 1999.

Beginning on June 17, 1999, a one year pilot study was conducted. SeaQuest™ was added to Goldmedal, Southern, 129th and Doty Well Plants, and MWD connection WB-25. The pilot study concluded that SeaQuest™ was effective at stabilizing water quality.

January 2001, a permit amendment was issued to add SeaQuest™ to water sources in the Southwest District for the following purposes: (1) control pipeline corrosion, (2) to control biofilm growth, (3) to mitigate low residual, and (4) to restore hydraulic carrying capacity.

Despite the use of SeaQuest™, Golden State Water continued to experience chloramine residual degradation and customer complaints in many areas of the distribution system. A July 2007 report prepared by CH2MHill entitled *Southwest System Water Quality Study* concluded: The addition of SeaQuest™ to the Southwest System water supplies provide little or no benefit in terms of maintaining chloramine residuals of at least 0.5 mg/L in the distribution system. A review of system wide water quality complaints from 2001 through 2014 illustrates that water quality complaints persisted and at times increased during the addition of SeaQuest™.

Customer Complaints – All Water Quality:

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
213	412	415	301	174	241	301	323	314	475	343	204	175	346

In 2010, Golden State Water implemented the current UDF program to increase chloramine residual, reduce biofilm, and thereby decrease customer complaints. The program has been successful; customer complaints have decreased drastically and chlorine residuals have generally increased in the areas where UDF has been performed. Golden State Water concluded that an ongoing UDF program was a more effective means of maintaining high water quality in the distribution system than the addition of

SeaQuest™. The complaint referenced above was located in a WQA that had not previously been flushed by UDF.

From the initiation of the UDF program in May 2010, water quality complaints decreased every year until 2014. In 2015 additional resources (flushing crews, engineering, and administrative support) were put in place to perform UDF to a larger area of the distribution system more quickly.

In July 2012 Golden State Water submitted a Permit Amendment Application requesting the cessation of SeaQuest™. The source water was determined to be non-corrosive and UDF was determined to be the most effective tool for controlling biofilm, increasing chlorine residual and restoring hydraulic carrying capacity. This was supported by the September 24, 2012 report by Frank Baumann who was hired by DDW to evaluate the request. Mr. Baumann also noted that the phosphate additions apparently not only have not prevented biofilm problems, the added nutrient may even have contributed to biofilm formation.

The DDW expressed concerns about discontinuing SeaQuest™ throughout the distribution system, and so a six-month pilot study during which SeaQuest™ would be stopped in the areas where UDF had been performed was approved. At the end of the study period of October 1, 2012 to March 31, 2013 Golden State Water prepared and submitted a report entitled *Pilot Study to Discontinue SeaQuest*, dated July 2013. The report summarized the results of the water quality monitoring conducted during the pilot study and the number of water quality complaints during that time.

The report concluded that there were no significant changes after use of SeaQuest™ was discontinued and no significant changes in water quality parameters that would indicate an increase in corrosion in the distribution system occurred after use of SeaQuest™ was discontinued.

Following subsequent discussions, the DDW approved SeaQuest™ cessation at the sources located within each water quality area after UDF was completed in that water quality area. In February 2015, UDF was completed in WQA 4 and UDF is anticipated to be completed in WQA 3 by April 2015.

Currently, Golden State Water is required to add SeaQuest™ to Belhaven, 129th Street, and Compton Doty Well Plants. As part of our long-term plan to maintain good water quality in the system, we request approval to discontinue the addition of SeaQuest™ at all water sources.

If you should have any questions or need additional information, please do not hesitate to contact me at (310) 263-4141 x110.

Sincerely,

Alex Chakmak
Water Quality Engineer
Golden State Water Company

cc: K. Nutting, GSWC
D. White, GSWC
D. Chang, GSWC
D. Cathcart, GSWC

Kurt Souza
State Water Resources Control Board
Division of Drinking Water
500 North Central Avenue, Suite 500
Glendale, CA 91203

Enclosure 2

Golden State
Water Company
A Subsidiary of American States Water Company

March 31, 2015

Sutida Bergquist, P.E.
District Engineer
State Water Resources Control Board
Division of Drinking Water
500 North Central Avenue, Suite 500
Glendale, CA 91203

Subject: Water System Operations and Maintenance Plan
Golden State Water Company
Southwest System – No. 1910155

Dear Ms. Bergquist:

Golden State Water Company (Golden State Water) submits this *Water System Operation and Maintenance Plan* (Plan) as requested by the Division of Drinking Water (DDW) in your February 23, 2015 letter.

As requested by the DDW and pursuant to Title 22, Article 8, subsection 64600(a) 3, 7, 8, 9, 12, this Plan consists of the following elements.

- Flushing Program
  Schedule and procedure for flushing dead end mains and the procedures for disposal of the flushed water including dechlorination;

- Customer Service Procedures for Water Quality Complaints
  Plan and procedures for responding to consumer complaints;

- Cross-Connection Control Program Summary
  Schedule and procedures for testing backflow prevention assemblies;

- Valve Maintenance Program
  Schedule and procedures for routine exercising of water main valves; and

- Biofilm Control Program
  Program for control of biological organisms on the interior walls of water mains.

14401 Chadron Avenue, Hawthorne, CA 90250
Tel: (310) 263-4141 Fax: (310) 263-4144

If you should have any questions or need additional information, please do not hesitate to contact me at (310) 263-4141 x110.

Sincerely,

Alex Chakmak
Water Quality Engineer
Golden State Water Company

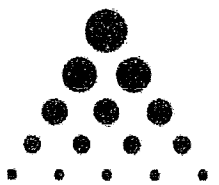
cc: K. Nutting, GSWC
D. White, GSWC
B. Gedney, GSWC
D. Cathcart, GSWC

Kurt Souza
State Water Resources Control Board
Division of Drinking Water
500 North Central Avenue, Suite 500
Glendale, CA 91203

Flushing Program

Schedule and Procedure for Flushing Dead End Mains and the Procedures for Disposal of the Flushed Water Including Dechlorination

FLUSHING PROGRAM



Golden State
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Flushing Program

I. General InformationError! Bookmark not defined.

Flushing is important to the maintenance of water quality in a water distribution system. Because the water quality and pipe conditions are constantly changing, the flushing program is continually evolving to meet the system requirements.

A. System Map

There is a system map for the distribution system, which is divided into detailed grid maps and combined into a binder. All service trucks are equipped with a system map. Fire hydrant and gate valve locations, piping sizes, and other basic information in the distribution system are clearly indicated on the map. These maps can be photo copied and highlighted to indicate which valves should be closed for unidirectional flushing of an area.

Large system maps are used by operators for tracking the flushing progress. A log of completed flushing is created during flushing events, detailing the time, location, duration, gauge readings, and water quality observations.

B. Routine Flushing Schedule

The frequency of flushing is determined by water quality in the area. Some areas are prone to deposition of sediments. When disturbed, these sediments may cause water quality complaints. The systematic flushing of water mains prevents excessive accumulation of these sediments.

Areas of low flow in the system are scheduled for more frequent routine flushing to maintain desired chlorine residuals. Other flushing objectives may include the reduction of disinfection by-product precursor materials, the removal of accumulated biofilm, and the opportunity to exercise valves and otherwise verify the integrity of the system under non-emergency conditions.

There are two types of routine flushing commonly utilized in the program, conventional flushing and unidirectional flushing. Conventional flushing consists of opening hydrants or blowoffs in a specific area of the distribution system and does not require valve isolation. Conventional flushing is conducted at low velocities and minimal scouring. Unidirectional flushing consists of isolating a particular pipe section or loop, typically through closing appropriate valves and creating a single-direction flow which increases the maximum possible flushing velocity in the water main. Unidirectional flushing always progresses from a clean source or already flushed pipes systematically toward the end of the distribution system. Extensive planning and the use of a hydraulic model are critical for unidirectional flushing in most systems.

C. Dead-End Flushing Schedule

Dead-end flushing of water mains is important to remove sediments, and to increase chlorine residuals in low flow areas. All dead-ends are flushed on a schedule based on the needs and circumstance of each area but no less than annually. In areas where there is inadequate surface drainage or no storm drain system dead-ends may be flushed less frequently to avoid potential flooding and property damage. Some dead-end areas may require more frequent flushing depending on maintenance of chlorine residuals.

D. Flushing Report

A Flushing Report is used in the field to document the flushing event. It includes the date and time, location of the flushing, the hydrant or flush-out number, start and stop time, minutes flushed, flow rate, total gallons flushed, and chlorine residual. There is also an area for the operator to write comments about the initial and end water quality.

The flushing reports provide documentation to the regulatory agencies that the activities were performed. The number of gallons flushed is totaled on the Monthly Water Used in Operations Report. Water quality observations recorded on the flushing reports can also help determine optimal flushing frequencies for a particular area.

E. Implementation

Flushing may occur during off-peak hours to minimize disturbance to the system, especially in areas with sediment deposition. If flushing is scheduled during normal working hours, it may be beneficial to give residents prior notice, especially if colored water is anticipated. Dead-end flushing can generally be performed during the day with minimal system disturbance.

The Customer Service Center should always be advised in advance where the flushing activities will occur, and the expected duration of the flushing. This way they can accurately respond to customer inquiries that do occur, and alleviate customer concerns.

II. Mechanics of a Systematic Flushing Program

A. Considerations

The following tasks must be performed during routine flushing:

1. The flushing crew should be properly advised concerning correct field procedures, such as the necessity of opening hydrants fully when flushing and exercising care not to open or close valves too rapidly in order to minimize the occurrence of water hammer.

2. Water used to flush a main should originate from a main that has already been flushed or from a main large enough to resist being stirred up by the increased flow.

3. A larger main should not be flushed from a smaller main. The velocity reduction in the larger main will decrease the effectiveness of the scour.

4. Maximum flow velocities can be attained by keeping the length of main as short as possible. This may necessitate closing and reopening gate valves. The importance of keeping track of closed gate valves to assure that they will be reopened cannot be overemphasized.

5. If gate valves are closed to facilitate flushing effectiveness, they should be reopened before the hydrant or hydrants are shut down. This will remove slugs of dirty water that may have settled near the valves.

6. During flushing, particularly in low-pressure zones, extra care must be taken to avoid reducing main pressures below 20 psi so that back-siphonage into the distribution system does not occur.

7. If a specific main is to be flushed in an area that has not been flushed for a long time, it is suggested that gate valves be operated to isolate the main and prevent potential problems in peripheral areas.

8. It is not recommended that only one or two hydrants be flushed in response to customer complaints. This procedure may result in additional complaints from peripheral areas.

Warnings:

Cavitations and water hammer are the two types of hydraulic problems that may occur while operating a valve. Cavitations result when a partial vacuum (void) occurs on the downstream side of a valve and a small section of the pipe is filled with low-pressure vapor pockets. These pockets will collapse downstream (implode) and in doing so create a mechanical shock that causes small chips of metal to break away from the valve surfaces.

Water hammer is caused by closing a valve too quickly. The water flow is suddenly stopped, shock waves are generated, and the resulting large pressure increases (even though very brief) throughout the system may result in significant damage.

B. Flushing Procedures

1. Safety, traffic control and environmental best management practices (BMPs) will be implemented before and after the flushing.

2. Use a diffuser equipped with a built-in pitot device to deflect the water away from the traffic and measure for flow rate.

3. Environmental best management practices should include, at a minimum, dechlorination and sediment control. Prepare and apply dechlorinating agent to ensure complete dechlorination before discharge reaches storm drain. Implement sediment control BMPs to prevent erosion and to control turbidity of discharged water to the extent practical. Contact Environmental Quality Department regarding any additional flushing monitoring or reporting requirements.

4. Slowly open the hydrant or blow-off to create maximum discharge while monitoring residual pressure in the distribution system using a pressure gauge. Throttle the flow after a period long enough to stir up the debris in the main.

5. Record the time and read the flow rate at the gauge meter.

6. Test chlorine residual after dechlorination.

7. Continue flushing until the water clears.

8. Slowly close the hydrant and record the time.

9. Flushing should be performed by opening one hydrant or blowoff at a time, particularly in areas that may experience low-pressure, to prevent a reduction in main pressure that could result in contamination via back-siphonage.

C. Flushing Report

1. The Flushing Report must be completed at the time of flushing. The amount of water used in flushing should be estimated and recorded. This procedure will assist our company in efforts to account for water. Make sure to describe the water initially and at the end of flushing. Any area specific reporting requirements such as reporting flushing volumes over 100,000 gallons to the Water Quality Engineer must be completed.

2. The plan maps may be used to indicate the closing and opening of gate valves. It should be marked with the actual condition and location of the mains, valves and fire hydrants.

3. The Valve Database Form may be used to update information about gate valves used for isolation.

4. The Fire Hydrant Database Form may be used to update information about fire hydrants flushed.

D. Recommended Flushing Equipment

* Hydrant Wrench
* Pitot Diffuser
* Pressure gauge
* Gate Valve Key
* Shovel
* Large Digging Bar
* Small Pry Bar
* White Bucket / Clear Beaker
* Flashlight
* Dechlorinating AgentDechlorination Diffuser
* Flushing Report Form
* Safety Equipment (gloves, reflective vest, boots)
* Traffic Control Equipment
* Environmental BMP equipment (for sediment control)

Customer Service Procedures for Water Quality Complaints

Plan and Procedures for Responding To Consumer Complaints

Golden State Water Company
A Subsidiary of American States Water Company

Water Quality

Overview

Background

This procedure complies with the following CPUC Rules:

Rule	Description
No. 2	Description of Service
No. 12	Information Available to Public

Refer to applicable CPUC Rules for details.

This procedure complies with General Order 103, Rules Governing Water Service.

Definition

A water quality complaint is a report of dissatisfaction with the color, odor, turbidity or taste of the water being delivered by the Company.

A water quality inquiry is a request for information.

Purpose of Water Quality Cases

A "Water Quality Case" documents every customer contact that pertains to a Water Quality complaint or inquiry. It is critical to create a Water Quality Case for every customer contact that pertains to a Water Quality issue for reporting purposes.

Company Positions

The company considers any perceived water quality complaint an emergency and will investigate immediately.

The company considers a request for information on the quality of water an inquiry. The information requested should be given to the customer immediately if the request can be satisfied over the phone. If the request cannot be satisfied immediately, and additional follow up is necessary, it should be completed within three (3) business days.

Continued on next page

Guidelines

In this procedure

This procedure contains the following topics.

General Inquiries

If the caller requests information on the quality of the water such as hardness, fluoride, etc., the information may be obtained in the water quality report.

Hardness is a particularly common question. It is expressed in parts per million (ppm) in GSWC's water quality reports. However, most consumers request this information expressed in grains per gallon (gpg) for home appliance applications. The formula to convert parts per million to grains per gallon is as follows:

Note: Reported ppm / 17.1 gpg = *answer* in gpg. Refer to the water quality report for the system in question.

Known situations

The following circumstances in the CSA, could result in a water quality investigation:

- Changing source of supply
- Construction of mains
- Dead end mains (cul-de-sac)
- Drained reservoir
- High or low chlorine residual
- Main, service leak or repair (scheduled or emergency)
- Malfunctioning pump, booster or chlorinator (power outage)
- Meter change program
- Sheared hydrant, flow test
- System flushing

Continued on next page

Guidelines, Continued

Possible Causes Review the following possible causes with the customer:

IF the concern is...	Possible cause is...
white/cloudy/milky water	air in lines due to: • overheating of hot water system • warming up of cold water lines • galvanized pipe • recent shutdown and opening of the plumbing system • cross-connections
red/yellow/brown water and/or foreign particles	• house piping, particularly aging galvanized iron pipe • home filtering system • hot water system • plumbing repairs • softener resin • iron/manganese • cross-connections
black water and/or foreign particles	• iron/manganese • hot water system • cross-connections
taste and odor	• hot water tanks • aged piping • type of piping • exposed water lines • softening agents added by customer • kitchen/bathroom sink odors • idle water lines • cross-connections Note: Sink odors maybe misinterpreted as coming from the drawn water.

Continued on next page

Golden State Water Company
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Guidelines, Continued

Review with the customer

Questions to ask to determine if external/internal:

1. Is the concern color, odor, taste or particles?
2. When the problem was first noticed (today, last week, month, etc.)?
3. Is this a recurring problem or the first time?
4. Where does the problem exist (kitchen, bathroom, or entire dwelling)?
5. Ask how long it's been since the water has been used at the location (Returning from vacation, just moved in, etc.)
6. If business, list the type of business and ask if the water quality situation is affecting the operation. If so, how?
7. Any waterline shut-off valve(s) (house-valve, water softener etc) not open?
8. Any new or changes to irrigation systems or other plumbing repairs (clogged water lines, shut off valve not open)?
9. Does the problem clears up after running the water for a few minutes.
10. Ask the consumer if they have a water softener or home treatment system. If so, does it treat all the water or only parts and has it been serviced recently?
11. Verify if the problem is with both hot and cold water.

Annual Water Quality Report

Information on the quality of the water such as hardness, fluoride, etc can be obtained in the Annual Water Quality Report.

Continued on next page

Guidelines, Continued

Sequence of responsibility

1st Level	Lies with the CSR who receives the original complaint. The CSR should make every effort to resolve the complaint/inquiry at the time of the initial contact. If a resolution cannot be reached in the first contact, the CSR will generate a "Water Quality Investigation" Case. The investigation should be scheduled as soon as possible, not to exceed 24hrs, unless other arrangements are made with the customer.
2nd Level	Lies with Water Distribution Operator. Investigations should be with the customer present as often as possible. If contact is made: • The Water Distribution Operator will complete the Field Order by documenting the Read, Current Conditions and Actions Taken • Return Completed Field Order to the CSA Superintendent If no contact is made: • The Water Distribution Operator will complete the Field Order • Leave a door-tag stating the reread, date, time and contact information • Return Completed Field Order to the CSA Superintendent
3rd Level	Lies with the appropriate CSA Superintendent. The Superintendent must review investigation and make final decision of investigation and mark the appropriate field on the Field Oder "Complaint" or "Inquiry" and return completed Field Order to the CSA CSR.
4th Level	Lies with the CSA CSR to follow-up on the complaint. The CSR will enter all findings and results in CC&B Water Quality Investigation Case. The CSR will follow-up with the customer by phone, and send a follow-up letter. The CSA CSR should update CC&B by indicating if contact was made with customer via phone. If no contact is made via phone, CSA CSR will send a letter to the customer and note CC&B.
5th Level	Lies with the appropriate CSA Superintendent who will review all available information regarding the Water Quality issue and take any necessary action. Superintendent should not sign off on Investigation Report until customer is satisfied.

Continued on next page

Guidelines, Continued

Cases Generate Field Activities Automatically

Cases automatically generate Field Activities. Here are some main features of this function:

- The user adds a Characteristic to the Case which determines what type of Field Activity is generated (in this case, the type of Quality Field Activity.)
- Notes entered into the Case "Comments" field will be transferred to the FA "Instructions" field when the system creates the Field Activity.
- CC&B automatically creates the Field Activity once the "Send to Field" button on the Case is selected.
- The Field Activities go automatically to the correct Dispatch Group.
- Appointments will still be handled manually.
- Any changes to the Schedule Date will be handled manually.

Attaching External Files

You can attach external files -- documents, photographs, spreadsheets, scans, etc. to Cases. This gives you an easy way to organize, store, and access all external documentation associated with a Case. For example, let's say you are doing a High Bill Investigation, and you take a picture of water running down the street from a faulty sprinkler. You can attach that picture (file) to the Case.

This involves two processes: 1) Saving the file to a secure location on GSWC's network, and 2) Attaching the file to the case. See Topic "How to Attach External Files (Documents, Spreadsheets, Photos, etc.) to a Case" for details.

Creating Water Quality Case

Procedure Follow the steps below to Create a Water Quality Case:

Step	Action
1	Begin at Control Central.
2	Search for Customer Account (Account ID, Premise or other field).
3	From the Dashboard (located on the right hand side of the screen), in the Current Context zone, click on the "Account Context Menu" button.
4	Select "Go To Case" and click the "Add" button.
5	From the "Case Type" field, click the "Search" button and select "Water Quality". **Results:** The following field populate: • Person • Account • Premise • Responsible User • Contact Person
6	Enter any appropriate notes in the "Comment" field. (These Comments will be transferred to the FA "Instructions" field when the system creates the FA.)
7	From the "Preferred Contact Method" field, click on the dropdown list and select applicable Contact Method.
8	Enter any appropriate notes in the "Contact Instructions" field.
9.	In the Characteristics Zone, click the "+" button to add a new Characteristic. Select the drop down menu to select the "FA Types for Quality" Characteristic Type. Use the Go Look button to the right of the Characteristic Value field to select the appropriate Quality Type. Result: The appropriate Quality Type appears in the "Characteristic Value" field. (This determines the type of FA to be automatically generated.)
9.	Click on Save.

Continued on next page

Creating Water Quality Case, Continued

Procedure (continued)

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>10</td><td>Use the table below to determine your next step:
<table>
<tr><th>IF...</th><th>Then...</th></tr>
<tr><td>Resolved without Field Investigation</td><td>• Click on "First Call Resolution button.
• Click on Complete.</td></tr>
<tr><td>Field Investigation Required</td><td>Click on "Send to Field" button.
If you would like to change the FA Schedule Date, Click on the "Premise Context Menu" button.
• Click on "Field Activity".
• Select the Quality FA which has been generated.
• Tab to "Schedule Date/Time" field and enter the date you want to change to.
• Click the "Characteristics/Remarks" tab.
To make an Appointment for the FA, press the + (plus) button to add the "FA APPT" Characteristic Type, and at the Characteristic Value, select "AM" or "PM".
• Click the save button.
• <u>Result:</u> Case is created.</td></tr>
<tr><td>Case Lodged in Error</td><td>• Click on "Cancel".
Note: Once the "Send to Field" button has been pressed and the Field Activity has been associated with the CASE, the Case cannot be canceled.</td></tr>
</table></td></tr>
</table>

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Golden State Water Company
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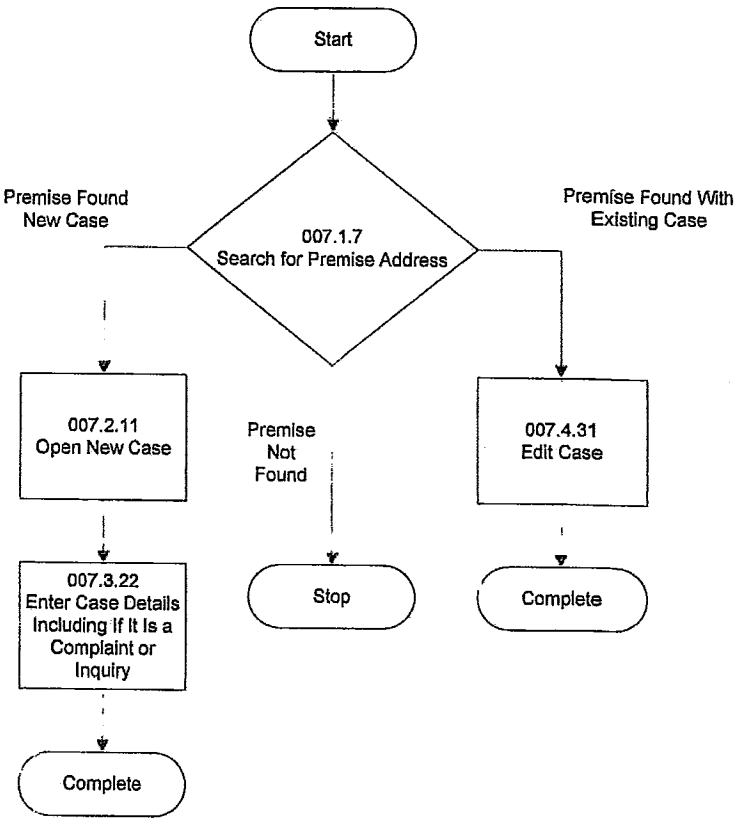
Creating Water Quality Case, Continued

Procedure Diagram

007 - How to Create a Case



How to Complete a Case

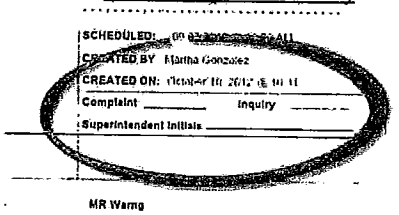
Before you Begin

Once the Water Quality Investigation Field Order returns from the field, ensure that the Superintendent reviews the results. The Superintendent must document and make the final decision as to the end results of the Water Quality Investigation by marking the "Inquiry" or "Complaint" field on the Water Quality Investigation Field order and sign it.

Procedure After Water Quality Field Activity is Completed

After the Quality Field Activity is completed, you will transition and complete the corresponding Case. For information on how to complete the Field Activity, refer to Procedure No. 62 Field Activity and Field Order Completion.

Follow the steps below to transition and complete a case:

Step	Action
1	Begin at Control Central.
2	Search for Customer Account (Account ID, Premise or other field).
3	From the Dashboard (located on the right hand side of the screen), in the Alerts zone, click on the "Water Quality Case - Lodged" Hyperlink. **Result:** Case Portal displays.
4	Click on the "Superintendent Decision" button in the "Actions" zone.
5	Depending on what the Superintendent selected – Complaint or Inquiry – on the Field Activity, click the Complaint or the Inquiry button. (See Graphic below) 

Continued on next page

How to Complete a Case, Continued

Procedure After Water Quality Field Activity is Completed, (continued)

Step	Action
6	**For a Complaint:** • From the "Required Characteristics" window, click the "Search" button next to the "Characteristic Value" field to get list. • From the listing, select the corresponding Water Quality type (Arsenic, Cloudy, Color, Health Concerns, Lead, Odor Taste, Other) Note: The Water Quality type selected should be based on the WDO written results. • Click "OK". • Click on Log tab, press "+", and update Notes field. • Click "Complete" - or - • If there are outstanding issues, Click on "Refer to Environmental Quality" button **Result:** Creates a To Do for the Water Quality Department, which will take the Case from that point on. **For an Inquiry:** • Follow up with the Customer to share results of the investigation. **Note:** The Customer's Preferred Contact Method can be found in the Case notebook at the Contact Information zone. • Click on the "Log" tab. • Click on any of the " " buttons to enter the investigation results and indicate whether communication was made with customer. (See example below) Called customer on Tuesday, 12-11-2012 at 11:00 AM to let her know that her water tested fine. There are no water quality issues. Perhaps it was her water softener. • List the Date and Time that you contacted the customer in the Log Tab. • If the Customer is satisfied, click on Complete. Result: Date/Time Closed will have current date. Case will be completed. • **If the Customer is not satisfied, contact the Superintendent.**

How to Attach External Files (Documents, Spreadsheets, Photos, etc. to A Case)

Overview

You can attach files such as documents, spreadsheets, photos, etc. directly to Cases. This involves two processes: 1) Saving the file to a secure location on GSWC's network, and 2) Attaching the file to the case.

Saving a file to a secure location

Follow the steps below to complete this task:

Step	Action
1	Within MS Explorer, My Computer, etc. right click on the file you want to attach and select "Copy."
2	Press the CSA Folders Page Link within the CC&B Dashboard
3	From the CSA Folders Page, press the Attachment icon  for your CSA.
4	Double Click on the subfolder where the file is to be stored.
5	Paste the file into the folder.
6	Highlight and copy the path listed in the Address line.

Attaching the file to the Case

Follow the steps below to complete this task:

Step	Action
1	Open the Case Notebook. In the Characteristic area, add the "External Attachments" Characteristic.
2	In Characteristic Value, paste the path of the file of the file. (Highlighted in the example below.) Then, at the end of the path, type the file name. For example: \\ggonactl1\CCB_Attach\101\PHOTOS\waterrunningdownstreet.jpg
3	Save

How to View the FA Appointment Summary

Procedure

Follow the steps below to complete the task(s):

Step	Action
1	From "Main Menu" hover over "Field Order."
2	Click on "Appointment Summary."
3	Double click in the "schedule date" field to select the range of dates you would like to query
4	Select the applicable CSA from the drop down menu.
5	Click the "refresh" button. **Results**: Appointment summary will populate towards the top of the page.
6	Click the "Broadcast" button. Results: "FAs with Upcoming Appointments" will populate towards the bottom of the screen.
7	Click the hyperlink to under the "Field Activity Information" to view appointment details.

How to Print or Export the FA Appointment Summary

Procedure Follow the steps below to complete the task(s)

Step	Action
1	From "Main Menu" hover over "Field Order."
2	Click on "Appointment Summary."
3	Double click in the "schedule date" field to select the range of dates you would like to query
4	Select the applicable CSA from the drop down menu.
5	Click the "refresh" button. **Results**: Appointment summary will populate towards the top of the page.
6	Click the "Explorer Menu Zone" button towards the upper left of the page.
7	Use the table below to determine your next action:

IF	Then....
Printing the FA Summary	• Click "Print Zone"
Exporting the FA Summary	• Click "Export to Excel"

Cross-Connection Control Program Summary

Schedule and Procedures for Testing Backflow Prevention Assemblies

Cross-Connection Control Program

Regulations of the State of California, Administrative Code, Title 17 Public Health and the California Public Utilities Commission Rule 16 state that the water supplier has primary responsibility for protecting the public water system from contamination and/or pollution occurring through backflow by preventing water from unapproved sources or any other substances from entering the distribution system. Golden State Water Company (Golden State) fulfills this requirement by implementing a Cross-Connection Control Program (CCCP). At Golden State, the CCCP is administered by certified cross-connection control specialists within the Water Quality Department. In summary, the CCCP document provides the guidelines under which staff:

- Evaluate the degree of potential health hazard to the public water supply which may be created as a result of conditions existing on a user's premises
- Require installation of appropriate, approved backflow preventers
- Notify customer when testing of backflow preventers is needed (at least annually or more frequently as deemed necessary) and when it must be completed
- Maintain reports of testing and maintenance for a minimum of three years

Golden State fulfills its responsibility to protect the public water system by requiring meter service protection at selected locations and is not responsible for internal cross-connection protection programs. The cost of installation, repair, and testing of backflow assemblies installed as meter service protection are borne by the customer. The utility may refuse or discontinue service for reasons provided in CPUC Rule 16. C. 5. "Refusal to Serve or Discontinuance of Service." Procedures for discontinuing service as a result of non-compliance with testing requirements are provided within the CCCP document.

The duties associated with the implementation of the CCCP can be categorized into two main areas: Survey & Installations Administration and Annual Testing Administration.

Survey and Installations Administration:

Golden State must conduct a survey of the premise to evaluate the degree of potential health hazard to the public water supply which may be created as a result of conditions existing on a user's premise. This requires a physical inspection and identification of any known hazards or conditions that create a potential risk.

Conditions can change at existing services and some changes result in potential hazards or risk to the water supply. Golden State conducts surveys at industrial, commercial or other services where there is a potential risk with no existing backflow protection. A cross connection control survey includes a physical inspection of the premise to look for any activity or equipment that has the potential to introduce a contaminant into the water supply (i.e. chemical tank directly connected to a supply line).

Annual Testing Administration:

All backflow protection devices must be tested at least annually in order to ensure that they will protect against a backflow incident should one occur. Device owners are responsible for conducting the tests, and submitting confirmation to Golden State that the device has been tested by a certified backflow prevention assembly tester and that the test shows the device is in working order. A test notice is sent to each device owner as a reminder 30 days before testing and certification is due. The device owner hires a certified tester who completes a form after the device passes the test (or after repairs are made following a failure and the device is tested again). Golden State staff enter the required information (test results, tester information, etc.) into its Customer Care and Billing (CC&B) system database.

For customers who do not comply with the 30-day notice to test, a second notice is sent reminding the customer to comply within ten days. Failure to respond to the second notice results in a third notice reminding the customer to comply within five days. Failure to respond still results in a 48-hour notice of discontinuance of water service for failure to comply. A phone call as an attempt to reach the customer is made before sending a 48-hour notice to disconnect. This is done to minimize the number of customers disconnected for failing to test their backflow prevention assemblies.

In CC&B, backflow assemblies are installed as "items" on "service points" under the "equipment" tab. Characteristics of the item identify the backflow assembly, including the serial number, size, type, manufacturer, model, alternate mailing address, and testing schedule. When the annual testing date for a backflow assembly approaches and the test notices are sent to the device owner, a "case" is automatically created within CC&B as a tracking mechanism. When satisfactory results are submitted to Golden State and processed, the case is closed.

Valve Maintenance Program

Schedule and Procedures for Routine Exercising of Water Main Valves

Valve Maintenance Program

Objective

The objective of the valve maintenance program is to establish a Company-wide program that is proactive rather than reactive. The data collected from this program will provide an accurate condition assessment of all distribution system valves which will then support a prioritized approach to the repair or replacement of inoperable valves.

In order to ensure that all valves are routinely exercised and properly recorded, Golden State Water Company ("Company") has adopted the following procedures derived in part from the American Water Works Association Manual of Water Supply Practices, M 44, in combination with existing Company programs and input from operations staff throughout the Company.

Safety First

Appropriate traffic control should always be reviewed prior to dispatch of personnel with special consideration given to areas of heavy traffic congestion, commercial/residential traffic, time of day work restrictions. Proper safety equipment includes but is not limited to safety vests, steel toe shoes, directional arrow boards and traffic cones. Lane closure configurations shall adhere to the Work Area Traffic Control Handbook (WATCH).

Preventative Maintenance Schedule

AWWA standards recommend that valves be operated at least once every five years. It is recommended that valves in GSWC's water systems be operated every five years, with critical system valves operated more frequently. There are various approaches or methodologies used to create a valve exercising/maintenance program. One method is a north to south, east to west type approach to work through and exercise all valves within the system. A second method is to establish the number of valves to be operated each year beginning with critical system valves. The goal of the program is to have all valves exercised on a five year cycle.

Best Management Practices (BMP's)

Proper valve exercising procedures include flushing debris and rust from the valve seat during the exercise cycle. This is accomplished by establishing a flow of water from the fire hydrants(s) that are in close proximity to the valve(s) being exercised. Appropriate storm water system protection BMP's must be in place when conducting flushing activities during valve maintenance/exercising activities.

Continued on next page

Valve Identification

The following identification color scheme will be utilized as a means to assist the operator in locating and determining the location of system valves.

- Red to indicate **Normally Closed**
- Blue to indicate **Normally Open**
- White or a White X to indicate **Temporarily Closed**
- Yellow to indicate that it is a valve on a hydrant lateral.

An alternative approach for the normally closed valves is to have a locking debris cap or a 4"x 4" pressure treated section of lumber painted red and equal in length to the depth of the valve can, inserted into the valve can to prevent accidental opening.

In service areas that may be sensitive to having valve markings in the public right-of-ways, alternative marking schemes can be used such as a smaller paint mark on the outside of the valve lid, mark the inside of the lid or fastened a tag to the inside of the valve lid.

Valve Operation Procedures

Operation and maintenance procedures for various types of valves are detailed in the manufacturers' operation manuals and in the appropriate specifications and standards. The following procedures provide a guideline for gate valve exercising activities in most situations:

1.	Locate the closest fire hydrant to the valve(s) to be exercised and establish a moderate flow of water from the fire hydrant.
2.	Remove debris from valve stack and verify condition of operating nut.
3.	Begin the valve exercising cycle by applying steady torque in the direction necessary to close the valve. This action should be applied through the first 3 to 8 rotations. If using valve machine, do not exceed 300 foot pounds of torque unless authorized by the Chief Water Distribution Operator. When using a valve machine with a torque indicator, record the torque value observed at the start of the valve exercising cycle.
4.	Reverse for 2 to 3 rotations (opening).
5.	Resume closing the valve for 5-10 more turns. Reverse for 2 to 3 rotations.
6.	Resume closing the valve until fully seated. Depending on the size of the valve, the close/open cycling of the valve may be required until the valve is fully seated. When using a valve machine with a torque indicator, monitor the torque value throughout the exercising cycle.
7.	Once the valve is closed, partially open the valve to flush any sediment from the valve seat. Observe the quality of water flowing from the fire hydrant.
8.	Fully close valve again before returning to the full open position. Record the torque value observed during the opening cycle.
9.	Appropriate procedures should be followed for other types of valves, such as butterfly valves.

Continued on next page

Valve Operation Procedures (continued)

NOTE: Valves should not be exercised without complete knowledge of the impact to the operation of the distribution system. Care should be taken when fully opening any normally closed valve or closing any mainline valve. Valves noted as broken, difficult to operate, or inoperable should be recorded and scheduled for appropriate repair/replacement. When using a valve machine with a torque indicator, the torque values observed during the closing and opening cycles should be consistent throughout the cycle.

Record Keeping/Asset Management

All information should be transferred from the field to the permanent record as soon as possible after operation of the valves. Utilizing hand held devices to locate valves and report their status is encouraged, as is the use of laptop computers in order to readily input data from the field. Implementation of record keeping should utilize an EXCEL format to allow valve information to be easily collected and sorted. Any discrepancies between actual field data and system maps shall be communicated in writing to the Asset Management department.

The type of data collected is as follows:

- Date Operated
- Time Operated
- Operator
- Map Book Page #
- Address
- Street
- Cross Street
- Cannot Locate (yes/no)
- Valve Condition (good, fair, poor, inoperable, unknown)
- Valve Use (in-line, hydrant lateral, unknown)
- Valve Size
- Valve Type (gate, butterfly, other, unknown)
- Turns
- Depth to Nut
- Valve Stack Cleaned (yes/no)
- Operation Method (manual, electric, hydraulic)
- Max Torque
- Final Torque
- Normal Valve Position (open, closed, unknown)
- Position Found (open, closed, unknown)
- Final Position (open, closed, unknown)

Continued on next page

Record Keeping Asset Management, (continued)	• Packing Leak (none, leaks when exercised, snugged-no leak, snugged-still leaks, unknown) • Valve Lid Painted (blue, red, yellow, white) • Surface Type (asphalt, concrete, dirt, grass, gravel, unknown) • Map Accuracy (accurate, conflict size/turns, not on map, other) • GPS Coordinates (easting, northing)
Field Worksheet	Implementation of standardized field work sheets and the permanent database provides for the following. • Reduction of error or confusion in transferring field data to the permanent data base • CSA's using laptops in vehicles can eliminate duplication of records by inputting data directly into the permanent data base
Valve Maintenance Program Benefits	Implementation of the valve maintenance program will establish an accurate valve condition assessment for each of the Company's water systems. In addition to providing information for regulatory compliance, this information will be utilized for rate case justifications, calibration of hydraulic models and annual budgeting purposes.

Biofilm Control Program

Program for Control of Biological Organisms on the Interior Walls of Water Mains

Biofilm Control

(1) Objective

Golden State Water Company's program to control biofilm includes source water treatment where needed to produce biologically stable water, maintenance of a disinfectant residual, and controlled unidirectional flushing to remove existing biofilm.

(2) Background

Biofilms are formed in distribution system pipelines when microbial cells attach to pipe surfaces and multiply to form a film or slime layer on the pipe. While attached, biofilms do not usually cause many problems; however, when disrupted the biofilm material can enter the water received by customers. This affects the visual aesthetic quality of the water and can also cause the water to have an odor.

A large amount of biofilm in the water can give a cloudy appearance and sometimes looks like "floc" particles suspended in the water. The color can be grey, white, brown, black or rust colored. The odor can be described as musty, septic or of hydrogen sulfide (rotten egg smell). While biofilm can harbor pathogens or opportunistic pathogens, drinking water with biofilm will not likely cause illness. Source water treatment, pressure management and disinfectant residual are all in place to ensure that the drinking water is safe.

An optimized distribution system includes water that is biologically stable, meaning that the rate of biological growth does not exceed the rate of disinfection. Controlling the factors that support growth though is extremely difficult and it is likely that all distribution systems contain biofilm. The objective is to produce water that is biologically stable and where biofilm is present, appropriate mechanisms are employed to control or remove the biofilm.

Control strategies include source water treatment and the application of a disinfectant. The most practical, effective **management** strategy is properly planned and executed unidirectional flushing (UDF). Where UDF is not effective, the only other strategies are pigging, main rehabilitation and main replacement.

(3) Source Water

Wherever possible, source water treatment should include measures to control constituents that support bacterial growth (food). Bacteria require sources of carbon, nitrogen and phosphorus. They also require other trace nutrients but those are not typically growth limiting. Surface water treatment optimization includes removal of total organic carbon (TOC). Higher levels of TOC are less typical in groundwater systems but when found put that system at higher risk of biofilm development.

The most common source of available nitrogen in drinking water sources and distribution systems is ammonia. It is critical that naturally occurring ammonia in source water is treated to either remove it or bind it with chlorine to form chloramine. Systems with chloramine residual are monitored closely because chloramine degradation can release free available ammonia and will promote biological growth in the form of nitrification. There should be no free available ammonia entering the distribution system from any well or plant.

Source waters vary in naturally occurring phosphorus but in most cases it is low or not detected. Phosphorus in the form of zinc orthophosphate or a polyphosphate blend is sometimes added for sequestration or corrosion control and occasionally intermittently as a well treatment. While mostly beneficial, the added phosphorus can encourage bacterial growth and biofilm problems.

(4) Disinfectant Residual

A disinfectant is added to all water before it enters the distribution system. For all surface water and some groundwater sources, the purpose is disinfection and proper dosages and contact times are ensured. For groundwater wells that do not need disinfection, chlorine or chloramine is applied such that a residual is maintained in the distribution system.

Most of our systems target a free chlorine residual in the distribution system of around 1.0 mg/L. This varies depending on a many factors but in all cases it is monitored closely by our operators.

The water purchased from some wholesalers, including MWDSC, contains chloramine rather than chlorine. The Southwest System is the only system at this time where we produce chloraminated water at our plants. Chloramines have been shown to be more effective at controlling biofilm than free chlorine.

(5) Operations

Operational controls to reduce water age can help to maintain chlorine residual and therefore control or slow the formation of biofilm. Distribution system tanks are managed to maximize turnover.

In times of drought, our customers are asked to lower their water usage. This can result in lower flows and slower velocity of water in the distribution system. Low flow pipes generally show increased growth of biofilm organisms compared to pipes with higher flows.

Annual flushing of dead end mains is conducted to discharge the water that otherwise does not turn over. This type of flushing is conducted at low velocity so that sediments are not stirred up in areas outside the targeted pipe. It should be noted that some dead end pipes may need to be flushed more often and some less depending on pipe age, length, flow and other factors.

(6) Unidirectional Flushing

Conventional flushing moves water and can remove loose sediments but does not achieve water velocity sufficient enough to scour the pipe. UDF is designed to move water in one direction at 5 feet per second or higher from a source of clean water systematically to the end of the distribution system. UDF is the only flushing method that can reliably clean water pipes with biofilm.

Golden State Water has a *Flushing Program* that outlines steps needed to clean established biofilm from distribution pipes. Specific, detailed UDF plans are developed using a hydraulic model and when executed properly have achieve desired results even in areas of severe biofilm.

There are rare circumstances where 5 feet per second cannot be achieved or where UDF is not successful. The only process that can scour or clean a pipeline better than UDF is pigging which is considerably slower and more costly than UDF. Recent industry evidence using ice pigging shows promise and may be an option for Golden State Water where UDF is not sufficient.

References:

1. Investigation of Pipe Cleaning Methods, Water Research Foundation 2003
2. Pressure Management: Industry Practices and Monitoring Procedures, WRF #4321
3. Seminar Publication: Control of Biofilm Growth in Drinking Water Distribution Systems, EPA/625/R-92/001 June 1992

Enclosure 3

California Department of Public Health
MEMORANDUM

DATE: September 24, 2012

TO: Sutida Bergquist, P.E., D.E., Los Angeles Central District

FROM: Frank Baumann, Retired Annuitant

SUBJECT: Golden State Water Company

Among many locations throughout the state, GSWC operates systems in the Central District of Los Angeles. These systems serve locally produced groundwater supplemented with purchased water from the Metropolitan Water District of Southern California.

The present evaluation addresses eight (8) separate systems (areas) within the district wherein GSWC operates three iron/manganese removal plants. These plants appear to be working satisfactorily. To my knowledge there are no reported complaints regarding iron or manganese. All sources, the ones with, as well as the ones without, iron/manganese removal plants are further treated with chloramines and Seaquest blended phosphate.
According to information received from GSWC's Sabine Arweiler, it was a pilot plant study in 1999 that concluded polyphosphates should be added to the waters to determine their effect, if any, on

System Pipe Corrosion Rate
Biofilm Formation and Mitigation
[Disinfectant] Residual Persistence

The goals for this project were, at the time, identified as follows:

1. To determine the effect of polyphosphate on unlined steel and cast iron pipe tubercles.
2. To determine the relationship between the polyphosphate application(s) and the changes in chlorine/chloramines residuals.
3. To study the effect of polyphosphate addition on nitrification and biofilm accumulation in the distribution system.
4. To determine the effect of polyphosphate on cement pipes and cement-lined pipes, specifically, to learn whether the polyphosphates are dissolving calcium from the pipe walls.
5. To determine the effect on water meter accuracy and performance.

I understand that in addition to the above five study areas, a memo of September 27th 1999 listed "Corrosion Control" as another possible objective of the pilot study. From what I can gather, the study was performed, and resulted in a decision to feed a blended phosphate formulation "Seaquest" [Aqua Smart, Inc.] to the sources. (It would be interesting to see the report of piloting). I further understand that Seaquest has been fed to these systems ever since.

Apparent Results of Treatment and Current Situation

The first listed objective of the pilot study was to determine the effect(s) of phosphate additions on system pipe corrosion rates. This was probably quite unnecessary in that, had an optimization study been done, it would have shown that *none* of the systems' waters can be classified as aggressive. Water quality and corrosion parameters are shown on the attached table and further illustrate the waters are not corrosive. The table shows the systems' minima, maxima and averages of WQPs and corrosion data. It will be noted that of all the data points *only two,* the minima of system 2(b) and system 4, exceed the theoretical maximum copper dissolution of 1.3 mg/L allowed under the Lead and Copper Rule. (In actual practice, waters rarely attain theoretical dissolution maxima). Thus, the effect, or lack thereof, of the Seaquest addition on system corrosion rates is unknowable.

The second objective shown is [the study of] biofilm formation and mitigation. I understand that GSWC continues to experience severe biofilm problems throughout the study areas. According to information obtained, the system has been forced to utilize as much as 20% of its production volume to flushing of the distribution system. The phosphate additions apparently not only have not prevented biofilm problems (as Seaquest's literature claims such treatment will), the added nutrient (phosphate) may even have *contributed* to biofilm formation.

The third study objective listed is "Residual Persistence". The problem of disinfectant decay, of course, goes hand in hand with the above-mentioned biofilm problem. It has been reported that disinfectant residuals 'disappear' in very short runs of main pipes. If the biofilm problem is indeed as severe as stated, the disinfectant decay should not be at all surprising. This situation, if allowed to continue, must be considered a threat to the health of water customers in that the absence of a disinfectant residual in the mains is very likely to result in microbiological regrowth and possible reintroduction of potentially pathogenic bacteria. By not being capable of controlling biofilm, the phosphate additions have actually directly contributed to the disinfectant decay problems. (A check with colleagues at the USEPA, and with an Australian expert on biofilms shows mounting evidence of the "aggravation" of biofilm problems, particularly nitrification, by the presence of chloramines and *any kind* of phosphate corrosion control chemical.)

Another study objective was to determine the effect(s), if any, of the polyphosphates on unlined steel and cast iron pipe tubercles. One of Seaquest's advertising claims (see web site and literature) is that addition of polyphosphate will 'clean" existing scale and

tubercles from pipes, as well as lay down a protective monomolecular film. These claims are mutually exclusive, and cannot occur concurrently. The "cleaning" claim is true only if high polyphosphate dosages are applied to a system for an initial short time period. The protective film claim only is possible if the cleaning is followed by normal dosages. At the low parts per million concentrations presently fed in these systems, no such cleaning will occur, and any film would only be formed on the existing tubercles thus contributing to the biofilm problems..

Items 2 and 3 (from page 1) have already been discussed. Item 4, the effect of the polyphosphate feed on cement and cement-lined pipes, was to be studied. It is uncertain whether the concern was over *deposited* calcium (due to scale) dissolution, or calcium *leached* from the cement/mortar. Although I have not come across a problem of polyphosphate additions *leaching* calcium from cement-lined systems, Seaquest's claim that their phosphate will dissolve existing scale could well be interpreted in that light.

The final study objective was the effect of polyphosphate on the performance and accuracy of water meters. Phosphates' effect on water meter working parts should be positive unless the biofilm/regrowth problem is so severe as to cause filamentous organisms to clog meter orifices.

Discussion and Recommendations

I understand that GSWC is seeking a permit revision to allow the company to operate the systems *without* the phosphate feeds. Considering GSWC has (to my knowledge) not experienced any Lead and Copper Rule problems, and apparently has no ongoing red or black water complaints (other than perhaps 'black' water due to flushing) in these systems, I am inclined to favor such a permit revision on a trial basis.

I would recommend that for a given period (i.e. six months, one year?) GSWC be permitted to stop phosphate additions *except* if and where such additions are necessary for iron and manganese sequestration. During this trial period GSWC should be required to closely monitor water delivered to the consumers' taps for compliance with the LCR, and should keep an accurate record of consumer complaints. If, at the end of the trial period the D.E. is satisfied that the systems can operate without the phosphate addition, the permit requirements can then be revisited.

I realize what follows is not part of my assignment as a CDPH employee, and I have not been retained as a consultant to GSWC, but I do recommend that the water company perhaps try to clean tuberculation and biofilm in at least one of the areas the way polyphosphate *should be used* for this purpose. I must warn, however, that this method is not without possibly unpleasant consequences. Feeding a dosage of about 10 mg/L of *poly* (not *blended)* phosphate for about ten (10) days to two weeks should clean accumulated tuberculation (and with it the biofilm) from the system, unless there is heavy accumulation, in which case a longer time period may be necessary. The polyphosphate will preferentially react with existing corrosion product *not only* in the distribution system, but also in homeowners' plumbing system. In older systems

(especially in galvanized ones) this may initially lead to numerous leaks where joints were 'held together' by rust. Sloughing off tuberculation and biofilm will also impact consumers with discolored water. Following this short high-dose period, the phosphate dose should be reduced to 2-3 mg/L, and at this juncture a blended phosphate is acceptable, though the poly portion really is not necessary. If GSWC considers a cleaning attempt on one of the areas, I strongly recommend that customers be informed and warned ahead of time of possibly short-term adverse effects to attain a long-term benefit.

Regardless of any decisions on phosphate additions, however, GSWC should continue its rigorous flushing program, perhaps also interspersing chloramination with short-term high-doses of *free chlorine* in an ongoing effort to finally control, and perhaps even eliminate, the biofilm problems.

I appreciate the opportunity to be of service to you in this matter. I will welcome questions and/or comments.

Frank J. Baumann, P.E.

Attachment

GOLDEN STATE WATER COMPANY
Water Quality and Corrosivity Parameters

Area	Range	TDS	Ca	Alk	pH	LI	CCPP	Copper	Zinc
01	Min	300	29	72	7.5	-0.64	-7.8	0.72	1.82
	Max	466	63	200	8.54	1.09	25.8	0.22	0.04
	Avg	362	52	165.5	8.19	0.63	13.3	0.33	0.12
2(a)	Min	340	22	190	7.7	-0.15	-4	1.11	0.61
(b)	Min	355	34	190	7.6	-0.26	-7.4	1.39	0.88
(a)	Max	410	39	230	8.55	0.97	22.2	0.25	0.04
(b)	Max	440	62	270	8.6	1.20	32.1	0.24	0.03
(a)	Avg	365	34.5	215	8.06	0.44	11.4	0.58	0.17
(b)	Avg	392	44	208	8.08	0.54	14.7	0.54	0.16
04	Min	330 (A)	27	190	7.15	-0.61	-31.3	4.13	4.52
	Max	400 (A)	31	210	8.47	0.76	15.2	0.26	0.05
	Avg	370 (A)	29.3	197	8.04	0.31	7.05	0.55	0.19
05	Min	330	31	170	7.65	-0.10	2.7	1.11	0.76
	Max	440	59	200	8.4	0.94	22.9	0.28	0.06
	Avg	400	51	186	8.04	0.52	13.6	0.52	0.19
06 (a)	Min	260	29	120	7.6	-0.31	-6.1	0.90	1.01
(b)	Min	250	23	168	7.79	-0.07	-1.55	0.81	0.44
(a)	Max	250	59	200	8.5	1.08	25.8	0.23	0.04
(b)	Max	340	60	190	8.3	0.86	21	0.31	0.08
(a)	Avg	295	56	106	8.02	0.33	9.8	0.30	0.25
(b)	Avg	282	49	163	8.14	0.57	12.2	0.37	0.14
07	Min	255	28	96	7.65	-0.37	-5.3	0.65	0.92
	Max	444	61	200	8.4	0.95	23.5	0.28	0.06
	Avg	345	38.5	169	8.04	0.37	7.95	0.47	0.19
12	Min	350	22	80	7.65	-0.57	-6.3	0.54	1.04
	Max	520	57	260	8.45	1.06	32.4	0.35	0.05
	Avg	416	45	194	7.88	0.32	9.5	0.76	0.33
14	Min	310	53	150	7.86	0.29	7.15	0.61	0.37
	Max	460	60	180	8.2	0.71	17.1	0.36	0.12
	Avg	350	56.5	169	8.0	0.45	12.6	0.51	0.22

(a)(b) = same area, different sampling points

A= Assumed data point
All units, except pH and Langelier Index, in mg/L

[End of Appendix A]