Water Department

Water Commission Agenda
Regular Meeting
7:00 p.m. – Monday, August 24, 2015
Council Chambers
809 Center Street, Santa Cruz

Agenda

Call to Order

Roll Call

Presentation *Organized groups may make presentations to the Water Commission. Presentations that require more than three minutes should be scheduled in advance with Water Department staff.*

Statements of Disqualification *Section 607 of the City Charter states that "…All members present at any meeting must vote unless disqualified, in which case the disqualification shall be publicly declared and a record thereof made."*

The City of Santa Cruz has adopted a Conflict of Interest Code, and Section 8 of that Code states that no person shall make or participate in a governmental decision which he or she knows or has reason to know will have a reasonably foreseeable material financial effect distinguishable from its effect on the public generally.

Oral Communications No action shall be taken on this item.

Announcements No action shall be taken on this item.

Consent Agenda (Pages 5-14)

Items on the consent agenda are considered to be routine in nature and will be acted upon in one motion. Specific items may be removed by members of the advisory body or public for separate consideration and discussion. Routine items that will be found on the consent agenda are City Council Items Affecting Water, Water Commission Minutes, Information Items, Documents for Future Meetings, and Items initiated by members for Future Agendas. If one of these categories is not listed on the Consent Agenda then those items are not available for action.

1. City Council Items Affecting Water☆ (accept info) (Pages 5-8)
2. Approve the May 4, 2015 Water Commission Minutes☆ (Pages 9-14)

Items Removed from the Consent Agenda

General Business (Pages 15-87)

Any document related to an agenda item for the General Business of this meeting distributed to the Water Commission less than 72 hours before this meeting is available for inspection at the

Water Administration Office, 212 Locust Street, Suite A, Santa Cruz, California. These documents will also be available for review at the Water Commission meeting with the display copy at the rear of the Council Chambers.

1. Water Supply Update☆ (Pages 15-22)

   Recommendation: Motion to receive and accept a status report.

2. Financial Impact of the Drought☆ (Pages 23-24)

   Recommendation: That the Water Commission receive information regarding the Financial Impact of the Drought on Water Department Revenues in FY 2015 and projected revenues in FY 2016. Accept information regarding the Financial Impact of the Drought on Water Department Revenues in FY 2015 and projected revenues in FY 2016.

3. Update on Water Loss Study ☆ (Pages 25-80**)**

   Recommendation: Motion to receive and accept a status report.

4. Implementation of the Department's Capital Improvement Plan☆ (Pages 81-84)

   Recommendation: Receive information and provide feedback on various capital improvement projects currently underway and on how they fit in with the Department's Strategic Goals and potential recommendations from the Water Supply Advisory Committee.

6. Gravity Trunk Main Valve Replacement Project ☆ (Pages 85-87)

   Recommendation: Receive information about plans to improve a critical element of the City's treated water infrastructure and provide feedback.

Subcommittee/Advisory Body Oral Reports

1. WSAC Update (Oral Report)

Director's Oral Report No action shall be taken on this item.

Adjournment The next meeting of the Water Commission is scheduled for October 5, 2015 at 7:00 p.m. in Council Chambers.

☆Denotes written materials included in packet

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APPEALS - Any person who believes that a final action of this advisory body has been taken in error may appeal that decision to the City Council. Appeals must be in writing, setting forth the nature of the action and the basis upon which the action is considered to be in error, and addressed to the City Council in care of the City Clerk.

Other - Appeals must be received by the City Clerk within ten (10) calendar days following the date of the action from which such appeal is being taken. An appeal must be accompanied by a fifty dollar ($50) filing fee.

The City of Santa Cruz does not discriminate against persons with disabilities. Out of consideration for people with chemical sensitivities, please attend the meeting fragrance free. Upon request, the agenda can be provided in a format to accommodate special needs. Additionally, if you wish to attend this meeting and will require assistance such as an interpreter for American Sign Language, Spanish, or other special equipment, please call Water Administration at 831-420-5200 at least five days in advance so that arrangement can be made. The Cal-Relay system number: 1-800-735-2922.

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WATER COMMISSION
REPORT

DATE: Monday, August 24, 2015

TO: Water Commission

FROM: Rosemary Menard
Water Director

SUBJECT: City Council Item Affecting Water

City Council of May 12, 2015:

Referral to Closed Session- Purchase of Easements for the North Coast System Rehabilitation Project (WT)
Motion carried Councilmember Terrazas moved, seconded by Vice Mayor Mathews, to refer to closed session the purchase of easements on the following parcels needed for the North Coast System Rehabilitation Project for purposes of providing direction to the city negotiator regarding terms, price, or other direction: APN 059-121-09 owned by Andrew Chien-Yau & Wan-Jea Hsu; APNs 059-022-05, 059-131-01, 059-022-04, and 059-131-05 owned by the State of California; APNs 059-141-04 and 059-041-30 owned by Granite Rock Co.; and APN 059-023-10 owned by the Santa Cruz Regional Transportation Commission.

Bay Street Reservoir Replacement Project – Phase 3 Construction – Contract Change Order No. 2 (WT)
Motion carried to ratify Contract Change Order No. 2 with Gateway Pacific Contractors, Inc. (Sacramento, CA) to furnish and install high-security fencing in the amount of $203,980.

City Council of May 26, 2015:

Graham Hill Water Treatment Plant Filter Rehabilitation and Upgrades Project Design and Construction Support Services – Contract Amendment No. 3 and Budget Adjustment (WT)
Motion carried authorizing the City Manager to execute Contract Amendment No. 3 with Kennedy/Jenks Consultants (San Francisco, CA) in the amount of $99,300 for additional engineering services during construction, in a form approved by the City Attorney. Resolution No. NS-28,944 was adopted to amend the Water Department's FY 2015 budget adding $99,300 to Capital Improvement Project c701303, WTP Filter Rehabilitation and Upgrades, to support the Kennedy/Jenks contract amendment.

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Award of contract for Water Loss Control Program (WT)
Motion carried to award a contract to Water Systems Optimization, Inc. of San Francisco, CA for the Water Loss Control Program in the amount of $150,080 and reject all other proposals and to authorize the City Manager to execute an agreement in a form approved by the City Attorney.

FY15 Budget for Implementation of Stage 3 Water Rationing – Budget Adjustment (WT)
Resolution No. NS-28,945 was adopted transferring funds and amending the FY 2015 Water Department budget in the amount of $72,500 to address the financial impact of implementing Stage 3 water rationing for the remainder of this fiscal year.

Water System Development Charge Update (WT)
This item was postponed to the next Council meeting.

City Council of June 9, 2015:

North Coast System Rehabilitation – Phase 3 – Construction Inspection and Contract Management Services – Award of Contract (WT)
Motion carried to accept the proposal of Covello Group, Inc (Walnut Creek, CA) for Construction Inspection and Contract Management Services in the amount of $1,025,000 and to authorize the City Manager to execute an agreement in a form approved by the City Attorney.

Beltz Well No. 12 Design and Construction Support Services – Contract Amendment No. 3 (WT)
Motion carried authorizing the City Manager to execute and ratify Contract Amendment No. 3 in the amount of $19,000 with Luhdorff and Scalmanini Consulting Engineers (Woodland, CA) for design and construction support services, in a form approved by the City Attorney.

Award of contract for Loch Lomond Recreation Area Overlay and Pavement Repair Project – Phase One (WT)
Motion carried to 1) approve the plans and specifications for Phase One Loch Lomond Recreation Area Overlay and Pavement Repair Project, 2) accept the informal bid from Granite Rock Company (San Jose, CA) in lieu of a formal bid, and 3) authorize the City Manager to execute an agreement in the amount of $104,227, in a form acceptable to the City Attorney.

University Reservoir No. 5 Rehabilitation Project – Tank Design and Construction Services Contract (WT)
Motion carried to approve the Tank Design and Construction Services contract with Robert W. Miles, Consulting Civil Engineer for the University Reservoir No. 5 Rehabilitation Project, in the amount of $223,000 and to authorize the City Manager to execute an agreement in a form approved by the City Attorney.

Water System Development Charge Update (WT)

Director of Water R. Menard gave a PowerPoint presentation and responded to Council's questions.

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Motion carried Vice Mayor Mathews moved, seconded by Councilmember Terrazas, to approve Option Two: to adopt Resolution No. NS-28,951 to adjust the Water System Development Charges and rescind portions of Resolution No. NS-26,803, phasing in the implementation of the revised fee structure over two years with half of the fee increase effective on July 1, 2015, and the second half plus the relevant annual adjustment effective on July 1, 2016; and introduce Ordinance No. 2015-09 for publication amending Chapter 16.04.041 of the Santa Cruz Municipal Code pertaining to the System Development Charge.

City Council of June 23, 2015:

FY 2016 Budget for Implementation for Stage 3 Water Rationing – Budget Appropriation (WT)
Motion carried modifying the FY 2016 Water Department budget, and its incorporation into the final FY 2016 Adopted Budget, to include an additional $213,253 to address the financial impact of managing Stage 3 water rationing.

North Coast System Rehabilitation Project – Phase 3 – Approval of Drawings and Specifications, and Authorization to Advertise for Bids and Award Contract (WT)
Motion carried to approve the drawings, specifications, and contract documents for the North Coast System Rehabilitation Project-Phase 3 and authorize staff to advertise for bids. The City Manager is hereby authorized and directed to execute the contract in a form approved by the City Attorney and as authorized by Resolution No. NS-27,563.

Ordinance No. 2015-09 Amending Chapter 16.04.041 of the Santa Cruz Municipal Code Pertaining to Connection of new Water Services (WT)
Motion carried Councilmember Terrazas moved, seconded by Vice Mayor Mathews, to adopt Ordinance No. 2015-09.

Joint Study Session Between the Santa Cruz City Council and the Council Appointed Water Supply Advisory Committee on Technical Analysis and Committee Work to Date (WT)
Discussion of Water Supply Advisory Committee technical analysis and work to date and direction to the Committee and staff as needed.

City Council of August 11, 2015:

Water Supply Modeling – Professional Services Contract – Budget Adjustment (WT)
Motion authorizing continuation of services with Gary Fiske and Associates Inc. (Portland, OR) for professional services related to water supply modeling for the City of Santa Cruz Water Department.
Resolution appropriating funds and amending the FY 2016 budget in the amount of $75,000 from the Water Enterprise Fund (Fund 711) and Water System Development Charges Fund (Fund 715).

Graham Hill Water Treatment Plant Filter Rehabilitation and Upgrades Project – Approval of Revised Budget and Authorization to Execute Change Orders with Anderson Pacific Engineering Construction Inc. – Budget Adjustment (WT)

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Resolution appropriating funds and amending the Water Department's FY 2016 Adopted Budget in the amount of $520,000 to revise the Graham Hill Water Treatment Plant Filter Rehabilitation Project budget.
Motion authorizing the Water Director to approve construction change orders with Anderson Pacific Engineering Construction Inc., in a form approved by the City Attorney, for amounts that are within the approved revised budget.

Loch Lomond Recreation Area Cape Seal Project – Budget Adjustment (WT)
Resolution appropriating funds and amending the FY 2016 budget in the amount of $122,500 from the Water Enterprise Fund (Fund 711) to fund the cost of the Loch Lomond Recreation Area Cape Seal Project Phase Two.

Purchase of Sensus Water Meter Equipment and Parts (WT)
Motion authorizing the City Manager or designee to execute contracts, in a form approved by the City Attorney, for the continuation of purchase of Sensus water meters equipment and parts from Sensus Metering Systems (Pittsburgh, PA) and their local distributor, Golden State Flow Measurement (El Dorado Hill, CA).
Motion authorizing the City Manager or designee to execute a contract, in a form approved by the City Attorney, for the continuation of purchase of compatible parts for the Sensus meter reading system from Badger Meter Inc (Milwaukee, WI).

Water Supply Advisory Committee Update (WT)
Receive update and direct staff as appropriate.

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Water Department

Water Commission
DRAFT
7:00 p.m. – Monday, May 4, 2015
Council Chambers
809 Center Street, Santa Cruz

Minutes of a Water Commission Meeting

Call to Order –Chair **D. Baskin** called the meeting to order at 7:04 p.m. in the City Council Chambers.

Roll Call

Present: D. Baskin, G. Mead, D. Schwarm, A. Schiffrin, D. Stearns, W. Wadlow, and L. Wilshusen.

Absent: None.

Staff: R. Menard, Water Director; T. Goddard Administrative Services Manager; G. Rudometkin, Administrative Assistant III; C, McIsaac, Administrative Assistant II; M. Kaping, Management Analyst and N. Dennis, Principal Management Analyst.

Others: 1 member of the public.

Presentation –There were no presentations.

Statements of Disqualification –There were no statements of disqualification.

Oral Communications –There were no oral communications.

Announcements –There were no announcements.

Consent Agenda

1. City Council Items Affecting Water
2. Approve the April 6, 2015 Water Commission Minutes
3. Information Item: State of the Water System, Item Presented to WSAC

Items Removed from the Consent Agenda

Commissioner A. Schiffrin moved the Consent Agenda as amended. Commissioner L. Wilshusen seconded.
VOICE VOTE: MOTION CARRIED
AYES: D. Baskin, G. Mead, D. Schwarm, A. Schiffrin, D. Stearns, and L. Wilshusen.

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NOES: None
ABSTAINED: W. Wadlow due to April 6th absence.
ABSENT: None.

General Business

1. Water Commission Action/Recommendation on Revised System Development Charges
   R. Menard, Water Director and N. Dennis, Principal Management Analyst responded to Commission questions.

Commission Questions/Comments:

- A thank you was extended to staff for the detailed replacement of cost calculations for all of the existing assets, as many water agencies don't have that kind of information on existing assets available.
- Considering proposals for rate increases in the future, with the addition of the revised system development charges do you foresee that this will help improve the financial stability of the Water Department? Response: Yes, we have relatively little revenue that comes from system development charges, the fact that it is more aligned with what it really will cost will be a help to allow the department to fund conservation, demand management and make contributions to the capital program, every little bit helps.
- On page 3 of the water system development report under the legal framework it says "local laws" and I believe it should be State laws. Response: There are two kinds of laws; there is impact fee based legislation, which is overseen by state law as well as municipal code.
- Can we change this to say State and local law to ease confusion? Response: Yes
- Concern expressed on page 23 where it states system development charges will be reviewed periodically. To avoid the situation we are in now where the system development charges haven't been reviewed in 11 years can we revise the language to make more of a commitment to do a regular review and say no less often than every five years? R: I believe this was supposed to imply the indexing change and not the review change. The term periodically allows us to review every three years, five years whatever would be deemed appropriate at the time and what is needed but we can certainly add that language.
- Can you remind us why the name is being changed from System Development Charge? R: Historically this is what is has been called here.

Public Comment

- No Comment

Commissioner A. Schiffrin moved the staff recommendation with the changes to the ordinance on page 23, the title of 16.04.041 to be system development charges and in Section B., second paragraph to substitute "no less often than every 5 years" from periodically. Commissioner L. Wilshusen seconded.
VOICE VOTE: MOTION CARRIED

AYES: All.
NOES: None

2. FY 2016-18 CIP Financing & Operating Budget Overview
R. Menard, Water Director N. Dennis, Principal Management Analyst who provided the presentation and responded to Commission questions.

Commission Questions/Comments:

- In the CIP Chart for the 2015 amended budget, it has 20.8 million dollars and in the encumbrance and the actual expenditures is only 13.6 million dollars what happened to the other $7.2 million dollars. Response: Projects with extensive planning fall subject to delays or even with speeding up a project comes the difference that you are seeing between those two are in the second column the amended budget is actually the budget that was approved plus any carryovers from the prior year and then the 2015 is what we actually project to spend. The excess will be brought forward into the next year and we will continue to use those funds to work on those projects.
- On the amended 2015 budget of the 20.8 million dollars is there any rollover from 2014 reflected in that? Response: Yes.
- Where is the detailed fund balance? Response: On page 4 of staff report (p. 33 in packet) that is the current fund balance amounts; these numbers are more up to date. Also, on page 51 of the packet, this is reflective of what Council will see during their May budget hearings, the details are displayed by section.
- There has been discussion of two pipelines going to and from the reservoir is that being looked at by the Water Supply Advisory Committee? Response: This work is in 2017 and is to my understanding that this parallel pipeline will be looked in the Water Supply Advisory Committee environment with their technical team so that we understand the benefits before we get to this.
- What money is going to be spent on for Loch Lomond improvements, where 100,000 dollars is proposed for 2016? My understanding is that Loch Lomond is going to be closed again this year because of the drought, so what is the money going to be spent on? Response: With the information gathered from the use study which gave the Department a lot of recommendations with community input on what we could be looking at when we develop a master plan, so this money and any carryover will be put into that master plan. I will add what we will be doing this year with the operating budget at Loch Lomond is some paving and ADA improvements which can be done much more easily now that the lake is closed.
- The North Coast Rehabilitation project is the most expensive project by far in 2016 its 4.2 million dollars, the total is 9 million. Is it realistic to think the City can bid on this project in 2016? What is permit status on this; will there be an EIR, does the city have the permits? Response: We are currently in the process of developing easements, there are some hurdles left to go but we are still on schedule to go out to bid at the end of this fiscal year or beginning of next year proceed within this fiscal year or next fiscal year. It will definitely take two construction seasons to do primarily due to mitigations due various animal

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species. We have split the 9 million dollars between 2016 and 2017. The plans and specs are complete.

- What percentage of water is coming from the North Coast, what are we getting from it now? Response: Last year it was 10%.
- Under water supply reliability, can you clarify the estimated actuals for 2015 is just about 2 million dollars, is that what was spent on the Water Supply Advisory Committee? Response: Correct.
- The bottom line for the sum between the years of 2016-2018 is approximately 48 million dollars and some change that are being spent. The next three years between 2019-2021 the money spent is over $118 million dollars which is a significant increase, which will most likely be cause for water rate discussions, which is very significant and I am sure you are aware of.

Public Comment

- No Comment

Commissioner A. Schiffrin moved staff recommendations as amended. Commissioner D. Baskin seconded.
VOICE VOTE: MOTION CARRIED
AYES: All.
NOES: None

Subcommittee/Advisory Body Oral Reports No items.

1. WSAC Update (Oral Report)
   - In our materials packet this week our technical experts shared a series of confluence models to see how our system would operate if we removed certain constraints, the constraint being water storage and they figured out that we have enough water in the San Lorenzo River to function almost all of the time but we don't have enough storage, something that we figured out in 1970 or even before which is why they built Zyante dam. The inability to build storage is what lead us to the path of desalination because we couldn't build another dam. In lieu of the dam we now can explore the opportunity to store water in aquifers and everyone thinks it is a great idea, if it works, which we don't know and we will probably spend 10-20 million dollars investigating if it will work. In 20-30 years if this actually works it would be great because there is a significant energy toll that comes from recycled and desalinated water. Having a storage facility or combination of facilities that would allow us to get off of something so energy intensive would be a great thing, if it does work. In the short term we have nothing by recycled water and desalination and we recognize that we will have public resistance to both of those. What will happen in the next few meetings as we go forward is how we are going to include study for the long term but also figuring out what we are going to do in the short term and the immediate problem that we are because it turns out we are in an extended drought like we have never seen before.

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- The State of California has decided that recycled water for potable use is going to happen. The regulations just came out for how you apply for funds for the Prop 1 money and at the top of the list of Water Supply Projects is Recycled Water for Potable use, it also indicates that it would help pay for 35% of the cost which could be up to 15 million dollars which provides motivation, desalination is not yet on that list.
- Then challenge that we face when you plan for a long horizon and timeline and you factor in greenhouse gasses and energy footprint into the equation you can think of desalination or the lower energy footprint but higher yuck factor if you will of direct potable use. One of these will have to happen if we want to have a reliable water supply; of course we could go on and not have a reliable water supply.
- Regarding the aquifers, at each general location where we want to pump water in and hope to get it out we have to do a pilot plant, it would take 4-8 years to do each pilot study and if they are successful, success meaning that it looks like aquifer will hold the water and let us take the water out sometime down the line, it could be another 10-20 years, we don't quite know yet because we don't know enough about the hydrogeology yet.
- When will WSAC and Water Commission discuss directions towards alternatives together? Response: We need to plan a general Town Hall meeting during mid-summer. There will be a study session joint meeting between WSAC and the City Council On June 23, 2015 from 7:00 – 9:30 p.m. down at Louden Nelson to discuss process, information and direction.

Director's Oral Report No action shall be taken on this item.

1. Monthly Status of Water Supply (to be distributed at meeting)
    - The month of May has transitioned us from critically dry to dry. We are still seeing stream flows that are low and we will continue to have challenging conditions. Considering NOAAH, we are providing flows that are more than last year but not completely at the City proposal level and not at DFG 5 proposal level. We have the temporary urgency petition for Newell Creek which runs until August and we just signed a tolling agreement that has the short term flows in it.
    - Question was asked - does having more water in Loch Lomond mean leaving more water for fish flows? Response: It revolves around flows in the river. We are not giving flows all the way up, though we are providing more water for the fish this year than last year.
    - Question was asked if we can we predict when we can make use of North Coast sources? Response: Not sure. With exception of Liddell, the North Coast streams are being affected by the drought just as other sources are. We are unsure because we are unsure of what the climate will do.

Adjournment **Meeting adjourned at** 8:39 p.m. The next regular meeting of the Water Commission is scheduled for June 1, 2015 at 7:00 p.m. in Council Chambers.

Respectfully submitted,

Amy Poncato

Digitally signed by Amy Poncato
DN: cn=Amy Poncato, o=Water Department, ou=Administration, email=aponcato@cityofsantacruz.com, c=US
Date: 2016.05.10 14:36:12 -07'00'

Staff

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WATER DEPARTMENT
MEMORANDUM

DATE: August 17, 2015

TO: Water Commission

FROM: Toby Goddard, Administrative Services Manager

SUBJECT: Water Shortage Emergency Status Report

RECOMMENDATION: Motion to receive and accept a status report.

BACKGROUND: The City of Santa Cruz, along with the entire state of California, is currently facing an extraordinary drought event. After four consecutive years of below average rainfall and runoff, the City Council on April 14, 2015 adopted a resolution declaring a Stage 3 water shortage emergency for the second year in a row. Water rationing for the City's residential and irrigation customers and a variety of other measures aimed at reducing customer water use by 25 percent began May 1, 2015. The overall goal is to ensure adequate water supply is available next year if the drought continues.

At around the same time, Governor Brown issued an executive order calling for, among other actions, all urban water suppliers statewide to cut back water use by an overall 25 percent. Emergency regulations were adopted May 5, 2015, and took effect beginning in June. The framework adopted by the state gives each supplier its own specific conservation standard to achieve based on its residential per capita water use in 2014. Communities with very low per capita water use, including Santa Cruz, were assigned an 8 percent cutback from 2013 levels. Cutbacks ranged up to 36 percent for communities with the highest residential use.

DISCUSSION: The purpose of this report is to update the Water Commission on the status of the water shortage emergency and the City's water supplies. Some of the highlights are as follows:

- Gross monthly water consumption was down more than 30 percent in May, June, and July compared to the same period in 2013, exceeding conservation goals (Attachment 1). On a daily basis, system consumption is averaging about 7.5 million gallons per day (mgd), compared to about 11.0 mgd this time two years ago. (Attachment 2).

- Reservoir storage is trending better than was forecast for the end of July (Attachment 3). Like 2014, low water demands helped plant operators avoid drawing on the reservoir until early July. Reservoir storage currently stands at 78 percent of capacity.

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- The overwhelming majority of customers are managing to maintain their water use at or below their monthly allotments. Only 3 percent, or 649 accounts out of 21,700 residential accounts, incurred an excessive use penalty in their June utility bill, compared to 7 percent last year. In July utility bills, only 4 percent or 1,019 accounts incurred a penalty for excessive use.

- Large irrigation accounts, including many City parks, have cut back the most on a percentage basis, consistent with the City Water Shortage Contingency Plan. About three quarters of the 130 sites with dedicated irrigation meters are at or under their allotment, compared to about half last year. Additional workshops, outreach, and individual assistance have helped improved compliance with this customer group.

- Large businesses (using over one million gallons per year) were required to update the conservation plans that they developed for their facilities last year. All but two have met this requirement. The University of California has again succeeded in cutting its water use back by more than its 20 percent target through a highly coordinated water working group effort involving every sector of the campus, and deployment of new metering technology.

- No appeals have been filed so far this year. Penalties are being waived through the City's Water School and through the standard leak forgiveness procedure administered in the Customer Service section.

- The Water Department continues to patrol the service area seven days a week for instances of water waste, and to follow up on reported violations. Most of these cases – which number fewer than last year – are resolved with a single contact, avoiding any penalty.

Attachment 4 presents the monthly water supply forecast for 2015, with actual volumes produced so far this year compared to forecast volumes. Coast production is running a little bit less than projected back in March, while river production has varied compared to monthly forecast volumes.

Attachment 5 presents mean monthly stream flows in the San Lorenzo River at the USGS stream gauge in Felton. Currently, the San Lorenzo River is trending close to its historic minimum flow of about 7 cubic feet per second (cfs). Downstream at the Tait Diversion, the water Department is bypassing 3 cfs on a continuous basis for habitat protection purposes. In addition, the bypass is increased to 6 cfs twice a week, for 12 hour intervals, in accordance with the City's short-term agreement with fishery agencies. Upstream at Newell Creek, the State Water Resources Control Board just approved a third order on August 10, 2015 extending the temporary reduction in downstream release from Loch Lomond from 1.0 to 0.2 cfs. Monitoring of Newell Creek downstream indicates the reduced bypass flows has not changed passage conditions in critical riffles nor created hydrologic discontinuity.

The Santa Cruz community has once again demonstrated a widespread commitment and tremendous cooperation in responding to this water shortage emergency, doing even more than asked or even expected. Such large cutbacks in water use experienced this year, however, have,

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in turn, caused a corresponding reduction in Department's water revenue well beyond what was anticipated. This is a subject that is addressed in a separate agenda item in this packet.

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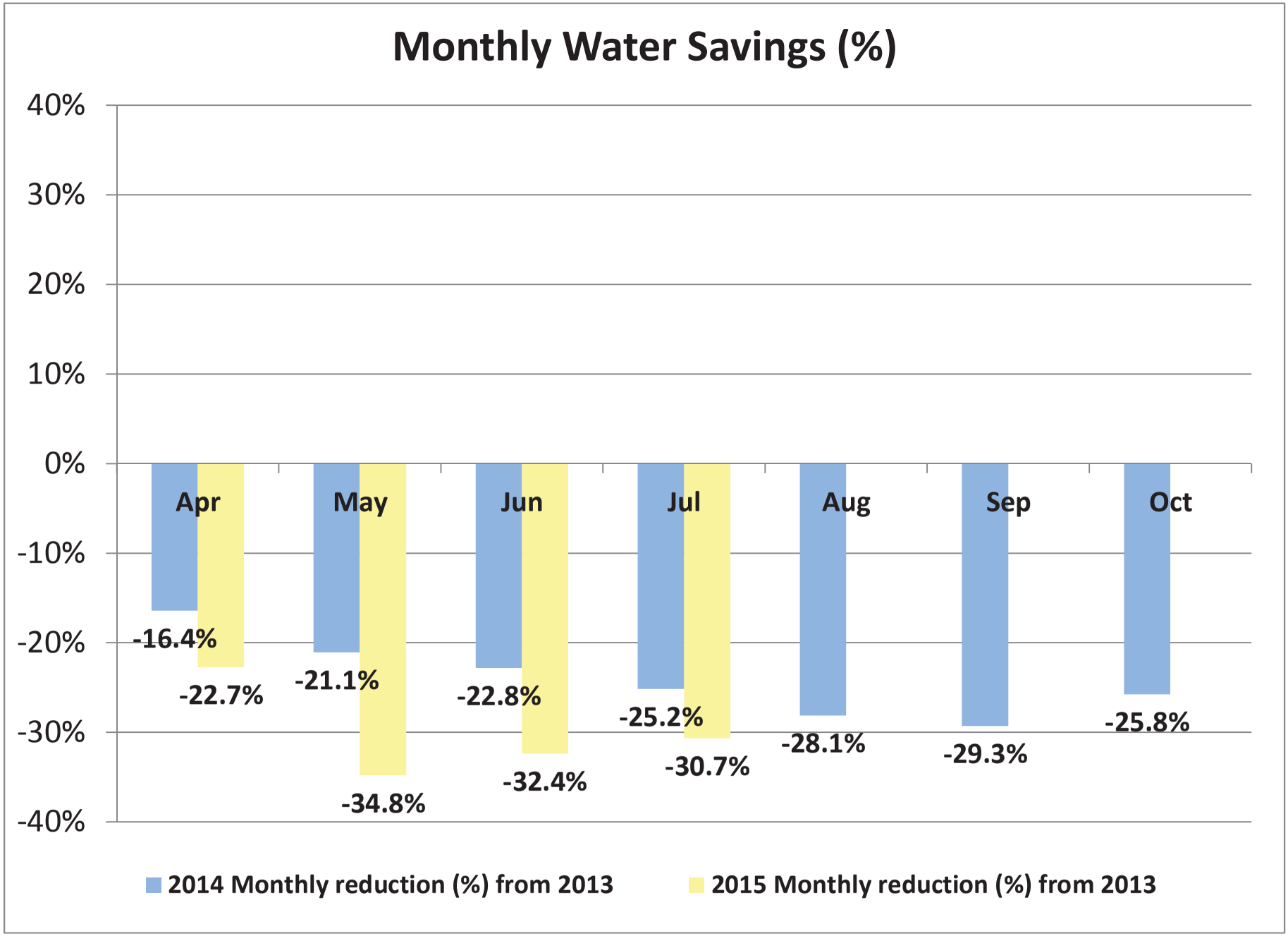
Monthly Water Savings (%)
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
Apr
May
Jun
Jul
Aug
Sep
Oct
-16.4%
-22.7%
-21.1%
-34.8%
-22.8%
-32.4%
-25.2%
-30.7%
-28.1%
-29.3%
-25.8%
2014 Monthly reduction (%) from 2013
2015 Monthly reduction (%) from 2013

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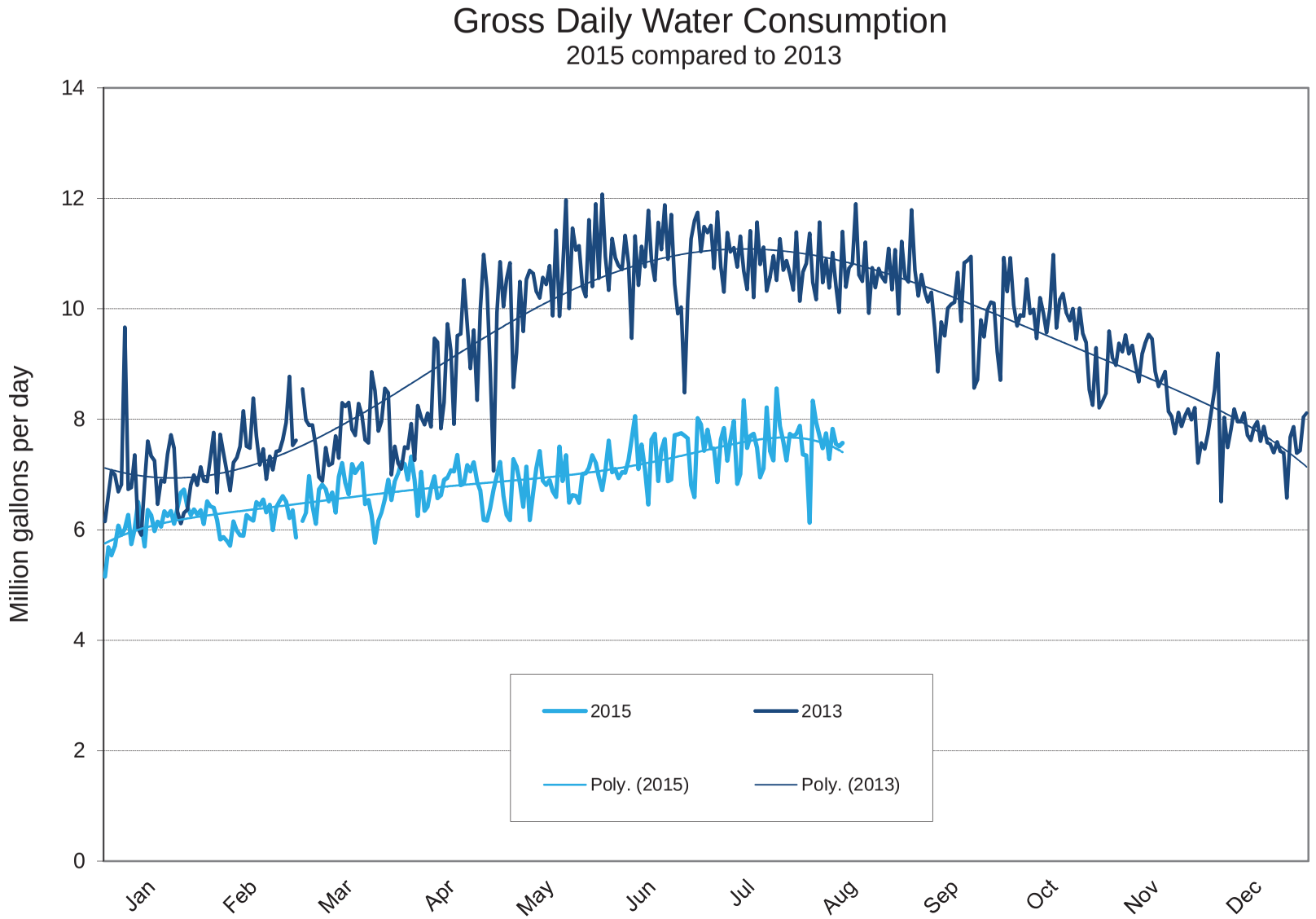
Gross Daily Water Consumption
2015 compared to 2013
Million gallons per day
14
12
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2015
2013
Poly. (2015)
Poly. (2013)

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Attachment

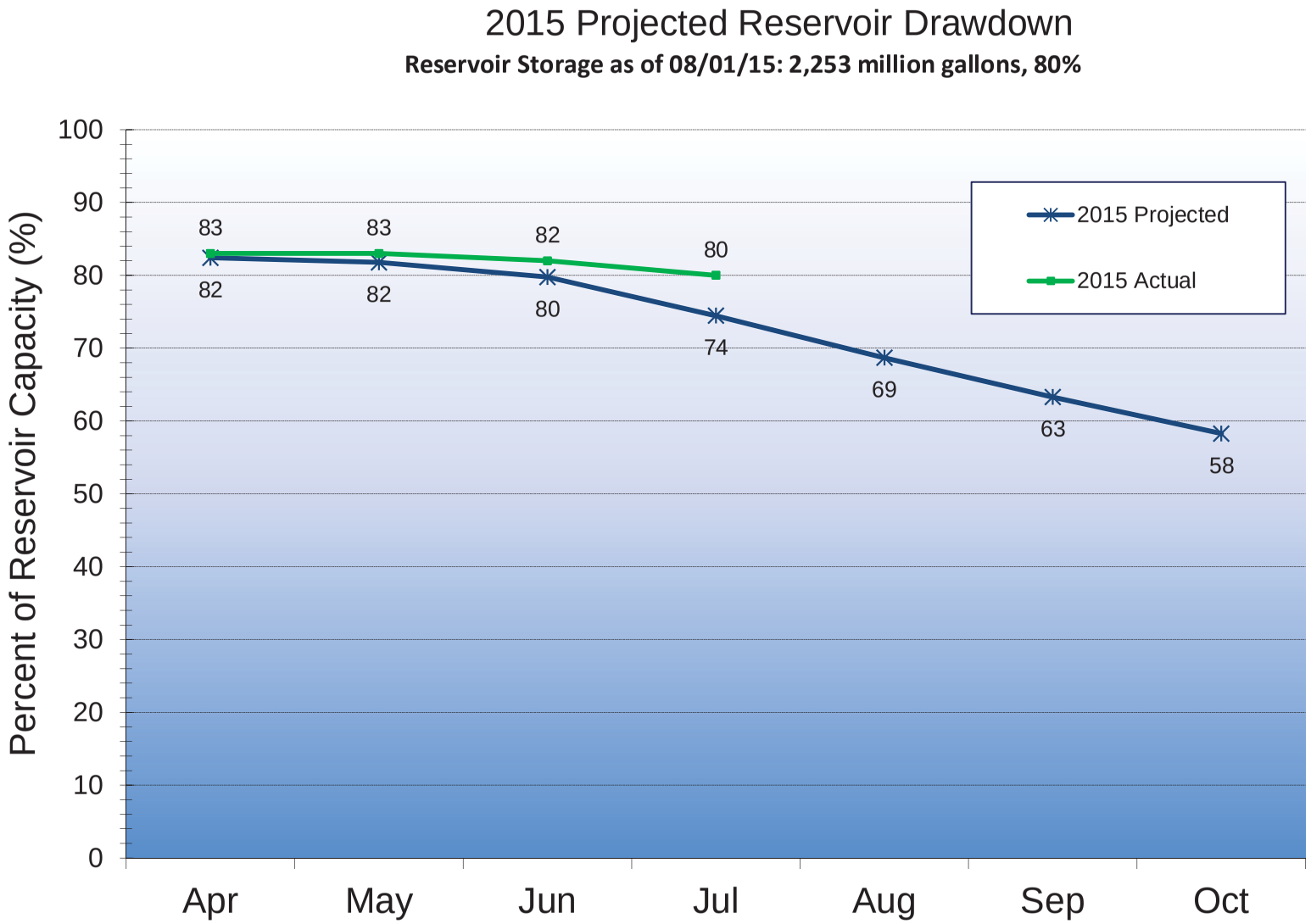

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Table 1. 2015 Water Supply Forecast-Scenario Y

SCWD Production Forecast (million gallons)	April			May			June			July			Aug			Sep			Oct			Total		
	Projected	Actual	Variance	Projected	Actual	Variance	Projected	Actual	Variance	Projected	Actual	Variance	Projected	Actual	Variance	Projected	Actual	Variance	Projected	Actual	Variance	Projected	Actual	Variance
North Coast (gross production)	*	--	--	*	--	--	*	--	--	*	--	--	*	--	--	*	--	--	*	--	--	0	--	--
North Coast (net production)	32	27	-5	46	43	-3	40	35	-5	39	32	-7	35			32			37			378		
San Lorenzo River	225	174	-51	232	149	-83	156	163	7	80	122	42	65			49			51			1,381		
Live Oak Wells	12	1	-11	25	22	-3	25	20	-5	25	29	4	25			25			25			219		
Tait Wells	8	12	4	8	11	3	8	10	2	8	12	4	8			8			8			114		
Total Production without Lake	269	202	-67	303	214	-89	221	218	-3	144	183	39	125			106			113			1,978		
Projected System Demand	265	--	--	328	--	--	325	--	--	338	--	--	332	--	--	301	--	--	301	--	--	2,190	--	--
Curtailed System Demand	228	205	-23	262	213	-49	260	220	-40	270	235	-35	266			241			240			2,493		
Lake Production Needed to Meet Demand	**0**	5	5	**0**	0	0	**39**	1	-38	**127**	51	-76	**141**			**135**			**128**			**517**		
Evaporation (feet)	0.2	--	--	0.3	--	--	0.3	--	--	0.4	--	--	0.4	--	--	0.3	--	--	0.2	--	--	2	--	--
Evaporation (mil gal)	9	--	--	13	--	--	13	--	--	18	--	--	18	--	--	13	--	--	9	--	--	93	--	--
Fish Release (mil gal)	5	--	--	5	--	--	5	--	--	5	--	--	5	--	--	5	--	--	5	--	--	35	--	--
Beginning Lake Volume	**2,346**	2,341	-5	**2,332**	2,351	19	**2,314**	2,341	27	**2,257**	2,325	68	**2,107**			**1,944**			**1,791**					
End of Month Lake Volume	**2,332**	2,351	19	**2,314**	2,341	27	**2,257**	2,325	68	**2,107**	2,253	146	**1,944**			**1,791**			**1,649**					
End of Month Lake Elevation (ft above msl)	**568.2**	568.6	0.4	**567.9**	568.4	0.5	**566.8**	568.1	1.3	**563.7**	566.7	3.0	**560.0**			**556.6**			**553.1**					
Monthly change in elevation	-0.3	0.2	0.5	-0.3	-0.2	0.1	-1.1	-0.3	0.8	-3.1	-1.4	1.7	-3.7			-3.4			-3.5					
Cumulative change in elevation	-0.3	0.2	0.5	-0.6	0.0	0.6	-1.7	-0.3	1.4	-4.8	-1.7	3.1	-8.5			-11.9			-15.4					
Percent of capacity (%)	82.4	83.1	0.7	81.8	82.7	1.0	79.8	82.2	2.4	74.5	79.6	5.1	68.7			63.3			58.3					

North Coast Gross: No estimate

North Coast Net: Liddell Spring and Majors Creek production equal to that of 2014, Zero production assumed from Laguna Creek.

San Lorenzo River forecast flow (see below) based on no additional rain after 3/6/15 Equal to Critically Dry, 90% exceedance

Releases at Tait: Exceedance category 5

Live Oak Wells: 170 MG/pumping season (April to Nov)

Level of Curtailment Imposed (May thru October) 20%

Flows in San Lorenzo River are Critically D 90% exceedance

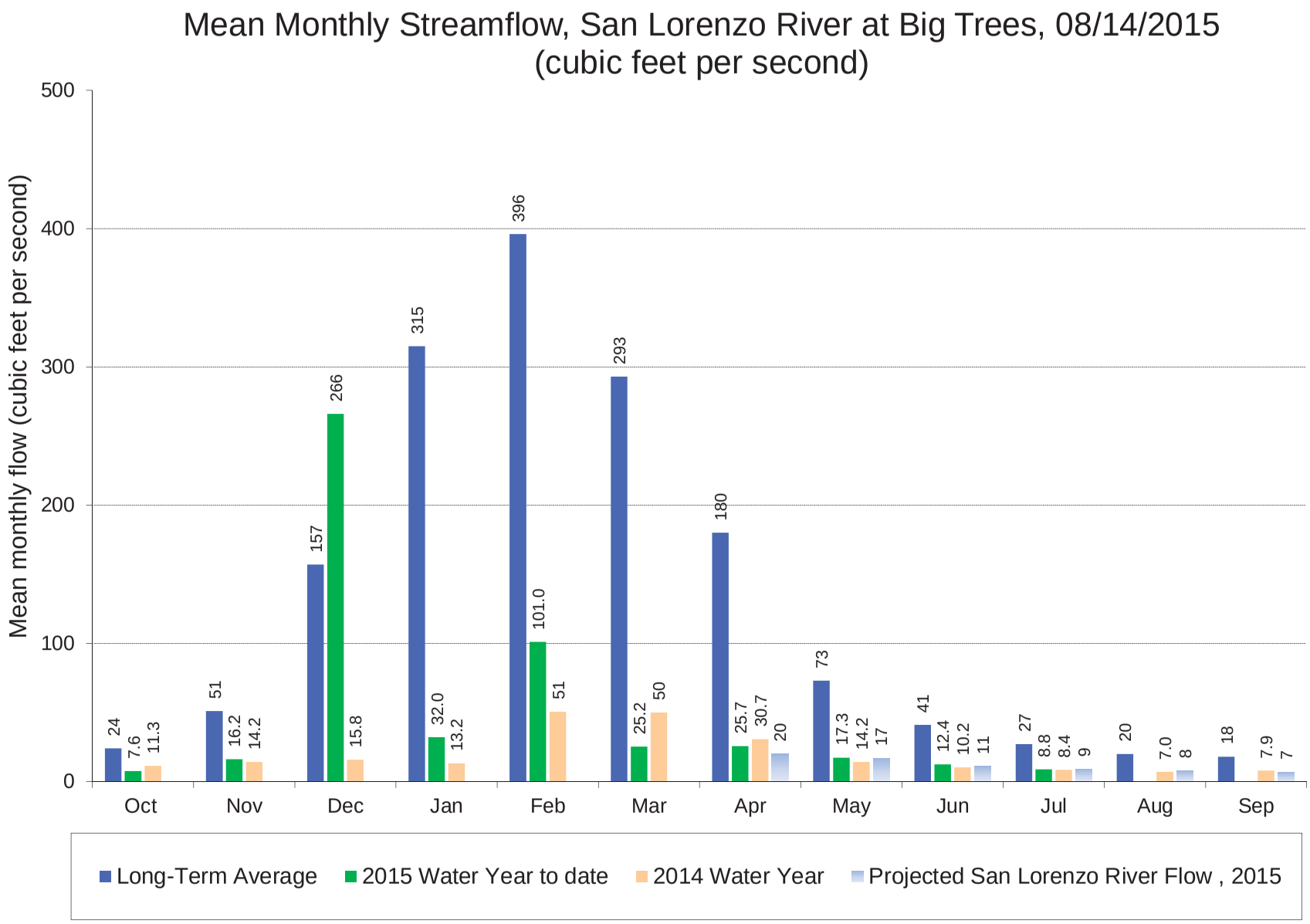
Flows in Coast source(s) are 100% of 2014 Production

Projected unconstrained system demand based on 100% of 2013 monthly demand, to be consistent with state reporting.

Assumptions for Loch Lomond Reservoir include: starting elev at 568.5 (82.9%), no additional pumping from Felton Diversion, & no significant natural inflow after March. 568.5

Newell Creek Fish Release - Assume Temporary Urgency Petition remains in place - 0.2 cfs

Projected San Lorenzo River Flow 2015 (cfs)	20	17	11	9	8	7	7
Additional Inflow below Felton	2.0	1.3	0.3	0.0	0.0	0.0	0.0
Flow at Tait St Diversion (cfs)	22.0	18.3	11.3	9.0	8.0	7.0	7.0
Continuous Release past Tait (cfs)	9.0	5.0	3.0	3.0	3.0	3.0	3.0
Release Buffer (cfs)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Intermittant Release (6cfs*12 hours/2days/week)	1.0	1.0	1.0	0.85	0.85	0.85	0.85
Available Flow (cfs)	12.5	12.8	7.8	4.7	3.8	3.0	3.0
Production (mg)	225	232	156	80	65	49	51
Bypass Release as % Total Flow @ Tait	40.9%	27.3%	26.5%	33.3%	37.5%	42.9%	42.9%
Actual San Lorenzo River Flow (cfs)	25.7	17.3	12.4	8.8			
Pleasure Point Monitoring Well Projected Groundw	8.3	6.1	5.2	4.6	4.1	3.7	3.4
2013 Demand	265	328	325	338	332	301	301
2014 Demand	228	259	251	253	239	213	225
80% of 2013 Demand	212	262	260	270	266	241	240
Mgd	7.6	8.5	8.7	8.7	8.6	8.0	7.8


Mean Monthly Streamflow, San Lorenzo River at Big Trees, 08/14/2015
(cubic feet per second)
Mean monthly flow (cubic feet per second)
500
400
300
200
100
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
24
7.6
11.3
51
16.2
14.2
157
266
15.8
315
32.0
13.2
396
101.0
51
293
25.2
50
180
25.7
30.7
20
73
17.3
14.2
17
41
12.4
10.2
11
27
8.8
8.4
9
20
7.0
8
18
7.9
7
Long-Term Average
2015 Water Year to date
2014 Water Year
Projected San Lorenzo River Flow , 2015

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WATER COMMISSION
INFORMATION REPORT

AGENDA OF: August 24, 2015

TO: Water Commission

FROM: Nicole B. Dennis
Fiscal Office

SUBJECT: Financial Impact of Drought

RECOMMENDATION: Receive information regarding the Financial Impact of the Drought on Water Department Revenues in FY 2015 and projected revenues in FY 2016.

BACKGROUND: As described, in detail, in a separate report agendized before the Commission; the City of Santa Cruz is facing a fourth year of drought and a second consecutive year of mandatory reduction of 25% in water use. The community has met and exceeded this goal. While the community's actions have helped to preserved water supply in the reservoir, the reduction in consumption has had a significant impact on water sales revenues.

DISCUSSION: On September 23, 2014, the City Council took a number of actions to improve the financial status of the Water Department. Included in the actions were the creation of a Drought Cost Recovery Fee (DCRF) and a series of five 10% rate increases on both the fixed and volumetric portions of the water bill.

The DCRF was instituted to mitigate the impact of lost revenues due to drought. The amount of the DCRF is tied to both meter size and the stage of drought declared and approved by the City Council. The DCRF related to the 2014 drought was designed to recover $2.25 million in lost water sales revenue in FY 2015. The amount of DCRF revenue that will be recovered in FY 2016 is $2.95 million.

FISCAL IMPACT: For FY 2015, water sales revenues which include both the DCRF and a 10% increase beginning October 2014 were down $2.1 million or a 9% reduction from the base year of FY 2013 as illustrated in the table on the following page:

	FY 2015
FY 2013 Base Year Revenues	$24,057,800
Actuals	$21,945,219
Difference $	($2,112,581)
Difference %	(9%)
DCRF Amount	$2,250,000
Impact w/o DCRF	($4,362,581)
Impact w/o DCRF %	(18%)

The FY 2015 projected ending fund balance for the Water Enterprise Fund (Fund 711) is $5.5 million and the projected balance in the System Development Charge Fund is $2.6 million.

In FY 2016, the community is on target to reduce water usage more than the 25% requested by the Department. The following table illustrates the impact on water sales revenues with 25% and 35% reduction in consumption.

	FY 2016	FY 2016
FY 2013 Base Year Revenues	$24,057,800	$24,057,800
25% Reduction	$25,166,286	
35% Reduction		$23,858,912
Difference $	$1,108,486	($198,888)
Difference %	5%	(1%)
DCRF Amount	$2,954,573	$2,954,573
Impact w/o DCRF	($1,846,087)	($3,153,461)
Impact w/o DCRF %	(8%)	(13%)

If it were not for the DCRF, the impact on water sales revenue would be even greater despite the second water rate increase of 10% taking affect July 1, 2015.

In order for the Department to meet the financial requirements of the operating and capital improvement budgets, the Department plans to issue at least $30 million in new debt this fiscal year.

PROPOSED MOTION: Accept information regarding the Financial Impact of the Drought on Water Department Revenues in FY 2015 and projected revenues in FY 2016.

WATER DEPARTMENT
MEMORANDUM

DATE: August 18, 2015

TO: Water Commission

FROM: Toby Goddard

SUBJECT: Water Loss Control Project

RECOMMENDATION: Motion to receive and accept a status report.

BACKGROUND: The City of Santa Cruz water system provides water service to approximately 95,000 people within a 20-square mile service area through an underground distribution system consisting of 272 miles of pipeline and some 26,792 individual water and fire service connections. Like all urban water suppliers, a portion of the water entering the aging distribution system from the City's water treatment facilities is lost in delivery to the customer.

The Water Conservation Office has conducted an annual water audit of the City's water distribution system since 1997. Water audit results indicate average system water loss from 2001 to 2010 is approximately 7.5 percent of total treated water production. Of this amount, it is estimated that 5 to 6 percent is lost due to physical leakage in the distribution system, also referred to as "real" losses, including leaking service lines, valves, fittings, and water mains. It is estimated that another 1 to 2 percent is not physically lost but goes unreported on the billing system primarily due to sales meter inaccuracies, billing and accounting errors, and other factors. This second category of losses, labeled "apparent" losses, has a negative impact on both utility revenue and on consumption data accuracy. In 2012, system water losses rose to 10.8 percent and then dropped back to 9.2 percent in 2013. Results of the 2014 audit are still outstanding.

As the need to manage water resources with a greater sense of stewardship and efficiency grows, water suppliers around the world are increasingly focused on taking steps to control and minimize system water losses. These efforts have led to new approaches to characterize and account financially for distribution system water losses, and improve the overall operational efficiency of water systems.

Accordingly, one of the fundamental measures recommended in the City's proposed Water Conservation Master Plan is for the City to contract with a firm specializing in water loss control to examine the City's water system and operations practices to better validate where losses are occurring, evaluate options, and set forth a formal strategy to improve water accountability and reduce lost water. In addition, as a member of the California Urban Water Conservation Council,

the City is committed to implementing listed Best Management Practices, which requires taking additional steps to support water loss control activities.

DISCUSSION: The Water Department issued a Request for Proposals in March 2015 and received four proposals by the April 15, 2015 deadline. Proposals were reviewed and rated for their proposed approach, technical qualifications and experience in evaluating water loss and designing water loss control programs, and project cost. Water Systems Optimization, Inc. of San Francisco (WSO) was judged to provide the best overall proposal. The City Council subsequently approved a contract with WSO on May 23, 2015.

WSO was formed in 2002 and is an industry leader specializing in water loss management in North America. The project director, Reinhardt Sturm, is a recognized international expert in the field. The company has successfully provided water and revenue loss management professional services to some of the largest water utilities in the United States, including 30 water utilities in California. The company has led research projects, helped author water industry manuals, and conducted training for various organizations, including the California Urban Water Conservation Council, Alliance for Water Efficiency and the U.S. EPA.

WSO's proposal, including its work plan for this project (see page 15 of the proposal), is included as Attachment 1. In summary, the proposed scope of work is organized into three tasks, involving the following elements:

1. Water audit validation, to assess the accuracy of the system input meters and data transfer systems, and to perform a business process review of meter testing, reading, and billing activities;

2. Component analysis of real losses, to quantify the volume of different types of leaks and determine the economic level of leakage – the balance between the value of the water that is lost through leakage and the cost of finding and fixing leakage or reducing leakage through pressure management; and

3. Water loss program design to outline the most cost-effective strategies for reducing both real and apparent losses over time.

The project began in July and will take approximately 9 months to complete. The project involves an internal team approach that includes input and assistance from almost every section of the Water Department, including Administration, Production, Engineering, Distribution and the Meter Shop, Customer Service, and Conservation.

The results of the most recent 2013 water audit are provided as Attachment 2. Also attached is a staff report prepared last year for the Water Supply Advisory Committee on system water losses and water loss control (Attachment 3) and the introductory chapter of the AWWA manual on water audits and loss control programs (Attachment 4) for additional information.

Attachments
1. WSO Proposal/Work Plan
2. 2013 Water Audit and Water Balance
3. System Water Losses and Water Loss Control

4. AWWA Manual M36, Chapter 1

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City of Santa Cruz

Water Audit, Component Analysis and Design of Water Loss Control Program

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WATER SYSTEMS OPTIMIZATION, INC.

WSO

PROPOSAL SUBMISSION

DUE APRIL 15, 2015

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RFP COVER PAGE

April 13, 2015
To: Mr. Neal Christen, Water Conservation
City of Santa Cruz
212 Locust St., Suite B
Santa Cruz, CA, 95060

2. **Proposal Response Sheet**
The undersigned, upon acceptance, agrees to furnish the following in accordance with the specifications and terms and conditions per City of Santa Cruz "Request for Proposals for **Water Audit, Component Analysis and Design of Water Loss Control Program**" dated **March 2015**, at the prices indicated herein.

The undersigned, under penalty of perjury, declares not to be a party with any other business to an agreement to bid a fixed or uniform price in connection with this proposal.

The unsigned declares under penalty of perjury that she/he is authorized to sign this document and bind the business or organization to the terms of this contract.

The undersigned recognizes the right of the City of Santa Cruz to reject any or all proposals received and to waive any informality or minor defects in proposals received.

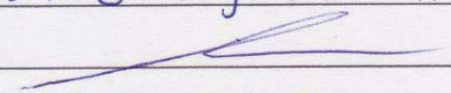
Consultant Name: WATER SYSTEMS OPTIMIZATION, INC.

Address: 290 DIVISION ST. STE 311, SAN FRANCISCO, CA, 94103

Telephone Number: 415-538-8641

Fax Number: 814·286·1556

E-mail address: reinhard.sturm@wsoglobal.com

Signature of Authorized Representative: 

Printed Name of Authorized Representative: REINHARD STURM

3. **Addenda**
The City may determine it is necessary to revise any part of this solicitation. Revisions will be made by written addenda and it is the Consultant's responsibility to comply with any addenda to this solicitation. Any addenda will be:
- Emailed to known interested vendors, or
- Posted on the City's website, www.cityofsantacruz.com, under Bidding Information, or

Consultants may contact Neal Christen, Water Conservation Representative, at **831-420-5235** or email **nchristen@cityofsantacruz.com.**

How many addenda were issued for this solicitation? 1 Addendum was issued on 4/10/15

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WATER SYSTEMS OPTIMIZATION PROPOSAL

1 BACKGROUND & QUALIFICATIONS

National Leaders in Water Loss Management

Water Systems Optimization (WSO) was formed in 2002 and is the industry leader in water loss management in North America. Our work to date shows our expertise and dedication**: we teach, design, and implement water loss control – it's the only focus of our services.**

WSO has extensive experience the American Water Works Association's (AWWA) recommended water loss management and assessment methodologies. In fact, WSO was instrumental in developing these best practices through its involvement with the AWWA Water Loss Control Committee, which introduced and adapted the international best practices in water loss assessment and management for North American applications.

While a number of consultants are now utilizing the AWWA free water balance software to undertake top-down water audits – WSO is one of the few specialized companies with the necessary knowledge and experience to combine the top down water audit with **a detailed component analysis of real and apparent losses.** WSO has developed its own proprietary software package, AuditSolve™, for these analyses. By conducting detailed component analysis, we are able to calculate economically optimum levels of real and apparent losses, a critical step in the design of the most cost effective water loss control program for the City of Santa Cruz ("the City").

Beyond our work with water agencies, WSO contributes to the field of water loss control through its research. WSO was th**e lead firm on two key water loss related research studies** for Water Research Foundation (formerly AwwaRF):

- "Leakage Management Technologies" (Project #2928)
- "Evaluating Water Loss and Planning Loss Reduction Strategies" (Project #2811)

In 2012, WSO solidified its role as the nation's top water loss specialist upon selection to complete the WaterRF project #4372, Effective Organization and Component Analysis of Water Utility Leakage Data. All of these studies have been published by the Water Research Foundation to provide North American water utilities with guidance on their water loss management activities.

WSO consistently works to advance the water loss control industry nationwide. WSO team members are established members of the AWWA Water Loss Control Committee and the International Water Association (IWA) Water Loss Task Force. For example, Reinhard Sturm, Chief Operating Officer WSO, is the chair of the AWWA Water Loss Control Committee Real Losses Subcommittees and in charge of updating the Real Loss Section of the Association's reference on water loss, the M36 Manual.

Proven and Unmatched Water Loss Control Expertise: WSO's unmatched experience in this field is best summarized by the following achievements:

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- Lead research firm on all three WaterRF (formerly American Water Works Research Foundation) water loss related research studies
- Instrumental in introducing and promoting current water loss assessment and management best practices in the United States
- Successfully provided water and revenue loss management professional services to some of the largest water utilities in the U.S. e.g. Los Angeles Department of Power and Water, San Antonio Water Systems, Eastern Municipal Water District, Philadelphia Water Department, City of Phoenix, Nashville Metro Water, San Francisco Public Utilities Commission, Orlando Utilities Commission, City of Sacramento, etc.
- Successfully provided water and revenue loss management professional services to more than **30 water utilities in California**
- WSO, has a detailed and unmatched understanding of water loss management challenges in California. The Association of California Water Agencies (ACWA) has selected WSO as the preferred provider of Water Loss Management and Control Services for its member agencies, due to our proven knowledge of water loss control in North America and California and our commitment to service excellence.

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2 PERSONNEL

2.1 WSO Organizational Structure

WSO has an established team of water loss control experts. The company is organized as displayed in Figure 1. WSO has an office in San Francisco, CA and Nashville TN.

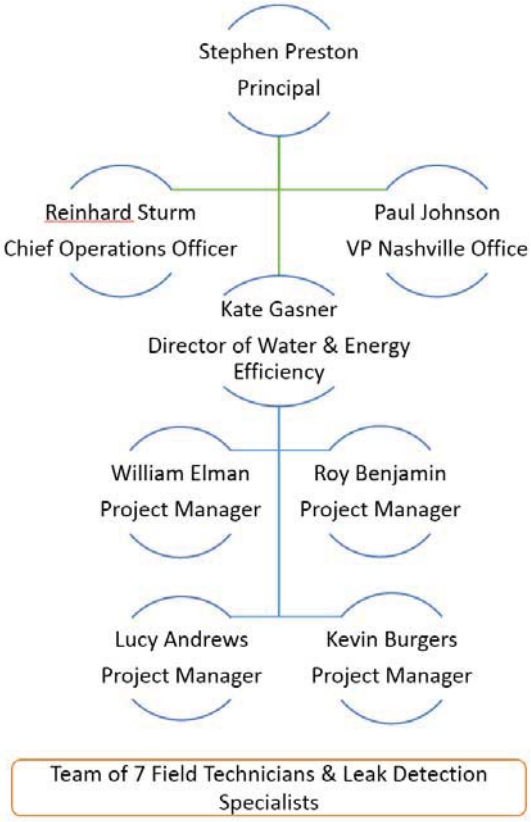

Figure 1: WSO Organizational Chart

2.2 Team Member Qualifications

WSO is able to provide a team of distinguished water loss management industry experts. Each of the key team members is an acknowledged specialist in water loss management – nationally and internationally. Our team seeks to do the very best work: our publications, our leadership in international and national professional associations, our long track record of highly successful water loss reduction projects, and the development of new software and water loss calculation models speak to our dedication and expertise. With the WSO team, the City is guaranteed to receive analysis and advising that incorporates the latest technologies and methodologies.

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Reinhard Sturm – Chief Operating Officer - WSO

Project Director

Firm
WSO

Education
University of Natural Resources and Applied Life Science, Vienna, Austria

M.SC. in Environmental Engineering 1998

Principal Office Address
290 Division Street, Ste. 311 San Francisco CA, 94103

15 Years of Experience

Professional Affiliations
International Water Association (IWA)

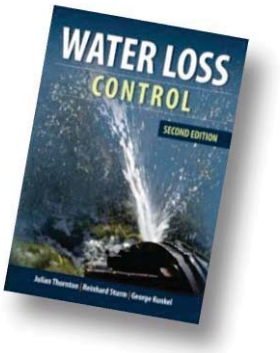
Water Loss Control Committee of the American Water Works Association (AWWA) and

Chair of the AWWA Real Losses Subcommittee

Reinhard Sturm is Chief Operating Officer for WSO. Reinhard has worked on Water Loss Control projects throughout the world, including countries such as USA, Canada, Malaysia, India, Sri Lanka, Kazakhstan, Egypt, and Moldova. For the past twelve years he has been involved in some of the biggest Water Loss assessment and reduction projects in the U.S.

Reinhard was the Co-principal investigator for the AwwaRF research project #2928 "*Leakage Management Technologies*" where he was the lead researcher and lead author in addition to being responsible for the successful management of the project. This very prestigious research project, published in August 2007, provides North American water utilities with detailed guidance on the most up to date and most applicable leakage management technologies such as DMA's and advanced pressure management. Reinhard is also a co-author of the AwwaRF research report "*Evaluating Water Loss and Planning Loss Reduction Strategies*".

Reinhard currently serves as the Principal Investigator for the WaterRF project #4372, Effective Organization and Component Analysis of Water Utility Leakage Data. This clearly highlights Reinhard's reputation as a leading expert in water loss control with unmatched expertise in component analysis. Reinhard is furthermore the co-author of the professional manual published by McGraw Hill – "*Water Loss Control – 2nd Edition*". Reinhard has published more than 15 specialized papers on various topics related to water loss management, his latest publication was a peer reviewed article in the AWWA Journal on PWD's real loss control activities utilizing DMA's and pressure management to manage leakage losses.



Reinhard is actively involved in the International Water Association – Water Loss Task Force (WLTF) where he served two terms as technical secretary and he is also actively involved in the American Water Works Association – Water Loss Control Committee (WLCC), where he participated in the update of the AWWA M36 manual and the AWWA water audit model. As chair of the AWWA Real Losses Subcommittee, Reinhard is currently in charge of updating the real losses chapter of the AWWA M36 update.

In 2006, Reinhard was invited by the California Urban Water Conservation Council (CUWCC) to act as technical advisor on their revision of a best management practice for reduction of Non-Revenue Water. He has since then advised the council on how to assess and economically reduce all components of Water Loss and conducted several successful water loss management workshops for the CUWCC. In August 2010, the CUWCC selected Reinhard to provide several 2-day workshops to its member agencies

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on the implementation of BMP1.2 and the use of the AWWA water audit model. Most recently Reinhard conducted Water Loss webinars for the WRF, CUWCC, the Alliance for Water Efficiency and the EPA.

Some of the Water Loss assessment and reduction projects Reinhard recently managed for clients such as the California Department of Water Resources (2014 – ongoing), City of Sacramento (2014 – ongoing), SAWS (2014 – ongoing), LADWP (2012 – 2013), SSWA (2012 – ongoing), WaterRF (2012 – ongoing), EMWD (2011 – 2012), City of Hayward Utilities Department (2010 – 2011), the City of Folsom Utilities Department (2008 to present), Southern California EDISON, LVMWD, AVRWC, LACSD (2008 to 2009), Contra Costa Water District (2009), City of Phoenix Water Services Department (2008 to 2010), Philadelphia Water Department PWD (2003 to 2007 and 2007 to 2011 and 2011 to present), San Francisco Public Utilities Commission SFPUC (2005 to 2007), and El Dorado Irrigation District EID (2005). All of these projects included components very similar to the tasks outlined in the current statement of qualifications.

Stephen Preston, President - WSO

Technical Project Advisor

Firm
WSO

Education
Graduateship of Royal Society of Chemistry (Pt1 with Practical) – Preston Polytechnic

HNC Chemistry – Wigan College of Technology

HNC Civil Engineering – Wigan College of Technology

Principal Office Address
290 Division Street, Ste. 311 San Francisco CA, 94103

30 Years of Experience

Stephen Preston is President of WSO. He is also Managing Director of WSO's parent company, Waterframe Limited and is also Managing Director of the WSO's sister companies in Papua New Guinea and Malaysia. He has 30 years experience of water distribution system design, operation, network modeling non-revenue water and leakage management. He has worked in many countries worldwide including USA, UK, Middle Eastern, African, Asian and Pacific regions. He developed highly successful Non-Revenue Water reduction projects in Malaysia and Papua New Guinea. In 2003, Stephen developed the Port Moresby Non-Revenue Water Reduction project for WSO's sister company, Water Systems Optimization (PNG) Limited. This three-year performance-based non-revenue water reduction contract was successfully completed under Stephen's direction in June 2006, and delivered a reduction in non-revenue water in excess of 9 million gallons per day out of a starting production level of 45 million gallons per day. The annual savings to the client water company is of the order of $2.5 million.

Stephen has extensive experience in creating DMA's and implementing pressure management schemes, having successfully implemented several system-wide DMA and pressure management schemes over the past 30 years. Stephen was

involved in the original development of the Burst and Background Estimate (BABE) software concepts used for component analysis, and he developed numerous water loss modeling and pressure management software suites during his career. Most recently he developed modeling software for component analysis of real losses, allowing for target setting and selection of appropriate intervention strategies against real losses. He also authored WSO's AuditSolve™ software for carrying out comprehensive validated audits in North America, including component analysis of real and apparent losses. Most recently Steve developed the NRWmanager™, an online data viewing and reporting system for Non-Revenue Water management, which is currently being implemented for the City of Folsom, CA.

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Recent WSO contracts that Stephen has participated in include the series of Nashville Water Audit contracts carried out from 2004 to 2011, the Phoenix Water Audit of 2004 and 2008-09, the Technical Assistance with the Philadelphia Water Departments' Long Term Water Loss Management Strategy projects, and the Southern California EDISON - Water Leak Detection Program and Water System Loss Control Study, and the City of Folsom Water Audit and 2-Year Water Loss Control Program

In 2009, Stephen established WSO Malaysia in the State of Sabah, Malaysia to provide specialist technical support for Non-Revenue Water reduction projects being carried by the Sabah State Water Department in the towns of Kota Kinabalu, the state capital of Sabah, and the more remote provincial towns of Tawau, Lahad Datu and Semporna.

Katherine Gasner, Director of Water and Energy Efficiency - WSO

Project Manager

Firm
WSO

Education
Yale University, Environmental Engineering, 2009

Principal Office Address
290 Division Street, Ste. 311 San Francisco CA, 94103

4 Years of Experience

Kate is the Director of Water and Energy Efficiency for WSO working on Water Loss reduction projects throughout California and the US. In the Water Loss Control field, she has worked on all aspects of the preparation of a standard AWWA water audit and component analysis of real losses, including meter testing, flow and pressure data collection and analysis, detailed billing data analysis, and leakage modeling. Kate managed the water audit and detailed component analysis projects for Eastern Municipal Water District and the Los Angeles Department of Water and Power. Kate also managed all the participating utilities and literature review work in the latest Water Research Foundation project on water loss control (#4372).

Before joining WSO, Kate held leadership positions with The Artemis Project and Imagine H2O. She managed the international "Water Energy Nexus" prize competition for entrepreneurs with ventures in water.

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3 WATER LOSS CONTROL EXPERIENCE

WSO has undertaken the largest non-revenue water (NRW) management projects in the United States over the last decade: most recently, we have produced water loss control plans for the Los Angeles Department of Water and Power (LADWP), Eastern Municipal Water District (EMWD), and San Antonio Water System (SAWS) – all of which are provided as reference. Additionally, please reference Table 1 for a list of recent work that feature the same services that the City will include in their upcoming program (note that it is not comprehensive).

In addition to consultancy services, WSO also carries out major water loss intervention contracts. For example, we have an ongoing water loss control service contract for the city of Nashville, TN. This 5-year contract involves setting up of temporary district metered areas (DMA's), measuring flow and pressure and then analyzing that data to determine leakage levels, prioritize the DMA's for leak detection, and then provide leak detection survey services to identify unreported leaks. All these services are provided in-house by WSO, while the City's direct labor workforce repairs the detected leaks.

We're also currently working with the City of Folsom, California on a water loss intervention program. Under this contract WSO is sustainably reducing the city's water loss volume to an economically optimum volume through proactive leak detection and pressure management over the course of two years. WSO is also installing a permanent water loss monitoring system, utilizing the city's SCADA system and their Advanced Metering Infrastructure (AMI). This monitoring system will allow the city to continuously monitor the water loss level in each of their pressure zones, only intervening to conduct leak detection when it is economically justified.

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Table 1: Related Experience Matrix – Select Water Loss Control Projects in WSO's Portfolio

RECENT and RELEVANT PROJECTS / TASKS		TASK 1: WATER AUDIT REVIEW	TASK 2: COMPONENT ANALYSIS	TASK 3: WATER LOSS CONTROL PROGRAM DESIGN
Los Angeles Department of Water & Power	2012 – 2013 Ongoing	✓	✓	✓
Water Loss Audit & Component Analysis; NRW Reduction Strategy				
San Antonio Water System	2013-2014 Ongoing	✓	✓	✓
Water and Revenue Loss Management Services				
Eastern Municipal Water District	2011-2012 Ongoing	✓	✓	✓
Water Loss Control Program & NRW Reduction Strategy				
Nashville Metro Water Services	2004 - Ongoing	✓	✓	✓
Detailed Water Audits & Leakage Control Program				
Coastside County Water District	2014 - Ongoing	✓	✓	✓
Water Audit & Water Loss Control Program Implementation				
San Diego Gas & Electric / City of San Diego	2015 - Ongoing	✓	✓	✓
Leak Loss Detection, Remediation & Pressure Management				
Moulton Niguel Water District	2014	✓	✓	✓
Preparation of Water Balance & Water Loss Program				
Philadelphia Water Department	2003 - Ongoing	✓	✓	✓
Technical Assistance with Long Term Water Loss Management Strategy				
City of Folsom Utilities Department	2011-2012 2014 - Ongoing	✓	✓	✓
Water Audit & 2-Year Water Loss Control Program				
City of Hayward	2010 - 2011	✓	✓	✓
Detailed Water Audit and Component Analysis				
Southern California EDISON	2008-2009 2013-2014	✓	✓	✓
Water Leak Detection Program and Water System Loss Control Study (most recently featuring 5 water agencies' participation)				
City of Panama City	2008	✓	✓	✓
AWWA Standard Water Balance and Audit				
San Francisco Public Utilities Commission	2005 to 2007	✓	✓	✓
Detailed Water Audit and Component Analysis				
City of Phoenix Water Services Department	FY07-08	✓	✓	✓
Water Loss Study & Development of NRW Reduction Strategy				

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The following skills – beyond the experience and reference projects described above – uniquely qualify this project team for the City's Water Loss Control Program:

Experience with Scope & Scale: As the reference projects above detail, the project team leads the water loss control field in experience of managing large programs. Such experience is coupled with cutting edge research and comprehensive understanding of best practices.

Clear Communication: The project team has a proven track record of clearly communicating the technical concepts of water loss control programs. Thorough and timely communication of the project's findings, obstacles, and planning is a key piece of the project team's approach.

Prompt Delivery: The project team prides itself on strict adherence to timeline of deliverables.

Training & Transfer of Knowledge: The project team appreciates the importance of ensuring the program's maintained impact and longevity through training and education.

Please see Table 1 and Exhibit A for details on relevant experience and details of similar programs.

4 LOCATION

The WSO team will be performing work from the San Francisco office, located at 290 Division St. Suite 311, San Francisco, CA, 94103.

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5 CLIENT REFERENCES

Client Reference #1: Los Angeles Department of Water and Power

Client:	Los Angeles Department of Water And Power
Project Title:	Water Audit and Component Analysis Program
WSO Lead and Key Personnel:	Reinhard Sturm, Project Director
Project Manager:	Katherine Gasner
Contact Person:	Ms. Penny Falcon, P.E.
Title:	Manager of Water Conservation Policy, Legislation and Grants
Telephone Number:	(213) 367-4647
Email:	Penny.falcon@ladwp.com
Project Start Date:	2012
Project Completion Date:	Ongoing (in a technical advisor role now)

In 2012, the Los Angeles Department of Water and Power (LADWP) hired WSO after a competitive bidding process to undertake a Water Loss Audit and Component Analysis Project examining the efficiency of the water LADWP distribution system and non-revenue water management practices. Specifically, WSO was tasked to investigate the current ability to accurately identify real and apparent losses; determine the economic optimum level of water losses; and identify, prioritize, and recommend the most efficient and cost-effective loss intervention strategies to minimize water loss. WSO is currently contributing to the "Water Loss Task Force", which is taking our recommendations and developing business plans around next steps toward implementation.

Services Provided & Notable Findings:

- Evaluated existing reports and documents on Non-Revenue Water management.
- Conducted a detailed assessment of the system input volume through data validation and inspections. Found significant areas of improvement for metering at a treatment plant site.
- Compiled an independent standardized IWA/AWWA water balance and assigned 95% confidence limits to each component of the water balance and determined which of those components contributed the highest level of error.
- Validated consumption components of the water balance: this included an initial data integrity review and in later years featured an effort that segregated consumption by flow and volume brackets for meter and service types to allow for a first look at potential under and over sized meters.
- Initiated small meter test samples to better calculate apparent losses by size category. Determined that the small meter population is operating at a relatively high level of accuracy. The economic analysis showed that at present there is no economic case for any immediate action on widespread small meter replacement. However, WSO isolated the worst performing, most economic, meter groups (by size and make) for a targeted meter replacement program.
- Reviewed current work order management system for leak data collection to provide recommendations for improvements and conducted a component analysis of real losses.
- Evaluated the practices and programs of the LADWP's Meter Shop to maximize data collection on meter accuracy and control of apparent loss volumes. The maintenance of the large meter

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population was reviewed in depth, and the overhaul schedule was analyzed and an optimized replacement schedule was developed to achieve two main goals: 1) LADWP will be able to implement the large meter maintenance schedule with its current work force, 2) potential revenue loss due to under-registration from large meters will be reduced to an economic optimum.

- Helped LADWP evaluate if DMA technology is an appropriate and worthwhile piece of LADWP's overall water loss control activity portfolio by implementing three temporary DMAs.
- Analyzed field pressure data collected during the study to provide recommendations for advance pressure management options.
- Conducted an economic analysis of real losses to design an economically optimized real loss control strategy. Even though LADWP's real losses are low compared to most water utilities with 3.5% real losses, the analysis conducted by WSO clearly showed that there is an economic incentive to implement proactive real loss control (proactive leak detection, advanced pressure management, and the use of pressure zones for permanent water loss monitoring) and further reduce real losses. This is largely due to the relatively high cost of water and existing conservation targets. The real loss control program developed by WSO was identified as an additional component of LADWP's overall conservation portfolio and water resources management strategy.
- Developed a five-year apparent loss control program for reducing apparent losses to economically efficient levels and a 10-year real loss control program for reducing real losses to economically efficient levels.

Our work with LADWP is very similar in scope to the proposed City of Santa Cruz program. Long-term water loss control plans were devised after detailed and thorough assessment of the system's initial water loss baseline and cost-effective options.

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Client Reference #2: Eastern Municipal Water District

Client:	Eastern Municipal Water District
Project Title:	Water Loss Control Program FY13/14
WSO Lead and Key Personnel:	Reinhard Sturm, Project Director
Project Manager:	Katherine Gasner
Contact Person:	Mr. Khos Ghaderi
Title:	Director of Water Operations
Telephone Number:	(951) 928-3777, ext.6240
Email:	ghaderik@emwd.org
Project Start Date:	2011
Project Completion Date:	2012

In 2011, Eastern Municipal Water District (EMWD) hired WSO after a competitive bidding process to work on the "Water Loss Control Program" contract. This work involves validation of all water balance volumes, a component analysis of real losses, and the design of a cost-effective water loss control program.

Services Provided & Notable Findings:

- Complete review of water audit data resulted in significant improvement recommendation on the maintenance of production meters. Accuracy tests resulted in low confidence in some of their primary production meters.
- Thorough examination of the billing database unveiled opportunities to properly categorize authorized consumption accounts.
- Random small meter accuracy testing provided for improved apparent loss calculations. Overall, it was found that the meter stock was performing well: there was no strong economic case to do immediate replacements of any one size or model of meter. Instead, ongoing testing program was outlined. Meter testing also unveiled important inconsistencies in meter characteristic data filed in the billing database.
- Compiled an independent standardized IWA/AWWA water balance and assigned 95% confidence limits to each component of the water balance and determined which of those components contributed the highest level of error.
- Following a component analysis of real losses, a real loss control plan was designed and detailed. This included a plan for improved repair response times, leak detection, and pressure management recommendations.

WSO was hired again to revisit and reevaluate EMWD's water loss program in 2015.

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Client Reference #3: San Antonio Water System

Client:	San Antonio Water System
Project Title:	Water And Revenue Loss Management Services
WSO Lead and Key Personnel:	Reinhard Sturm, Project Director
Project Manager:	Katherine Gasner
Contact Person:	Mr. Patrick Shriver
Title:	Water Resources Project Coordinator
Telephone Number:	210.233.3687
Email:	Patrick.Shriver@saws.org
Project Start Date:	2013
Project Completion Date:	Ongoing (as technical advisors)

At the end of 2013, WSO was selected in a competitive bid process to work with San Antonio Water Systems on the development of a Non-Revenue Water management plan. Over the course of the program, WSO found sizable opportunities for real loss savings and unbilled-unmetered authorized consumption reduction.

Services Provided & Notable Findings:

- Validating all production data for the water balance revealed numerous opportunities to improve the accuracy of the System Input Volume: well field operation recommendations were developed and meter tests were conducted.
- Unbilled unmetered uses were estimated at all well sites (used for lubrication of well pumps) and evaluated for significant savings.
- Billing data was evaluated for consistency and accuracy: procedures around flagging sequential zero reads on active accounts were detailed.
- Random sample of small meter tests were conducted to enhance the understanding of apparent losses. We designed a testing schedule and database so that SAWS will be able to initiate meter replacement when a certain meter size-make group reaches the threshold where meter replacement becomes an economically viable option based on its inaccuracy.
- A component analysis of real losses was completed. Though all of the information required for a component analysis was captured, we determined the quality and reliability of the input data needed improvement. We provided a template for capturing more complete data.
- An intervention analysis was designed to examine the costs of hiring more repair crews and benefits of reducing leakage run times.
- Given the component analysis results and a concurrent pilot leak detection program, we developed cost-effective a leak detection program that would reduce unreported leakage to an economically efficient level.
- A program for collecting pressure data and initiating a pressure management program was detailed.

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6 WORK PLAN

WSO is uniquely equipped to develop a viable Non Revenue Water management strategy and implementation plan for the City. Our proposed work plan follows this framework:

1. Comprehensively review of each water audit volume.
2. Conduct a component analysis of water losses.
3. Design a cost effective water loss control program.

Throughout the project, WSO will lead the adoption and full incorporation of industry best practices in water loss management and accounting for the City. WSO will emphasize training and will support the City's staff in developing the understanding and skills around robust water loss control planning and implementation. The following sections outline the work involved in each of these steps.

TASK 1: WATER AUDIT

TASK 1A: System Input Volume Validation

The first step in assessing water loss will involve full accounting and validation of all inputs into the City's distribution system. Metering error and/or data handling error from the system input or wholesale export meters can significantly impact the water balance calculation. Fully assessing and validating the accuracy of the system input meters, the data transfer systems, and protocols around meter testing is essential to any water loss determination.

1A.1: Review of Raw Production Data & Determination of Total System Input Volume

WSO will review all of the production data for the year of water audit review (the "audit period"). This will involve assessing the data integrity of each system input meter's raw production data. The City's data collection and data management protocols will be reviewed and validated.

1A.2: Assessment of Installation Conditions

The reliability of system input data is directly related to the operating conditions of each system input meter. WSO will determine if the existing system input meters can accurately measure flow based on their installation location, setup and existing technology. WSO will gather and review existing reports, drawings, and documentation on these selected meters (manufacture, type, size, installation requirements, and piping configuration) and will field assess their installation conditions. This will directly inform the analysis of the system input volume accuracy.

1A.3: Assessment of Data Transfer Accuracy

Beyond the accuracy of the meter itself, it's important to validate the accuracy of the system input meter data transfer. This validation step is achieved by testing the accuracy of data transfer from flow meter to the SCADA system using portable data loggers, which will be connected to selected system input meters recording the raw 4-20mA signal. The recorded raw 4-20mA signal will then be converted into flow values according to the meters calibration flow range and compared against the flow data recorded by the SCADA system. Figure 2 shows the results of a 4-20mA signal data transfer analysis for a reservoir raw water meter of a Californian water utility. Here a significant difference between the flow rate recorded by SCADA and the actual flow rate recorded by the raw water meter was detected.

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Identifying these types of data integrity issues is crucial in understanding the reliability of the System Input Volume used for the water balance.

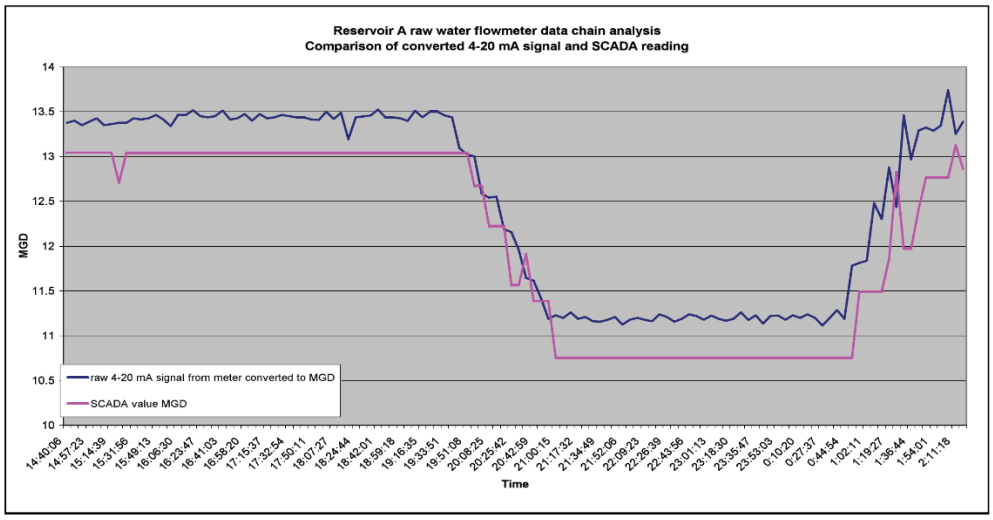

Figure 2: Example of a 4-20mA Signal Data Transfer Analysis

1A.4: Assessment of System Input Meter Testing Procedures & Accuracy Determination

WSO will review the testing procedures currently in place to inform the findings on system input accuracy. The review of this existing test data will directly inform the level of confidence related to each of system input meters and the volume recorded by each system input meter. Where feasible, WSO will identify select meters to carry out accuracy tests.

Task 1A Outcomes:

- *Full examination and assessment of system input meter accuracy*
- *Validated production data (organized by system input meter) for the audit period*
- *Validation of meter installation conditions – are meter installed according to best industry practices?*
- *Validation of system input meter data collection, data management and computation process*
- *System input meter accuracy tests were feasible*
- *Recommendations on modifications for accuracy improvement (in testing protocol and/or meter installation and technology, internal QA/QC procedures for system input volume data)*

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TASK 1B: Consumption Volume Validation

The next step in establishing a validated water balance for the City involves a thorough examination of all consumption volumes. A billing database usually provides the basis for customer bill generation and is a critical component of any utility's financial processing. This database can provide a wealth of information on customer consumption, and the practice of "data-mining" these databases in order to isolate audit relevant consumption data is a critical component of water loss control programs.

1B.1 Validation of Billed Metered Consumption

Meter reading data will be taken from the City's billing system to determine billed consumption. WSO will request the export of the raw billing data for the audit period plus two months on each side of the audit period. This billing data will include, among other things, the meter reads, read dates, and usage for all accounts during the audit period, and all the account details. This raw set of data includes bills with errors, duplicate bills, and bills with estimated consumptions, all of which may have been subsequently corrected and/or cancelled. In "cleaning" the billing database, WSO will determine a reliable volume of billed metered consumption.

WSO has vast experience in analyzing and validating billing databases and has a good understanding of the main challenges utilities face in determining a reliable billed metered consumption for the water balance. We will conduct a detailed examination and validation of the City's billing system.

This examination typically includes, but is not limited to, the following:

- Lag-Time Analysis: this review reveals whether or not the delay between actual consumption and the meter read/bill generation process affects the water balance. Allocation of consumption by month can resolve any problematic lag.
- Consumption Disaggregation by Consumer Type
- Consumption Range Analysis by Meter Size: this breakdown helps identify suspicious accounts (meters reading far above or below the average in their size group)
- Error Flag Review for Estimation Impact
- Impact analysis of consecutive zero consumption reads
- Review of customer classification to identify mislabeled customers

It is important to note that the examination of billing data also directly informs the determination of apparent losses (Task 3).

1B.2 Validation of all Other Consumption Volumes:

Though the billing data will provide a majority of the consumption volume for the water balance, it is important to establish a thorough accounting of all withdrawals from the distribution system (whether metered, unmetered, billed or unbilled). This involves review of all tracking mechanisms and estimations procedures for the following types of consumption:

- Billed Un-metered Consumption
- Un-Billed Metered Consumption
- Un-Billed Un-Metered Consumption

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Task1B Outcomes:

- *Full examination and assessment of billing data integrity*
- *Validated consumption data (organized by type of consumption) for the audit period*
- *Recommendations on billing procedures that would improve accuracy of billing data as a source for aggregate consumption analysis*
- *Meter reading, billing and business process review*
- *Customer use evaluation to identify potential for meter resizing efforts in order to maximize returns to the City and to minimize apparent losses*
- *Breakdown of consumption by meter size and type that will directly inform Task 1.C and Task 3*
- *Meter reading Lag-time analysis and apportioning of monthly consumption if needed*
- *Evaluation of the City's procedures for determining un-metered authorized consumption components*

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TASK 1C: Apparent Loss Volume Determination

Apparent losses can result from meter malfunctions, meter reading errors, data transcription errors, customer accountability problems, inaccurate consumption estimates, and theft. In most utilities the majority of the apparent loss volumes are created by meter malfunctions. The amount of under-registration for any given customer is a function of both the meter accuracy and the consumption profile for that customer. This task will allow for a thorough understanding of the accuracy of the City's meter stock. With important insight from the billing data analysis outlined in Task 1B, the total apparent loss volume for the audit period will be determined.

1C.1 Identify and Analyze Pertinent Existing Meter Test Data

Based on the detailed billing data analysis WSO will identify key categories of meters (usually organized by meter make, size, and age) and will identify and analyze pertinent existing test data. Statistical examination to determine on how representative this existing test data is of the whole meter stock will follow.

1C.2 Consideration and Implementation of Supplemental Small Meter Testing

WSO will also suggest additional meter testing where feasible to ensure sound statistical analysis of the mean accuracy of each meter size and category. The size of test sample that is required is a function of the general condition of the total population of meters. In general, the wider the variation in accuracy that exists in the total population, the larger the size of the test sample needs to be. WSO will review current customer meter data and determine whether or not another round of testing is warranted for this program.

1C.3 Review of Current Large Meter Testing

This stage of the apparent loss analysis involves assessing the appropriate testing and/or overhaul procedures for the City's large meter stock, examining the opportunities for meter right-sizing, and reviewing the current large meter sizing and specification procedures.

Equipped with the billing data analysis, WSO will be able to present a targeted program that highlights the accounts that should be prioritized for testing and at what interval. The analysis here will enhance the City's large meter program to incorporate considerations around consumption and revenue opportunities, improving overall cost-effectiveness.

1C.4 Total Apparent Loss Determination

Given the test results the billing data base consumption analysis, WSO will determine the volume attributed to meter under-registration for audit period broken down by meter size and make. In parallel, WSO will determine the apparent loss volumes attributed to data handling errors and unauthorized consumption (this will involve a review of any documentation and/or assessment of appropriate estimations to apply and a review of the meter reading and bill procedure currently in place).

Task 1C Outcomes:

- *Validation of all apparent loss volumes: small meter under-registration, large meter under-registration, unauthorized consumption, and data handling errors.*
- *Review of current small meter test data*

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- *Creation of statistically representative small meter test data (supplemented by more testing if necessary)*
- *Evaluation of current small meter replacement strategy and recommendations for improvement if applicable*
- *Provide a list of large meter accounts that are candidates for further right-sizing or investigation*
- *Recommend a large meter testing program that prioritizes revenue recovery opportunities*
- *Identify and quantify any obvious errors in data handling and identify unauthorized consumption*
- *Un-authorized water consumption will be identified based on data provided by the City for illegal connections, meter by-passes, fire hydrant misuse, and other un-authorized uses.*
- *Create a short to medium term plan around apparent loss intervention strategies*

TASK 1D: Water Balance Compilation & 95% Confidence Limit Assignment

1D.1 Establish a Validated AWWA Water Balance

Equipped with the findings from each previous task, WSO will finalize the validated AWWA Water Balance and determine the water loss performance indicators for the audit period. Alongside the free AWWA Free Water Audit Software, WSO will provide a version of its in house designed water balance software "Audit Solve". This software also features the results of the component analysis of real losses, 95% confidence limits, ranking of water balance components by level of variance, full set of performance indicators, and graphic comparison of performance indicators against a North American data set and a California data set.

The results of the validated water balance will provide an **independently validated baseline** for water loss volumes for the audit period. In conjunction with subsequent tasks, the results of the validated water balance allow for the design of economically optimized water loss intervention strategies.

1D.2 Determine the 95% Confidence Limits for Each Water Balance Component

The use of 95% confidence limits to validate the degree of uncertainty in individual components of the water balance is currently the best practice among qualified water loss management professionals.

Using 95% confidence intervals allows generating a lower and upper limit for each water balance component. The interval estimate (or lower and upper limit) gives an indication of how much uncertainty there is in the volume used for each water balance component. The narrower the interval, the more precise is the value used. This sub-task will involve reviewing the findings on each water balance input and quantifying the error range as a 95% confidence limit.

Task 1D Outcomes:

- *Independently validated water loss audit and baseline*
- *Copy of the AuditSolve software with water audit results, including 95% confidence limits & performance indicator graphs*
- *Copy of the AWWA Water Audit software with water audit results*

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TASK 2: COMPONENT ANALYSIS OF REAL LOSSES

Using an annual "Breaks and Background Estimates" (BABE) model (also known as a real loss component analysis), WSO will separate the leak and break volumes of real loss into the following categories: background losses, reported leakage, and unreported leakage (see Figure 3). Understanding how the Real Loss volume breaks down into these different components is critical in developing intervention strategies to reduce Real Losses (and will directly inform Tasks 3).

For example, the failure repair data collected for this analysis will allow the project team to model the impact of any improvement in location and repair of both reported and unreported leaks on the annual volume of real losses. Further, this component analysis also allows for modeling the effect a change in system pressure will have on the volume of real losses and its subcomponents. This analysis also provides for understanding how much unreported leakage could be recovered through additional proactive leak detection.

In the process of collecting and reviewing the failure repair data necessary for the component analysis, WSO will help the City enhance the standard leak repair data collection practices and protocols to improve future component analysis and Economic Level of Leakage results.

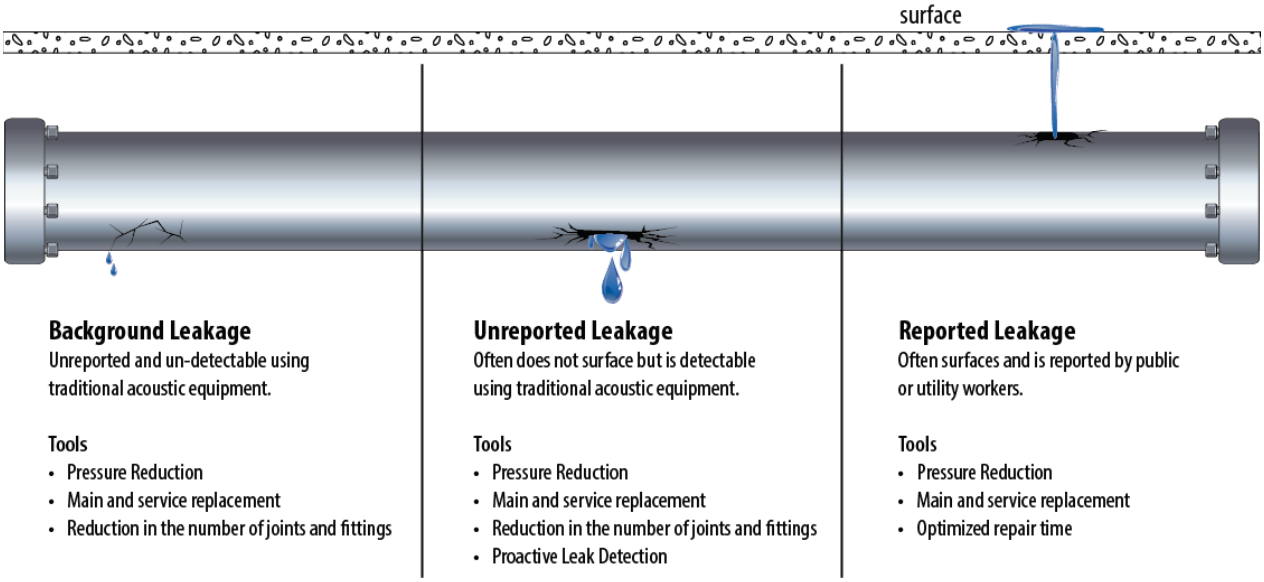

Figure 3: Real Loss Components[1]

2.1 Determination of Background Leakage

WSO will review infrastructure data to determine the volume of background leakage throughout the system. This involves some amount of sensitivity analysis given the system's infrastructure components, system age, operational characteristics and operating pressure.

[1] Graphic courtesy of Water Research Foundation, as featured in "Advances in Water Research", July – September 2014; Volume 24, Number 3.

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2.2 Determination of Reported Leakage

WSO will review all documentation of reported failures for the audit period. Validating the runtimes of each failure instance and estimating flow rates culminates in calculation of water loss attributed to reported leakage.

2.3 Determination of Unreported Leakage

WSO will review any leak detection activity that occurred during the audit period. If applicable, we will validate the runtimes of each failure instance and estimate flow rates to calculate the water loss attributed to unreported leakage.

Task 2 Outcomes:

Real Loss Components Volume Determination

- Identify the volumes of each type of real losses: background leakage, unreported leakage, and reported leakage.
- Quantify the volume of hidden leakage, the volume of unreported leakage that continues uninterrupted throughout the system.
- Quantify the volume of leakage currently lost through reported and unreported leaks that were addressed by the City during the audit period
- Break frequency analysis and comparison to national and international data sets and benchmarks
- The results of the real loss component analysis are crucial for the calculation of the City's Economic Level of Leakage, which will provide the basis of the development of the City's water loss control strategy.

Real Loss Tracking and Process Review:

- Review of leak repair data to evaluate efficiency of leak repair response times
- Data review and validation of the following information: leak repair database information and data handling and collection process, leak detection program results, average system pressure and infrastructure condition
- Provide guidelines on leak repair data collection to meet current industry best practices
- Training in real loss component analysis

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TASK 3: WATER LOSS PROGRAM DESIGN

3.1 Determine Economic Level of Leakage for Real Losses

Leakage (Real Losses) costs money. It has a cost associated with the intrinsic value of the water and energy that is lost, and it has a cost associated with locating and repairing the leak and any damage it may have caused to nearby infrastructure. For all utilities there is a balance between the value of the water that is lost through leakage and the cost of finding and fixing leakage and reducing leakage through pressure management. In simple terms, this balance is described as the Economic Level of Leakage (ELL) and is presented graphically in Figure 4. The economic level of leakage identifies the point where the total cost, which is the sum of cost of leakage losses and cost of leakage intervention strategies (e.g. leak detection and pressure management), is at a minimum.

In this sub-task, WSO will calculate the ELL for the City.

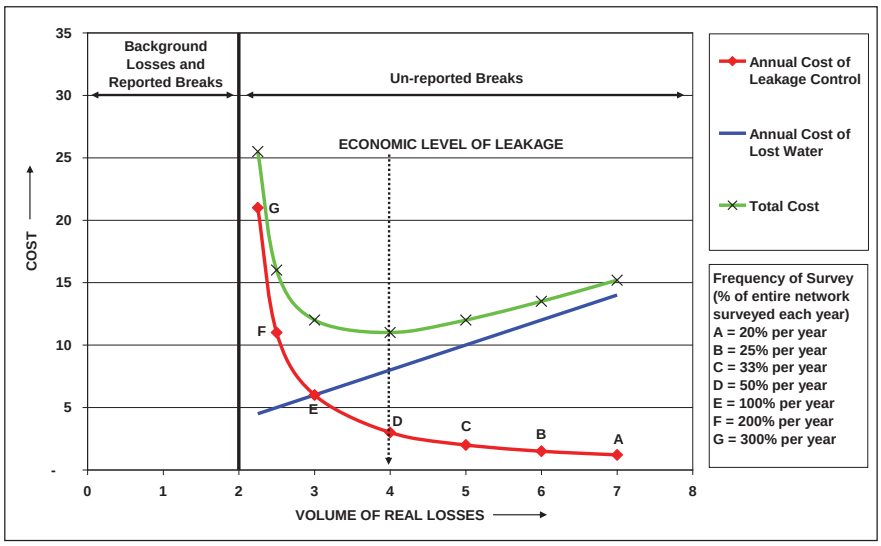

Figure 4: Economic Model for Regular Leak Detection Survey

This analysis will provide the framework for the five-year water loss reduction goal setting process. The previous work completed in Task 1 and Task 2 will enable the presentation of water loss reduction goals with appropriate and necessary acknowledgement of the uncertainty associated with each volume.

3.2 Evaluate Real Loss Reduction Strategies and Provide Economically Optimized Intervention Strategy

Given the valuation of real losses and the costs of intervention, WSO will outline the most cost-effective real loss reduction strategies moving forward. This will involve developing appropriate recommendations for the following real loss interventions:

- Proactive Leak Detection
- Pressure Reduction
- Repair Response Time Improvement

Apparent Loss reduction strategies will be included in the reporting and recommendations provided in Task 1C (see above).

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3.3 Long-Term Non Revenue Reduction Roadmap

Each element of the roadmap will represent conclusions from the through economic analysis of intervention strategies. For the City, a detailed implementation plan and schedule, budget estimations, savings potential and return on investment projections will supplement each element on the roadmap. Table 2 shows the summary of an example Long-Term Non Revenue Reduction Roadmap.

Table 2: Example of Long-Term Non Revenue Reduction Roadmap

<table>
<tr><th>Fiscal Year</th><th>Proactive Leak Detection</th><th>Improved Location and Repair Times for Reported Leaks</th><th>Pressure Management Program</th></tr>
<tr><td>FY 2015 – 2016</td><td>Prepare for implementation of proactive leak detection program</td><td>Focus on collection of better leak repair data</td><td>Prepare for implementation of pressure monitoring pilot in 5 to 10 pressure zones</td></tr>
<tr><td>FY 2016 – 2017</td><td>Detailed leak detection in 10% to 15% of the distribution network using internal leak detection staff</td><td>Update analysis on improved location and repair times and evaluate the necessary additional budget for reducing the average location and repair time for reported mains leaks.</td><td rowspan="2">Implement Step 1 of the pressure management program</td></tr>
<tr><td>FY 2017 – 2018</td><td>Detailed leak detection in 10% to 15% of the distribution network using internal leak detection staff</td><td rowspan="6">If found cost effective, deploy additional repair crews to reduce average location and repair times to optimum levels</td></tr>
<tr><td>FY 2018– 2019</td><td>Evaluate results of detailed leak detection efforts and update strategy according to findings over past 2 years</td><td rowspan="2">Implement Step 2 of the pressure management program</td></tr>
<tr><td>FY 2019 – 2020</td><td rowspan="5">Implement updated proactive leak detection strategy and if/where AMI is implemented utilize AMI and SCADA data for prioritizing areas for ongoing leak detection based on calculated leakage loss levels by pressure zone.</td></tr>
<tr><td>FY 2020 – 2021</td><td rowspan="3">Implement Step 3 of the pressure management program</td></tr>
<tr><td>FY 2021 – 2022</td></tr>
<tr><td>FY 2023 – 2024</td></tr>
<tr><td>FY 2023 – 2025</td><td></td></tr>
</table>

Task 3 Outcomes:

- Determine the Economic Level of Leakage for the City
- Evaluate the economically optimized level of real loss intervention in each of the following areas: leak detection, pressure management, failure repair and response times
- Develop a long term Non-Revenue Reduction Roadmap that outlines the recommended investment, return on investment, and savings for each piece of the plan – for both real loss and apparent loss reduction strategies

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WORK SCHEDULE

The section above outlines the tasks involved in developing a comprehensive water loss control program for the City of Santa Cruz. The following schedule provides a best estimate for the work flow by task. Starting in July 2015, WSO aims to complete the work outlined here by the end of March 2016. Figure 5 shows the estimated allocation of time per task.

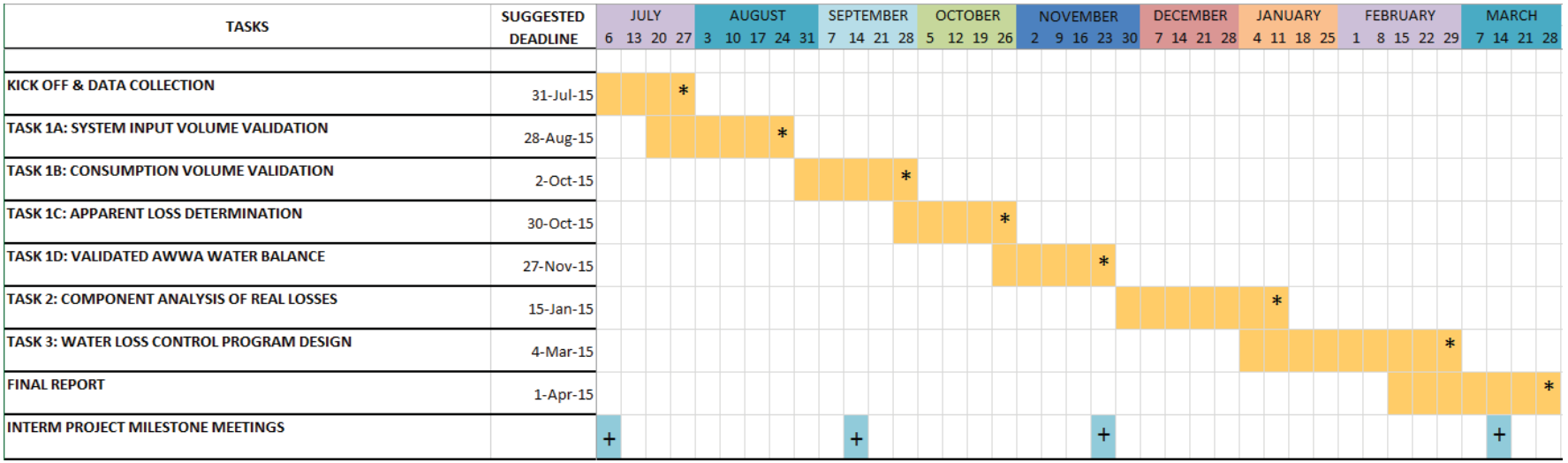

Figure 5: Estimated Schedule for Proposed Program

7 SUBCONTRACTORS

WSO does not plan to hire any subcontractors for the work outlined here. All deliverables will be completely handled by WSO staff.

8 FEE SCHEDULE

Table 3 outlines an estimation of hours required to complete the proposed work. The total budget estimation for the program is $120,080 and represents a not to exceed amount.

City of Santa Cruz Cost Estimate Summary by Task						
	WSO	WSO	WSO	WSO	Value	Total hours
Position	Techn Advisor	Project Directo	Project Manager	Project Engineer	Task	Per Task
Rate/hr	$250.00	$240.00	$140.00	$110.00		**TOTAL**
Employee	Preston	Sturm	Gasner	Andrews/Elman		
Project Kick Off and Data Collection	0	8	16	20	**$6,360.00**	44
TASK 1: WATER AUDIT VALIDATION						
1A: System Input Volume Validation	4	24	40	64	**$19,400.00**	132
1B: Consumption Volume Validation	8	16	40	64	**$18,480.00**	128
1C: Apparent Loss Determination	8	24	40	64	**$20,400.00**	136
1D: AWWA Water Balance	0	16	12	24	**$8,160.00**	52
TASK 2: COMPONENT ANALYSIS OF REAL LOSSES	4	20	32	64	**$17,320.00**	120
TASK 3: DEVELOP WATER LOSS CONTROL PROGRAM	16	40	64	40	**$26,960.00**	160
Grand Total Hours	**40**	**148**	**244**	**340**		**772**
Grand Total Cost for Direct Labor	**$10,000.00**	**$35,520.00**	**$34,160.00**	**$37,400.00**	**$117,080**	
Expenses						
Hotel ($120/night)		$ 360.00	$ 360.00	$ 480.00	**$1,200.00**	
Per diem ($66/day)		$ 396.00	$ 396.00	$ 528.00	**$1,320.00**	
Gas ($60/day)		$ -	$ -	$ 480.00	**$480.00**	
Total	**$0.00**	**$756.00**	**$756.00**	**$1,488.00**	**$3,000**	3%
Grand Total Project Cost					**$120,080**	

Table 3: Cost Estimate for City of Santa Cruz

As an additional – and optional – service, WSO could provide the City with a comprehensive leak detection survey. This would serve to both supplement the City's understanding of recoverable losses, while getting a head start on implementation and water loss recovery. At a rate of $300 per mile, WSO could survey approximately 100 miles of the City's system within the project timeframe. Table 4 outlines this proposed addendum to the scope.

Budget with Optional Leak Detection Services	
Original Budget as Outlined in RFP and Work Plan in Section 6	$120,080
Comprehensive Leak Detection Services for ~100 miles	$30,000
Total Proposed Budget with Additional Leak Detection Services	$150,080

Table 4: Alternative Budget with Optional Leak Detection Services

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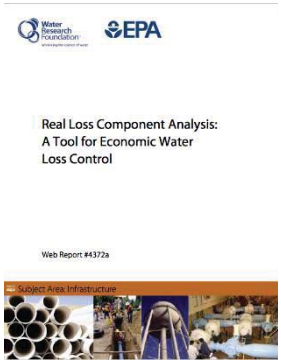
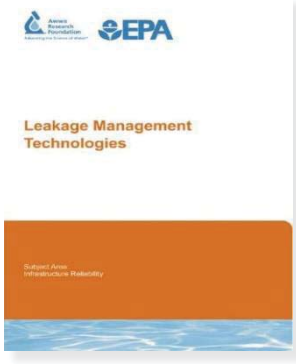
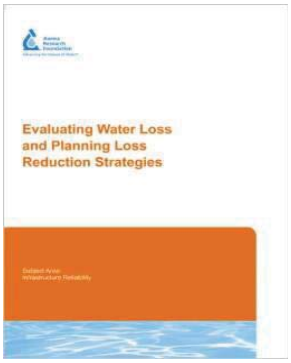
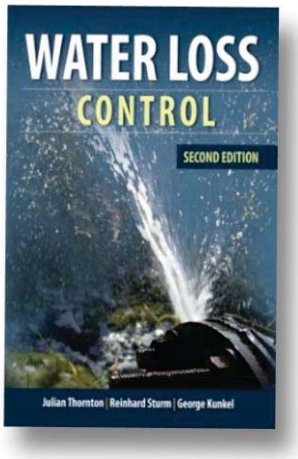
APPENDICES

A. WSO'S NATIONAL RESEARCH REPORTS & PEER REVIEWED PUBLICATIONS

Below is a selection of published and peer reviewed work by WSO.

Real Loss Component Analysis: A Tool For Economic Water Loss Control. Denver, Colo.: WRF. 2014	**Leakage Management Technologies**. Denver, Colo.: WRF. 2007	**Evaluating Water Loss and Planning Loss Reduction Strategies.** Denver, Colo.: WRF. 2007
		
Piloting Proactive, Advanced Leakage Management Technologies in Philadelphia, American Water Works Association, AWWA Journal, February 2011.	**Water Loss Control Using Pressure Management: Life-Cycle Energy and Air Emission Effects**, Environmental Science and Technology, American Science and Technology Publications, 2013	**Water Loss Control – Second Edition.** New York: Mc Graw Hill, 2008
		

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B. LETTERS OF RECOMMENDATION

Please see the following letters of recommendation as a testament to WSO's previous work – of very similar scope – with water loss control program development.

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CITY OF
FOLSOM
DISTINCTIVE BY NATURE

ENVIORNMENTAL & WATER
RESOURCES DEPARTMENT
50 NATOMA STREET
FOLSOM, CALIFORNIA 95630
916.355.7200 / 916.351.5603 FAX

April 9, 2015

To Whom It May Concern:

SUBJECT: **LETTER OF RECOMMENDATION FOR WATER SYSTEMS OPTIMIZATION**

I have worked with Water Systems Optimization (WSO) since 2011 as part of the City of Folsom's ongoing efforts to implement a comprehensive water loss control program.

Within this program, WSO has performed a thorough water audit, designed an economically water loss control strategy for the City of Folsom, conducted three comprehensive leak detection surveys, and provided guidance as we transition to zonal management of leakage. Their efforts have been instrumental in significantly helping reduce the level of leakage in the system.

Having had the opportunity to work with a number of their staff, I can say that WSO brings a wealth of experience and expertise. Additionally, they carry themselves with professionalism and enthusiasm, and are committed to serving the particular needs of the project at-hand.

I feel certain that you will be just as impressed with WSO as I am and would not hesitate to recommend WSO for any water loss control program. Please feel free to contact me at (916) 351-3415.

Sincerely,

Vaughn Fleischbein, PE
Associate Engineer
(916) 351-3415
vfleischbein@folsom.ca.us

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City of Manhattan Beach
Department of Public Works

3621 Bell Avenue, Manhattan Beach, CA 90266
Phone: (310) 802-5313 Fax: (310) 802-5301 TDD: (310) 546-3501

April 10, 2015

Neal Christen, Water Conservation Representative
City of Santa Cruz
212 Locust St., Suite B
Santa Cruz, CA, 95060

Dear Mr. Christen,

I worked with Water Systems Optimization (WSO) in 2014 as part of a water-energy program funded by Southern California Edison.

The work that WSO performed for the City of Manhattan Beach included:

- Thorough water system audit
- Comprehensive leak detection survey, and
- Designed an economically optimized water loss control strategy

Having had the opportunity to work with Kate Gasner, as project lead, and a number of their staff, I can say that WSO comes fully equipped to deliver a highly circumspect level of expertise that encompasses all aspects of water systems operations, including engineering, water quality, water conservation and financial.

With their guidance and a superb Water Loss Control Program final report, we have an enhanced appreciation for our system's leakage and a detailed understanding of where we can improve going forward. There are just a few reference documents that I keep immediately at hand – WSO's final report is one of them!!

I highly recommend WSO for any water loss control program.

Please do not hesitate to call me at 310.802.5315 if you have any questions.

Sincerely,

Raul Saenz
Utilities Manager

EASTERN MUNICIPAL WATER DISTRICT
SINCE 1950

April 13, 2015

To Whom It May Concern

Subject: Letter of Reference

Water Systems Optimization (WSO) was hired by our agency in 2011 to complete a thorough water audit, and a component analysis of real losses. WSO designed an economically optimized water loss control strategy for Eastern Municipal Water District (EMWD), and we have been adopting their recommendations since. We recently hired WSO again to re-evaluate our current levels of losses and further customize our water loss control strategy going forward.

Having had the opportunity to work with a number of their staff, I can say WSO has done a great job working with us, and making actionable recommendations. I would not hesitate to recommend WSO for any water loss control programs.

Should you have any questions or require additional information please contact me at (951) 928-3777 extension 6240.

Sincerely,

Khos Ghaderi, P.E.
Director of Water Operations
Eastern Municipal Water District

Moulton Niguel Water
Leading the Way in Service

April 13, 2015

Reinhard Sturm
Chief Operating Officer
Water Systems Optimization, Inc.
290 Division Street, Suite 311
San Francisco, CA 94103

Dear Reinhard:

I had the pleasure of working with Water Systems Optimization, Inc. in 2015 as part of Moulton Niguel Water District's effort to assess water loss control practices. The original scope of work included a review of our existing water loss control efforts, a high-level water audit validation, and general recommendations for the next steps.

You and William Elman went above and beyond the original scope—WSO not only thoroughly completed the agreed upon tasks, but was able to oversee a comprehensive customer meter testing sample, design interactive toolkits specifically catered to our agency's operations, and provide hands-on staff training on how to use those tools.

In addition to WSO's expertise in the field, both you and Mr. Elman demonstrated genuine interest and commitment. WSO visibly makes a concerted effort to translate technical concepts into findings and recommendations that are understandable and actionable. Your work will certainly inform key operational decisions that we will make to reduce our water losses.

Based on my experience working with WSO, I would recommend them as a valuable partner in any water loss control effort.

Sincerely,

MOULTON NIGUEL WATER DISTRICT

Marc A. Serna
Director of Engineering and Operations

MAC:vg

AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

American Water Works Association.

? Click to access definition

+ Click to add a comment

Water Audit Report for: City of Santa Cruz Water Department

Reporting Year: 2013 (1/2013 - 12/2013)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

To select the correct data grading for each input, determine the highest grade where the

<---------- Enter grading in column 'E' and 'J' ---------->

WATER SUPPLIED

				Master Meter and Supply Error Adjustments		
				Pcnt:	Value:	
Volume from own sources:	5	3,364.670	MG/Yr	7	-20.240	MG/Yr
Water imported:			MG/Yr			MG/Yr
Water exported:			MG/Yr			MG/Yr
WATER SUPPLIED:		**3,384.910**	MG/Yr	Enter negative % or value for under-registration Enter positive % or value for over-registration		

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	7	3,041.990	MG/Yr			
Billed unmetered:	10	0.272	MG/Yr			
Unbilled metered:	9	27.760	MG/Yr			
Unbilled unmetered:	9	3.094	MG/Yr		3.094	MG/Yr
AUTHORIZED CONSUMPTION:		**3,073.116**	MG/Yr	Use buttons to select percentage of water supplied **OR** value		

WATER LOSSES (Water Supplied - Authorized Consumption)

311.794 MG/Yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:	6	0.001	MG/Yr		0.001	MG/Yr
Customer metering inaccuracies:	4	58.950	MG/Yr		58.950	MG/Yr
Systematic data handling errors:	7	0.001	MG/Yr		0.001	MG/Yr
Apparent Losses:		**58.952**	MG/Yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **252.842** MG/Yr

WATER LOSSES: **311.794** MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: **342.648** MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	7	271.8	miles
Number of active AND inactive service connections:	8	26,792	
Service connection density:		99	conn./mile main
Are customer meters typically located at the curbstop or property line?		Yes	
Average length of customer service line:			(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure:	8	91.7	psi

COST DATA

Total annual cost of operating water system:	7	$24,095,629	$/Year	
Customer retail unit cost (applied to Apparent Losses):	8	$4.07	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	7	$399.00	$/Million gallons	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 65 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources

2: Customer metering inaccuracies

3: Billed metered

AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

Water Audit Report for:	City of Santa Cruz Water Department	
Reporting Year:	2013	1/2013 - 12/2013
Data Validity Score:	65	

Water Exported
0.000

Billed Water Exported

Own Sources
(Adjusted for known errors)
3,384.910

Water Supplied
3,384.910

Authorized Consumption
3,073.116

Billed Authorized Consumption
3,042.262

Billed Metered Consumption (water exported is removed)
3,041.990

Billed Unmetered Consumption
0.272

Revenue Water
3,042.262

Unbilled Authorized Consumption
30.854

Unbilled Metered Consumption
27.760

Unbilled Unmetered Consumption
3.094

Non-Revenue Water (NRW)
342.648

Water Losses
311.794

Apparent Losses
58.952

Unauthorized Consumption
0.001

Customer Metering Inaccuracies
58.950

Systematic Data Handling Errors
0.001

Real Losses
252.842

Leakage on Transmission and/or Distribution Mains
Not broken down

Leakage and Overflows at Utility's Storage Tanks
Not broken down

Leakage on Service Connections
Not broken down

Water Imported
0.000

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WATER DEPARTMENT
MEMORANDUM

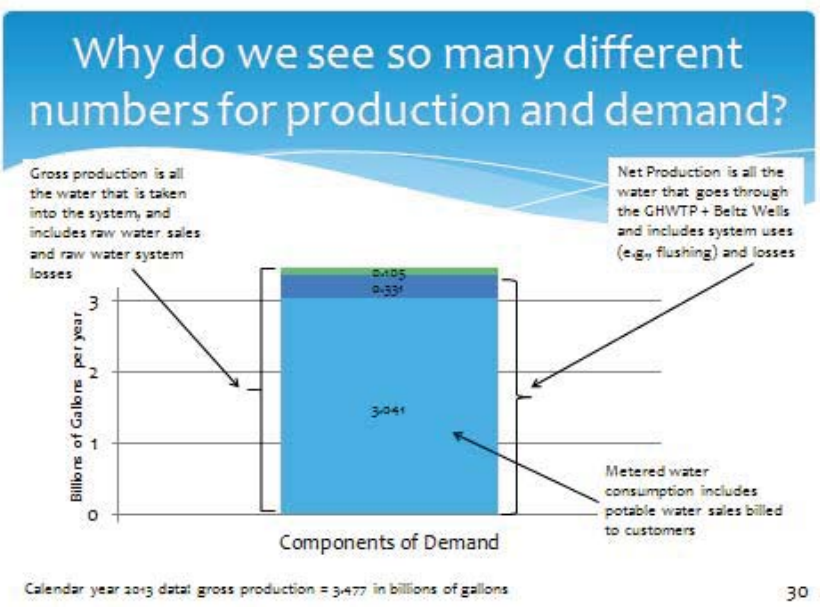
DATE: August 18, 2015

TO: Water Supply Advisory Committee

FROM: Toby Goddard

SUBJECT: System Water Losses and Water Loss Control

BACKGROUND: On June 26, 2014, The Water Supply Advisory Committee received a presentation providing an overview of water supply and demand characteristics in Santa Cruz. One of the topics introduced in the process of explaining the different terms and figures relative to annual water production and water demand was system water losses.



Shortly thereafter, the New York Times published an article entitled “The Art of Water Recovery” examining the subject of water losses in public water systems and the potential to reduce leakage (Attachment 1). The article highlighted two important issues:

- According to the U.S. Environmental Protection Agency, public water systems lose, on average, one-sixth of their water – mainly from leaks in pipes; and

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- The volume of leakage in the nation's 55,000 drinking water systems is unknown, because few conduct water audits using standards established by the International Water Association (IWA) and the American Water Works Association (AWWA).

This paper provides current information about system water losses in Santa Cruz, and measures the City is taking to minimize system losses.

DISCUSSION: Total system water demand includes not only metered water sales but also authorized, unmetered uses from fire hydrants such as main flushing, fire fighting, street sweeping, and sewer flushing, as well as losses due to underground leaks. The difference between the amount of water produced at the City's two water treatment plants entering the distribution system and the amount of water consumed, including both metered and unmetered uses, is referred to as system water losses.

System losses have two components: 1) physical losses from leaking service lines, valves, and water mains, also referred to as "real" losses and 2) "apparent" losses in which potable water is consumed but goes underreported due to sales meter inaccuracies, billing and accounting errors, and other factors.

The Water Department first began conducting annual water audits of distribution system in 1997. The purpose of a water audit is to quantify how much water and revenue are lost through both physical leaks and apparent losses and to identify steps to minimize system losses and improve the operational efficiency of the water system. Until 2006, the Department followed the approach described in the AWWA M36 Manual of Water Supply Practices – Water Audits and Leak Detection. Starting in 2006, the City began to use the new, standardized water balance approach developed through the IWA and AWWA referenced in the New York Times article.

Under the California Urban Water Conservation Council's MOU, Water Loss Control is listed as a Best Management Practice. Since 2009, agencies have been expected to use the new IWA/AWWA software to complete their annual water audits and to meet increasingly stringent requirements to support water loss control activities and identify areas for improved efficiency and cost recovery.

Annual Water Losses

Water audit results indicate system water losses vary from year to year but have averaged about 7.3 percent of total production over the last 15 years, or about 264 million gallons per year (mgy).

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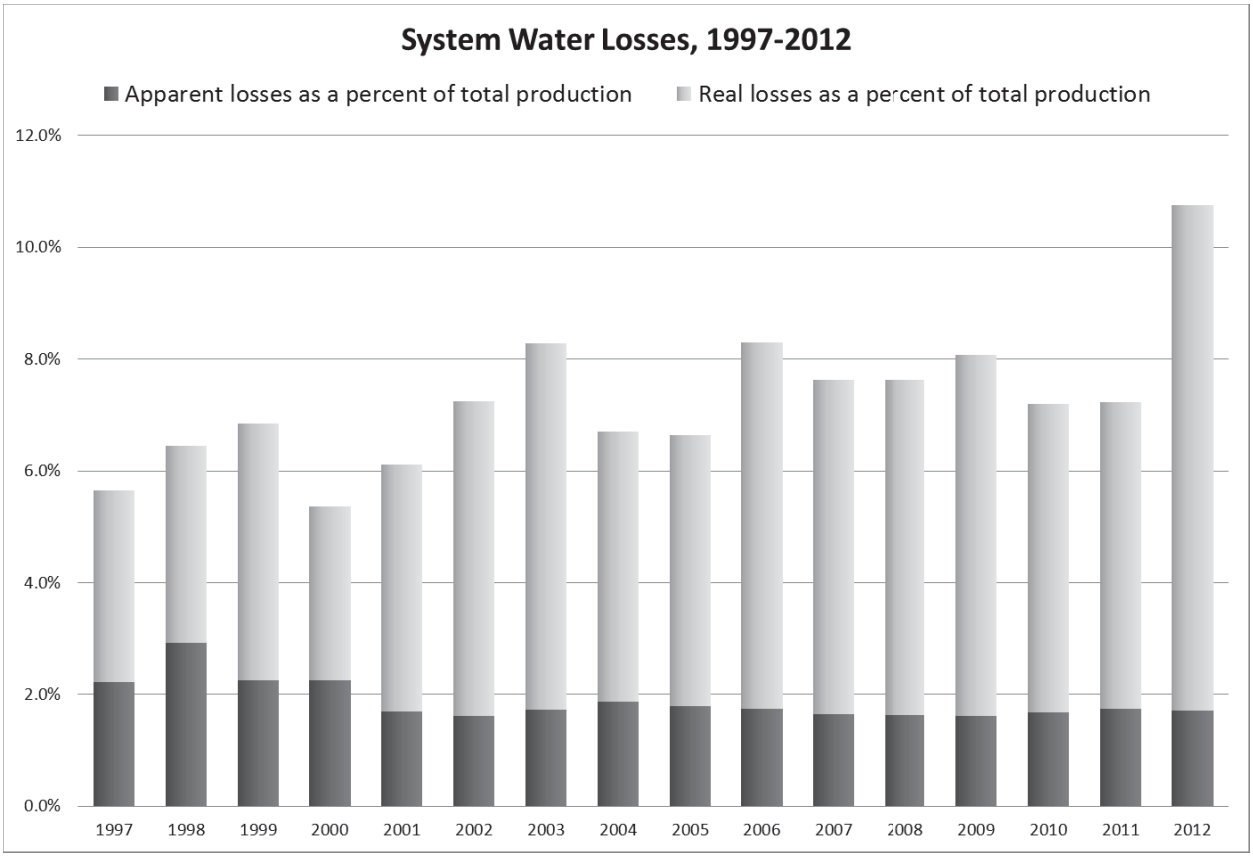

As seen in the chart above real water losses; i.e. distribution system leakage, is the larger of the two components that make up total system losses. Estimates of physical losses from underground leakage in service lines, water mains, valves, and distribution system controls average 5.4 percent of total production, or just under 200 mgy. Apparent losses are estimated at about 70 mgy or about 1.9 percent of all treated water entering the distribution system. There is considerable uncertainty, however, about the true magnitude between real and apparent water losses due to the fact that no formal, systematic meter testing program has been carried out by the Water Department for many years.

It can also be seen that in 2012, the City experienced a sudden jump in lost water to a level not previously seen. This occurred after a long period where the annual water loss rate had been relatively consistent. The cause of this sudden jump is yet to be understood.

Cost of Water Losses

The estimated cost to the City from system water losses is shown below using data from 2011 and 2012.

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Item	2011	2012	Difference
Total treated water production entering distribution system	3,000 mg	3,273 mg	+273 mg
Metered water consumption	2,760 mg	2,896 mg	+136 mg
Authorized un-metered water uses	24 mg	25 mg	+1 mg
Total consumption	2,874 mg	2,921 mg	+47 mg
Water losses	216 mg	352 mg	+136 mg
Water losses (as percent of total production)	7.2%	10.8%	+3.6%
Apparent losses (metering inaccuracies)	52 mg	56 mg	+4 mg
Real losses (leakage in mains and service connections)	164 mg	296 mg	+132 mg
Leakage (as a percent of total production)	5.5%	9.0%	+3.5%
$ Value of apparent losses[1]	$275,964	$300,944	+$24,980
$ Value of real losses[2]	$66,420	$132,608	+$66,188
Total $ value of losses	$342,384	$433,552	+$91,168

[1] Apparent losses was valued at $4.02/CCF (volumetric revenues for the calendar year/sales in CCF = Average $/CCF sold) or $5,374 per mg in 2012.
[2] Real water losses valued at variable production cost of current water supplies was $448 per million gallons in 2012.

Even though real losses are thought to be much larger by volume than are apparent losses, the lost revenue associated with inaccurate water meters represents a much greater cost to the utility than does underground leakage. This is because apparent losses are valued at the retail rate of about $4.00/CCF or $5,374/million gallons, whereas real losses are valued at the City's variable cost of producing water based on the cost of electric power for pumping and chemicals for treatment, currently estimated at $448/million gallons. This latter value does not, however, take into account costs of labor, repair, or property damage that results from certain water system breaks, disruptions, and ruptures, which can be significant, as vividly dramatized by the recent major water main break near the UC Los Angeles campus.

Water Balance Model

The new IWA/AWWA water balance approach is based on the following diagram and associated terms and definitions. It is a tool to help utilities better understand and quantify water uses and losses relative to annual system input volumes. No longer is there any reference to the outdated term "unaccounted for water". The water balance reflects that all drinking water managed by the utility is accounted for in the various categories of consumption and loss.

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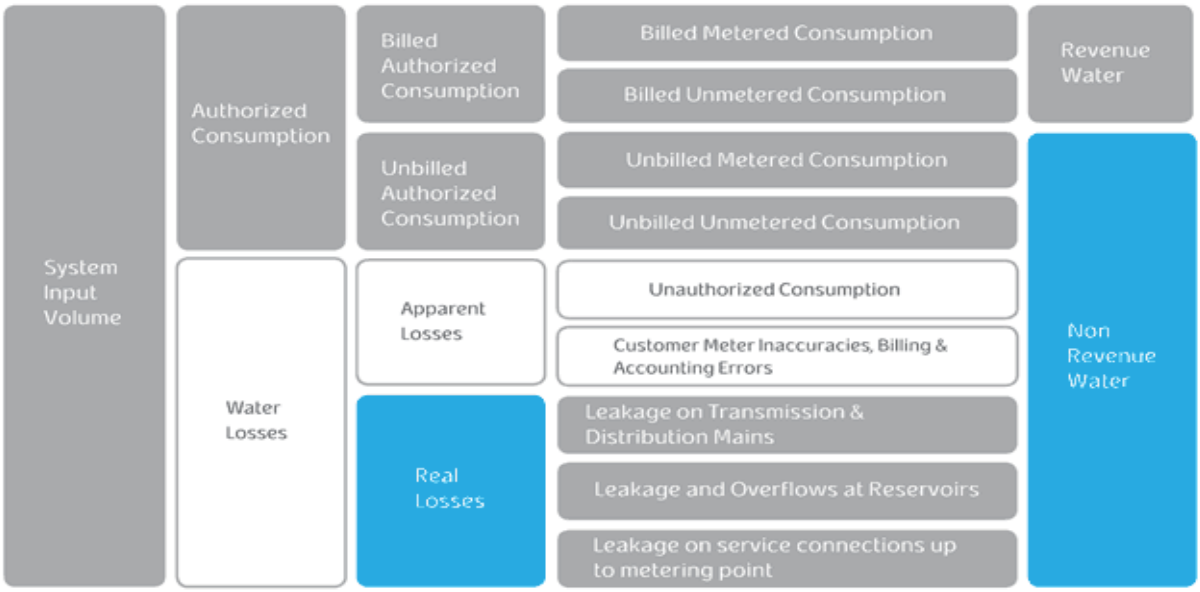

One of the most powerful features of the software is the numerical grading system where a specific rating is assigned to each of the analytical inputs when compiling and entering data to describe the confidence and accuracy of the data. These grades are helpful to assess priority areas for attention and to identify measures to improve water loss control.

The audit software also provides a variety of financial and operational performance indicators. These include the following:

- Nonrevenue water as percent by volume of water supplied,
- Nonrevenue water as percent by cost of operating system,
- Infrastructure leakage index – a ratio of a utility's current annual real losses to its unavoidable annual real losses (a theoretical reference value that represents the technically low limit of leakage given the length of mains, average pressure, and number of service connections.

The City's completed audit and associated worksheets for calendar year 2012 are included as Attachment 2.

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Approaches to Reduce Real Water Losses

Maintenance and improvement of the treated water distribution system is a major activity of the Water Department, and central to the Department's mission of providing a clean, adequate, and reliable supply of water. The Water Distribution section consists of 23 certified personnel, and a group of 6 technicians, specialists, and a supervisor in the Meter Shop, all dedicated to maintaining and repairing the system 24/7. It is organized into several crews that focus on the following activities:

- Main replacement
- Service line renewal
- Leak repair
- Valve maintenance
- Utility location and leak detection

Annual water main replacement projects are coordinated by the Department's Engineering section. Main replacement is guided by several factors. These include considerations for system reliability, water quality, fire flow, circulation, maintenance, as well as coordination with street paving and other public projects. The Distribution section also performs smaller main replacement projects, replacing about one mile of main per year.

A sheared fire hydrant is a one example of a real water loss

Several years ago, the Department considered the idea to operate an active, acoustic leak detection program. It was decided, based on analysis of leak types and volumes, to undertake a different approach, though, which was to establish a crew to proactively replace polybutylene service lines with copper service lines. Polybutylene service lines were being found, both locally and elsewhere throughout the industry, to fail prematurely, and represented a significant source of leakage. Over 5,000 plastic service lines have been replaced over the last decade to help prevent future leaks from occurring.

The following illustration shows the four potential areas where additional actions are possible to further reduce leakage to a level that is economically achievable. These actions include actively performing sonic leak detection surveys to find unreported

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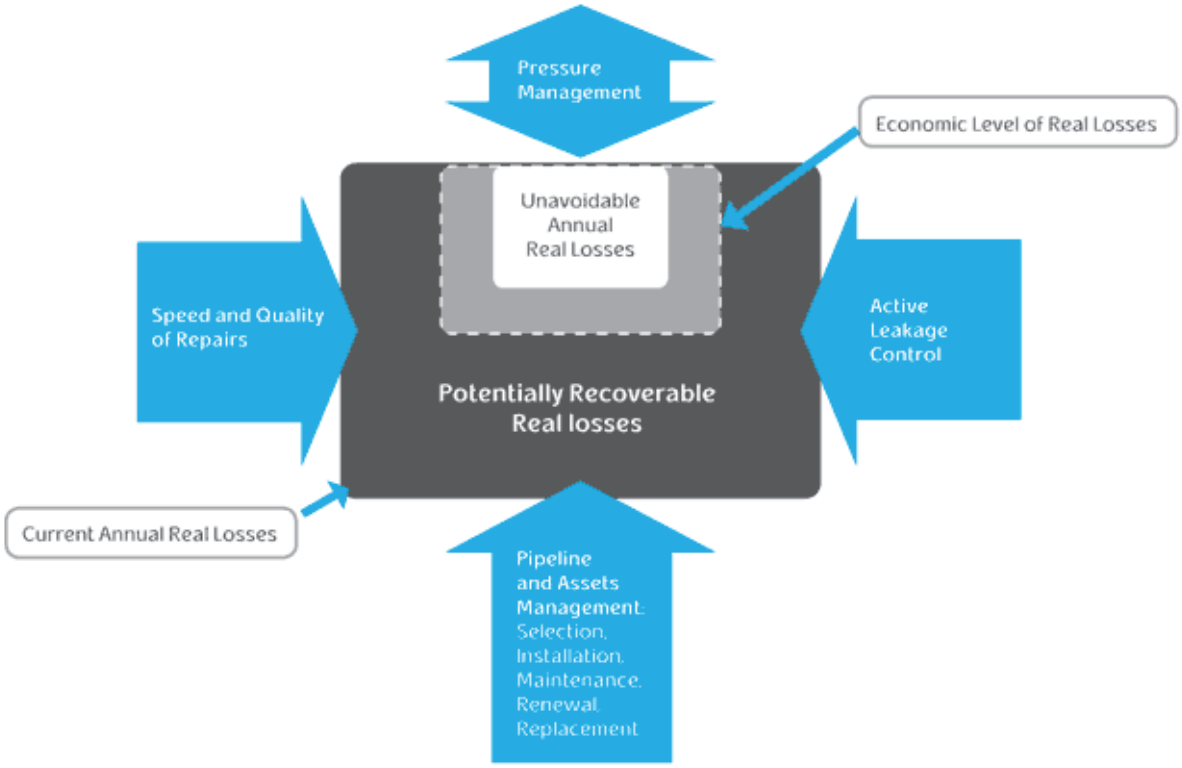
leaks, optimizing leak repair activities, managing pressure, and increasing the level of water main and service line replacement. Of these four approaches, active leak detection and asset management are the two areas thought to be where the most potential exists on the City's distribution system. The Department already has a good record of responding quickly to leaks. The potential for leak reduction through pressure management is uncertain, but probably relatively low, given the large area served by the City's gravity zone, and the lack of discrete areas where pressure could be managed.



The idea with the illustration is there is a hierarchy of real losses that includes: 1) the utility's current level of losses, 2) some potentially lower level that is economical to achieve, and 3) some even lower level that represents the unavoidable minimum level of loss. Under this model, eliminating all physical water losses is not practical to achieve.

Approaches to Reduce Apparent Water Losses

Apparent losses occur as a result of inefficiencies in the measurement, recording, archiving, or accounting operations used to track water volumes in a water utility. Unlike real losses, reducing apparent losses does not create new or more water, but it does improve revenue recovery and other benefits.

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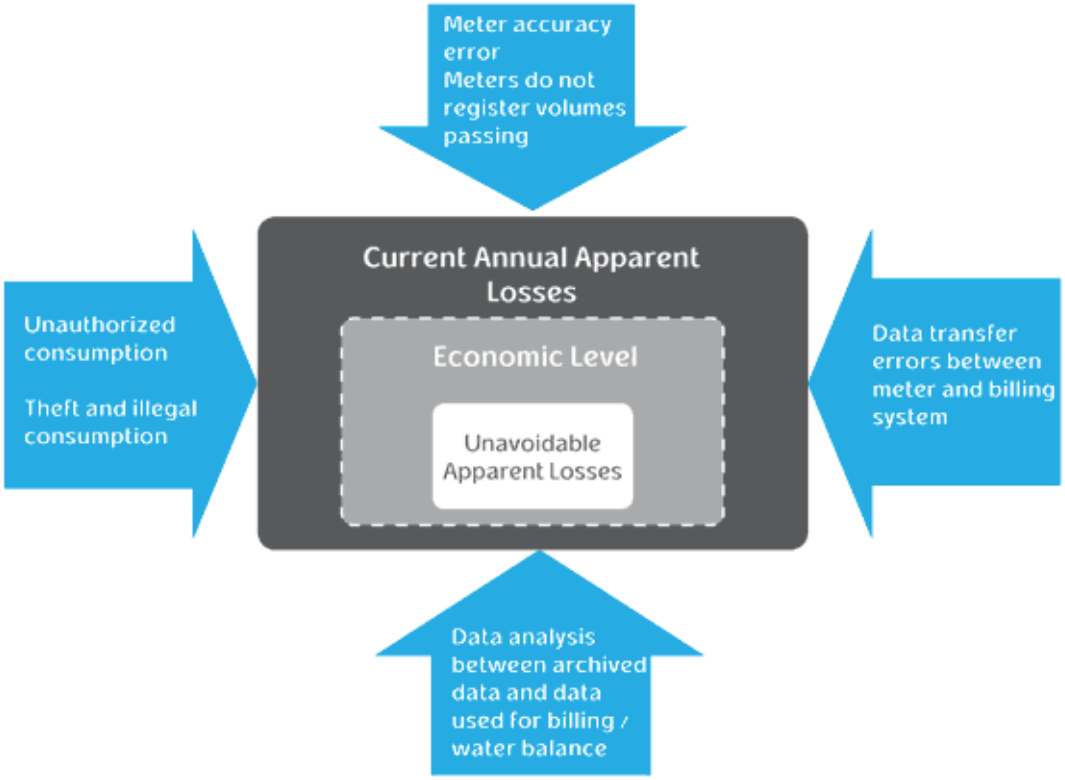
As with real water losses, there are four basic approaches to reducing apparent water losses, illustrated in the following diagram:



Inevitably, some water is used but not captured on a billing system due to all these different sources, and the City does not have good information at the present time to quantify their relative contribution. The Department knows of individual examples of situations where water is used but not recorded. For instance, movement on a fire service check meter is a type of water loss that goes unrecorded on the billing system, as does unauthorized usage on a closed account. While rare, a mis-programmed meter register or a meter that was not loaded up on the utility inventory system are examples of data transfer errors can also result in “missing water”. The Customer Service section and Meter Shop regularly run billing system reports known as the Meter Read Edit List and other controls to help identify and resolve such problems.

When it comes to apparent losses, though, the bigger unknown is the overall accuracy of the City’s 25,000+ meters. As meters age, the components inside meter registers wear down, causing under-registration of water volume, and, in some cases, reporting zero consumption. Beginning in the late 1990’s, the Water Department began a multi-year project converting from a manual to an automated meter reading (AMR) system to

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enable monthly billing, reduce risk of employee injury and accidents, and improve operational efficiency. This capital improvement project involved completing over 20,000 radio read meter installations that involved replacing, either completely or partially, the majority of the water meters on the water system, primarily in the smaller 5/8 and 1 inch size class. This project was completed in 2008. The last time a major meter replacement project was undertaken before then was in the late 1970's.

With the priority having been devoted primarily to the AMR conversion project for much of the last decade, no regular, formal meter testing program has been carried out by the City for many years. Some testing has been conducted on selected large meters on an intermittent basis. As mentioned above, it is currently estimated that about 2 percent of all treated water that enters the distribution system goes unrecorded due to meter inaccuracies. However, little current testing data exists either for the newly replaced small meter population or the current stock of large meters to understand the functional status or accurately gauge the level of meter error or sales revenue lost systemwide due to meter under-registration.

Water Loss Control in the Water Conservation Master Plan

One of the recommended measures in the City's proposed Water Conservation Master Plan is to contract with a firm specializing in water loss control to examine the City's water system and practices to better validate where losses are occurring, evaluate options, and set forth a formal strategy to improve water accountability and reduce lost water. The FY 2015 operating budget includes $150,000 to undertake this initial contract work.

Attachments

1. "The Art of Water Recovery", New York Times, July 10, 2014
2. 2012 AWWA Water Audit

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Chapter 1

Introduction: Auditing Water Supply Operations and Controlling Losses

Community drinking water supply systems around the world have been instrumental in improving the human condition by providing essential water to promote public health and safety and good hygiene, and to serve as a basis for economic development. For hundreds of years, societies have constructed infrastructure to withdraw water from available sources, to treat it to an acceptable standard, and to distribute it to communities, typically through buried piping distribution systems. Yet, for all their success in quenching human needs, many drinking water utilities operate with considerable inefficiencies in terms of water and revenue losses. As the world grapples with the dilemma of a growing population but a finite amount of water, these inefficiencies need to be brought under a reasonable level of control. This manual offers water utilities a set of tools and approaches to instill accountability and control losses, including

- Step-by-step procedures to conduct a water audit to assess the efficiency of the water distribution system and water accounting practices
- Worksheets and sample calculations for each step of the water audit
- Definitions and implications of apparent (nonphysical) losses and real (physical) losses
- Specific techniques to identify, measure, and verify all water sources, consumption, and losses
- A roadmap to control apparent losses in metering and billing operations and to recover missed revenues
- Steps to implement a leakage and pressure management program to control real losses and preserve source water resources

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- Planning steps to assemble the proper resources, information, and equipment to launch and sustain the accountability and loss control program
- Approaches for short-term and long-term goal setting for the loss control program
- Considerations for small water systems

Many water utilities suffer a variety of losses. Most operators recognize piping distribution system leakage, categorized under the heading *Real Losses*, as a primary type of loss. However, water suppliers also suffer losses from poor accounting, meter inaccuracy, and unauthorized consumption. These losses are collectively labeled *Apparent Losses* and have a negative impact on utility revenue and consumption data accuracy. While it is essential that system operators employ means to control such losses, the initial step is to assemble a water audit to identify the nature and volumes of losses existing in a water utility.

THE WATER AUDIT AND WATER BALANCE

Good management of any resource requires that the supplier maintain accurate records of transactions and deliveries of the commodity provided to its customers. An audit has been defined as "an examination of records or financial accounts to check their accuracy."[1] The *water audit* typically traces the flow of water from the site of withdrawal or treatment, through the water distribution system, and into customer properties. The water audit usually exists in the form of a worksheet or spreadsheet that details the variety of consumption and losses that exist in a community water system. The *water balance* summarizes the components and provides accountability, as all of the water placed into a distribution system should—in theory—equal all of the water taken out of the distribution system.

In 2000, the International Water Association (IWA) published the manual *Performance Indicators for Water Supply Services*.[2] This publication included a description of a water audit methodology developed during the period of 1997–2000 by the IWA Water Loss Task Force, a five-country group that included participation by the American Water Works Association (AWWA). Because a multitude of different water auditing practices existed around the world, the primary focus of the task force was to draw on the best practices of the various approaches and craft them into a single, standard best management practice methodology that could be applied worldwide, across the spectrum of differing system characteristics and units of measure. Many of the features of the IWA/AWWA best practice methodology were drawn from the original AWWA Manual M36, *Water Audits and Leak Detection*, published in 1990 and revised in 1999. Shortly after the Water Loss Task Force published its new method, the AWWA Water Loss Control Committee voiced support for the method in its committee report "Applying Worldwide Best Management Practices in Water Loss Control" published in the August 2003 edition of *Journal AWWA*.[3]

The IWA/AWWA Water Audit Method is detailed in Chapter 2, and it is recommended as the current best management practice by the AWWA Water Loss Control Committee for drinking water utilities to compile a water audit of their operations. Free Water Audit Software can be used to compile the water audit and is described in Appendix C. In addition to reliably tracking water consumption and losses using this method, water utilities also have a variety of effective means to economically control apparent and real losses. Great innovation in loss control methods and technologies has occurred since the early 1990s. Many of these techniques are given in Chapters 3 and 5. The final chapters of this manual provide guidance on planning and sustaining the loss control program and considerations for small systems.

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THE IMPORTANCE OF WATER AUDITS AND LOSS CONTROL

Strong water loss control produces benefits in four primary manners:

1. Water resources management, by limiting unnecessary or wasteful source water withdrawals.

2. Financially, by optimizing revenue recovery and promoting equity among ratepayers.

3. Operationally, by minimizing distribution system disruptions, optimizing supply efficiency, and generating reliable performance data.

4. System integrity, by reduction of potential for contamination.

Drinking water suppliers have obligations in all of the previous areas: they must act as stewards of the valuable water resources that they manage; they must be fiscally responsible to their customers, shareholders, and bondholders; and they must maintain safe, reliable operations that provide quality water service to their communities. Properly executed water auditing and loss control programs help water utilities meet their obligations in all of these areas, to the benefit of their customers and their own bottom line. The specific benefits of water auditing and loss control include

- *Reduced apparent losses.* Reducing apparent losses creates a financial improvement by recovering lost revenues from customers who have been undercharged or have gained water in an unauthorized manner.
- *Reduced real losses.* Reducing real losses saves operating costs including power, maintenance, and treatment costs. Because leakage volumes are a considerable portion of system input for many water utilities, expansion of water supply infrastructure might be deferred if successful leakage control is achieved. Likewise, better use of existing resources may ease drought restrictions or allow economic development to occur without exploiting new water resources. Reducing leakage volumes results in a corresponding reduction in the operation of equipment, thereby extending the interval between scheduled maintenance.
- *Improved data integrity.* Sound water auditing improves the accuracy and integrity of water system input volumes and customer consumption. Knowing true water consumption patterns promotes better water resources management, confirms water conservation benefits, and aids long-term planning.
- *Better use of available water resources.* Controlling losses helps stretch existing supplies to meet increasing needs, thus avoiding the exploitation of new water sources. Environmental impacts are limited as no more water is withdrawn from sources than is absolutely needed.
- *Increased knowledge of the distribution system.* During the water auditing process distribution personnel become familiar with the distribution system, including the location of mains and valves, pressure levels, and demand variations. This familiarity helps the utility to respond quickly to emergencies, such as water main breaks, and provides a basis for optimization of supply operations.
- *Increased knowledge of the customer metering and billing systems.* The water auditing process provides the auditor the opportunity to review the workings of the customer billing system. For many water utilities, inadvertent procedural or programming gaps exist in billing operations, allowing certain customers to receive water without paying for it.

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- *Safeguarding of public health and property.* Improved maintenance of the water distribution system helps reduce the likelihood of property damage and safeguards public health.
- *Improved public relations.* Consumers appreciate maintenance of the water distribution system. Field teams performing water audit and loss control activities provide visual assurance that the distribution system is being maintained. Consumers also appreciate value for their money. They expect high-quality service at a reasonable price. Efficient delivery of high-quality water, along with affordable, equitable water rates, create a strong reputation for the water utility in the minds of its customers.
- *Reduced liability.* By protecting public property and health and providing detailed information about the distribution system, water audits and loss control programs help protect the utility from expensive lawsuits.
- *Reduced disruption to customers.* More leaks are repaired on a proactive basis rather than developing into large leaks or main breaks that disrupt service and cause damage and customer ill will.
- *Favorable reviews from the financial community.* Effective operations and accountability instill credibility for the water utility in the eyes of the lending community, helping the utility to secure funding to sustain sound upkeep of the operation well into the future.

In summary, water and revenue losses are wasteful to the water utility, its customers, and society at large, while good accountability and loss control offer many benefits. It is likely that many, if not most, North American drinking water utilities can strongly benefit from improvements in their level of accountability and loss control practices. In this way, this manual serves as a valuable guide for drinking water utilities.

GETTING STARTED

Regulatory requirements for water audits have customarily been very limited in North America; hence, most drinking water utilities do not compile a regular audit of their water supply operations. For water utilities just getting started, the best practice water audit method given in this manual is an excellent tool to quickly obtain quantities of losses and their costs. In as little as several hours, readily available data can be accessed and input into the standard water audit format, revealing preliminary loss control standing and cost impacts. *The most important step is to just get started!*

THE FUTURE OF WATER SUPPLY EFFICIENCY

In 2001, AWWA commissioned an extensive survey of state and regional water resource and environmental agencies in the United States to uncover the extent and usefulness of their water accountability statutes and regulations. The project, entitled *Survey of State Agency Water Loss Reporting Practices* or the "States Survey Project," was successful in garnering valuable information from 46 jurisdictions, including 43 state agencies and 3 regional agencies.[4] The results of the survey found that widely varying language existed throughout many regulations and statutes of these agencies. Many did and still do define water losses as some form of *unaccounted-for* water but leave the components included in this parameter subject to interpretation *and manipulation.* As an example of the latter, many utilities have routinely included volumes from known leaks in *accounted-for* water categories, thus underestimating actual leakage or real losses. In attempting to gather voluntary data from large water utilities, one

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state agency found that water utilities that earnestly attempted to audit their supplies reported figures that appeared less flattering than counterparts who reported unrealistically low losses, with no substantiation of their data.[5] This type of gamesmanship reflects poorly on the US water industry, which has proven itself up to any challenge, including that of reliable water auditing and loss control. The final report of the States Survey Project was astute in its recommendation that "a better system of accounting is necessary if accountability is to be instilled in drinking water utilities."

The AWWA Water Loss Control Committee supports the methods offered in this manual as the "better system of accounting" called for in the States Survey report. The Committee recommends against continued use of the imprecise term *unaccounted-for* water as it does not exist in the best practice water audit method, and its continued use will only serve to confuse. The committee holds that the methods in this manual are workable, meaningful, and offer the greatest potential to bring about improved accountability and water efficiency in drinking water utilities. The methods can assist better service for drinking water customers, an improved bottom line for water utilities, and better management of water resources for the common good. It is recommended that these methods become the standards for quantitative management of drinking water resources in North America for water utilities, professional organizations, regulatory agencies, and all stakeholders who support safe and reliable drinking water.

Water accountability and loss control will garner increasing prominence in water resources management in coming years. Water sources will continue to become more difficult and costly to develop, water quality regulations and customer expectations will increase the value of water, and growing populations and economies will need adequate water supplies. All of these drivers will combine to create an increased focus on water accountability, efficiency, and conservation. By employing the methods included in this manual, water utilities have the tools to meet the growing challenges.

REFERENCES

1. *The American Heritage College Dictionary*. 1997. 3rd edition. Boston, Mass.: Houghton Mifflin Company.
2. Alegre, H., W. Hirner, J. Baptista, and R. Parena, 2000. *Performance Indicators for Water Supply Services*. Manual of Best Practice series. London, England: IWA Publishing.
3. Kunkel, G., et al. 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. *Journal AWWA*, 95(8):65.
4. Beecher, J. 2002. *Survey of State Agency Water Loss Reporting Practices*. Final Report to the Technical and Educational Council of the American Water Works Association. Indianapolis, Ind.: Beecher Policy Research, Inc.
5. McNamee, A. 2002. "Water Audits of Public Water Systems: Maryland's Experience." Proceedings, Technical Session on Promoting Progressive Approaches for Water Loss Control, American Water Works Association, Distribution & Plant Operations Conference, Nashville, Tenn. Denver, Colo.: AWWA.

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WATER COMMISSION
INFORMATION REPORT

DATE: August 7, 2015

AGENDA OF: August 24, 2015

TO: Water Commission

FROM: Heidi Luckenbach

SUBJECT: Implementation of the Department's Capital Improvement Plan

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RECOMMENDATION: Receive information and provide feedback on various capital improvement projects currently underway and on how they fit in with the Department's Strategic Goals and potential recommendations from the Water Supply Advisory Committee.

BACKGROUND: The Water Department maintains a long-term Capital Improvement Plan (CIP) that forecasts between 15-20 years into the future. This Plan is developed to reflect the mission and strategic goals of the department which include improving infrastructure integrity and system reliability, complying with water quality regulations, etc. (See attached.)

At a minimum, the Department reviews the CIP annually for the purposes of evaluating progress of prior years; aligning staff and budget resources for the future; and reviewing project priorities. All of these can result in additions to, deletions from and re-prioritizing of the CIP.

In the last decade or so the Department has been undertaking a much more aggressive CIP in terms of project size (footprint and cost) as well as implications to operations of the water system. Some of these include:

> Bay Street Reservoir Transmission Main: Installation of ~2 miles of 24" water main between Ocean Street and the Bay Street Reservoir site. This project, completed in 2007, allows the Graham Hill Water Treatment Plant (GHWTP) to operate at a more steady production rate and facilitates filling of the Bay Street Tanks (on the site of the now-demolished Bay Street Reservoir).
>
> Bay Street Tanks: Demolition of the 39milllion gallon Bay Street Reservoir and construction of two 6million gallon tanks. This project was completed in 2015 (with the exception of final landscaping). Downsizing this storage facility facilitates compliance with increasingly stringent water quality regulations while continuing to meet domestic and potential fire demands.

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Beltz 12 Production Well and Treatment Plant: Completed in 2014, this new well moves some of the City's groundwater pumping inland to protect coastal groundwater, and provides flexibility and redundancy to the system as a whole.

Rehabilitation of the filters at the GHWTP: Rehabilitating and upgrading the filters was selected as a first step to the current phasing of improvements at the GHWTP that will address the City's need to meet current water quality regulations as well as help maintain reliable production of up to 18million gallons per day. Construction of these improvements started fall 2014 and are expected to be completed in early 2016. Future improvements at the GHWTP would potentially enable higher production rates using higher turbidity water while increasing reliability.

North Coast Raw Water Transmission Main Replacement: The Department is currently working on the third of six phases of this project; scheduled to go out to bid in early 2016. This project, once complete, will increase reliable diversion of water from the North Coast sources and delivery to the GHWTP.

DISCUSSION: The Water Supply Advisory Committee has been meeting since April 2014. To aid in their ability to make a recommendation to the City Council for the future water supply objectives of the City, they have been exposed to the current water system and the CIP. While not knowing what the recommendations may include, but with the purpose of the WSAC in mind, the CIP has been prioritized and implemented so as to not advance projects that will have limited future utility.

Water Department staff will present the status of several current/ongoing projects and discuss in particular how they fit into achieving Department goals and potential future direction provided by Council based upon WSAC recommendation(s).

ATTACHMENTS: Strategic Goals

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City of Santa Cruz

WATER DEPARTMENT

Mission

To assure public health and safety by providing a clean, adequate and reliable supply of water

Vision

To serve the community in a courteous, efficient, cost effective and environmentally sustainable manner

Values

- **Integrity**
- **Innovation**
- **Objectivity**
- **Professionalism**
- **Teamwork**
- **Transparency**

Strategic Goals

- **Preserve and secure reliable water supplies**
  - Protecting surface water and groundwater resources
  - Developing flexible and dependable supplemental water sources
- **Promote efficient and sustainable water consumption**
  - Achieving maximum feasible water conservation and efficient use
  - Maintaining adequate drought and emergency preparedness
- **Meet the current and foreseeable drinking water standards**
  - Safeguarding source water quality
  - Complying with water quality monitoring and reporting requirements
  - Optimizing water system operations
- **Improve infrastructure integrity and system reliability**
  - Maintaining and rehabilitating aging facilities
  - Modernizing treatment plants
  - Optimizing storage, transmission, and distribution capacities and efficiencies
  - Obtain long-term environmental regulatory certainty for existing operations.
- **Create and foster maximum organizational effectiveness**
  - Maintaining high level competence in servicing the customers
  - Continuously improving organizational efficiencies
  - Providing responsible financial stewardship
  - Striving to be a socially, ethically and environmentally responsible organization

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□□COMM□□DA□□O□□□eceive information about plans to improve a critical element of the City's treated water infrastructure and provide feedbac□.

BACKGROUND: □he □ravity □run□ Main □□□M□ is a 36" diameter treated water transmission main made of bar-wrapped concrete cylinder pipe running approximately □.□ miles between the □iltered □ ater □an□ □□□ □□at the □raham □ill □ ater □reatment Plant □□□□ □P□ and the intersection of Ocean and □ennan Streets. See attached map. □uilt in the early □□□□s along with the □□□ □P, the □□M feeds downstream transmission mains at Crossing Street, □unolt Street, □ennan Street, Ocean Street, and □ ashburn Avenue. About 88% of the City's average production flows through the □□M.

□wo large diameter isolation valves on the □□M have become inoperable and stuc□ in the open position□a condition not uncommon for valves of this type and age. □he first is located at the intersection of Ocean Street □xtension and Crossing Street□the second is at the intersection of Ocean Street and □ennan Street. □hese valves, when operable, provide flexibility to isolate critical parts of the system for maintenance, inspection, or repair while □eeping the remainder of the system in water service. □his flexibility is critical during ordinary operation and maintenance situations as well as in emergency situations such as earthqua□es. □eplacement of these valves will also allow a detailed condition assessment of the □□M so that the remaining service life of the pipeline can be determined in order to proactively plan for its rehabilitation or replacement.

DISCUSSION: □he City has been preparing for replacement of the □□M valves for several years, starting with attempts in □□□□ to rehabilitate and restore use of them after it was discovered they did not wor□. □ hile those attempts were unsuccessful, valuable information for planning their replacement was gathered while they were exposed which led in part to the decision to split the pro□ect into three phases to facilitate constructability.

Phase 1 of the pro□ect is the most complicated. During Phase □, the □□□ □P must be shut down for an extended period of time □longer than standard scheduled shutdowns□while the □□M is

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drained, valves replaced, and the system flushed and restored to service. Because of the duration of the shutdown, the project has been delayed until the time when all treated water storage facilities are online at maximum capacity, consumer demands are at their lowest, and back-up supplies such as the new Soquel Creek Water District intertie facility and Beltz 8 well 10 have been brought online. These conditions provide the City with the most reassurance that the 10" DIM can be taken offline for the time necessary to complete the work and allow for some contingency if problems should arise, such as incidental, concurrent water main breaks, or trouble with the actual replacement work. With all treated water storage finally online as of this spring and the new intertie nearly complete, we expect to be ready for this work by September 10.

Phase 2 of the project will involve replacing the inoperable valve at the intersection of Ocean and Kennan Streets with an inspection device retrieval station assembly consisting of two 24" valves with a permanent access manhole between them. As a result of the work accomplished by Phase 1, Phase 2 of the project will not require a shutdown of the 1000 ZP and will affect very few customers in terms of water service interruption, although the work will take place in a very busy intersection with traffic implications. This work is targeted for late fall 2014 or spring 2015, weather permitting.

Phase 3 of the project will be coordinated with a special consulting firm qualified to perform inspection and analysis of bar-wrapped concrete cylinder pipe via the new inspection device retrieval station installed in Phase 2. Funding for this effort is targeted for next fiscal year, starting in July 2013. Depending on the findings and recommendations of the Phase 3 investigation, additional work, such as spot repairs and replacements of the 10" DIM may be recommended and accomplished as future phases.

PUBLIC NOTIFICATION: Phase 2 is currently on track to occur on September 2nd, 2013. This work will require a shutdown of up to 12 hours to 12 accounts serving an estimated 30 customers. The Department will provide notice to customers in the affected area. Most of these customers are residential in nature, with only a few businesses impacted. Due to the configuration of nearby facilities, the Department will be able to provide a temporary service to the one restaurant that is part of the shutdown.

With the potential to affect service to many more customers should issues be encountered during construction, the Department will provide additional notice to the broader community. This broader notification will also address the need to use a significant amount of water as part of the critical draining phase of the project. Staff will hold a neighborhood meeting and will use online tools, written correspondence, and the media (as appropriate), to communicate with customers. As the project date nears, staff will continue to evaluate the need for more direct outreach.

ATTACHMENT: Location Map

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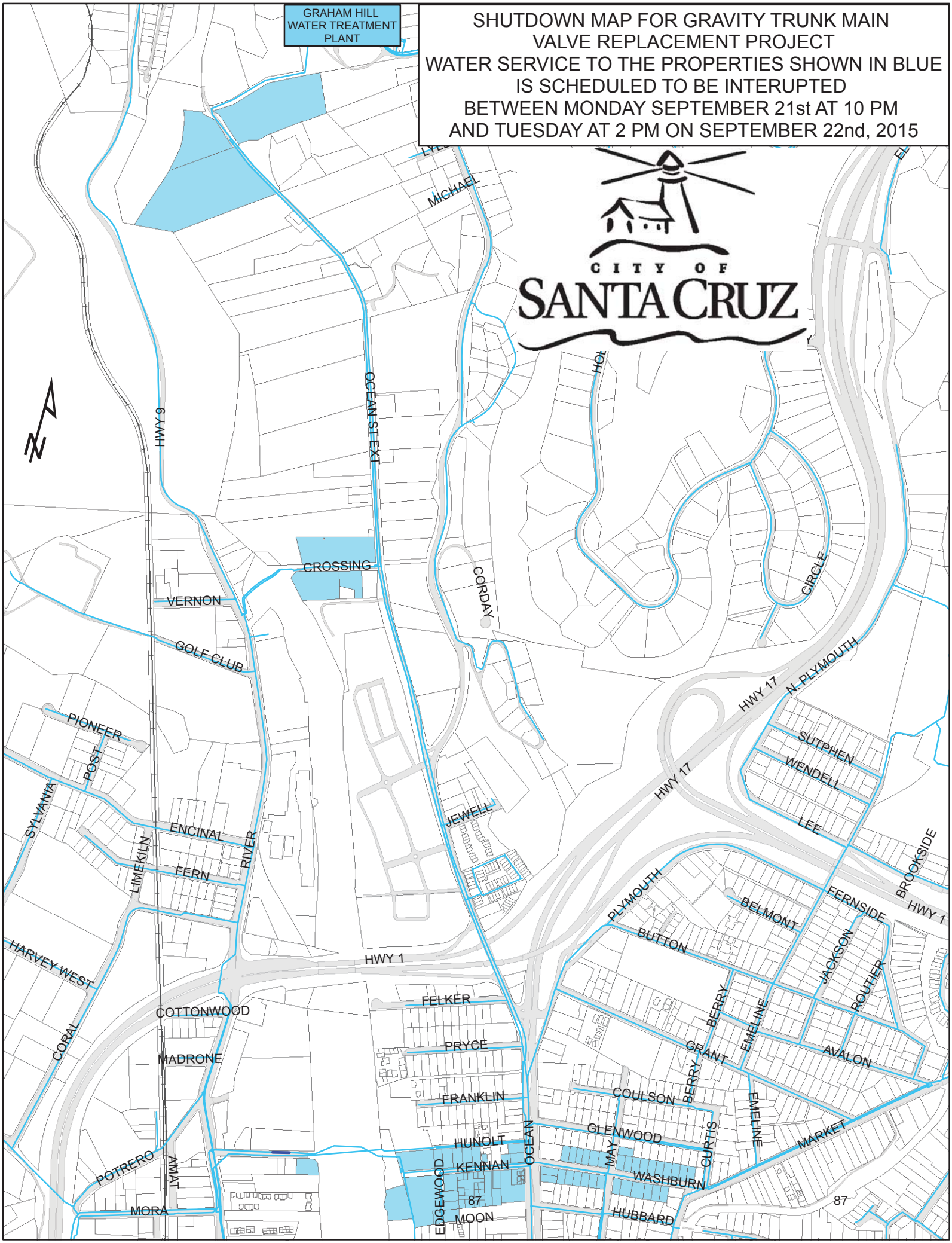
GRAHAM HILL
WATER TREATMENT
PLANT
SHUTDOWN MAP FOR GRAVITY TRUNK MAIN
VALVE REPLACEMENT PROJECT
WATER SERVICE TO THE PROPERTIES SHOWN IN BLUE
IS SCHEDULED TO BE INTERUPTED
BETWEEN MONDAY SEPTEMBER 21st AT 10 PM
AND TUESDAY AT 2 PM ON SEPTEMBER 22nd, 2015
CITY OF
SANTA CRUZ
N
HWY 9
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SUTPHEN
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LEE
BROOKSIDE
HWY 1
FERNSIDE
PLYMOUTH
BELMONT
BUTTON
JACKSON
ROUTIER
BERRY
EMELINE
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ENCINAL
FERN
LIMEKILN
RIVER
HARVEY WEST
CORAL
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Santa Cruz, CA, August 22, 2015

Dear Water Commissioners,

Please encourage the SC Water Dept. technical staff to investigate the chemical process invented by Enpro AS, of Norway that could solve our water shortages and offer other benefits as well.

Enpro AS is currently constructing a large scale pilot plant in Kollsnes, Norway, that takes in seawater and mixes with CO2 exhaust gases from the adjacent large BKK power plant, thus producing soda ash and other chemicals, solidifying green house gases, and producing unsalted water.

A smaller pilot plant in Abu Dhabi proved the process works with little energy consumption.

The unsalted water byproduct of this process is not mentioned in the literature or in their web site since potable water in Norway is not in short supply but readily available due to much rain, snow and ice.

Dr. Brent Constantz, former UCSC graduate student, founder of Los Gatos based Calera Corp, inventor of bone healing cement from coral, failed to develop a similar process of converting brine and fly ash into valuable chemicals and potable water. He formed the Moss Landing cement Company at the site of the former Kaiser Refractory's plant adjacent to the Duke Energy power plant to develop a similar chemical process. Apparently the process did not work well enough and he had fallout with the owner of the former Kaiser plant. Since then he is pursuing a Reverse Osmosis desalination scheme using water intake from the deep canyon offshore. The small organic matter from the deep would lessen the cost of cleaning the intake water prior to pushing it through the RO membranes. He founded DeepWater Desal to pursue this process. This process may work at the deep canyon off Moss Landing but not here in the Santa Cruz area and would not have the other benfits such as greenhouse gas reduction of the Enpro AS process.

Santa Cruz area has lost almost all industry and its associated employment over the years. Many manufacturers and industrial plants such as as Wrigleys, Lipton, GTE Sylvania, Victor Computer, Watkins-Johnson, Salz Tannery, Arrow, Levi, Intel, Manning, Borland, Giro helmets, Seagate, Davenport Cement, etc. have closed or moved elsewhere. Plantronics designs but no longer manufactures here.

If a desal plant using the Enpro AS process were built in Davenport near the ocean, the cement plant will be put back in operation to pvovide the needed Carbon Dioxide gas, then there will be a resurgence of cement and chemical production, employment, use of the newly purchased rail operation all the way to Watsonville Junction to transport the cement and other chemicals and paying passangers at other times and valuable reduction of greenhouse gases. The greenhouse gas reduction credits will be a valuable benefit from this process.

Please look into the Enpro AS method of chemical desalination and insist the technical staff of the Water Department contact Enpro AS and their Director and CEO Christian H. Theiste to ascertain the progress being made in Kollsnes, Norway.

Sincerely,

Peter Pethoe,

424 Escalona Dr.,

Santa Cruz, CA 95060

Cell phone: (831)325-3855,

ppethoe@google.com