FINAL REPORT

CONJUNCTIVE USE AND WATER TRANSFERS – PHASE II (TASK 6)

Proposition 84

Department of Water Resources

Integrated Regional Water Management Planning Grant

Northern Santa Cruz County Integrated Regional Water Management

Agreement No. 4600009400

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Regional Water Management Foundation

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Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

This report describes the results of technical, regulatory, and legal studies carried out to further define the feasibility of water transfer options between water agencies in the Santa Cruz Integrated Regional Water Management (IRWM) planning region. This work began in 2007 with Phase I of the Conjunctive Use Feasibility Study, funded by a Proposition 50 Integrated Regional Water Management (IRWM) implementation grant. Further evaluations were conducted in 2012-14 under the current effort, funded by a Proposition 84 IRWM Planning grant. This report presents the results of those evaluations, which can be utilized in the ongoing water supply planning efforts currently underway in the region.

Unlike many regions in the state, the Santa Cruz Integrated Regional Water Management (IRWM) planning region does not receive water imported via state or federal water supply projects. Despite the many benefits of a local water supply, the region's current water demand exceeds sustainable supply resulting in overdrafted aquifers, diminished streamflow, and inadequate long-term supply. These conditions are due in part to the timing of rainfall in the region – most of the rainfall occurs during the winter when demand is lowest. Exacerbating this situation is the situation that local water districts generally utilize only one source of water for supply, which has limited opportunities to better manage resources through conjunctive use.

This report evaluates the feasibility of transfering excess available surface water from the San Lorenzo River during the winter months of November through April. Water would be transferred from the City of Santa Cruz diversions on the San Lorenzo River to the surrounding groundwater agencies (Scotts Valley Water District, southern portion of San Lorenzo Valley Water District and Soquel Creek Water District) to supply their demands, allowing them to reduce pumping from their overdrafted groundwater basins, helping those basins to recover. As basin recovery occurs, increased groundwater levels will increase stream baseflow and available fish habitat, and during dry summers water could be provided back to the City of Santa Cruz to help meet their demands while leaving more flow in the streams for fish. The City of Santa Cruz would also benefit indirectly from some increase in San Lorenzo River flow and increase in groundwater levels in the western Purisima basin, which the City shares with the Soquel District.

As originally conceived, winter water would first be provided to the Scotts Valley area (Scotts Valley and San Lorenzo Valley Water Districts), which is within the San Lorenzo Watershed, and would eventually lead to increased baseflow in Bean Creek and the lower San Lorenzo River. Any available water in excess of Scotts Valley demand would be provided to Soquel Creek Water District. The eventual priority and timing of deliveries is a matter subject to negotiation and agreement among the water agencies. Interties already exist to transfer water to Soquel, and basin recovery there is a very high priority in order to prevent a worsening of seawater intrusion.

The timing and amount of water delivered back to the City would depend on three yet to be understood issues including the condition of the groundwater basins, pumping capabilities of the groundwater agencies, and policies for basin management established by the governing boards. With current infrastructure and the addition of a pump station at 41^{st} Avenue, Soquel could theoretically pump 1.44 mgd to the City, or 172.8 million gallons (530 acre-feet) over a 4 month period. This would be dependent on assurance that the additional withdrawal for that period would not have an adverse impact on seawater intrusion. This assurance could be provided by better knowledge of the location of the seawater interface, groundwater modeling, and/or an increase in basin storage resulting from prior deliveries and in-lieu recharge. Delivery in excess of 1.44 mgd to Santa Cruz from Soquel would require an increase in intertie and pumping capacity and additional wells. Delivery of water from Scotts Valley to

Santa Cruz would require construction of an intertie and additional wells to be able to deliver 1 mgd, (700 gpm) 120 million gallons (370 acre-feet) in a 4 month period.

The City of Santa Cruz utilizes the Confluence model to model the availability of water supplies and determine water supply shortages, taking into account the variation in demand, the availability of water from its various sources, and the capacity of its infrastructure to pump and treat the water. Confluence has been used to model the various water transfer scenarios to calculate the expected yield during the range of historical hydrologic conditions from 1937-2009. All model runs took into account the need to protect fish habitat throughout the City operations and utilized the "Tier 3" flow bypass requirements that had been under consideration in the City's Draft Habitat Conservation Strategy. Under those conditions, it should be noted that the City utilizes the Tait Street Diversion significantly more during winter months than they have historically used it, leaving less water available for transfer to neighboring agencies. The total amount potentially transferred in a day is also limited to the actual daily demand of the groundwater agencies.

Winter flow in the San Lorenzo River is frequently subject to higher sediment load, higher turbidity, and increased organic and potential pathogen load, requiring considerable treatment to meet State Drinking Water requirements. Depending on the amount of water transferred, pumping more winter water from Tait Street, with treatment at the City's Graham Hill Treatment Plant, will require upgrade of diversion and treatment facilities and increased operation costs. Kennedy/Jenks Consultants (2013) prepared an analysis of the improvements needed under the various scenarios and a planning level estimate of the capital and operational costs of those improvements.

The following transfer scenarios have been evaluated:

0. Use of current water rights, current Tait Street Diversion capacity (7.8 mgd), current Graham Hill Treatment Plant capacity (10 mgd), and existing interties between Santa Cruz and Soquel to transfer water to Soquel Service Areas 1and 2 of the Soquel Water District. This assumes a transfer capacity of 1.48 mgd, based on hydraulic capacity of those interties.
1. Utilize current water rights and diversion/treatment infrastructure, with new interties to Scotts Valley (1-2 mgd capacity) and to Soquel (1.5-3.5 mgd capacity). This would also require some upgrades to the Tait Street intake to better handle the increased sediment load from increased winter use.
2. Increase Treatment Plant Capacity to 16 mgd. This would require replacement of the pre-treatment solids settling and filtration components and oxidation/disinfection components at the Treatment Plant.
3. Increase Treatment Plant capacity to 16 mgd as in Scenario 2 and double diversion capacity at Tait Street to 14 mgd by constructing an additional new diversion works and upgrading pumps.
4. Increase Treatment Plant capacity to 16 mgd as in Scenario 2 and upgrade treatment process to treat turbid source water up to 200 NTU, by upgrading the solids handling process. This allows more days of diversion during the winter.
5. Increase Treatment Plant Capacity to 16 mgd and turbidity treatment to 200 NTU per Scenario 4 and Tait Street diversion capacity to 14 mgd per scenario 3.

The following table presents the results of the yield and cost analysis of the various scenarios.

Table 1. Summary of potential water transfer scenarios

	Scenario	SqCWD Average Yield MG(AF)	SVWD Average Yield MG(AF)	Total Potential Yield MG(AF)	Capital Cost $M[4]	Annual Cost $M[4]	Production Cost/AF $/AF[4]
0	Current Tait/GHTP Infrastructure/ Water Rights/ Connections, 1.48 mgd to SqCWD SA1 and SA2[1]	145 (445)	(no existing intertie)	145 (445)	5.8	0.1	1,020
1	Current Infrastructure/Rights[2,3] New interties (SV: 1-2mgd; SqCWD: 1.5-3.5 mgd)	39 (120)	106 (325)	145 (445)	26.95	1.90	4,260
2	Increase GHWTP Capacity from 10 mgd to 16 mgd[2,3]	95 (292)	108 (331)	204 (623)	77.53	5.24	8,420
3	Increase GHWTP Capacity and Increase Tait Capacity from 7.8 to 14 mgd[3,5]	333 (1,022)	154 (473)	488 (1495)	90.61	6.40	4,280
4	Increase GHWTP Capacity and Turbidity Treatment from 15 to 200 NTU (Tait at 7.8 mgd)[2,3]	136 (417)	124 (381)	260 (798)	85.73	5.91	7,410
5	Increase GHWTP Capacity, Increase Tait Capacity, Increase Turbidity Treatment[6]	384 (1,178)	174 (534)	558 (1,712)	91.68	6.68	3,900

<u>Sources/Notes</u>

[1] Kennedy/Jenks, Draft Technical Memo No. 3 Surface Water Transfer Alternatives, July 10, 2014
[2] Fiske, Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision), May 22, 2013
[3] Fiske, Water Transfer Phase 2 Summary, June 27, 2013
[4] Kennedy/Jenks, Water Transfer Infrastructure Summary Report, October 25, 2013; costs are costs of production and do not include additional costs of delivery to customers.
[5] Fiske, Phase 2 Water Transfer Project Draft Task 3 Technical Memorandum: Potential Transfers with Unlimited Tait Street Capacity, June 20, 2013
[6] Fiske, Supplemental Analysis of Water Transfer Volumes, July 24, 2013
[7] Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 Final, June 22, 2012

Implementation of any of these scenarios will require approval of a new water right and/or transfer of water under the City's existing rights. A variety of mechanisms were identified to accomplish this task, likely to include a combination of short term transfer under existing rights while a new water right application is filed with the State Water Resources Control Board.

Any water rights approval will require environmental review under CEQA and a demonstration that the transfer of water would have no significant impact on habitat for endangered coho salmon and steelhead. The transfer scenarios were designed to maintain flows necessary for fish and provide eventual habitat benefits. An effects analysis has shown no significant reduction in available habitat.

The City of Santa Cruz and the Soquel Creek Water District are both actively engaged in identifying new supplemental supply options, including the potential use of water transfers. A number of possibilities are currently under consideration and will be evaluated in relation to the transfer options described in this report. With the approval of an emergency transfer and local agreements, the infrastructure is already in place to move up to 445 acre-feet a year from Santa Cruz to Soquel.

Next steps for implementation of a water transfer project would include:

1. Consultation with fishery agencies and the State Water Resources Control Board,
2. Reevaluation of yields and capabilities for transfer from Santa Cruz in relation to new operating conditions and potential climate change effects,
3. Completion of additional technical work to establish the amount of water that could be returned to Santa Cruz,
4. Development of more detailed plans and cost estimates and CEQA analysis, and
5. Development of agreements and the institutional framework for moving a project forward.

1.0 INTRODUCTION

Integrated Regional Water Management (IRWM) is a statewide initiative by California's resource management agencies to promote collaborative, local solutions to water management challenges. IRWM enables self-forming regions to identify, integrate and implement water management measures appropriate for their needs. The fundamental principle of IRWM is that regional water managers are best positioned to manage regional water resources. While large, inter-regional water management systems, such as the State Water Project, Central Valley Project, and large flood management systems are important for California, the majority of the State's water resource management investments are made at the local and regional level.

The Santa Cruz region's rich natural resources provide critical habitat to numerous threatened and endangered species, drinking water for residents and visitors, and opportunities for recreational and commercial activities. The overwhelming majority of the region's water supply is locally derived from surface and groundwater sources – a unique fact in a state supported by large federal and state water projects. However, like many other areas of California, the region faces water resource challenges including impaired water quality, overdrafted groundwater basins, depleted streams, and locally degraded riparian habitat. Most of the groundwater basins are being pumped in excess of sustainable yield and the major water supply agencies do not have sufficient sustainable supplies to meet current and future projected demand. Historic salmon and steelhead populations have been greatly diminished by reductions in streamflow, increased erosion and sedimentation, barriers to migration, and removal of large woody material from streams.

The initial Santa Cruz IRWM plan was drafted in response to Chapter 8 of the voter-approved Proposition 50, which called for the development of such plans. The Santa Cruz IRWM region boundary is based upon watershed boundaries, jurisdictional boundaries, and water management issues and includes approximately 80% of the population and 85% of the geographic extent of the County (Figure 1). The 2005 IRWM plan was adopted by six partner agencies[1].

Development of the 2005 IRWM Plan helped secure a $12.5 million grant award from the State Water Resources Control Board for the implementation of 15 high-priority projects, one of which included Phase I of an analysis of conjunctive use opportunities in the lower San Lorenzo River watershed and Santa Margarita groundwater basin (Figure 2). The main goals of the project were to conduct initial analyses of streamflow, fishery regulations, existing infrastructure and other constraints to determine the feasibility of large-scale water exchanges and aquifer recharge projects.

Eight technical analyses grouped into four general areas were conducted in Phase I, including:

- hydrogeologic analyses (regional hydrogeology, groundwater recharge potential of various locations, and groundwater modeling of potential projects),
- surface water resource analyses (water rights, stream flow, water quality, and fisheries needs),
- engineering analyses (current water sources, existing and potentially new infrastructure, planning level cost estimates),

[1] 2005 Plan Partner Agencies Include: Soquel Creek Water District; City of Santa Cruz; Scotts Valley Water District; Davenport Sanitation District; County of Santa Cruz – Environmental Health Services and Department of Public Works; Resource Conservation District of Santa Cruz County.

- and regional water demand analyses (current and future local demands, current and future supply sources).

After completion of the technical studies and analysis of over 100 project alternatives, three preferred management strategies that warrant further analysis were identified:

1. stormwater recharge in the Scotts Valley area ,
2. inter-district exchange of water for in-lieu recharge of aquifers, and
3. surface water diversion from the San Lorenzo River for groundwater recharge in the Hanson Quarry area.

Figure 1 - Santa Cruz IRWM Water Districts

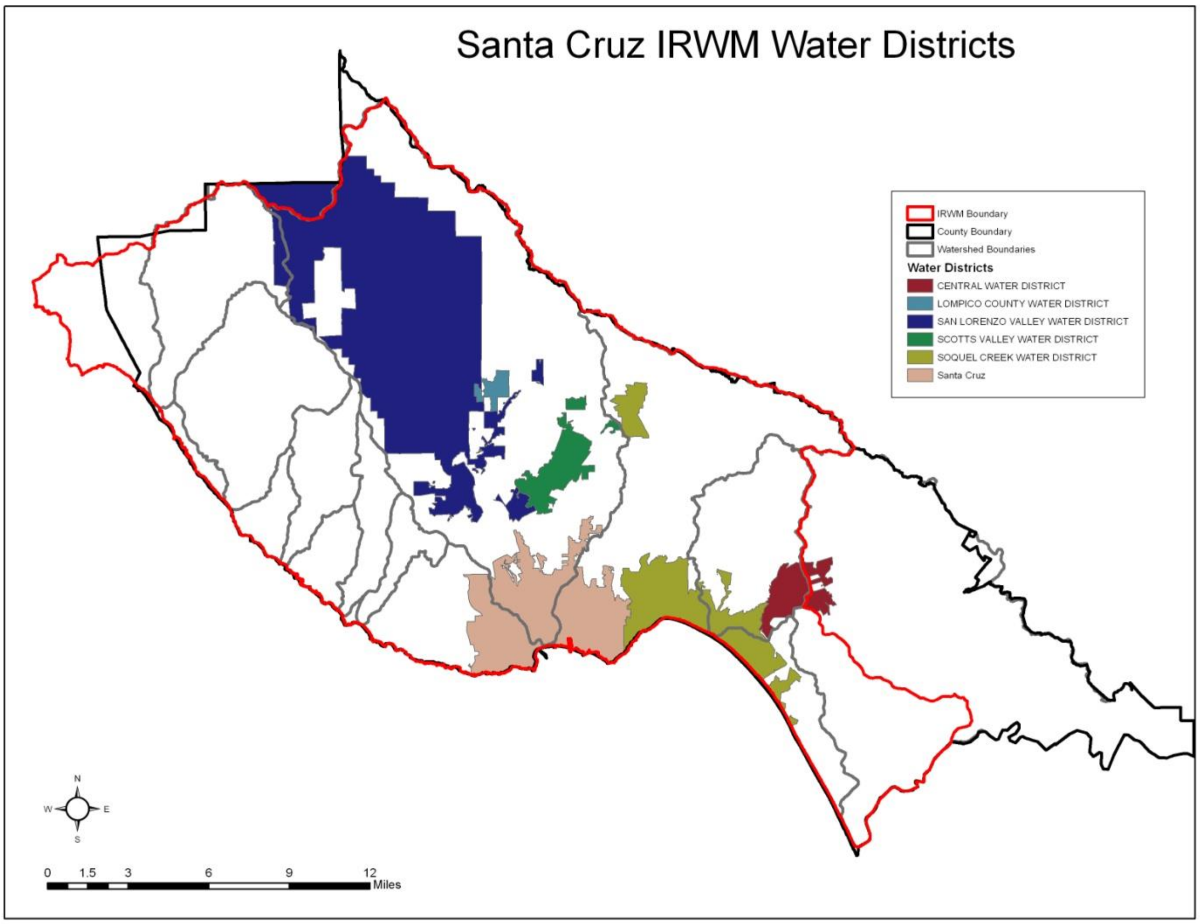
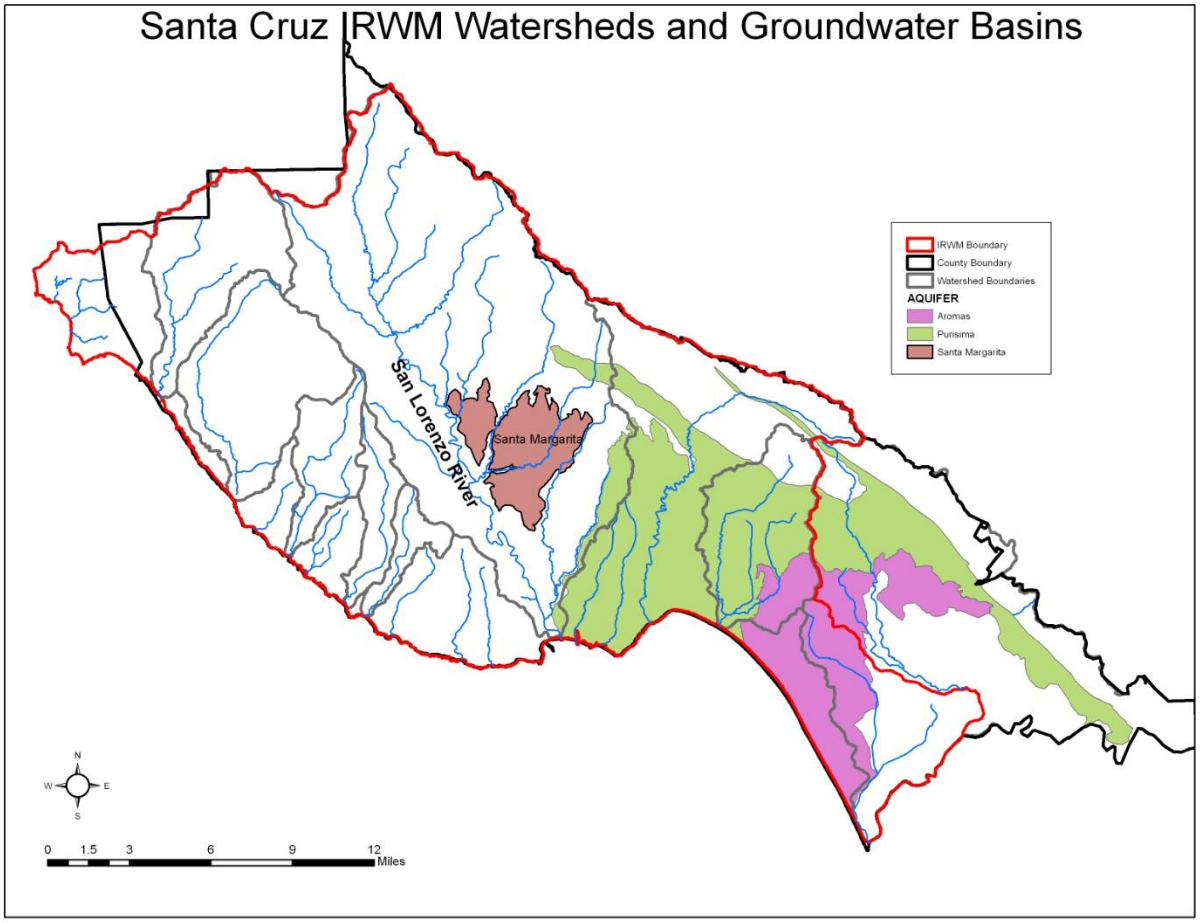


Figure 2 - Santa Cruz IRWM Groundwater Basins



A Proposition 84 Planning Grant was awarded by the Department of Water Resources to the Regional Water Management Foundation[2] for development of an updated Santa Cruz IRWM plan, including continued analysis of conjunctive use opportunities. Phase II builds on the technical information generated in Phase I by analyzing specific technical and regulatory aspects of a water exchange scenario between the City of Santa Cruz Water Department (City) and adjacent groundwater agencies in the Scotts Valley area (Scotts Valley Water District and the southern part of the San Lorenzo Valley Water District), and Soquel Creek Water District Soquel. The original concept for the project is that the City would use existing facilities to divert and treat surplus winter flows from the San Lorenzo River and transfer that water to Scotts Valley and/or Soquel. In drought years, the adjacent agencies could possibly send groundwater back to the City when its surface sources were inadequate to meet both City demand and fish flows.

[2] The Regional Water Management Foundation (RWMF) is a non-profit, 501(c)3, subsidiary of the Community Foundation Santa Cruz County. The RWMF was formed in response to the initial Proposition 50 award to act as the administrative and fiscal entity for the IRWM region for various grants.

Specific work items included modeling the City water system to estimate water yields potentially available for water exchange after the fish flow requirements and City demand was met. The modeling also computed residual flows that were used to analyze potential impacts upon fish habitat. The yield scenarios were used to develop planning-level engineering and cost estimates for potential upgrades to the water diversion and treatment infrastructure at Tait. The analysis examined seven scenarios from a simple water transfer with current infrastructure to a water transfer that included increased diversion and enhanced treatment and solids handling capacity. In addition to the engineering analysis, legal consultants completed a detailed draft memo of short term and long term options to obtain water rights approvals for water transfers.

The final work products from these analyses include (available as appendices to this report):

1) **Water Yield Monitoring – Gary Fiske and Associates, INC.**
   a) *Task 1: Short-term transfer analysis w/ existing infrastructure*
      i) Current infrastructure and water rights.
      ii) Direct Felton diversion to GHWTP.
      iii) GHWTP improvements to treat more turbid water.

      Report: Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision) (May 22, 2013)

   b) *Task 2: Short-term transfer analysis w/ infrastructure improvements*
      Report: Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity (June 11, 2012)

   c) *Task 3: Long-term transfer analysis with various scenarios*
      Reports:
      i) Water Transfer Project: Long-Term Analysis Scenario 1 (June 1, 2012)
      ii) Phase 2 Water Transfer Project Draft Task 3 Technical memorandum: Potential Transfers with Unlimited Tait Street Capacity (June 20, 2012)
      iii) Water Transfer Project: Long-Term Analysis Scenario 2 (Revised) (June 22, 2012)
      iv) Water Transfer Project: Long-Term Analysis Scenarios 3 and 4 (June 25, 2012)
      v) Water Transfer Project: Long-Term Analysis Scenario 5: GHWTP Improvements (July 2, 2012)
      vi) Water Transfer Project: Potential Transfers with Unlimited Tait Street Capacity, (June 20, 2013)

   d) Summary report
      Reports:
      i) Final Water Transfer Project Results Summary (July 6, 2012)
      ii) Supplemental Analysis of Water Transfer Volumes, (July 24, 2013)

2) **Fishery Habitat Impacts Assessment – Jeff Hagar, Hagar Environmental Science**
   a) Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon (Plots of various habitat parameters under different diversion and flow scenarios, June 25, 2013)
3) **Infrastructure and Cost Assessment – Kennedy/Jenks Consultants**
   a) Water Transfer Infrastructure Summary Report (October 25, 2013)
   b) Opinion of Probable Construction Costs. (July 25, 2013)
4) **Water Rights Assessment – Best Best & Krieger, LLP**
   a) Memorandum, County of Santa Cruz Water Supply and Water Rights Issues (October 28, 2013)
5) **Intertie Capacity Analysis – Akel Engineering Group**

a) Analysis of hydraulic capacity to pump water from Santa Cruz to Soquel and from Soquel to Santa Cruz under various scenarios (February 19, 2014).

2.0 Background Studies & Plans

The water supply challenges and related impacts to resources in the Santa Cruz Region have been known for decades. Numerous studies have been conducted in an attempt to identify supplement sources of water and reduce demand to minimize shortages. Recent efforts from the three agencies are described below.

2.1 Phase I - Prop 50 Conjunctive Use Report

This project conducted a series of technical analyses and evaluated a wide range of water source and aquifer recharge alternatives for the Santa Margarita Groundwater Basin. The intent of the study was to identify potential alternatives to reverse groundwater decline for the benefit of domestic water supply and fisheries habitat.

Eight technical evaluations formed the basis of this study. The evaluations were broken into hydrogeologic analyses (regional hydrogeology, groundwater recharge potential of various locations, and groundwater modeling of potential projects), surface water resource analyses (water rights, stream flow, and fisheries needs), engineering analyses (current water sources, existing and potentially new infrastructure, conceptual level cost estimates), and regional water demand analyses (current and future local demands, current and future supply sources). Potential project types and project components were identified and screened to determine which would have the greatest benefit to water supply in the lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin.

Three preferred alternative were identified: 1) stormwater recharge in the Scotts Valley area , 2) inter-district exchange of water for in-lieu recharge of aquifers, and 3) surface water diversion from the San Lorenzo River for groundwater recharge in the Hanson Quarry area. Conceptual-level engineering analyses, order-of-magnitude cost estimates, and implementation plans were developed for each of the three alternatives.

The following documents were prepared as part of the Conjunctive Use and Enhanced Aquifer Recharge study:

- Technical Memorandum 1A – Hydrogeology Evaluation
- Technical Memorandum 1B – Evaluation of Recharge Potential
- Technical Memorandum 1C – Groundwater Modeling Evaluation
- Technical Memorandum 2A – Water Rights Evaluation
- Technical Memorandum 2B – Source Water Assessment
- Technical Memorandum 2C – Fisheries Evaluation
- Technical Memorandum 3 – Engineered Facilities Evaluation
- Technical Memorandum 4 – Regional Water Demand
- Final Report (August 2011)

2.2 Water Agency Planning Documents

Water exchange has been evaluated as a potential source of alternative supply in Integrated Resource Plans prepared for the City, Soquel and the Urban Water Management Plan for the SVWD.

2.2.1 City of Santa Cruz Integrated Water Plan

For decades, the City had been considering possible new water supplies ranging from additional groundwater exploration to surface water impoundment sized to serve nearly all demand in a drought condition as severe as the 1976-1977 event. The City Council directed an approach that would look at combinations of water conservation, use curtailment in drought years, and development of a more modest water supply, hence an Integrated Water Planning (IWP) process. The purpose of the IWP was to (1) reduce the near-term drought year shortages, and (2) provide a reliable supply that meets long-term needs while ensuring protection of public health and safety. A key premise of the IWP is that, overall, it might be better for the City to accept and manage some level of peak season water shortage from time to time than to try to eliminate the possibility of any future shortage by developing enough supply capacity to overcome the drought of record. Based on studies and input from the community at that time (2001-03), the highest level of worst peak-season shortage that is tolerable for Santa Cruz water customers was 25%. Thus, strategies examined in the IWP only focus on curtailment profiles for which the worst peak-season shortage did not exceed this level (in addition to ongoing conservation efforts). Based on substantial analysis conducted as part of the IWP, desalination along with 15% worst-year curtailment were identified as the preferred alternatives. Water transfers, system interties and treatment upgrades had been identified as early as 1985 as a supply alternative, however a water exchange project was not carried forward citing , limited water supply benefit to the City, and the possibility of jeopardizing the City's existing water rights.

In the face of substantial public opposition to the proposed desalination project, in 2013, the City put the desal project on hold and initiated a further public review of demand projections, demand reduction options, and supply alternatives. The City's Water Supply Advisory Committee (WSAC) is presently reviewing a number of supply options, demand management strategies, and shortage levels, including the potential for pursing a portfolio of multiple projects and programs similar to the concept of the IWP. The WSAC is also contemplating potential impacts of climate change on weather and hydrology. The Committee is expected to make a recommendation to the City Council in October 2015. Water exchange is one of the possibilities being considered.

2.2.2 Soquel Creek Water District – Integrated Resources Plan

Beginning in the mid-1990's, Soquel began to respond to indications of groundwater overdraft though the development of an Integrated Resources Plan (IRP). In 2006, the IRP was revised with updated information and further evaluation of potential water supply alternatives. The IRP was revised again in 2012 based on more recent information developed regarding groundwater conditions of the Soquel-Aptos basin and reduced demand projections. The 2012 IRP identifies key water supply planning objectives including limiting groundwater pumping to 2,900 AFY, achieving that goal within 6 – 8 years, and continuing to limit the pumping to that level for at least 20 consecutive years. These objectives would be achieved through a variety of components, including demand management, groundwater management, conjunctive use supply projects, and local supplemental supply alternatives. Soquel had been pursuing the regional desalination project along with Santa Cruz, but when the City put that project on hold in 2013, Soquel redoubled their efforts to evaluate other options, including demand management, desalination, recycled water, groundwater injection, and surface water transfer from the San Lorenzo River.

2.2.3 Scotts Valley Water District – Urban Water Management Plan

An Urban Water Management Plan (UWMP) is a state-mandated planning tool that generally guides the actions of water management agencies. It provides a broad perspective on a number of water supply issues, but it is not intended to be a substitute for project-specific planning. In general, an UWMP describes the potential sources of supply and demand, given a reasonable set of assumptions about growth and water management practices, and how well those figures match up. The Scotts Valley UWMP states that, although there have been significant years of drought and declining groundwater levels, the overall storage in the basin is apparently sufficient to provide adequate resources for the district given the past, current and anticipated future demand. The long-term adequacy of the supply will rely on improving direct and in-lieu recharge, and reduction in groundwater pumping through improved water use efficiency, and recycled water production. The UWMP also states that the concept of water transfer has evolved into a viable supplemental source to improve supply reliability, stating that one of the most important aspects of any resource planning process is flexibility. A water exchange with the City of Santa Cruz is discussed in the UWMP along with potential recycled water exchange including City of Scotts Valley, Scotts Valley Water District, Santa Cruz, and the Pasatiempo Golf Course. Scotts Valley is also currently leading the effort to evaluate options to develop a groundwater recharge project at the abandoned Hanson Quarry using recycled water and/or surface water pumped from the San Lorenzo River. A recent grant has funded the construction of emergency interties between Scotts Valley Water District and the various service areas of the San Lorenzo Valley Water District, facilitating additional potential water transfer options, subject to evaluation of the potential environmental effects of such transfers.

2.3 Santa Cruz Habitat Conservation Plan (HCP) Efforts[3]

Recently, diversions from the Santa Cruz s surface water sources have been limited by Endangered Species Act (ESA) issues. All of the streams from which Santa Cruz diverts water, including the North Coast sources, San Lorenzo River, and Newell Creek, provide important habitat for steelhead trout, which are listed under the federal ESA as threatened. Additionally, the San Lorenzo River and Laguna Creek also provide habitat for coho salmon, listed under the federal and state ESAs as endangered.

Any activity that may have the potential to result in take of a federally listed species requires a federal Section 10(a) Permit. To take a species means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The term harm in this definition has been interpreted to include detrimental modification of a species habitat, such as the effect of streamflow reductions upon fishery habitat. Leading up to the application for the permit, the City must look critically at its operations and the potential to take any listed species and prepare an HCP. The anadromous fisheries HCP will describe measures that the City would take to minimize and mitigate take of these species to the maximum extent practicable. The City has been working with the National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS) and with the California Department of Fish and Wildlife (CDFW) on the HCP and the counterpart planning under the California ESA, as well as developing master streambed alteration agreements for all of its water diversions under the California Fish and Game Code.

Numerous studies undertaken in support of the HCP have evaluated how much water flow is needed in streams during various times of the year to protect the fisheries habitat during all freshwater life phases (migration, spawning, and rearing). These studies show that the City's operations are affecting special-status anadromous salmonid species and may result in take. Generally speaking, the impacts are greatest on the North Coast streams during the dry season and during dry water years. However, potential adverse effects can also occur during the wet season. Given this, the City is also confronted

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[3] Paraphrased From: URS Corporation. 2013. *SCWD² Regional Seawater Desalination Project Draft Environmental Impact Report.* City of Santa Cruz and Soquel Creek Water District. Pg. 3-13 – 3-17

with the requirement to provide adequate wet season in-stream flows to support anadromous salmonid migration, spawning, and egg incubation. Additionally, given the renewed focus on the San Lorenzo River for coho salmon recovery, the conservation strategy developed for the HCP must also address the relatively complex San Lorenzo watershed.

The HCP development process began in 2002 when the City hired a firm to develop a citywide, multi-species HCP. The City also conducted extensive technical studies of streamflow flow and available habitat under various flow conditions in the reaches downstream of the City diversions. In August 2011 the City developed the refined Draft Habitat Conservation Plan Conservation Strategy for Steelhead and Coho Salmon (Conservation Strategy) to serve as a key component of the HCP. A critical component to the Conservation Strategy is the identification of streamflow targets based on the amount of rainfall received in a given year. These targets or “tiers” reflect varying amounts of streamflow to remain in the stream, from existing diminished flows (Tier 1) up to the flow needed to maintain 80% of the fish habitat that would be available without the City diversions (Tier 3). Negotiations regarding the streamflows are ongoing with the resource agencies, and negotiations have focused on evaluating a CDFW flow proposal (DFG-5), which would leave more water in the streams in dry years, and potential water infrastructure modifications that might benefit fish flows. In the meantime, the City is already voluntarily releasing more flow downstream of its existing diversions at Tait Street and the North Coast.

The City utilizes the Confluence Water Resources Planning Model[4] to simulate current and future water supply system operation with user-providedweather and hydrologic conditions. Extensive Confluence water modeling has been initiated to evaluate the potential for decreased future water diversions with the potential infrastructure changes. From an operational standpoint, meeting fish flow requirements will be very complex to implement regardless of the agreed-upon strategy. According to the City UWMP, the process to secure an incidental take permit involves many more steps and could potentially take several more years to complete. While the outcome remains uncertain, it is clear that compliance with endangered species regulation at the state and federal levels will result in less water being available for use by the City from the San Lorenzo River and North Coast streams in future years, compared to the past. This, in turn, will place greater reliance on water stored in Loch Lomond Reservoir and groundwater to meet the community’s annual water needs, which will exacerbate the aforementioned problem of water shortage. This will also result in an increase in City wet weather diversions from the San Lorenzo River to make up for the reduced diversions from the North Coast sources.

[4] Gary Fiske and Associates, Inc. Confluence® Water Resources Planning Model. http://confluence-water.com/

3.0 Existing Surface Water Sources[5]

In order to provide the context for a potential water exchange project, the following is a brief overview of the City's water supply and delivery system operations.

The Santa Cruz City Water Department serves an estimated population of nearly 91,000 people who reside in the water service area, according to the 2010 U.S. Census. Some 59,950 people, or about two thirds of the total population, live inside the City limits. Another 31,350 people, or 34 percent of the service area population, live outside the City limits.

The City water system has four main water supply sources: 1) the North Coast sources including Laguna, Regiardo and Majors Creeks and Liddell Spring; 2) the San Lorenzo River; 3) Loch Lomond Reservoir; and 4) the Beltz Wells. In general, the City's water system has been managed to take advantage of the better quality and less expensive sources as a first priority and to retain the maximum amount of water possible in Loch Lomond Reservoir to safeguard against future droughts. Maximum diversion rates and minimum bypass requirements contained in the City's water rights also govern the operation of the water system.

The City water supplies are generally prioritized to meet daily demands in the following order: North Coast, San Lorenzo River, Beltz Wells, and Loch Lomond Reservoir. Due to the excellent water quality and lowest production cost, the North Coast sources have historically been used to the greatest extent possible. Further, water from the North Coast diversions are diverted under pre-1914 appropriative water right and least affected by water rights limitations. However, the fishery agencies are seeking significant increases in downstream bypasses as part of the HCP. Additional water needed to meet daily demands is pumped from the San Lorenzo River at Tait Street. Although there are presently no established bypass requirements at Tait, the maximum diversion rate is limited to 12.2 cfs. During the summer and fall, when the City's flowing sources are inadequate to meet peak-season daily demands, additional water is taken from the Beltz Wells and from Loch Lomond Reservoir. The Felton Diversion is operated intermittently as needed in the winter months to augment storage in Loch Lomond. However in normal to wet years, Loch Lomond fills without Felton Diversion water and in dry years, the operation of the diversion is limited by several factors, including bypass flow requirements, turbidity constraints, and demand needs at Tait Street, as well as pressure limitations on pipeline infrastructure to move water to the lake.. Currently, the same pipeline is used to fill and draw down the lake. On days the lake is being drawn down, water cannot be pumped from Felton.

Over the period between 2006-2010, gross production from the North Coast sources has averaged 1,065 million gallons per year (mgy), or 30 percent of the total supply, while the San Lorenzo River supply has averaged 1,889 mgy, or about 54 percent of the total supply. Together, these flowing sources provide over 80 percent of the City's yearly water needs. Water supplied from Loch Lomond Reservoir averaged

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[5] Paraphrased From: URS Corporation. 2013. *SCWD^2 Regional Seawater Desalination Project Draft Environmental Impact Report.* City of Santa Cruz and Soquel Creek Water District.

And

Kennedy/Jenks Consultants. 2013. *Water Transfer Infrastructure Summary Report.* Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation.

419 mgy, or 12 percent. Groundwater from the Beltz Wells provided an average of 156 mgy, or about 4 percent of the City's total supply. However, going forward, the ESA issues will likely affect the priority of source selection and the relative contribution of each source to overall production.

3.1 Tait Street Diversion

The Tait Street Diversion delivers San Lorenzo River surface water directly to the Graham Hill Water Treatment Plant (GHWTP). The diversion is located on the San Lorenzo River near Tait Street in Santa Cruz, and has a design capacity of up to approximately 12.2 cubic feet per second (cfs) (approximately 7.8 mgd). The Tait Street Diversion includes a diversion structure in the river, a diversion inlet structure with narrow-slot screens for fish protection, an intake sump with three multi-stage vertical turbine pumps, pump station building, a standby power generator, and associated piping, valves, instrumentation and controls. Water is pumped via a 24-inch pipeline from the diversion to the inlet of the GHWTP. Because the additional surface water for transfer would come from the San Lorenzo River, the capacity of the Tait Street Diversion may need to be increased to accommodate additional diversion needed for winter-time water transfers.

3.2 Felton Diversion

The Felton Diversion is used by the City to transfer water from the San Lorenzo River into the Loch Lomond Reservoir for storage. Water can then be brought down from the reservoir to the GHWTP. The Felton Diversion augments storage in the reservoir) and is not presently permitted to divert surface water directly to the GHWTP. Therefore, direct diversion from the Felton Diversion is not presently considered as an intake source for the additional winter-time surface water transfer. A water rights amendment and further evaluation of bypass flows for downstream fish habitat would be required to use Felton Diversion for water exchange, groundwater recharge, or other conjunctive use projects.

3.3 Graham Hill Water Treatment Plant

The City's Graham Hill Water Treatment Plant (GHWTP) was commissioned in 1960 and has a current target capacity of approximately 18 million gallons per day (mgd). The GHWTP is a conventional surface water treatment plant with pre-oxidation, periodic powdered activated carbon addition, rapid mix coagulation, flocculation, sedimentation, granular media filtration, and free chlorine disinfection. The current treatment process at the GHWTP is limited to treating source water with turbidity levels less than approximately 15 NTU. During wintertime storms the turbidity levels increase significantly above the 15 NTU limit for the GHWTP, and the GHWTP must limit or stop production from the river sources completely until the turbidity levels drop. The wintertime capacity of the GHWTP is also limited by operational maintenance requirements. In the wintertime, each of the three flocculation and sedimentation basins are sequentially taken out of service for cleaning and maintenance, limiting total winter time production capacity to 10 mgd.

In addition to improvements to the GHWTP for treating higher turbidity source water and meeting increased wintertime production requirements, improvements to the source water pumping stations and treated water delivery system would also be required to transfer significant quantities of water.

3.3.1 Production Capacity

As stated, the GHWTP has a current summer-time target peak production capacity of approximately 18 mgd and a winter-time production capacity of approximately 10 mgd. The nominal hydraulic capacity of the GHWTP is approximately 24 mgd however, the plant is unable to be operated at the rate due to equipment or process limitations, maintenance requirements, and the need to meet certain water quality objectives.. The current City daily winter-time demands at the GHWTP can range from approximately 6 mgd to 9 mgd. The winter-time water transfers would be in addition to the current City water demands served by the GHWTP.

Table 2 - Current Graham Hill Treatment Plant Capacities (in million gallons per day (mgd)

Design Parameter	Current Summer	Current Winter
Maximum Plant Production	18	~10
Average Plant Production	12	8
Nominal Plant Hydraulic Capacity	24	24

3.3.2 Treatment Requirements

The GHWTP produces water that complies with both federal and State rules, regulations, and guidelines established under the Federal and State Safe Drinking Water Acts, including the requirements in the Surface Water Treatment Rule (SWTR), Interim Enhanced SWTR (IESWTR), and Long Term 2 Enhanced SWTR (LT2ESWTR) for systems serving more than 100,000 people.

Turbidity: To meet the requirements of the California SWTR, the GHWTP must maintain filtered water turbidity less than or equal to 0.3 NTU in at least 95 percent of the filtered water samples collected during each month. In addition, both the settled water turbidity and recycled water turbidity objective is to be less than 2 NTU in accordance with the California Cryptosporidium Action Plan (CAP). The current treatment process at the GHWTP is limited to treating source water with turbidity levels less than approximately 10 to 15 NTU. During winter-time storms and high flows in the San Lorenzo River and the North Coast sources, the turbidity levels increase significantly above the 10 NTU limit for the GHWTP, and the GHWTP must limit or stop water withdrawal from the San Lorenzo River until the turbidity levels drop.

Microbial Removal and Disinfection: A typical surface water treatment plant is required to provide filtration removal and disinfection to achieve a 3-log Giardia and 4-log virus removal/inactivation performance standard. Since 1998, CDPH has required an increased level of 4-log (99.99%) Giardia cyst and 5-log (99.999%) virus removal/inactivation through the filtration and disinfection processes at the GHWTP to be in compliance with the SWTR. The basis for the increased removal-inactivation requirements was elevated levels of total coliform in the San Lorenzo River source waters to the GHWTP. This additional removal/inactivation requirement places constraints on the GHWTP production capacity. To accomplish the winter-time water transfers, an additional and more robust disinfection process such as ozone or ultraviolet light could be required.

3.3.3 Treated Water Disinfection

Many modern WTPs include a treated water tank (or clearwell) that is used for chlorine disinfection of the treated water after the water has been settled and filtered. Modern treated water disinfection clearwells have an efficient flow-through design to achieve the disinfection contact time before the water leaves the WTP. The existing GHWTP treated water tank (the “filtered water tank”)has a single inlet-and-outlet pipeline and is not designed for disinfection. The tank serves as a distribution system storage tank at the WTP site. Disinfection at the GHWTP is currently accomplished in the sedimentation basins, a process that would need to be modified in order to accommodate transfers. The City is in the process of evaluating potential use of all the concrete tanks to provide enhanced chlorination opportunities.

3.3.4 Washwater and Solids Handling

The GHWTP solids residual handling facilities capture and treat the waste flow streams containing solids that settle out in the flocculation and sedimentation treatment basins and that are removed by the filters. If source water with an increased sediment load were treated at the plant, the solids handling process would need to be modified to handle the increased load that would come from treating additional winter flow.

3.3.5 System Operation and Maintenance

City staff perform annual maintenance of the GHWTP treatment process equipment and infrastructure during the winter, when water demands are lower and treatment processes can be taken off-line. During the winter-time maintenance period, each of the flocculation-sedimentation basins and each of the filters are taken out of service sequentially for cleaning and maintenance. The basin maintenance period typically lasts from 2 to 4 weeks. As a result, over the winter maintenance period, only two flocculation-sedimentation basins would be available for operation. Filters are also taken out of service for maintenance that could last several days to weeks. During this period, only 5 filters would be available for operation.

3.4 Existing Water Rights

Surface water in California is a Public Trust Resource, and the State Water Resources Control Board is the agency responsible for allowing use of this resource through the water rights process. Simply stated, a water right is legal permission to use a reasonable amount of water for a beneficial purpose such as domestic supply, farming, or other uses. Water rights generally stipulate the amount and timing of water that can be diverted from a stream and the locations where that water can be put to beneficial use. Appropriative water rights in California are based on a priority system that generally adheres to the doctrine of, first in time, first in right, meaning that water rights established first are senior to those subsequently established. Senior water rights holders are generally entitled to their full allotment of water before more junior rights can be exercised. In California there are three main categories of water rights :

- Pre-1914 Appropriative Rights are rights established by an appropriation of water that was established before 1914. Pre-1914 water rights do not require a permit from the state, and thus generally do not have explicit restrictions on amount, timing or place of use. Despite not having these restrictions in a permit, water cannot be taken under these rights in a manner that would harm senior users or beneficial uses. The City diversions on the North Coast streams are all covered by pre-1914 water rights.
- Riparian rights are senior to appropriative rights and entitle streamside landowners to use a correlative share of the water flowing past their property for use on that property only. Riparian rights do not require permits, licenses, or government approval, but they apply only to the water which would naturally flow in the stream. Riparian rights do not entitle a water user to divert water to storage in a reservoir for use in the dry season or to use water on land outside of the watershed. Riparian rights remain with the property when it changes hands, although parcels severed from the adjacent water source generally lose their right to the water. None of the City’s water rights are riparian rights.
- Appropriativee rights: appropriative rights are for the use of water on non-riparian land. The SWRCB issues permits for appropriative rights that stipulate the timing, amount and place of

use of the appropriated water. The City's Felton and Tait Street diversions are both appropriative rights.

The State has a very different approach to groundwater regulation. In most areas of California, overlying land owners and municipal appropriators may extract percolating ground water and put it to beneficial use without approval from the State Board or a court. In several basins that have been adjudicated, however, groundwater use is subject to regulation in accordance with court decrees adjudicating the ground water rights within the basins. The recently adopted Sustainable Groundwater Management Act of 2014 requires management of groundwater extraction to prevent adverse affects on groundwater and surface water flow, but does not limit groundwater rights.

Current water rights for the Felton Diversion authorize diversion to storage in Loch Lomond Reservoir but do not allow for water to be diverted directly from Felton to the GHWTP. The City is seeking approval of change petitions that would add direct diversion as a method of diversion from the San Lorenzo River at Felton Diversion and from the Loch Lomond Reservoir to improve the operational flexibility of the system. The City is also requesting an extension of time allowed to put the full yield from the Felton Diversion to beneficial use. Resource agencies have protested the City's current applications, pending successful completion of HCP negotiations.

Table 3 - Summary of City of Santa Cruz Water Rights

Source	Period	Maximum Diversion Rate (cfs)	Bypass Requirement (cfs)	Annual Diversion Limit
North Coast (Pre-1914 Appro.) Liddell Spring Laguna / Reggiardo Creeks Majors Creek	Year-round	No limit	None	None
San Lorenzo River Tait Street	Year-round	12.2	None	None
San Lorenzo River Felton Diversion	September	7.8	10	977 mg/yr (3000 af/yr)
	October	20	25	
	Nov. – May	20	20	
	June – Aug.	0	--	
Newell Creek Collection	Sept. – Jun.	No Limit	1	1,825 mg/yr (5600 af/yr)
Newell Creek Withdrawal	Year-Round	--	1	1,042 mg/yr (3200 af/yr)

4.0 POTENTIAL WATER TRANSFER SCENARIOS

The Phase II Conjunctive Use project evaluated the potential yield of transferring winter flow from the San Lorenzo River under a variety of scenarios involving various levels of infrastructure improvement. The City's Confluence model takes into account the variation in demand, the availability of water from different City sources under different hydrologic conditions, requirements for fish flow bypasses, and the capacity of raw water infrastructure to pump and treat the water. The model simulates the operation of the City system on a daily time step using 73 years of historic hydrologic record. The model ensures that City demands and fish flows are first met and then calculates how much additional water would be available for inter-district water transfer. The fish flow requirements used in this study are the Tier 3 requirements, which are intended to maintain fish habitat at least 80% of what would be available if there were no City diversions.

In the scenarios below, the City would continue to meet City drinking water demands with the following current priority of water supply:

1. North Coast Sources – highest quality water source, but reduced availability due to increased bypass for fish habitat.
2. Tait Street Diversion (San Lorenzo River) – lower quality water source, and subject to interruption due to high turbidity during winter storms.
3. Loch Lomond (Newell Creek) – lower water quality and minimize use to reserve water for stream releases and drought supply. Loch Lomond is generally only used during the winter during storm periods when the other sources are too turbid.
4. Felton Diversion (San Lorenzo River) – used to pump water to Loch Lomond during the winter when there is available capacity in Loch Lomond and San Lorenzo River flows are adequate.

Only when there was additional water in the San Lorenzo River, that was not needed to meet City demands or downstream fish habitat needs would that water be available for transfer. Furthermore, it is assumed that the City would not withdraw extra water from the North Coast or Loch Lomond to facilitate water transfers. All potential water transfer supply would come from the San Lorenzo River. Note also that the production capacity values for the GHWTP are maximum possible daily production values, not necessarily continuous production values. Since the water available for water transfer would come from Tait Street Diversion, this water source could be operating at the maximum production whenever there is sufficient water in the San Lorenzo River. The amount of water transferred in any given day was also limited by the amount of demand. If the amount of district demand that day was less than the amount of transfer capacity that day, the actual amount of transfer was the demand. For the purposes of most of the scenarios, it was assumed that Scotts Valley demand would be satisfied first, and then additional yield would go to Soquel. The reasons for this are discussed below.

For each water year, the Confluence model calculates the amount of water transfer for each day and then sums it for the year (November to April). Average annual yields were calculated for the whole 73 year period of record and averages were calculated for each type of water year: wet, normal, dry and critically dry. The model output was also used to prepare duration curves to show the frequency that a given flow or given yield might occur. This information could be used to optimize the capacity of infrastructure improvements. Examples of this additional information are shown in Table 5 and presented in the Appendices.

Table 4 summarizes the different scenarios, the conditions associated with each scenario, and the average annual yields averaged over the 73 year hydrologic record. The potential annual yield varies significantly by type of water year, depending on how wet it is (Table 5). Various infrastructure upgrades are required to accomplish the projected yields, as indicated.

Table 4 - Potential Water Transfer Scenarios and Yield Estimates

No.	Name	Source Water Turbidity (ntu)	Max. Tait Capacity (mgd)	Max. GHWTP Capacity (mgd)	Potential Transfer to Scotts Valley (mgy/afy)	Potential Transfer to Soquel Creek WD (mgy/afy)	Potential Total Annual Transfer (mg/af)
0	Current Tait & GHWTP Capacity, Existing intertie to Soquel only	<15	7.8	Up to 10	--	145 / 445	145 / 445
1	Current Tait & GHWTP Capacity	<15	7.8	Up to 10	106 / 325	39 / 120	145 / 445
2	Increase GHWTP Capacity	<15	7.8	Up to 16	108 / 331	95 / 292	204 / 623
3	Increase Tait & GHWTP Capacity	<15	14	Up to 16	154 / 473	333 / 1,022	488 / 1,495
4	Increase GHWTP Capacity & Treatment	Up to ~ 200	7.8	Up to 16	124 / 381	136 / 417	260 / 798
5	Increase Tait & GHWTP Capacity and Treatment	Up to ~200	14	Up to 16	174 / 534	384 / 1,178	558 / 1,712

GHWTP = Graham Hill Water Treatment Plant
Tait = Tait Street Diversion
ntu = nephelometric turbidity units
mgd = million gallons / day
mgy = million gallons / year

Scenario No. 0 utilized the 73-year flow record on the San Lorenzo River to examine the potential volume of water available for transfer between the City and Soquel at current levels of demand and infrastructure. Some additional water could be available for transfer by operating the current Tait Street Diversion and GHWTP up to the approximate 10-mgd winter-time capacity limitation when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 2 mgd from Tait Street could be treated for transfer.

Scenario No. 1 utilized the same assumptions as Scenario 0, with the addition of a new intertie to Scotts Valley, which allowed transfer to Scotts Valley as a priority over Soquel. The overall transfer volumes are the same, but divided among the two recipients.

Scenario No. 2 modeled the effects improvements to increase the capacity of the GHWTP up to 16 mgd, but still operating when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer.

Scenario No. 3 examined the water that could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 mgd. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer. This scenario still assumes no modification to treat water at higher turbidity levels.

Scenario No.4 examined the additional water that could be available for transfer by improvements to the GHWTP up to 16 mgd, and improvements to permit operating when turbidity levels are up to approximately 200 NTU, such as immediately following storm events. In this scenario, Tait Street capacity is not increased. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer.

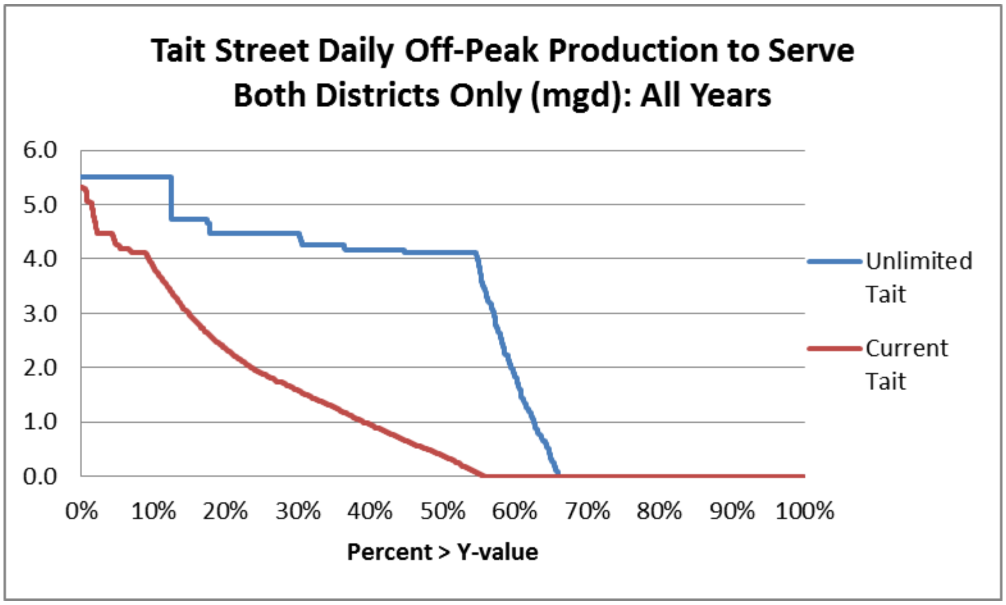
Scenario No.5 examined the additional water that could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 MGD, and improvements to permit operating when turbidity levels are approximately 200 NTU, such as immediately following storm events. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer.

Following are examples of the more detailed breakdown of information provided in Confluence and presented in more detail in the Appendices. This information is available for each of the scenarios.

Table 5. Average November-April Tait Street Production (mg) (Increased Tait Capacity, Scenario 3)

DEMAND SERVED	HYDROLOGIC YEAR TYPE				
	Critically Dry	**Dry**	**Normal**	**Wet**	**All**
Santa Cruz Only	823	879	812	663	**778**
Santa Cruz & Both Districts	1102	1345	1378	1179	**1262**
Both Districts Only	278	464	566	517	**488**
Scotts Valley	105	151	174	158	**154**
Soquel Creek	173	313	392	358	**333**

Figure 3. Duration curve showing frequency and rate of delivery (mgd) for Scenario 2, Current Tait; and Scenario 3, Unlimited Tait



Source: Gary Fiske and Associates, Inc. May 22, 2013. Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision)

4.1 Assumptions for Potential Water Transfers

The volume of potentially transferable water would be constrained by the duration of the diversion period in the months of November through April, the availability of surface flows that are in excess of anadromous fish needs, suitable water quality, available water rights, the amount of winter water demand, and capacity of available infrastructure. Because the City has existing diversion works and water treatment facility, the Graham Hill Treatment Plant (GHTP), the production characteristics of the plant, sources and volumes of surface water supply, and system infrastructure capacities were evaluated to determine how they could best be utilized.

4.1.1 Priority for Water Delivery

For the majority of the model runs, it was assumed that water would be transferred to Scotts Valley first, and any additional capacity beyond the Scotts Valley demand would be used to transfer water to Soquel. Therefore, with the lower yielding scenarios, Scotts Valley would receive more water than Soquel, even though the total Scotts Valley demand is lower. Scotts Valley was initially assigned a higher priority for the following reasons:

- The initial analysis in Phase I focused on restoring groundwater levels in the Scotts Valley portion of the Santa Margarita Groundwater Basin.
- Transferring water to Scotts Valley keeps the water in the San Lorenzo River Watershed, and with reduced use of the groundwater basin would ultimately contribute to additional baseflow in Bean Creek and the San Lorenzo River, with benefits to fish habitat and the downstream City of Santa Cruz diversion.

This priority and distribution of delivery is subject to future discussion and negotiation to determine what makes the most sense for long term regional water needs. The Soquel groundwater basin is currently threatened by seawater intrusion and water could be more immediately transferred there using already existing interties. Groundwater pumping in Scotts Valley has declined in recent years and groundwater levels have stabilized and recovered slightly, albeit at reduced levels, further supporting consideration of sending water to Soquel as a higher priority.

4.1.2 Source and Diversion Capacity

Water for transfer would be drawn from the San Lorenzo River at the City Tait Street Diversion. The existing winter-time capacity of the Tait Street diversion is 7.8 mgd, the capacity could be increased to 14 mgd to better meet the needs of the City and neighboring water agencies.[6] Diversion at Tait Street was chosen for this analysis over other points of diversion based on several considerations:

- Tait Street is lower in the watershed and has more options for working within the existing water rights.
- There are currently two pending water rights modification applications at the Felton Diversion, which could greatly complicate efforts for expanded diversion. Currently, Felton Diversion water is only able to be diverted to storage (Loch Lomond).
- Loch Lomond is the City's drought reserve and winter use is minimized to protect the reserve. Also, only Scotts Valley and the San Lorenzo Valley Water District are within the water rights place of use for Loch Lomond water. Any use outside of those areas would require an amendment of the existing water rights.
- While the North Coast sources have pre-1914 water rights, additional diversion from those streams was not considered likely due to resource concerns, in particular fish flows that are likely to be required under the HCP. However, current diversion amounts could potentially used for transfer, as there are less water rights limitations with this water.

4.1.3 Demand and GHWTP Objectives

Demand projections for both the City demand and the districts' demand are based on the demand projection for the year 2030. For the City, this was the demand projected in the Water Supply Assessment for General Plan 2030, of 4,046 million gallons per year. (Current demand projections are significantly lower.)Monthly demand for the modeling period was allocated based on the historical pattern of water use. Future demand for the districts was assumed to the same as their five-year average of 2005-2011 production. The Scotts Valley demand includes both the Scotts Valley Water District and the southern portion of the San Lorenzo Valley Water District. The potential daily demand used was the average daily demand for that month. The monthly district demands used are shown in Table 6.

[6] Gary Fiske and Associates, Inc. June 20, 2013. Phase 2 Water Transfer Project Task 3 Technical Memorandum: Potential Transfers with Unlimited Tait Street Capacity.

Table 6. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek
November	42.8	99.2
December	38.7	93.4
January	37.2	92.2
February	33.8	81.5
March	40.3	98.6
April	48.3	116.9
TOTAL	**241.1**	**581.8**

The additional maximum likely demands from the districts to provide for winter-time water transfers could reach approximately 5.5 mgd (Figure 3). If this occurred at the same time as typical maximum winter demands from the City customers, the GHWTP would need to produce approximately 15.5 mgd. Therefore, the design maximum winter-time production for the GHWTP, for this study, is 16 mgd. The average winter-time production with both water transfer demands and City demands is estimated at 11 mgd.

4.1.4 Winter Water Quality in San Lorenzo River

The quality of diverted water will have an effect on the usability of the water in the conjunctive use framework. The US EPA, as well as California Drinking Water Branch (CDWB), has developed Maximum Contaminant Limits (MCLs) for over 100 organic and inorganic compounds, some occurring naturally in water supplies but many occurring as a result of human activities in the watershed. Key constituents of concern in the San Lorenzo River that could potentially limit the yield available for transfer include turbidity, organic carbon, and fecal indicator bacteria. The winter-time storm water also contains elevated levels of natural organic matter as compared to typical summer and winter non-storm source water quality.

Typical coastal California watershed streams experience rapid increases in turbidity during and shortly after storm events. The turbidity level can spike up to several hundred NTU in a matter of hours, but will often drop back to levels of 40 to 50 NTU or lower relatively quickly. The organics level in the water will also rise during storm runoff periods. The turbidity and organics levels will then slowly drop over a period of days back to normal levels, unless another storm event occurs in the watershed. Operating experience indicates that the GHWTP sources can take several days for the turbidity to drop to 10 to 15 NTU and up to a week for the turbidity to return to average low levels after a storm event. During storm events, stream water turbidity rises rapidly and is followed by a smaller rapid drop and then a more gradual exponential-shaped decrease in turbidity as the stream flow decreases after a storm. Stream-borne debris can also contribute to the turbidity by scouring the stream bottom.

Currently the GHWTP can only treat water with turbidity up to 15 NTU. During storm events, the Tait Street diversion is not operated and North Coast sources or Loch Lomond are utilized. Water would not be available for transfer to other districts during such times. Improvements to the GHWTP could be made for winter-time water transfers that would enable the plant to handle turbidity events over several hundred NTU. The Water Transfer Analysis used a source water value of 200 NTU in the analysis of potential water transfers (Scenarios 4 and 5).

Based on source water coliform data for the San Lorenzo River, the CDWB-requires that the GHWTP provide a higher level of treatment to provide 4-log Giardia and 5-log virus reduction (removal and inactivation). The CDWB credits the GHWTP conventional filtration treatment process with 2.5-log Giardia removal credit as long as the filtered water turbidity is less than 0.3 NTU in at least 95 percent of the combined filter effluent samples analyzed at 15 minute intervals during each month. Therefore, 1.5-log disinfection inactivation is required to meet the overall requirements. The treatment processes at the GHWTP and the improvements to permit winter-time water transfers will need to address both the higher pathogen levels, turbidity levels and organics levels in the source water to meet the 4-log Giardia and 5-log virus removal/inactivation requirements.

4.1.5 System Operations and Maintenance

The City performs annual maintenance of the GHWTP treatment process equipment and infrastructure during the winter when water demands are lower and treatment processes can be taken off-line. During that time various elements of the treatment process are sequentially taken off-line for cleaning and maintenance over a period of 2 to 4 weeks. Any new treatment processes at the GHWTP will need to have the ability to accommodate the facility annual maintenance requirements, while meeting the system production objectives during the maintenance period.

4.1.6 Potential Impacts of Climate Change

The evaluation of the potential transfer scenarios was based on the past 73 years of hydrologic record (1937-2010) and current water demand of the agencies. Climate change would be expected to reduce the potential yields of all scenarios as a result of increased winter off-peak irrigation demand in the City service area, reduced groundwater recharge and lower winter baseflows, and potential increased winter turbidity from peak storm events. Generally the average yields might trend more to the dry and critically dry year estimates, which are 5-40% less than average yields across all year types. The City is currently preparing climate change scenarios to use in Confluence and these should be used in the future to better estimate the effect of climate change on potential transfer yields.

4.2 Use of Water for Direct Recharge

All of the above scenarios are based on the assumption that water would be treated and transferred to Scotts Valley and Soquel water districts to satisfy their normal winter demand and allow them to pump less groundwater, thereby helping their underlying groundwater basins recover. This is known as in lieu recharge. An additional approach was suggested in the Phase I Conjunctive use study, which would provide for excess winter surface water to be pumped and used for direct groundwater recharge either through percolation at an abandoned quarry or use of injection wells. The total amount of water able to be transferred under most scenarios was limited by the demand of the receiving districts. An analysis was done to assess the amount of additional raw water that might be available for direct recharge, after the winter demand of the districts was met. This analysis looked at using the City’s existing pumping station at the Felton Diversion dam, while maintaining the current downstream bypass requirements. In the calculation, the total amount diverted water was not constrained by the current annual limit of 3000 af, but the maximum diversion rate was limited to 20 cfs, as specified in the City’s current right. Under these conditions it was estimated that an average of 2900 af/yr (945 mgy) of raw water could be pumped from Felton Diversion for use in direct recharge.[7] The estimated available water is much greater than the scenarios presented on Table 4 because 1) the water is raw, and therefore not subject

[7] Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 Final, June 22, 2012

to the treatment limitations of the Graham Hill WTP, and 2) because the supply analysis assumed there was a end place of unlimited capacity to receive the water. This scenario is now being further evaluated, along with the potential for blending surface water with recycled water for recharge at the old Hanson Quarry.

Based on the Santa Margarita Groundwater Model, recharge of 1000 af/yr would result in increasing groundwater levels with an eventual increase of 0.5 cfs in Bean Creek baseflow [8] (0.32 mgd). For the first ten years of recharge, most of the added water goes to increasing basin storage, which would be available for pumping and delivery to Santa Cruz. Injecting more than 1000 af/yr would be expected to accelerate the increased storage and the increased baseflow.

4.3 Fish Habitat Effects

Any water resource projects proposing additional stream diversion will not only have to demonstrate no significant impact to local fisheries, but should also seek to mitigate impacts created by past or current water management. The water transfer proposals were developed bearing both these objectives in mind. It is critical to demonstrate no adverse impacts on salmonid species and aquatic habitat as a part of the environmental review process and water rights permit process. There a number of factors included in the potential d projects to prevent adverse impacts to protected anadromous species:

- The diversion location is located low in the watershed and has no impact on the extensive upstream habitat.
- The period of diversion is limited to historically high-flow winter months of November to April, when there is generally more than adequate flow to support the salmonid life cycle.
- Only flows in excess of 25.2 cfs would be available for diversion for water transfer. This is the minimum winter flow agreed to by the fishery agencies to support migration across downstream critical riffles. [9]
- The maximum amount of total diversion at Tait would be 21.7 cfs (14 mgd),) which is substantially less than the mean flow in the River of 263 cfs. from December through April.
- High flows that are too turbid to effectively treat, would not be diverted at all for periods of several days. These high flows are important for fish migration and “flushing-out” fine sediments from the streams.
- The yield calculations using the Confluence model calculated the flows available for transfer at Tait after the City’s 2030 demand was fully met while also meeting the stringent Tier 3 fish flow requirements at all the City diversions during the winter diversion season.
- The use of diverted winter flow to offset groundwater pumping and recharge the groundwater basin will result in increased dry season baseflow in the streams, and will eventually help the City reduce its dry season diversions, all of which will benefit summer rearing habitat, which is generally the most limiting factor for salmonid productivity. As described above, an increase of

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[8] Kennedy/Jenks, 2015, Draft Santa Margarita Groundwater Modeling Technical Study, for Scotts Valley Water District

[9] California Department of Fish and Game, September 18, 2012, Letter from Scott Wilson to Bill Kocher regarding City of Santa Cruz Instream Water Diversions

1000 af/yr recharge in the Scotts Valley groundwater basin is expected to result in an increase of 0.5 cfs in summer baseflow in Bean Creek.

The effects on fish habitat of the proposed diversions for water transfer were evaluated by the City's fishery consultant, Hagar Environmental Sciences, using the same methodology that is being used in the HCP process to evaluate the effects of the City diversions. The fisheries consultants utilized data on channel conditions, habitat models, and the results of the yield analysis, specifically the residual flows with and without diversions, to estimate the effects on downstream habitat. The methods used in developing this data are fully described in HES 2011 (Assessment of Streamflow Effects on Migration, Spawning, and Rearing Habitat for Anadromous Salmonids in Streams Influenced by City of Santa Cruz Water Diversions including Newell Creek). The objective of the habitat assessment is to quantitatively determine the relationship between streamflow and potential migration, spawning, and rearing habitat for steelhead and coho salmon in the affected reach of the San Lorenzo River.

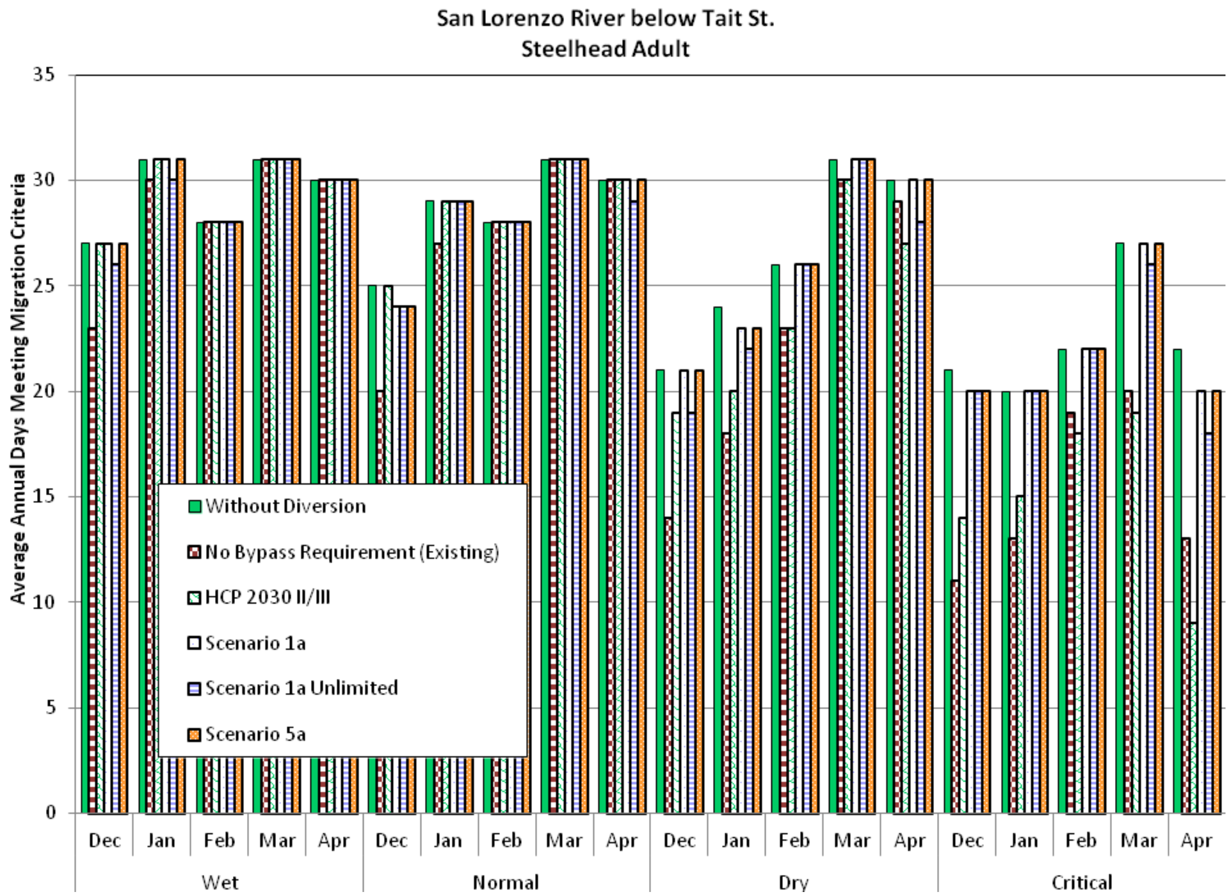
The critical life stages downstream of Tait Street November to April are steelhead adult migration (December to April) , coho salmon adult migration (December to January) and smolt out migration (both species, January to May). HES (2013) calculated the average number of days each month that met migration criteria under six different flow scenarios:

- No City diversions
- Existing diversions with no bypass requirements
- HCP 2030 demand, Tier 2/3 flows (City Proposal)
- Water Transfer Scenario 1: Existing Diversion and Treatment Capacity (shown n Figure 4 as Scenario 1a)
- Water Transfer Scenario 3: unlimited Tait capacity (shown in Figure 4 as Scenario 1a Unlimited)
- Water Transfer Scenario 4: Treatment Plant upgraded to treat 200 NTU turbidity (shown in Figure 4 as Scenario 5a)

For smolts, the transfer scenarios have no effect on the number of days meeting migration criteria as compared to the no diversion scenario. For coho adults, the number of days of migration is reduced by 1-2 days in wet and dry years but is unaffected in normal and critically dry years. There is only slight additional effect for steelhead adult migration as indicated in Figure 4.

In this study there was no evaluation of the potential fishery impacts of diverting additional water at Felton Diversion. The Felton Diversion is located approximately 6 miles upstream from Tait Street. The City's water right that it obtained in 1975 requires a minimum bypass of 20 cfs with a maximum diversion rate of 20 cfs.

Figure 4. Effect of Transfer Diversions on Steelhead Adult Migration below Tait



Source: Hagar Environmental Science, 2013, Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon. See narrative above for explanation of scenarios.

4.4 Transfer of Water to Santa Cruz

The initial beneficiaries of the water transfer scenarios would be the Soquel Creek, Scotts Valley and San Lorenzo Valley Water Districts. However, the City of Santa Cruz could ultimately benefit by receiving deliveries of water from groundwater storage during summer months and dry years. The amount of water returned to Santa Cruz will be a function of Santa Cruz projected need, delivery capacity, groundwater pumping capacity and the condition of the groundwater basins. With a projected annual demand of 3500 mg and Tier 3 fish flows, it is projected that Santa Cruz will experience peak season shortfalls in supply 35% of the years.[10] The peak season shortfall would be at least 880 mg at least 10% of the time. After 10-20% use curtailment, the shortage has been estimated at 2.5 -3.5 mgd, or 450-630 mg (1300-2000 af) requiring a 2.5-3.5 mgd supplemental supply for the peak season. More recent

[10] Fiske, February 12, 2014, Volumetric Shortage Analysis for Water Transfer Project

analyses are suggesting a peak demand shortage of as much as 13 mgd during a critically an extreme dry year.[11]

Delivery of water to the City from the Scotts Valley area would require construction of an intertie sized for 1-1.5 mgd. This could be the same intertie used to deliver water to Scotts Valley during winter months. This would also require construction of at least three additional wells in the Scotts Valley area to support a high enough rate of groundwater pumping. It is estimated that the groundwater basin has lost 28,000 af of storage since 1985, with localized groundwater level declines of 200ft. However, pumping amounts have declined and current annual pumping of about 2800 af/yr is not expected to result in further long term declines. Proposed water exchange and /or direct recharge would lead to more rapid recovery of groundwater storage and further facilitate direct transfer of water back to Santa Cruz and increased stream baseflow available for downstream diversion at Tait Street. The Santa Margarita Groundwater Model has recently been updated and could be used to simulate the effects of both the increased recharge as well as increased pumping and deliveries to Santa Cruz during dry periods.

Water could be transferred from Soquel to Santa Cruz at a rate of 1.44 mgd using the existing interties, with the addition of a 1,000 gpm pump station at Soquel Drive and 41st Avenue[12]. All of the Soquel wells in Service Area 1 and 2 would need to be running to sustain that flow as well as meet current Soquel demand during the peak season. 2014 peak day demand for Soquel Service areas 1 and 2 was 4mgd, compared to a production capacity of 5.5 mgd.[13]

The expected rate of recovery and ability to deliver water from the Soquel groundwater basin remains an open question. It has been estimated that over pumping has occurred since 1979 resulting in a total deficit of 21,600 af and groundwater levels lower than the level needed to prevent seawater intrusion[14]. The beginnings of seawater intrusion have already been observed in the western and eastern parts of the basin. In order to achieve recovery of the basin to levels that will safeguard against seawater intrusion, Soquel has established a goal of reducing pumping by 1500 af/yr for the next 20 years. This includes a reduction of 300-500 af/yr of pumping from the Purisima area. A peer review of these targets has suggested that the pumping reductions only need to be 500 af/yr, but this is still under review. Observation of the groundwater levels in response to the current 4 year drought may also provide some insight as to the extent the basin could be pumped more heavily in dry years. A groundwater model will be developed in the next two years to provide a better tool for managing the basin, projecting the recovery that might result from water transfers, and projecting the ability of the basin to sustain transfer of water back to Santa Cruz without increasing the threat of seawater intrusion.

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[11] Fiske, 2015

[12] Akel, 2014

[13] Soquel Creek Water District, 2015

[14] Hydrometrics WRI, 2012, Revised Protective Groundwater Elevations and Outflows for Aromas Area and Updated Water Balance for Soquel-Aptos Groundwater Basin, for Soquel Creek Water District

5.0 INFRASTRUCTURE IMPROVEMENTS

Infrastructure improvements would be required to facilitate the diversion and treatment of higher turbidity San Lorenzo River source water and transferring the excess water to the neighboring water agencies. The following sections describe conceptual level improvements to the Tait Street Diversion and the GHWTP to accomplish the winter-time water transfer concept.[15]

5.1 Tait Street Diversion Improvements

The Tait Street Diversion would need to be upgraded to handle the additional winter-time water capacity and increased grit loading and debris that accompany winter-time flows and storm events. The general elements of the Tait Street Diversion that would need to be improved include:

- Intake Structure, Bar Screens and Debris Removal and Haul-Away System
- Fish Screen System
- Grit Settling and Removal System
- Surface Water Pump Station
- Facility Support Systems

The improvements recommended for the Tait Street Diversion are based on a study conducted for the City in 2009 titled "Tait Street Diversion Sanding Study, Alternative Evaluation Report" (Wood Rodgers, 2009). The Tait Street Diversion Sanding Study evaluated a number of alternatives including improvements to the existing 7.5-mgd intake systems as well as replacing the existing system with a new 7.5-mgd intake system.

Depending on the different potential water transfer scenarios, different levels of improvements would be required for the Tait Street Diversion. Regardless of which scenario is employed, use of lower-quality winter-time San Lorenzo River water will necessitate additional sand and silt removal, haul away and disposal as well as increased maintenance of the facility. Also, improvements would need to be constructed in a manner that keeps the Tait Street Diversion in operation during construction. At a minimum, where water is withdrawn to the current capacity, upgrades would include improvements to the grit settling and removal system to handle the additional sand loads. In scenarios where increased withdrawals are considered, the current 7.5 mgd diversion would need to be expanded to approximately 14mgd. Where there are high flows and turbidities, upgrades include improvements to the screens and debris removal as well as grit settling and removal system to handle the additional debris and sand loads from winter-time storm flow type operations would be required.

The existing pipeline between the Tait Street Diversion and the GHWTP is 24-inch diameter. Despite increased velocities in the pipe considered for some of the scenarios, it can accommodate those flows. However, larger pumps would be required to transport that water.

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[15] Paraphrased From: Kennedy/Jenks. 2013. *Water Transfer Infrastructure Summary Report.* Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation. P. 20 -31

5.2 Graham Hill Water Treatment Plant

Most of the scenarios considered would require upgrade of the GHWTP to handle more challenging San Lorenzo River winter-time water quality. Also, depending on the scenario, additional winter-time water capacity would also be required. The treatment processes upgrades would include:

- **New pre-treatment flocculation and sedimentation basins: T**o facilitate operating the GHWTP at winter-time flow rates up to 16 mgd, when the source water turbidity is as high as 200 NTU, the existing flocculation and gravity sedimentation pre-treatment process should be replaced. A robust pretreatment process, such as ballasted flocculation and clarification process can consistently produce clarified water with turbidity less than 2 NTU with source waters in excess of 200 NTU. This is necessary to ensure that the granular media filters can consistently and reliably produce filtered water with turbidities less than or equal to 0.3 NTU to meet the Surface Water Treatment Rule (SWTR), and potentially less than or equal to 0.15 NTU so that the additional 1.0-log Giardia removal credit could be achieved.
- **Chemical feed system improvements:** the current chemical feed systems would need to be improved along with the new pre-treatment system and to permit enhanced coagulation.
- **New ozone oxidation and disinfection process:** the GHWTP treated water disinfection contact time is currently accomplished in the large gravity sedimentation basins. The replacement of the existing sedimentation basins with a new pretreatment process requires that the disinfection contact time be provided elsewhere in the treatment process. The proposed overall improved disinfection process at the GHWTP would include both ozone and free chlorine disinfection.
- **Treated water tank improvements:** The existing GHWTP treated water tank should also be modified for improved performance and disinfection.
- **Wastewater and solids handling systems:** The solids production and waste water stream from the pre-treatment process will increase. Based on the GHWTP's current operations and the limits on solids discharged from the GHWTP to the sanitary wastewater collection system, improvements would be required to the solids handling system.

5.3 Distribution System Connection to Scotts Valley Water District

A distribution system connection between the City and Scotts Valley would consist of approximately 8,200 feet of 12-inch pipe, running from the City distribution pipeline at the intersection of Sims Road and Brook Knoll Drive to the SVWD distribution connection along La Madrona Drive north of Silverwood Drive. The distribution system intertie would have an average capacity of 1-mgd but could have a maximum capacity of approximately 2-mgd to meet maximum SVWD water transfer demands. The SVWD distribution system connection would also require a pump station located near the SVWD connection along La Madrona Drive. The pump station would lift the water from the City distribution system into the water storage tanks in the SVWD system. This pipeline would also be used to transfer water back to Sana Cruz during dry periods.

5.4 Distribution System Connection to Soquel Creek Water District

Initial cost estimates for water transfer included significant upgrades to transfer capabilities between Soquel and the City and within the Soquel system. This included replacement of portions of both the City's and Soquel's existing water distribution pipelines with larger pipelines or installation of new pipelines. Upgrades to the City's distribution system would consist of approximately 5,200 feet of pipe between Morrissey Boulevard and the DeLaveaga Tanks and approximately 10,200 feet from the DeLaveaga Tanks to the Soquel Drive Intertie on Soquel Drive and 41st Avenue. In addition, the existing Morrissey pump station would be upgraded to provide a firm capacity of 5-mgd. Proposed upgrades to

Soquel's distribution system included replacement of approximately 3,600 feet of pipe partly along Soquel Drive between the Soquel Drive Intertie and East Walnut Street and installation of approximately 2,300 feet of new pipe on Soquel Drive and Park Avenue between East Walnut Street and McGregor Drive.

Many of the above improvements have either been completed or are would not be necessary if City to Soquel Creek transfers are restricted to off-peak winter months. The recent installation of an 8 inch intertie at Soquel Drive and 41st Avenue will allow water transfer from the City to meet the total Soquel Service Area 1 and 2 winter demand at 1,028 gpm (1.48 mgd) with head loss increase to 4-5 ft/1000ft.[16] This demand represents a total of 820-1100 acre-feet from November to April.

[16] Akel, 2014

6.0 Potential Scenario Yield and Associated Costs[17]

The following sections present planning level estimates of capital expenditures, annual operations and maintenance (O&M) costs and annualized costs for the improvements to the surface water supply systems, the GHWTP, and treated water delivery system that would be required to accomplish the wintertime water transfers.

The planning level costs of the project elements presented are based on information and costs developed by Kennedy/Jenks for this and other technical studies, and supplemented with budgetary cost estimates from equipment manufacturers, and from similar projects and professional experience. The association for the Advancement of Cost Engineering (AACE) provides information regarding the standard cost estimating level descriptions, accuracy and recommended contingencies based on the development level of the project. The proposed concepts and improvements to accomplish the winter-time water transfers have been developed to a planning level, with conceptual design criteria, site locations and a basic understanding of project elements and limitations. These include a planning level contingency of 40%.

6.1 Capital Costs

Estimated capital costs for the project components are shown and summed for each scenario in Table 7. For a full discussion of the components and their costs, see the Kennedy/Jenks, *Water Transfer Infrastructure Summary*, 2013. The capital expenditure estimates also include planning level markups for taxes, contractor overhead and profit, mobilization and bonding, engineering and construction management, and legal, permitting, and administrative costs.

6.2 O&M Costs

The planning level operating and maintenance (O&M) costs for the winter time water transfers were developed on a unit-of-water cost basis to determine the additional cost of treating and transferring water above what is currently done at the GHWTP. The unit-cost in dollars per acre foot ($/af) is then applied to the expected average volume of water for each scenario, to determine the O&M cost to treatment and transfer the winter-time water for that scenario.

The energy and O&M costs for the Tait Street Diversion are estimated at approximately $103 per acre-foot for the current 7.8-mgd capacity and increased production from the diversion. At 14-mgd capacity and increased winter-time production, the cost would increase to approximately $122 per acre-foot due to increase friction losses in the pipeline and increased solids and debris removal.

The energy cost for pumping from the City's distribution system pressures to the Scotts Valley and Soquel Creek Water District systems is estimated at a combined average of approximately $50 per acre-foot. The energy cost for pumping to Scotts Valley would likely be higher than for pumping to Soquel Creek Water District.

Table 8 summarizes the engineer's opinion of probable operations and maintenance costs for the GHWTP when operating with increased San Lorenzo River water for winter-time water transfers at

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[17] Paraphrased From: Kenned/Jenks. 2013. *Water Transfer Infrastructure Summary Report.* Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation. P. 32-38, with some updated information added.

average production in current (< 15 NTU) turbidity conditions and the potential higher turbidity (~200 NTU) water conditions that would occur during some of the winter-time water transfer scenarios. The O&M costs are presented for the winter-time (November to April) time period when additional water could be produced.

Table 7 – Planning Level Capital Costs

Project Component	Scenario 0: Existing Infrastructure, Transfer to Soquel Only	Scenario 1: Current Tait & GHWTP Capacity	Scenario 2: Increase GHWTP Capacity	Scenario 3: Increase Tait & GHWTP Capacity	Scenario 4: Increase GHWTP Capacity & Treatment	Scenario 5: Increase Tait & GHWTP Capacity and Treatment
Tait Diversion Improvements						
Improvements for existing 7.8mgd systems	$2,770,000	$2,770,000	$2,770,000	$2,770,000	$3,840,000	$3,840,000
Expansion to 14MGD capacity	n/a	n/a	n/a	$5,950,000	n/a	$5,950,000
GHWTP Improvements						
Pre-treatment	n/a	n/a	$24,800,000	$24,800,000	$24,800,000	$24,800,000
Oxidation and Disinfection	n/a	n/a	$20,240,000	$20,240,000	$20,240,000	$20,240,000
Solids Handling	n/a	n/a	$5,538,400	$12,670,000	$12,670,000	$12,670,000
Distribution System Improvements						
Connection to SVWD	n/a	$5,770,000	$5,770,000	$5,770,000	$5,770,000	$5,770,000
Connection to Soquel	n/a	$18,410,000	$18,410,000	$18,410,000	$18,410,000	$18,410,000
Total Scenario Project Cost	**$2,770,000**	**$26,950,000**	**$77,528,400**	**$90,610,000**	**$85,730,000**	**$91,680,000**

Table 8 – Planning Level O&M costs, GHWTP

Component	GHWTP Winter-Water Transfer (15 NTU Turbidity) Operations	GHWTP Winter-Water Transfer (High Turbidity) Operations
Power	$145,000	$216,000
Chemicals	$209,000	$327,000
Sand for Pretreatment	$2,000	$4,000
Solids Handling	$50,000	$198,000
Solids Disposal	$31,000	$122,925
Maintenance Materials	$228,000	$418,000
Labor	$250,000	$350,000
Total Estimate	**$915,000**	**$1,636,000**
$/af	**165**	**245**

6.3 Life-Cycle Unit Water Costs

The life-cycle unit water cost in $/af is the sum of the annualized capital costs for the improvements, plus the operating costs to treat and transfer the water, divided by the total potential additional production from winter-time water transfers. The annualized capital cost is calculated based on a project life of 30 years and an interest rate of five percent.

The life-cycle unit water costs do not include all of the routine and administrative costs of operating a water systems. Although the calculated life-cycle cost of transferring water with limited infrastructure improvement under Scenario 0 is $1,020/af, the current City of Santa Cruz charge for bulk water is about $2,700/af and is proposed to increase to $3,500/af. Water districts currently typically charge other districts the bulk water rate when water is transferred through interties for emergency or other purposes.

Table 9 – Planning Level Annualized Life-Cycle Unit Water Cost

Project Cost Component	**Scenario 0 Transfer to Soquel Only**	**Scenario 1: Current Tait & GHWTP Capacity**	**Scenario 2: Increase GHWTP Capacity**	**Scenario 3: Increase Tait & GHWTP Capacity**	**Scenario 4: Increase GHWTP Capacity & Treatment**	**Scenario 5: Increase Tait & GHWTP Capacity and Treatment**
Annualized Water Transfer Capital Cost	$313,400	$1,754,400	$5,047,100	$5,898,700	$5,581,000	$5,968,400
Additional Tait Street O&M Cost ($/yr)	$45,000	$45,000	$63,100	$182,700	$97,500	$209,200
Additional GWHTP O&M Cost ($/yr)	$73,300	$73,300	$102,600	$246,300	$195,800	$420,000
Additional Pumping Cost ($/yr)	$22,300	$22,300	$31,200	$74,800	$39,900	$85,600
Total Life-Cycle Cost ($/yr)	**$454,000**	**$1,895,100**	**$5,224,000**	**$6,402,500**	**$5,914,200**	**$6,683,200**
Total Estimated Yield (af/y)	445	445	623	1,495	798	1,712
Unit Cost ($/af)	**$1,020**	**$4,260**	**$8,420**	**$4,280**	**$7,410**	**$3,900**

7.0 WATER RIGHTS

The legal firm of Best Best & Krieger (BB&K) was contracted to provide an assessment of water rights constraints and opportunities for the water exchange project.[18] In general there are two potential pathways to address water rights in order to implement a water transfer project: (1) work within the City's existing water rights at Tait Street to seek approval for a short term or long term transfer, or (2) apply for new water rights on the San Lorenzo River. As discussed in Section 3.4, the City has water rights to the San Lorenzo River at Tait Street for which it appears that there is generally available water and diversion capacity to transfer a moderate amount of water during high flow winter months. Transfer of the full amount of water analyzed in some of the scenarios would require an additional water right. Whichever path is chosen to proceed, it is imperative that the existing City's rights are not jeopardized, and any rights petition would need to demonstrate that other lawful users are not injured, that fish and wildlife would not be unreasonably harmed, and that the transfer is in the public interest. The various options are described below and summarized in Table 10.

7.1 Short Term Options

7.1.1 Transfer of Pre-1914 Appropriative Water Right

California Water Code section 1706 provides for the transfer of water that is governed by a pre-1914 appropriative water right provided that the transfer causes no injury to other legal users of the water, regardless of their priority of right.[19] Transfer of pre-1914 water does not require approval of the State Water Resources Control Board (SWRCB), but is subject to challenge in the courts if another user believes they are injured by the transfer.

7.1.2 Temporary Urgency Transfer

California Water Code section 1435 authorizes a temporary change to an existing permit to allow for a different point of diversion, place of use, and/or purpose of use where an urgent need exists for the temporary change. These temporary change orders automatically expire after 180 days, but can be renewed for good cause. A temporary urgency transfer could be used to transfer water outside of the City's existing place of use, for example, to Soquel. Several finding must be made by the SWRCB prior to issuing a change order, including:

- The permittee has an urgent need to make the proposed change;
- The proposed change may be made without injury to any other lawful user of water;
- The proposed change may be made without unreasonable effect upon fish, wildlife, or other in-stream beneficial uses; and
- The proposed change is in the public interest.

A petition for a temporary urgency transfer would likely be accompanied by a parallel non-urgent petition for a permanent right. Among other considerations, the advantages of this approach are that it could potentially be implemented quickly, but the transfer would have to be renewed after 180 days

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[18] Paraphrased From Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues.

[19] SWRCB, 1999, Guide to Water Transfers

and it is not statutorily exempt from the California Environmental Quality Act (CEQA). If an individual CEQA exemption does not apply it may cause significant delay.

7.1.3 Temporary Transfer

California Water Code section 1725 authorizes a temporary change to the point of diversion, place of use, or purpose of use for up to one year. A temporary transfer would need to only involve the amount of water that would otherwise be used by the existing right's holder. The advantages of this approach are that it is an expedited process and specifically exempt from CEQA. The disadvantages include that it is short-term and could impact the City's ability to transfer previously unused surplus water.

7.1.4 Temporary Urgency Permit

California Water Code section 1425 allows for temporary diversions of water, for up to 180 days, when the SWRCB finds that an urgent need exists. The key distinction between a temporary urgency permit and a temporary urgency change is that the petition does not need to be filed by the existing water rights holder – i.e. it would be a new permit. The advantage of this approach is that it is an expedited process and could be achieved by an entity other than the City. However, this approach is not statutorily exempt from CEQA.

7.1.5 Excess Municipal Water

California Water Code section 1462 provides a specific option for third parties to obtain a temporary permit to appropriate water that a municipality is entitled to use, but is in excess of its current needs. The option would require a showing that the City is not using its full appropriative right, and the process for making such an application is not clear. This approach is likely not in the best interest of the City.

7.2 Long-Term Options

7.2.1 Long-Term Transfer

California Water Code section 1735 allows for petitions for long-term transfers of water or water rights. In contrast to a temporary transfer, a long-term transfer requires public notice and opportunity to review. This is significant as it provides resources agencies with the ability to protest the action. Currently, resource agencies have protested the City's petitions on the Felton Diversion, and any additional actions could also be protested until the resolution of the City's HCP process. Also, long-term transfers are not specifically exempt from CEQA. The benefit of this approach is that a successful petition would be effective for many years, and that there is no requirement to demonstrate that the water would have otherwise been consumptively used, as would need to be demonstrated under a temporary transfer.

7.2.2 Petition to Change Place of Use

California Water Code section 1701 allows for petitions to change the place of use of its water rights. A change petition would likely involve a rigorous environmental review process, and it is not specifically exempt from CEQA. However, these types of petitions are generally processed more quickly than a new water rights application. A disadvantage to this approach is that it does not entitle the use of water beyond the City's existing 12.2 cfs diversion right.

7.2.3 Application for New Water Rights

An application for a new, appropriative right would likely be a component of a larger, long-term water transfer strategy. This would be a long and rigorous process. The SWRCB's current estimate to process new water rights applications is two to five years, but it can take considerably longer depending on the complexity of the petition, CEQA review, and fishery agency approval. Under such a petition the SWRCB would conduct an extensive analysis of a variety of different factors in deciding whether or not water is available to grant a new appropriative right. Such an analysis would include potential impacts to the environment, existing users and the protection of the overall public interest.

Table 10 - Summary of Water Rights Options

Description	Water Code Section	Applicant	Duration of Permit	Amount of Water	Timing to Process Application	Other Requirements
Transfer Pre-1914 Appro-priative Water	1706			Within current right	No SWRCB approval required	No injury to other legal users, as determined by courts
Temporary Urgency Transfer	1435	City	180 days, renewable	Within current right	<90 days	Demonstrate urgency. File for longer term change also
Temporary Transfer	1725	City	1 year, may be extended	Within current right	<60 days No CEQA	Water would have been consumptively used
Temporary Urgency Permit	1425	Other Party	180 days, renewable	Excess Unappropriated water	Expedited	Demonstrate Urgency. File for longer term change also
Excess Municipal Water	1462/ 1203	Other +City cooperation	Temporary	Within current right	Process Unclear	Not often used
Long-Term Transfer	1735	City	Many years	Within current right	1-3 yrs	
Petition to Change Place of Use	1701	City	Permanent	Within current right, amends right	More than 1 yr	
Application for New Water Right	1202,1205-1207, 1250 et seq.	Any party	Permanent	New available water	2-5 yr + 10-20 yr	

Notes: All options require demonstration of no injury to other legal users of water and no unreasonable effect on fish and wildlife (except a Section 1706 transfer). All options require CEQA review, except a Section1725, Temporary Transfer and a Section 1706 Pre-1914 transfer.

Sources: Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues; SWRCB, 1999, Guide to Water Transfers

7.3 Fishery and CEQA Issues

Most of the water rights approaches require review and evaluation under the California Environmental Quality Act (CEQA), and the approval of the state and federal fishery regulatory agencies. The most significant potential impact under CEQA would be potential impacts on fish and aquatic habitat. During development of the various exchange scenarios, an effort has been made to ensure that they would be operated with no significant effect on fish or the environment. Substantial information has already been developed through the City's HCP process to support those findings. Additional discussions with the agencies will be needed, but it is anticipated that the CEQA review process for the water rights could proceed relatively quickly and could perhaps be supported by a mitigated negative declaration. The scenarios that will require significant modification of the Tait Street diversion will require more extensive environmental review to evaluate the construction related impacts and any impacts on the stream channel and riparian areas.

8.0 NEXT STEPS

This report defines the benefits and costs, technical, and legal considerations for possible water transfer projects between the City and adjacent groundwater agencies. Work remains to evaluate the benefits for the City in relation to other potential supply projects, evaluate the potential effects of climate change, identify a critical path towards addressing water rights, and develop the institutional framework and agreements for proceeding with a project.

8.1 Consideration of Other Conjunctive Use Options

This effort to evaluate water transfer options was initiated in 2011 and largely completed by the end of 2013. During and after that time a number of other potential l supplemental water supply projects have been identified and are currently being evaluated, many of which are related to the components of the scenarios evaluated in this project. Both the City of Santa Cruz and the Soquel Creek Water District are actively engaged in efforts to quantify their water supply shortfalls and to quickly identify projects to remedy long-standing supply deficits. Following are some of the projects currently under consideration:

1. Divert 1000-1500 af/yr from Felton Diversion with a pipeline to the abandoned Hanson Quarry for storage, treatment and recharge into the Santa Margarita Groundwater Basin, with groundwater supply available to Santa Cruz in dry periods.
2. Use subsurface radial collection well(s), such as a Ranney® collector, at Felton and/or Tait Street, which would allow diversion of higher quality winter flow during high turbidity events with reduced need for treatment upgrade at the GHWTP. This could also facilitate direct diversion of water from Felton to the GHWTP, with amendments to existing water rights.
3. Construct an entirely new treatment plant to replace the GHWTP and provide a higher volume and level of treatment for winter flow.
4. Utilize advanced treated recycled water from Scotts Valley for groundwater recharge, potentially blended with winter flow diverted from the San Lorenzo River.
5. Utilize advanced treated recycled water from the City or County Sanitation District to recharge the Soquel-Aptos Groundwater basin.
6. Utilize low impact development and managed recharge to recharge stormwater into the Santa Margarita and Soquel-Aptos Groundwater Basins.

8.2 Further Technical Evaluations

Following are the additional technical evaluations that need to be completed:

1. Evaluate the potential effects of climate change on project yield by running the transfer scenarios in Confluence with hydrology and demand scenarios based on projected climate change possibilities.
2. Use the updated Santa Margarita Groundwater model to evaluate the effects of dry year pumping and delivery of groundwater to Santa Cruz, in conjunction with the various water exchange options for recharge of the Santa Margarita Groundwater Basin.
3. Evaluate the potential for increased groundwater delivery to Santa Cruz from the Soquel-Aptos groundwater basin in conjunction with the various options to increase groundwater storage. This will be facilitated by completion of the new Soquel-Aptos groundwater model in the next two years.

4. Evaluate the yield, cost, and reliability of the water transfer options identified in this report in relation to other potential supplemental supply projects. This work is underway through several related efforts.

8.3 Consideration of Fishery and CEQA Issues

Fishery and CEQA issues will have a strong impact on the feasibility, cost and timing of any project. These issues need to be further evaluated:

1. Consult with state and federal fishery agencies regarding the provisions incorporated in the water exchange scenarios to ensure that the agencies are satisfied that fishery resources are adequately protected. Consider and evaluate additional measures as needed.
2. Consult with CEQA experts on the appropriate course of action for competing CEQA requirements first for water rights approval and second to proceed with project implementation.

8.4 Water Rights

A critical path for securing water rights will likely include both short and long-term actions. The approach to water rights should involve all of the affected agencies and ideally would be accomplished in consultation with fisheries agencies.

1. Reach preliminary agreement among local agencies on the best way to approach water rights in terms of regional collaboration, lead agency, and approach for application(s).
2. Consult with State Board staff on various short and long term water rights options and the most effective way to proceed.
3. In the short term, the agencies could petition the State for a temporary urgency transfer or a temporary transfer of water under the City's existing Tait Street water right to the San Lorenzo River. Key determinations would need to be made as to whether or not the existing water supply situation constitutes urgency – impending sea water intrusion could likely make a fairly strong argument for that assessment. A temporary transfer under section 1725 is also a possibility, given the City's recent water savings through conservation. This process is made attractive given that it is specifically exempt from CEQA, which could streamline the process.
4. A short term (temporary) application should be accompanied by a long-term approach that would involve an application for a new water right on the San Lorenzo River. The entity applying for the permit would need to be defined through the institutional framework that is developed, as would the details regarding amount and place of use.

8.5 Institutional Framework

A memorandum of agreement, joint powers authority or some other institutional framework would need to be developed between the participating agencies. Depending on the approach taken, such an agreement would define roles and responsibilities among the agencies. The agreement might also contain specific operational agreements regarding the amount, timing, and process for transferring water. Cost sharing and funding would also likely be a critical component of any such agreement. An important next step in the discussion is a determination of the amount of water that could be returned to the City in drought years. In part, this amount would depend on the amount of water transferred to Soquel and the progress of basin recovery. However, ultimately, the amount of water returned to the City would be defined by the institutional agreements developed under a water transfer scenario. Next steps include:

1. Complete a proposed agreement regarding protection of the City's existing water rights
2. Develop a memorandum of agreement among the local participating water agencies regarding proceeding with a joint water rights applications that would include provisions for allocation of priority and amount though future local agreement and negotiations.
3. Develop agreements regarding the amounts and terms under which water could be pumped and sent to Santa Cruz.
4. Develop agreements regarding responsibilities and financing for proceeding next steps.

8.6 Short Term Project

Transfer of water to Soquel is a project that could potentially be implemented on a short term basis with limited if any additional infrastructure required. This could provide up to 445 af/yr, and even in dry and critically years, Soquel could receive 360 af and 290 af, respectively.[20] Implementation of this with water from Tait would include:

- Updated Confluence analysis of this scenario under current parameters of demand and delivery capacity and City operations to confirm yields and frequency of yields.
- CEQA review.
- Approval from the fishery agencies and the State Water Resources Control Board for a short term transfer.
- Approval of an agreement between the City and Soquel for transfer of winter water, including terms, costs, and potential for transfer of water back to Santa Cruz given that certain conditions in the basin were met.
- Development of a simple operations plan to increase winter diversions and treatment
- Opening the valve in the 8 inch intertie at Soquel and 41st Avenue when the operational conditions and fish flows were met.
- During dry periods, water could potentially be sent to Santa Cruz from the new O'Neil well, or through a new pump station.

[20] Fiske, April 26, 2012, Water Transfer Project Task 1: Short-term Analysis

9.0 References.

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Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 (Revised) (June 22, 2012)

Fiske, Water Transfer Project: Long-Term Analysis Scenarios 3 and 4 (June 25, 2012)

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Fiske, Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision) (May 22, 2013)

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Hagar Environmental Science, June 2013, Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon.

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State Water Resources Control Board, July 1999, A Guide to Water rights Transfers

URS Corporation. 2013. *SCWD^2 Regional Seawater Desalination Project Draft Environmental Impact Report.* City of Santa Cruz and Soquel Creek Water District.

10.0 APPENDICES

Available Separately

10.1 Appendix A – Water Rights and Fish Habitat Impacts

- Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues.
- Hagar Environmental Science, June 2013, Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon.

10.2 Appendix B – Yield Modeling

- Fiske, Water Transfer Project: Long-Term Analysis Scenario 1 (June 1, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity (June 11, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 3 Technical memorandum: Potential Transfers with Unlimited Tait Street Capacity (June 20, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 (Revised) (June 22, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenarios 3 and 4 (June 25, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenario 5: GHWTP Improvements (July 2, 2012)
- Fiske, Final Water Transfer Project Results Summary (July 6, 2012)
- Fiske, Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision) (May 22, 2013)
- Fiske, February 12, 2014, Volumetric Shortage Analysis for Water Transfer Project
- Akel Engineering Group, February 19, 2014, City of Santa Cruz Water Department and Soquel creek Water District Intertie Capacity Analysis

10.3 Appendix C – Infrastructure and Costs

- Kennedy/Jenks. 2013. *Water Transfer Infrastructure Summary Report.* Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation.

APPENDIX A – Water Rights and Fish Habitat Impacts

CONJUNCTIVE USE AND WATER TRANSFERS – PHASE II (TASK 6)

Proposition 84

Department of Water Resources

Integrated Regional Water Management Planning Grant

Northern Santa Cruz County Integrated Regional Water Management

Agreement No. 4600009400

May 2015

Prepared by:

Santa Cruz County Environmental Health Services

Submitted to:

Regional Water Management Foundation

Department of Water Resources

Appendix A – Water Rights and Fish Habitat Impacts

- Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues.
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Memorandum

To: John Ricker
Director, Water Resources Division
County of Santa Cruz
From: Best, Best & Krieger LLP
Date: October 28, 2013
Re: County of Santa Cruz Water Supply and Water Right Issues

I. Introduction

This memo provides an overview and general information regarding potential alternatives to divert water from the San Lorenzo River during high flow winter months to provide critically needed supplies to the Soquel Water District (Soquel), the Scotts Valley Water District (Scotts Valley) and/or the San Lorenzo Valley Water District (San Lorenzo), either for direct use or for groundwater recharge. It is our understanding that Soquel, Scotts Valley and San Lorenzo rely predominantly on groundwater, and all are facing current and projected water shortages within their service areas. One approach would be to partner with the City of Santa Cruz (City). The City has existing appropriative water rights to the San Lorenzo River pursuant to permits and licenses issued by the State Water Resource Control Board (State Board). In particular, the City has two licenses to divert water at Tait Street which are further discussed below. Another approach might involve application(s) for new water rights on the San Lorenzo by Soquel, Scotts Valley, San Lorenzo or a combination of those parties, independent of the City's existing rights. The contents of this memo have been discussed with the City's special water rights counsel, and feedback from counsel is incorporated herein.

II. Analysis

A. Overview of City of Santa Cruz Tait Street Post-1914 Appropriative Water Rights to San Lorenzo River

According to information you provided to us, the City of Santa Cruz has post-1914 appropriative water rights to the San Lorenzo River at Tait Street pursuant to two licenses issued by the State Board as follows:

- Tait Street Diversions and Wells - License Nos. 1553 and 7200: 12.2 cfs year-round with fish flow bypasses by agreement with the Department of Fish and Wildlife (DFW), as discussed below.

Based on the City's 2010 Urban Water Management Plan (UWMP) and submissions to the State Board in connection with the above-referenced licenses, it appears that during high flow winter months, in select years, available San Lorenzo River flows and diversion

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capacity (supply) at Tait Street has the potential to exceed present City needs (demands). This difference in supply and demand creates a window of opportunity for other agencies to collaborate with the City to maximize use of its rights for the benefit of the region. The City's UWMP indicates that between 2006 and 2010, the City diverted on average approximately 5,796 acre-feet at the Tait Street Diversion and wells.[1] According to reports filed with the State Board, the City's Tait Street diversions were 6,336 acre-feet in 2008, 6,253 acre-feet in 2009, 4,506 acre-feet in 2010, 4,500 acre-feet in 2011, and 6,065 acre-feet in 2012. The filings also indicate the City reached its maximum rate of diversion (12.2 cfs) at some point in almost all of the months during these years and consistently diverted at this rate on a monthly basis (236 million gallons per month) when conditions permitted and there was sufficient City demand. Thus, while the City is exercising the full amount of the licenses, under certain circumstances there may be water available within the City's rights for use by the other agencies. Another benefit of the Tait Street licenses is that they authorize direct diversion, and do not involve use of the City's Newell Creek Reservoir. That reservoir is of limited capacity and is an essential element of the City's water operations and drought protection. The Tait Street diversions operate independently of the Newell Creek Reservoir water rights and operations.

B. Fishery Issues and Draft Habitat Conservation Plan

The City has worked closely with the DFW and the National Marine Fisheries Services (NMFS) to develop a Draft Habitat Conservation Plan (HCP) for an area that includes the San Lorenzo River. The purpose of the HCP is to provide the City with coverage under incidental take permits for activities that could potentially result in take of steelhead and coho salmon.[2] The focus of the HCP is on the development of a conservation strategy to avoid or minimize potential adverse effects of the City's diversions.

An important piece of the HCP relating to the use of excess water is the City's proposed instream flow targets for each waterway. According to the HCP, the targets represent a floor for City diversions such that diversions would not reduce flows below these certain levels.[3] There are minimum flow targets proposed for the Tait Street diversion and wells.[4] The City reports that it is now operating to those targets by agreement with DFW. For purposes of this analysis, we have not evaluated how these minimum flow requirements might impact the quantity of water that is diverted pursuant to the City's licenses or the timing and quantity of any available water not needed by the City. We understand that the County has worked with the City and its consultants to model the impact of the flow targets on the City's diversions and has calculated potential availability of additional flow under various scenarios, all of which maintain flow targets below Tait Street. As discussed below, any type of appropriative diversion from the San Lorenzo River will almost certainly be subject to rigorous review by multiple agencies to

[1] 2010 UWMP, Pg. 3-8.
[2] HCP, Pg. 9.
[3] HCP, Pg. 35.
[4] HCP, Pg. 38. The proposed minimum flow targets for Tait Street are organized into three tiers and vary considerably based on the time of year and rearing baseflow conditions.

determine whether the diversion will result in adverse impacts to fish, wildlife or other instream beneficial uses.[5]

C. Using Surplus/Excess Water Maximizes Reasonable and Beneficial Use

Based on our discussions with you and your discussion with City staff (Bill Kocher and Kevin Crossley), this analysis assumes that under certain circumstances the City currently does not utilize the full amount of water that could be diverted under its appropriative rights to the San Lorenzo River at the Tait Street facilities. This is consistent with the typical municipal development pattern, and is the basis for the "municipal diligence doctrine" under California water rights law described below. Indeed there is no indication that any portion of the City's rights are subject to any claims of loss, forfeiture or abandonment. As noted above, although the City fully exercises its rights in terms of maximum rates of diversion, under certain conditions the City currently does not utilize the full quantity of water available under its vested rights, as is normal with virtually all water rights. More specifically, it appears that except in dry and critically dry years, the City does not always use the full quantity of its rights during high flow winter months (i.e., November through April) from Tait Street.

Generally speaking, a municipality that holds appropriative rights to surface water is not required to use the full amount of its rights, but rather is able to "grow into" its rights, and the non-use of its full right does not result in loss, forfeiture or abandonment of any portion of the municipal right. (See, e.g., Water Code §§ 1203, 1462.) Regarding any presently unused portion of the City's Tait Street appropriative rights, such unused amounts, assuming they can be quantified at the technical level, can be put to additional reasonable and beneficial use. This approach is supported by Article X, Section 2 of the California Constitution and related case law.[6] It also finds support in various provisions of the California Water Code that apply to temporary and/or urgency uses of waters, which are discussed in more detail below.

D. Short-Term Options – City's Existing Water Rights

1. Temporary Urgency Transfer. Water Code section 1435 authorizes the State Board to grant a permittee/licensee a temporary change to a different point of diversion, place of use, and/or purpose of use where an urgent need exists for the temporary change. These temporary change orders automatically expire after 180 days, but may be renewed by the State

[5] See, e.g., Water Code §§ 1243, 1257, 1257.5, 1425(b)(3), 1435(b)(3), 1727(b)(2).

[6] As provided in Article X, Section 2 of the California Constitution, the reasonable and beneficial use doctrine generally provides that no person or entity can have a protected interest in the unreasonable or non-beneficial use of water, and that the waste or unreasonable use, method of use, or method of diversion of water shall be prevented in the interest of the people and for the public welfare. (Cal. Const., Art. X, § 2; Water Code §§ 100-101; *United States v. State Water Resources Control Board* (1986) 182 Cal.App.3d 82; *City of Barstow v. Mojave Water Agency* (2000) 23 Cal.4th 1224.)

Board, and may be modified or revoked in the State Board's discretion.[7] Prior to issuing a change order, the State Board must make all of the following findings:

- The permittee has an urgent need to make the proposed change;
- The proposed change may be made without injury to any other lawful user of water;
- The proposed change may be made without unreasonable effect upon fish, wildlife, or other instream beneficial uses; and
- The proposed change is in the public interest (including conditions to ensure that other users and fish and wildlife are not injured).

"Urgent need" means the existence of circumstances from which the State Board may in its judgment conclude that the proposed temporary change is "necessary to further the constitutional policy that the water resources of the state be put to beneficial use to the fullest extent of which they are capable and that waste of water be prevented."[8] The Board may not find that an "urgent need" exists if it determines in its discretion, and if applicable, that the petitioner has not exercised due diligence in petitioning the State Board for a non-urgent petition (see Water Code § 1725) or in pursuing such a petition.[9] With regard to the scenarios discussed herein, the City would not be pursuing an additional non-urgent petition and therefore this discretionary factor would likely not apply.

As applied to the San Lorenzo River and the circumstances described above, the City, as the permittee/licensee, would petition the State Board for a temporary change to the place of use in connection with the City's existing water permits/licenses to transfer water on an urgency basis to Scotts Valley, Soquel and/or San Lorenzo (assuming that the point of diversion and purpose of use would not need to change). The petition for change would need to establish an urgency basis for the State Board to make the above findings, possibly including that the overdraft situation is important enough to warrant emergency action, and that water which currently could be put to reasonable and beneficial use, which is excess to the needs of the fishery as provided in the HCP, is wasting to the ocean. Given that the definition of "urgent need" is very broad, and given the compelling Article X, Section 2 arguments that apply in this scenario, the parties could likely make a strong showing that an urgent need exists. Although Water Code section 1435 does not expressly require that a "water emergency" must be declared in order to demonstrate urgent need, that type of declaration or the imposition of water restrictions by one or more of the districts would likely be relevant.

The City would also have to demonstrate that other lawful users would not be injured, that fish and wildlife would not be unreasonably harmed, and that the transfer is in the public interest. Assuming that the City would be proposing to transfer surplus or conserved

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[7] Water Code § 1440.
[8] Water Code § 1435(c).
[9] Id.

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water (see discussion below) within its existing appropriative rights, these findings should be more easily supported than otherwise. However, given the presence of protected anadromous fish and related habitat in the San Lorenzo River, the State Board, DFW and NMFS would all likely conduct a review to determine the potential impacts of such a temporary transfer. In addition, and as referenced above, a petition for a non-urgency temporary change, long term transfer, or expanded water right may need to be filed and pursued on a parallel basis by the district(s) benefitting from the urgency petition.

Pros:

- Expedited process.[10] A hearing is not required but may be held in the Board's discretion.
- The level of review is less exacting than a longer term transfer assuming the City can make a good case for the "urgent need."
- A temporary urgency transfer by the water rights holder does not involve any new water rights, but only involves transferring water that is within the City's existing water rights. Consequently, the potential impacts, if any, should be easier to quantify.
- No impacts to City's water rights.

Cons:

- The transfer can only be for 180 days (although additional 180-day term(s) may be possible upon a new application).
- Urgency transfers are not statutorily exempt from CEQA, and if an individual exemption does not apply, it may cause significant delay.[11]

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[10] State Board staff have indicated that temporary urgency transfers usually take less than 90 days to process, and can take less time depending on the circumstances.

[11] As noted below, temporary water transfers under Water Code section 1725 are expressly exempt from CEQA review. (Water Code § 1729; CEQA Guidelines § 15282(u).) A similar statutory exemption is not provided for urgency transfers under Section 1435, although some contend it should be. On this issue the State Board has adopted a regulation stating that "[a]ny order approving a change under Articles 15 [change in point of diversion, place of use or purpose of use], 16.5 [temporary urgency changes], or 17 [long-term transfer of water or water rights] shall include compliance with any applicable requirements of Division 13 (commencing with Section 21000) of the Public Resources Code." (23 Cal. Code Regs. § 792.) Among other exemptions that could be considered, CEQA's emergency exemption applies to activities such as (1) emergency repairs to facilities necessary to maintain service essential to the public health, safety, or welfare, and (2) specific actions necessary to prevent or mitigate an emergency (not including long-term projects undertaken for the purpose of preventing or mitigating a situation that has a low probability of occurrence in the short-term). (See CEQA Guidelines § 15269.) This appears to be a stricter standard than what the State Board requires to justify an urgency transfer under Water Code sections 1435 and 1425 (below), but it is not entirely clear. Another approach could seek to utilize CEQA's catchall exemption, which requires no possibility of a significant effect on the environment. Here the parties would contend, among other things, that authorization already exists under the City's right to divert the amount(s) in question. If an exemption does not apply, the required level of environmental review would need to be evaluated (i.e., Neg. Decl., Mitigated Neg. Decl. or EIR). All of these approaches involve some level of risk under CEQA, and if this option is

- The State Board may, in its discretion, modify or revoke the change order at any time (although not likely).
- A petition for a non-urgency change of some kind will likely need to be filed by the district(s) benefitting from the urgency petition.
- It is not known how the State Board would evaluate whether groundwater and other water shortage conditions in Soquel, Scotts Valley and/or San Lorenzo present an "urgent need," although as indicated above, the parties could likely make a fairly strong showing of urgency.

2. Temporary Transfer. Water Code section 1725 authorizes permittees/licensees (the City in this case) to temporarily change the point of diversion, place of use, or purpose of use due to a transfer or exchange of water or water rights for up to one year if the transfer:

- Would only involve an amount of water that would "have been consumptively used or stored by the permittee or licensee in the absence of the proposed temporary change";
- Would not injure any legal user of water; and
- Would not unreasonably affect fish, wildlife, or other instream beneficial uses.[12]

The State Board is required to make a decision within 60 days of receiving a petition, but may extend the time or decide to hold a hearing with the consent of the permittee/licensee.[13]

For purposes of Section 1725, "consumptively used" means the amount of water that has been consumed through use by evapotranspiration, has percolated underground, or has been removed from use in the downstream water supply as a result of direct diversion.[14] In short, the transfer must involve water that otherwise would have been consumptively used in the absence of the water transfer. This is important because it could limit or eliminate the City's ability to apply under this Section for a water transfer of previously unused water. However, an argument can be made that amounts of water no longer used because of conservation efforts or in lieu use of recycled water may be transferred and could apply towards this requirement.[15] Determining if the water otherwise would have been "consumptively used" is the key factor for utilizing this kind of short term transfer from the City.

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pursued we would recommend additional research and discussion with State Board staff. On its face, however, given changes in stream flows that presumably would occur, it is likely that an EIR would be required.

[12] Water Code § 1727(b).

[13] Water Code § 1726(g).

[14] Water Code § 1725.

[15] Water Code § 1011(b). See also SWRCB "A Guide to Water Transfers" (1999) pg. 6-6.

Pros:

- Expedited process.
- Can be for up to one year, and potentially extended.
- No urgency requirement.
- Such transfers are specifically exempt from CEQA review.[16]
- No impacts to City's water rights.

Cons:

- Short-term.
- "Consumptively used" requirement could limit the City's ability to transfer previously unused surplus water, although amounts conserved by the City and offset by the use of recycled water may be relevant in this regard.[17]

E. Short-Term Options – New Rights

1. Temporary Urgency Permit. Similar to Water Code section 1435, Water Code Section 1425 allows for temporary diversions of water (up to 180 days with potential renewals) in certain cases where the State Board finds that an urgent need exists, the diversion and use will not injure any lawful user of water or have any unreasonable effect upon fish and wildlife, and the diversion is in the public interest. The definition of "urgent need" in Section 1425 is exactly as defined in Section 1435, as discussed above. As with Section 1435, there is no statutory exemption from CEQA for this kind of petition.

The major difference between Section 1425 and Section 1435 is that under Section 1425, the party applying for the temporary permit to divert water does not need to be a permittee/licensee with an existing water right. As applied here, either Soquel, Scotts Valley, San Lorenzo, or perhaps an entity composed of all districts (which could also include the County), could apply for a temporary urgency permit to divert water from the San Lorenzo pursuant to Water Code section 1425, independent of the City.

The State Board must make the required findings described above, and the applicant would have to provide sufficient information to demonstrate a reasonable likelihood that unappropriated water is available in the context of those findings. The City's existing appropriative rights and the minimum flow targets in the draft HCP would need to be considered in analyzing whether unappropriated water exists for diversion. According to the State Board's

[16] Water Code § 1729.
[17] The City's 2010 UWMP indicates that approximately 900 million gallons per year (2,761 acre feet) have been conserved in the past decade. (See UWMP, Pg. 6-27.)

Declaration of Fully Appropriated Streams, the San Lorenzo is not fully appropriated during the season of November 1st to May 31st.[18]

Pros:

- Expedited process.
- The level of review is probably less rigorous than a longer term permit application assuming the applicant(s) can make a good case for the "urgent need."
- The applicant(s) can take the lead in applying, independent of the City and its water rights.
- Does not directly impact the City's existing water rights.
- Creates access to "new" water.

Cons:

- Short-term.
- Unlike temporary transfers, there is no specific statutory exemption from CEQA, which could cause considerable delay unless another exemption applies.[19]
- It is not known how the State Board would evaluate whether groundwater and other water shortage conditions in Soquel, Scotts Valley and/or San Lorenzo present an "urgent need," although as indicated above, the parties could likely make a fairly strong showing of urgency.
- May be opposed by the City.
- Applicant(s) would likely be required to file a petition for a new long-term water right in conjunction with the temporary request.

2. Application to Use Surplus Municipal Water. Water Code section 1462 provides a specific option for third parties to obtain a temporary permit to appropriate water that a municipality is entitled to use but is in excess of its current needs. Section 1462 provides:

> Where permission to appropriate is granted to any municipality for any quantity of water in excess of the existing municipal needs therefor, the board may, pending the application to beneficial use of the entire appropriation permitted, issue permits for the temporary appropriation of the excess of the permitted appropriation over and above

[18] Water Right Order 98-08, Exhibit A, Declaration of Fully Appropriated Streams, November 19, 1998.
[19] See discussion above in Footnote 13.

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> the quantity being applied to beneficial use from time to time by the municipality.

This approach is also codified in Water Code section 1203, which states that a person may put surplus municipal water to beneficial use until such time as the municipality can use the surplus water.[20] This option would require a showing that the City is not yet using its full appropriative water rights.[21] The process to make such an application is not well defined in the Water Code, and it is difficult to estimate how long such a process would take. Initial research indicates this option has not been used frequently. From a practical standpoint, a temporary permit seems most akin to a long-term transfer under Water Code section 1735 (below). The City's cooperation would be instrumental, and the State Board would likely require certain showings in support of this type of application.[22] Section 1462 has very few details regarding process, and thus additional research and possibly conversations with State Board staff would be needed to move forward with this option.

F. Long-Term Options – City's Existing Water Rights

1. Long-Term Transfer. Pursuant to Water Code section 1735, the State Board may consider petitions for long-term transfers of water or water rights (more than one year). The State Board may approve such transfers "where the change would not result in substantial injury to any legal user of water and would not unreasonably affect fish, wildlife, or other instream beneficial uses."[23] In addition, the State Board must provide notice of the petition and an opportunity for a hearing, including notice and an opportunity to review and make recommendations to DFW. Furthermore, unlike temporary transfers under Section 1725 (above), long-term transfers under Section 1735 are not specifically exempt from CEQA review. Consequently, processing this type of application can take a significant amount of time.[24] On the other hand, unlike a temporary change under Section 1725, there is no express statutory requirement that the transferred water be that which otherwise would have been consumptively used, and thus "surplus" water would be available to transfer. However, the "no injury" rule can have a similar effect.[25] Again, the analysis of potential impacts would be very important, and the State Board would likely require a long-term transfer to be evaluated in the context of the Draft HCP and the potential for decreased flows in the River.

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[20] Water Code § 1203 specifically states that Section 1203 supplements Sections 1460-1464.

[21] As noted above, the City needs and uses the full amount during certain times, and may need to alter its operations in light of demands imposed by the HCP.

[22] As noted herein, Section 1735 applications are evaluated according to whether the change would result in substantial injury to any legal user of water or unreasonably affect fish, wildlife, or other instream beneficial uses.

[23] Water Code § 1736.

[24] Based on general/anonymous conversations with State Board staff, this process can take from one to three years, and in some cases longer.

[25] The differences between long term transfers and long term changes to a water right (see section on petitions to change place of use below) are not well defined. The Water Board has indicated that it can take matters not specified in the particular authorizing statute into account in reviewing and acting on long term transfers. (See footnote 21, Revised WRO 2002-13.)

Pros:

- May be effective for many years.
- May directly transfer surplus water regardless of whether it would have been consumptively used, thus providing greater flexibility.
- No impact to City's water rights. This is true even if the water rights themselves are transferred, as they revert back to the City at the termination of the transfer period.
- A long-term transfer of unused water can help protect against losing a right for non-use, although in this case the City's water rights are not in any danger of being lost.

Cons:

- Longer approval process (possibly 1-3 years).
- No specific CEQA exemption applies.
- Because it is long-term, review of potential impacts to fish and wildlife in the context of the Draft HCP likely to be more rigorous.
- Not permanent, but effectively can be permanent in some cases depending upon terms of an agreement.
- Limited to surplus amounts within the City's existing water right, and does not guarantee any new water.

2. Petition to Change Place of Use. The City may also file a petition with the State Board pursuant to Water Code section 1701 to change the place of use of its water rights to add the Soquel, Scotts Valley and/or San Lorenzo service areas, which essentially would be an amendment to its existing Tait Street licenses. The City would need to show to the satisfaction of the State Board that the change would not injure any legal user of the water involved.[26] Section 1702 does not contain specific requirements to avoid unreasonable effects on fish and wildlife, although the State Board would likely require that type of analysis based on CEQA, the public trust doctrine and/or the existing HCP process. In addition, pursuant to Water Code section 1701.3, the State Board may also require information to demonstrate compliance with the Fish and Game Code and Endangered Species Act. In short, a change petition would likely involve a rigorous environmental review process.

This type of petition likely would take more than a year to process, as it is not specifically exempt from CEQA. However, we understand that the State Board generally tries to move these along and that they do not take as long as a new water right application, which can take between 2-5 years (or possibly much longer). This option presents a fairly straightforward approach, as it would simply expand where the City could use its water, which seemingly would

[26] Water Code § 1702.

be sold on some type of wholesale basis to Soquel, Scotts Valley and/or San Lorenzo. Similar to many of these options, an agreement would need to be worked out between the parties regarding amount and cost of any water transferred.

Pros:

- Relatively straightforward and possibly expedited.
- May be effective over the long-term.
- No impact to the City's water rights.
- Using more water within an existing right can help protect the right, although in this case the City's water rights are not in any danger of being lost.
- Assuming there is surplus water available for use within the City's existing rights, this can be done without seeking a new permit.

Cons:

- While possibly expedited, can take a considerable amount of time.
- No "new" water right for the other Districts in the long-term, as any diversion would derive from the City's existing rights.
- No specific CEQA exemption applies, and thus could involve extensive environmental review.

G. Long-Term Options – Application for New Water Rights to San Lorenzo

New appropriative applications on the San Lorenzo should be part of a larger long-term effort and strategy to secure sufficient and reliable water supplies for Soquel, Scotts Valley and San Lorenzo. As indicated above, the San Lorenzo River has not been declared "fully appropriated" by the State Board during the season of November 1st to May 31st. Consequently, new applications can be filed by Soquel, Scotts Valley and/or San Lorenzo, or other entities including the City, to appropriate water from the San Lorenzo River during those times.[27] The State Board's current estimate to process new water right applications is two to five years, but it can take considerably longer depending on the complexity of the situation.[28] The State Board conducts an extensive analysis of a variety of different factors in deciding whether water is available to grant a new appropriative right, including potential impacts to the

[27] See, e.g., Water Code §§ 1202, 1205-1207, 1250 et seq.

[28] Based on the limited information that we have, it is difficult to predict how long this process would take. There are however a number of complexities involved that could cause it to take many years (possibly up to ten years or more), such as the existence of endangered species, the ongoing HCP process, and the multiple parties that have interests in the River (and whether they will be working together or not). Again, at this early stage, the timing required to process a new water right application is very difficult to predict.

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environment and other users and the protection of the overall public interest. As with the long-term options discussed above, any new application to appropriate water would be subject to environmental review and, given the draft HCP, would likely be evaluated in concert with the current or a renewed HCP process.

Scotts Valley, Soquel, San Lorenzo, the City and/or others could agree to work together in filing a joint application. In advance of filing, the parties would collaborate on point(s) of diversion, place(s) of use, purpose(s) of use, quantity and other terms of a joint application. Collaborating would provide a number of advantages, including the avoidance of any potential conflicts between the parties, cost savings, and consistent communications with state and federal entities.[29] Furthermore, a joint application appears consistent with the State and State Board's emphasis on regional water planning. Because the parties are already working collaboratively, and based on the benefits of continuing to do so, a joint application should be given serious consideration.

Pros:

- Assuming a joint application or agreement by the parties, provides a long-term solution for a new water supply above and beyond existing rights.
- If water can be shown to be available, California law supports putting it to maximum reasonable and beneficial use.
- A new right does not impact the City's existing water rights.

Cons:

- Process likely to take a considerable amount of time. Although State Board staff indicates a 2-5 year process for new appropriative applications, the process here could take considerably longer (up to twice as long or more) because of endangered species issues, HCP development, limited supplies and multiple party interests involving the San Lorenzo River.
- No specific CEQA exemption applies, and thus environmental review would be extensive.
- Given existing fishery issues, review by DFW and NMFS likely to be rigorous and involve HCP processes.
- Unclear whether surplus water is available for appropriation.
- If the parties do not coordinate with each other, it may lead to conflict and leave regional water supply problems unresolved.

[29] For purposes of submitting a joint application, the agencies may need to form a JPA, enter a joint powers agreement, or otherwise formalize their relationship and understandings.

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H. Moving Forward

Despite the potential hurdles, it is our recommendation that some variation of the short-term and long-term approaches discussed above should be considered and pursued. Assuming all of the parties are working together, a plan of action would likely involve the City, Scotts Valley, Soquel and/or San Lorenzo jointly pursuing a short-term temporary urgency transfer or temporary transfer, possibly in conjunction with a petition for a long-term transfer. A transfer would depend on the availability of excess water within or independent of the City's existing rights and the ability to transfer that water in a way that does not harm the fishery. Both issues would need to be evaluated in more detail. A petition for a change in place of use and/or point of diversion may also be considered. The longer-term aspect of the overall strategy would involve an application for a new water right, either by one or all of the parties, or a long-term transfer that is effectively permanent pursuant to an agreement. For the reasons stated above, our recommendation at this point is for the parties to work together in developing a joint application based on an agreement between the parties.

III. Conclusion

As indicated above, all of these approaches will require a comprehensive effort, and will likely involve fishery issues, related habitat conservation plan processes, infrastructure other technical factors, and detailed State Board proceedings. In addition, as you know, we have reviewed a limited amount of documents and information, and while it appears that there are times when the City does not need the full amount of water available under the Tait Street licenses, we have not independently reviewed whether there is surplus high flow water in the San Lorenzo River, either within or independent of the City's existing rights. Provided such water exists, we believe that the temporary and/or long-term use of that supply is supported by the reasonable and beneficial use doctrine as set forth in Article X, Section 2 of the California Constitution and explained in numerous court and State Board decisions. We recommend that the County, Soquel, Scotts Valley and San Lorenzo continue to work closely and coordinate with the City to the greatest extent practicable regarding any filings to be submitted to the State Board.

Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon

Hagar Environmental Science

June 2013

For City of Santa Cruz and County of Santa Cruz

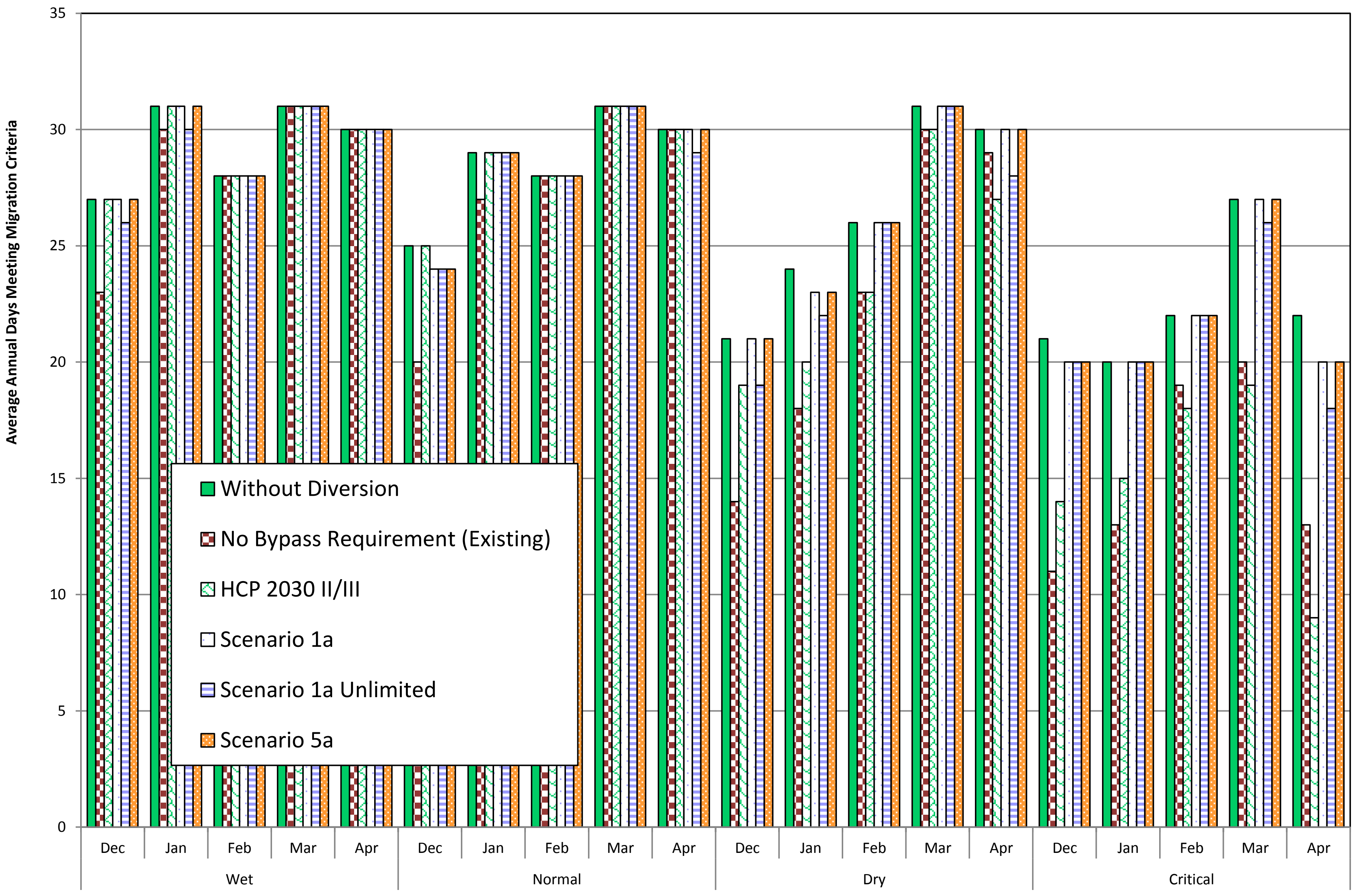
Methodology and Explanation

The effects on fish habitat of the proposed diversions for water transfer were evaluated by the City's fishery consultant, Hagar Environmental Sciences, using the same methodology that is being used in the HCP process to evaluate the effects of the City diversions. The fisheries consultants utilized data on channel conditions, habitat models, and the results of the yield analysis, specifically the residual flows with and without diversions, to estimate the effects on downstream habitat. The methods used in developing this data are fully described in HES 2011 (Assessment of Streamflow Effects on Migration, Spawning, and Rearing Habitat for Anadromous Salmonids in Streams Influenced by City of Santa Cruz Water Diversions including Newell Creek). The objective of the habitat assessment is to quantitatively determine the relationship between streamflow and potential migration, spawning, and rearing habitat for steelhead and coho salmon in the affected reach of the San Lorenzo River.

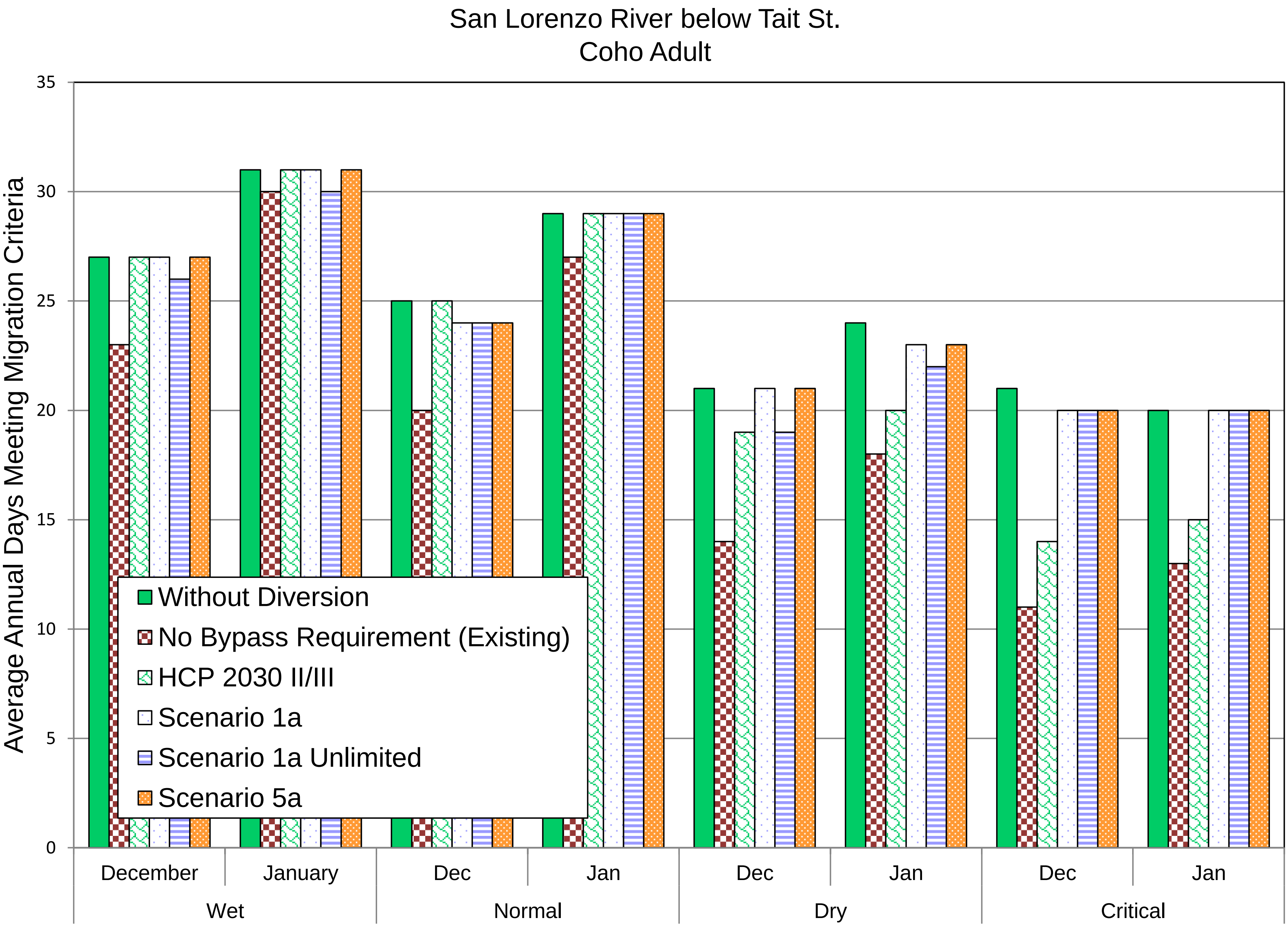
The critical life stages downstream of Tait Street November to April are steelhead adult migration (December to April) , coho salmon adult migration (December to January) and smolt out migration (both species, January to May). HES calculated the average number of days each month that met migration criteria under six different flow scenarios:

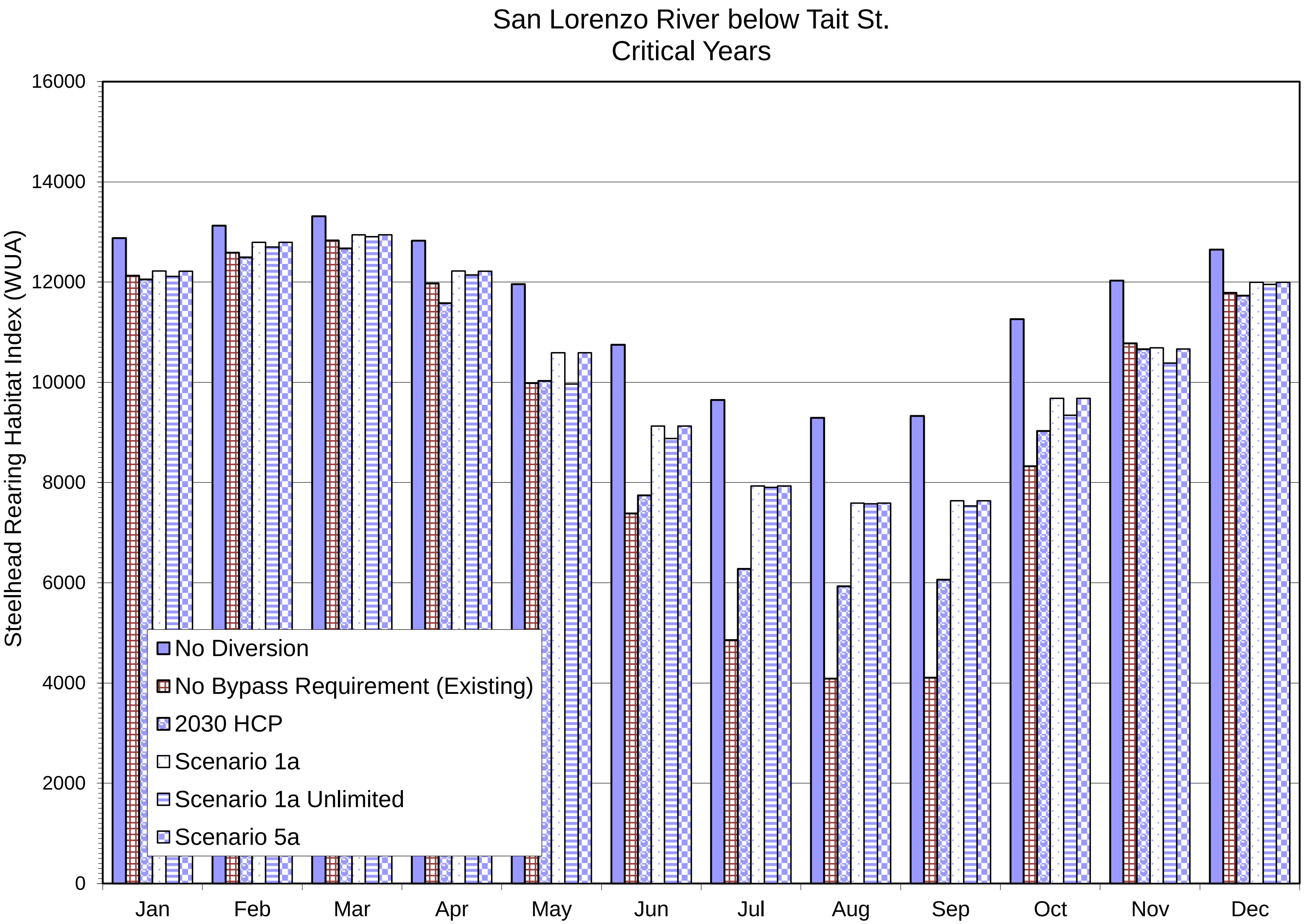
- Without Diversions: Flow that would exist without any City water diversions (Unimpaired flow)
- Existing diversions with no bypass requirements and no transfers
- HCP 2030 demand, Tier 2/3 flows (City Proposal), with no additional diversion for transfers
- Scenario 1a: Transfer with Existing Diversion and Treatment Capacity (Scenario 1 from the report)
- Scenario 1a Unlimited: Transfer with Tait diversion capacity up to 14 mgd (Scenario 3 from the report)
- Scenario 5a: Treatment Plant upgraded to treat 200 NTU turbidity Tait capacity of 7.8 mgd (Scenario 4 from the report)

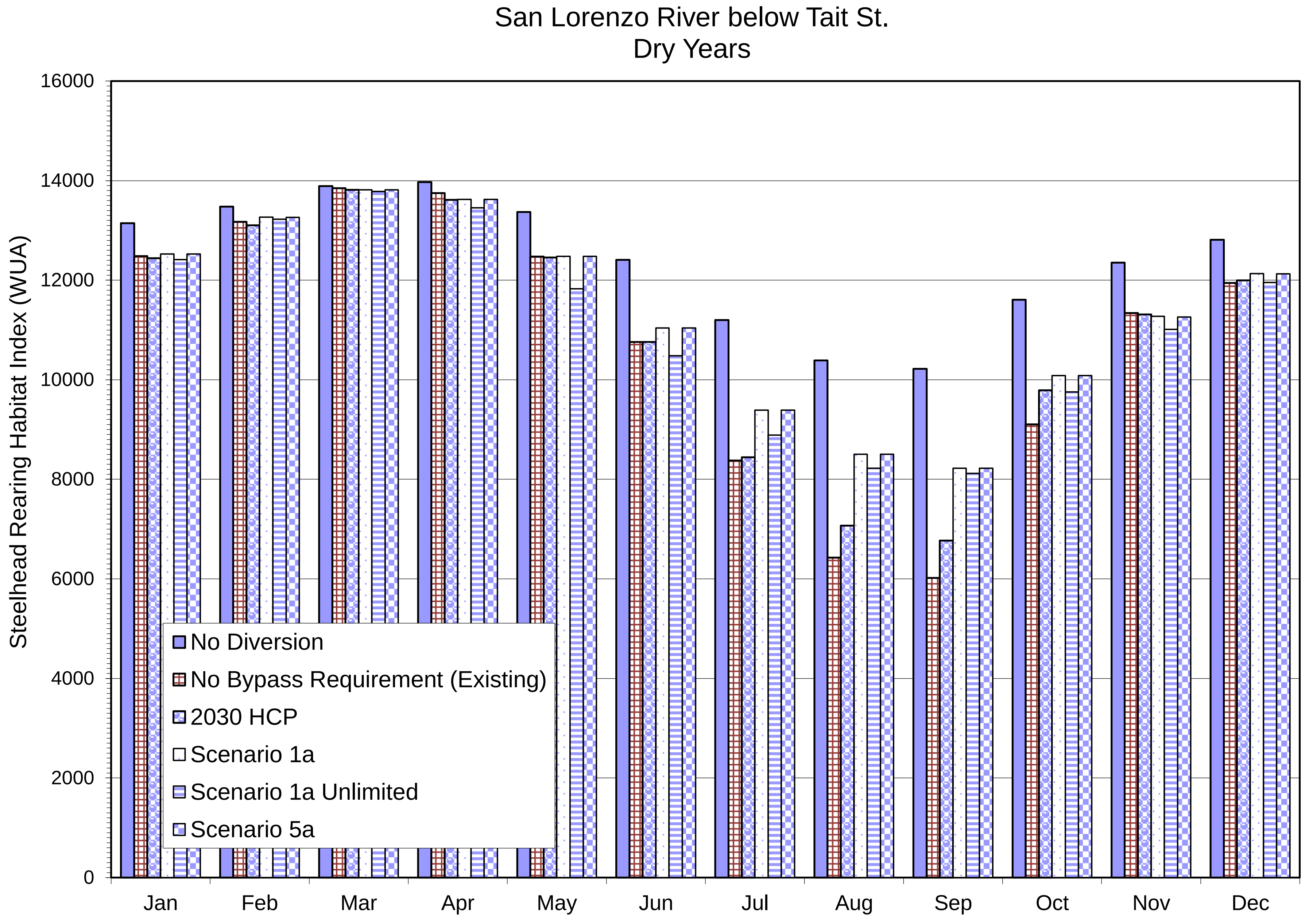
San Lorenzo River below Tait St.
Steelhead Adult

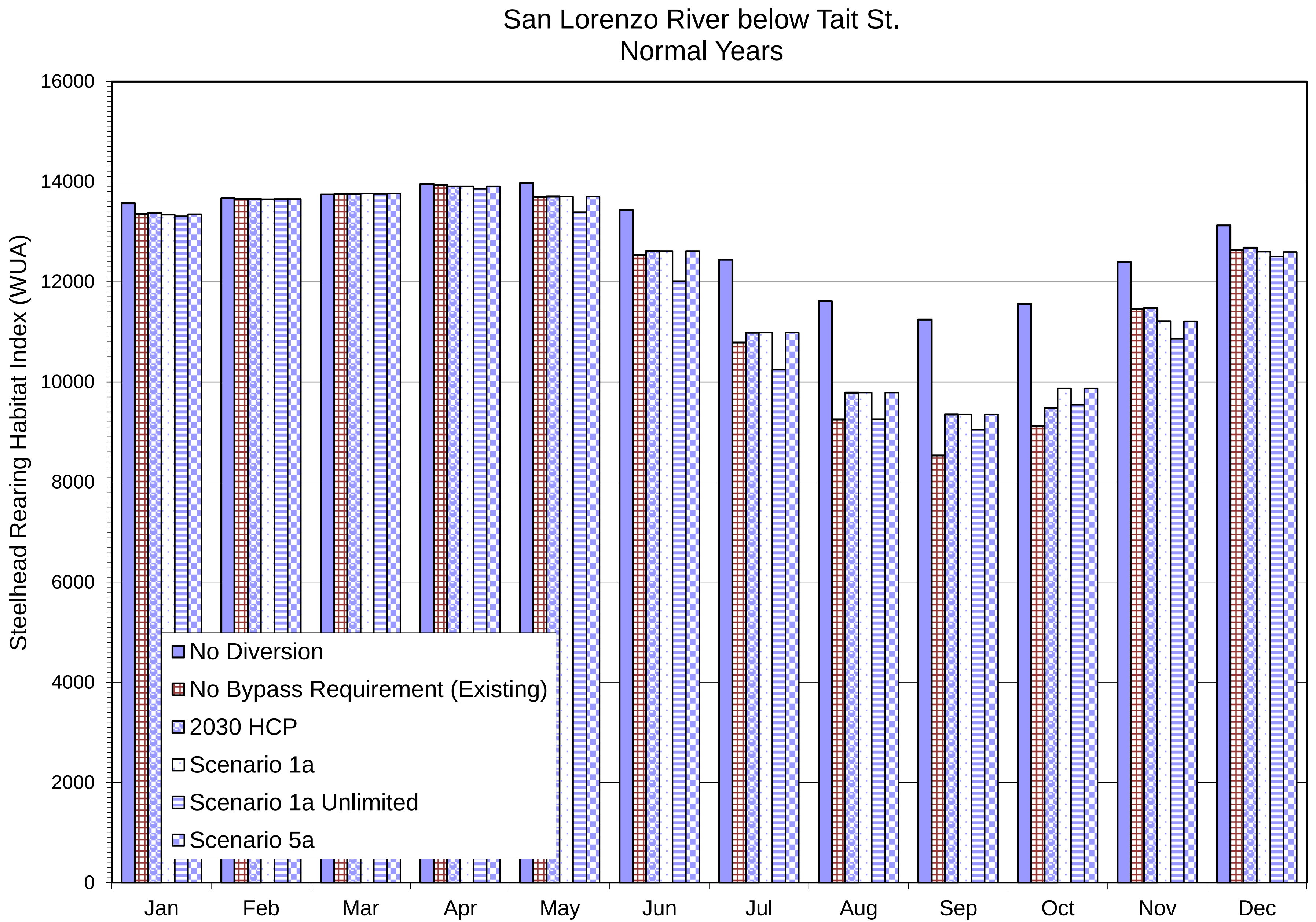


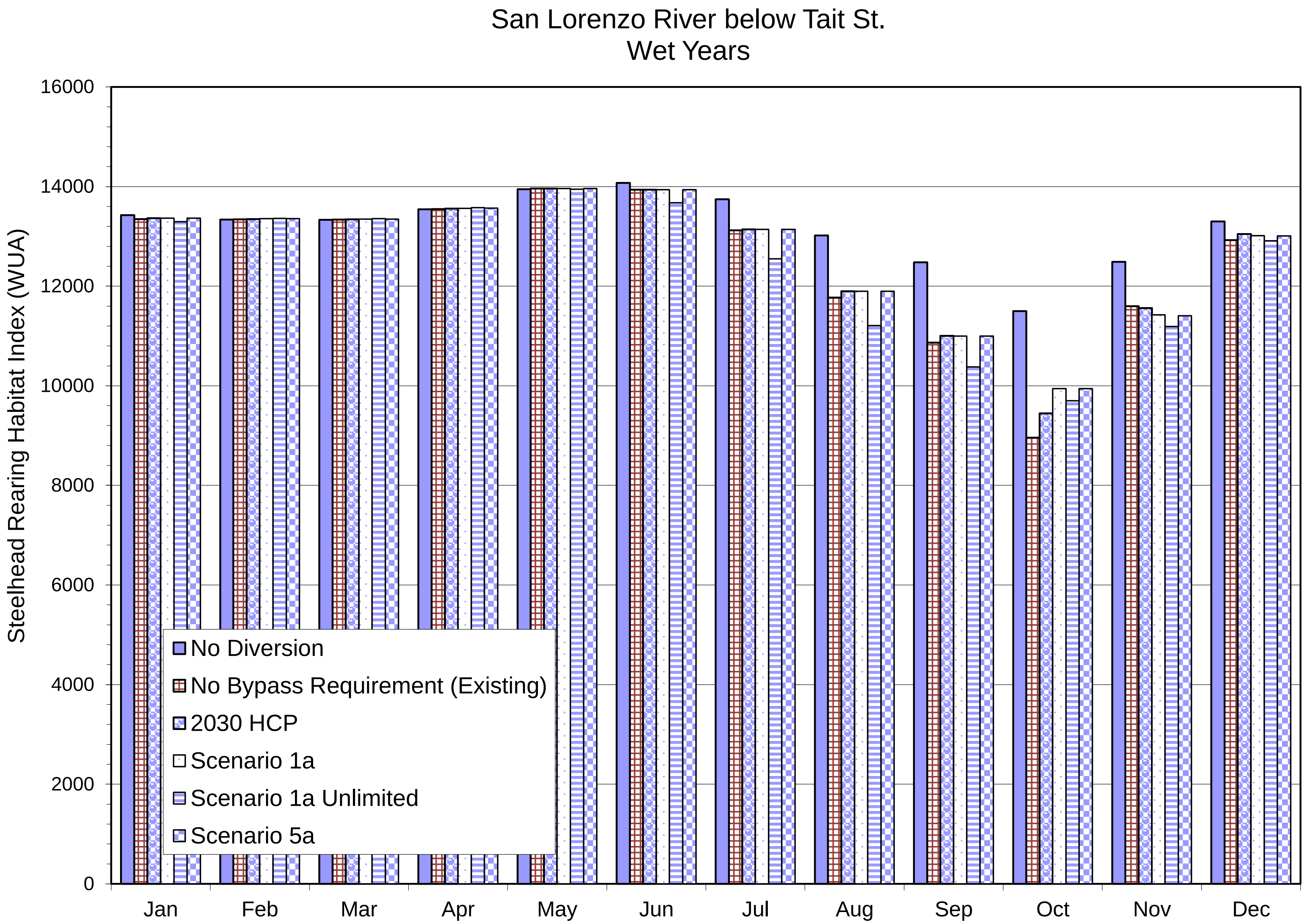

San Lorenzo River below Tait St.
Smolt
Average Annual Days Meeting Migration Criteria
35
30
25
20
15
10
5
0
Without Diversion
No Bypass Requirement (Existing)
HCP 2030 II/III
Scenario 1a
Scenario 1a Unlimited
Scenario 5a
Jan
Feb
Mar
Apr
May
Wet
Normal
Dry
Critical

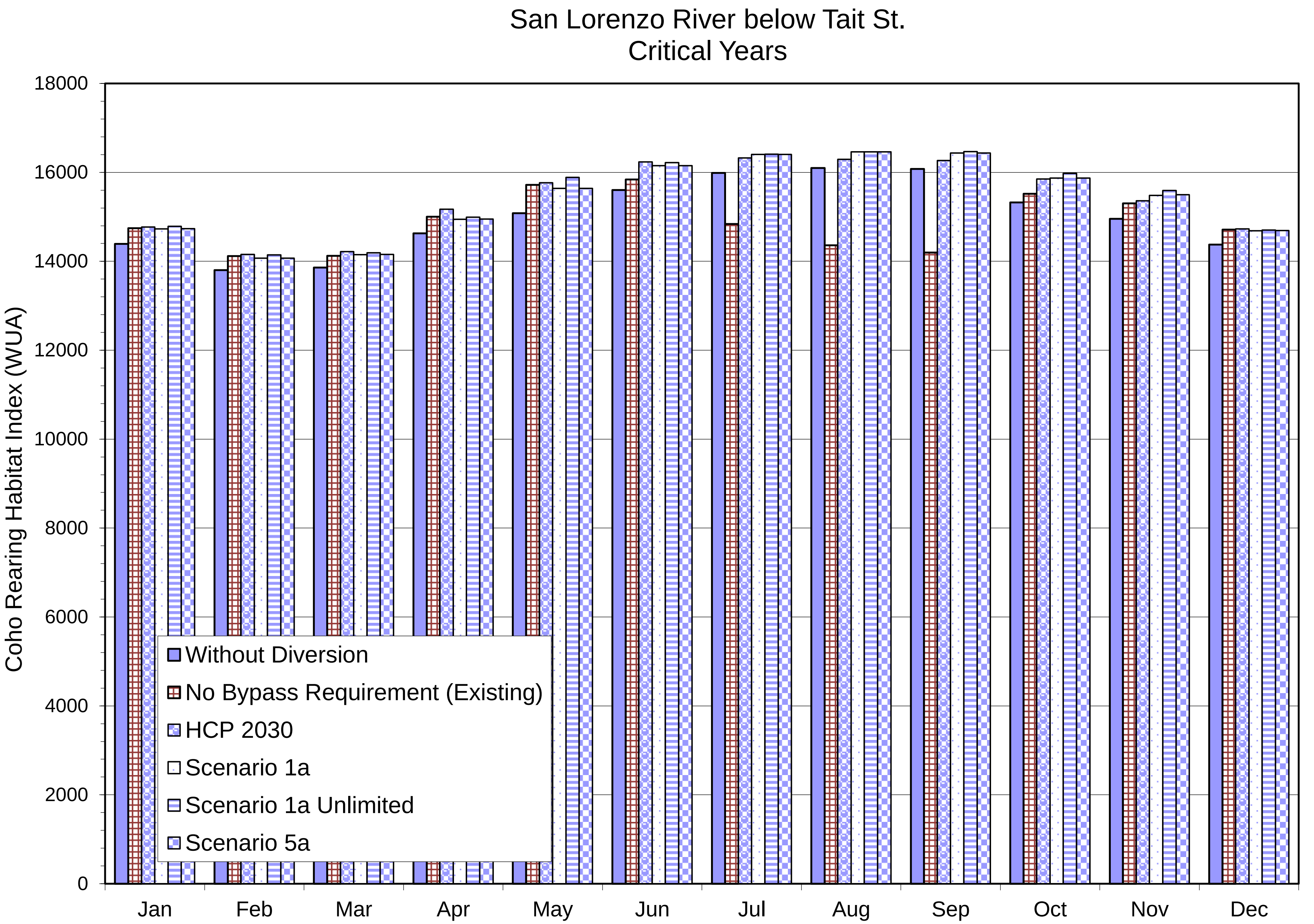

San Lorenzo River below Tait St.
Coho Adult
Average Annual Days Meeting Migration Criteria
35
30
25
20
15
10
5
0
Without Diversion
No Bypass Requirement (Existing)
HCP 2030 II/III
Scenario 1a
Scenario 1a Unlimited
Scenario 5a
December
January
Dec
Jan
Dec
Jan
Dec
Jan
Wet
Normal
Dry
Critical

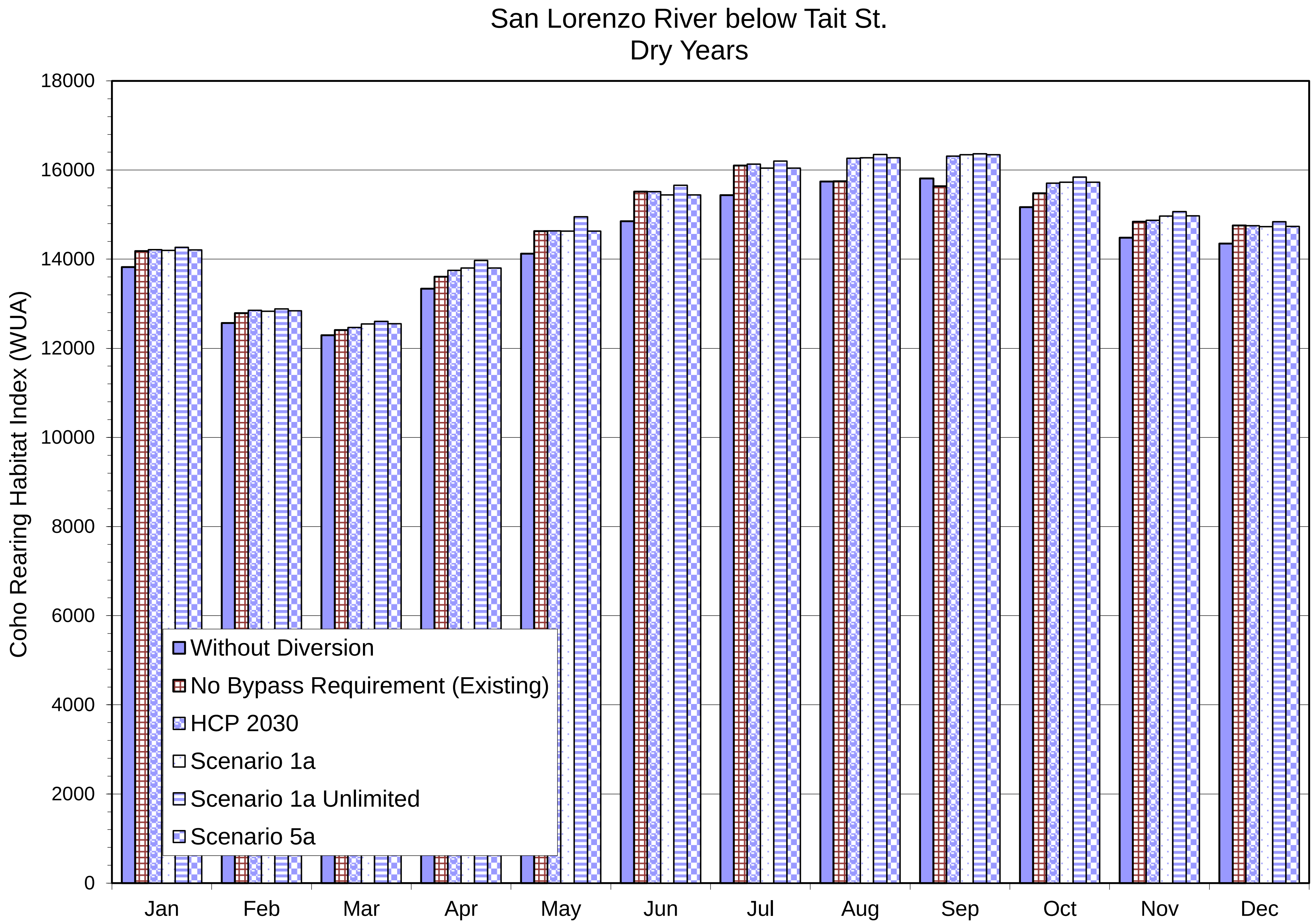

San Lorenzo River below Tait St.
Critical Years
Steelhead Rearing Habitat Index (WUA)
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
No Diversion
No Bypass Requirement (Existing)
2030 HCP
Scenario 1a
Scenario 1a Unlimited
Scenario 5a

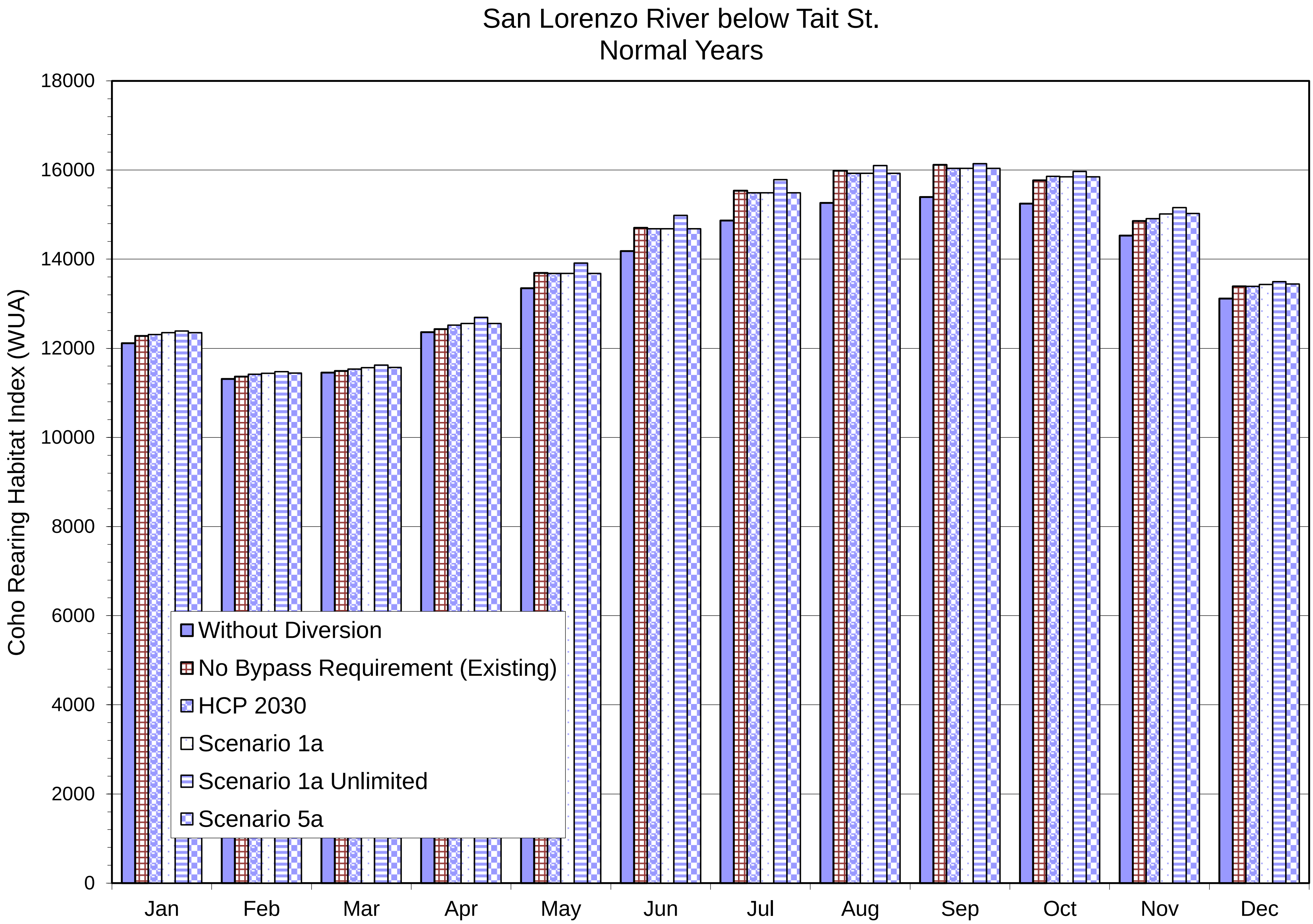

San Lorenzo River below Tait St.
Dry Years
Steelhead Rearing Habitat Index (WUA)
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
No Diversion
No Bypass Requirement (Existing)
2030 HCP
Scenario 1a
Scenario 1a Unlimited
Scenario 5a

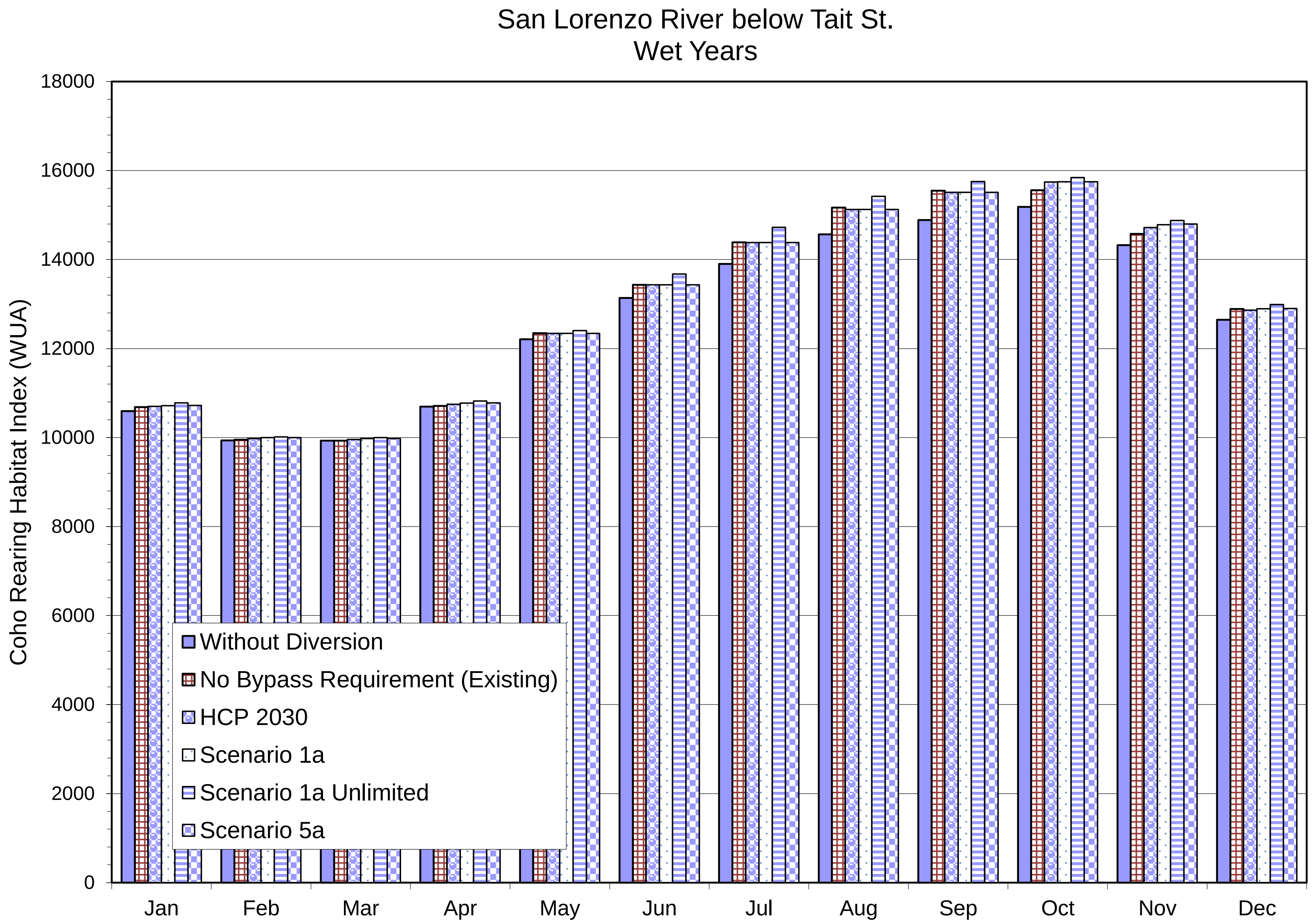

San Lorenzo River below Tait St.
Normal Years
Steelhead Rearing Habitat Index (WUA)
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
No Diversion
No Bypass Requirement (Existing)
2030 HCP
Scenario 1a
Scenario 1a Unlimited
Scenario 5a


San Lorenzo River below Tait St.
Wet Years
Steelhead Rearing Habitat Index (WUA)
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
No Diversion
No Bypass Requirement (Existing)
2030 HCP
Scenario 1a
Scenario 1a Unlimited
Scenario 5a


San Lorenzo River below Tait St.
Critical Years
Coho Rearing Habitat Index (WUA)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Without Diversion
No Bypass Requirement (Existing)
HCP 2030
Scenario 1a
Scenario 1a Unlimited
Scenario 5a


San Lorenzo River below Tait St.
Dry Years
Coho Rearing Habitat Index (WUA)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Without Diversion
No Bypass Requirement (Existing)
HCP 2030
Scenario 1a
Scenario 1a Unlimited
Scenario 5a


San Lorenzo River below Tait St.
Normal Years
Coho Rearing Habitat Index (WUA)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Without Diversion
No Bypass Requirement (Existing)
HCP 2030
Scenario 1a
Scenario 1a Unlimited
Scenario 5a


San Lorenzo River below Tait St.
Wet Years
Coho Rearing Habitat Index (WUA)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Without Diversion
No Bypass Requirement (Existing)
HCP 2030
Scenario 1a
Scenario 1a Unlimited
Scenario 5a

APPENDIX B – Yield Modelling

CONJUNCTIVE USE AND WATER TRANSFERS – PHASE II (TASK 6)

Proposition 84

Department of Water Resources

Integrated Regional Water Management Planning Grant

Northern Santa Cruz County Integrated Regional Water Management

Agreement No. 4600009400

May 2015

Prepared by:

Santa Cruz County Environmental Health Services

Submitted to:

Regional Water Management Foundation

Department of Water Resources

Appendix B – Yield Modeling

- Fiske, Water Transfer Project: Long-Term Analysis Scenario 1 (June 1, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity (June 11, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 3 Technical memorandum: Potential Transfers with Unlimited Tait Street Capacity (June 20, 2013)
- Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 (Revised) (June 22, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenarios 3 and 4 (June 25, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenario 5: GHWTP Improvements (July 2, 2012)
- Fiske, Final Water Transfer Project Results Summary (July 6, 2012)
- Fiske, Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision) (May 22, 2013)
- Fiske, February 12, 2014, Volumetric Shortage Analysis for Water Transfer Project
- Akel Engineering Group, February 19, 2014, City of Santa Cruz Water Department and Soquel creek Water District Intertie Capacity Analysis

GARY FISKE AND ASSOCIATES, INC.
Water Resources Planning and Management

Date: June 1, 2012
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Water Transfer Project: Long-Term Analysis Scenario 1

This memo reports the results of the first of 4 scenarios to be analyzed as part of Task 2, the long-term analysis. Scenario 1 assumes current infrastructure[1] and water rights. The remaining scenarios look at various water rights and infrastructure changes.

The long-term analysis examines how much of the existing demands of the Scotts Valley, San Lorenzo Valley, and Soquel Creek Water Districts in the off-peak months (November-April) will be able to be met by surplus Santa Cruz supply in the year 2030. As in the short-term analysis, water will be transferred only on days when Santa Cruz Water Department demands are fully met. The transfers will be of volumes that can be diverted from the San Lorenzo River at the Tait Street diversion on such days.

Assumptions

Other than the assumption of unlimited treatment capacity at Graham Hill, all supply, demand, facility, and operational parameters for the City of Santa Cruz system are consistent with those used in the recent Integrated Water Plan update. Available flows are assumed to be Tier 3, as developed in the ongoing HCP negotiation process.

The intertie capacities between Santa Cruz and the other districts are assumed to be unlimited.

Monthly demands for each of the three agencies are assumed to be the five-year average of 2006-07 through 2010-11 well production.[2] The San Lorenzo Valley demands are combined with those of Scotts Valley. Throughout the remainder of this memo, these combined demands are referred to as "Scotts Valley." The demands are shown in Table 1.

Scotts Valley demands are served first. On any day, Soquel Creek Service Area 1 demand is only served if there is surplus supply after serving all of that day's Scotts Valley demand.

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[1] As discussed below, the exceptions to this are the Graham Hill Water Treatment Plant and the Soquel Creek intertie, both of which are assumed to not be capacity-limited.

[2] For Soquel Creek, these are the wells serving Service Area 1.The Soquel Creek and San Lorenzo Valley averages for the months of November-February also include actual well production for 2011-12. For Scotts Valley, the November-January averages include 2011-12.

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PHONE (503) 577-3003 • FAX (503) 327-8698 • EMAIL gary@fiske-assoc.com

Table 1. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek (SA1)
November	42.8	39.6
December	38.7	36.1
January	37.2	35.6
February	33.8	32.2
March	40.3	37.4
April	48.3	41.9
TOTAL	**241.1**	**222.7**

Averages and Distributions of Water Transfer Volumes

Table 2 shows the 2030 monthly average Scotts Valley and Soquel Creek transfers across all hydrologic years.

Table 2. 2030 Monthly Average Transfers Across All Hydrologic Years (millions of gallons)

Month	Scotts Valley Transfer Volume	Soquel Creek Transfer Volume	Total Transfer Volume
November	21.4	6.0	27.4
December	11.9	5.5	17.4
January	14.0	8.5	22.5
February	15.9	10.6	26.5
March	23.6	15.0	38.6
April	25.0	10.0	35.0
TOTAL	**111.8**	**55.6**	**167.4**

Figure 1 shows the duration curves for the annual transfers.

Table 3 shows the average transfers for each hydrologic year type, and Figures 2-5 show the transfer duration curves for each year type.

Figure 1

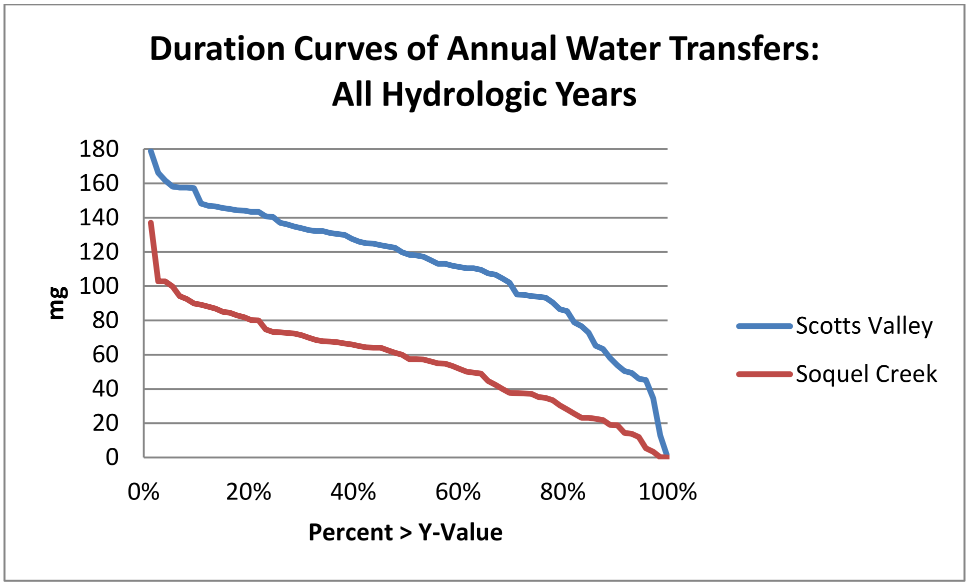


Table 3. 2030 Annual Average Transfers by Hydrologic Year Type (mg)

Year Type	Scotts Valley	Soquel Creek	Total
Critically Dry	74.5	30.7	105.2
Dry	87.7	31.4	119.1
Normal	127.9	58.2	186.1
Wet	125.3	76.7	202.0
Average	**111.8**	**55.6**	**167.4**

Figure 2

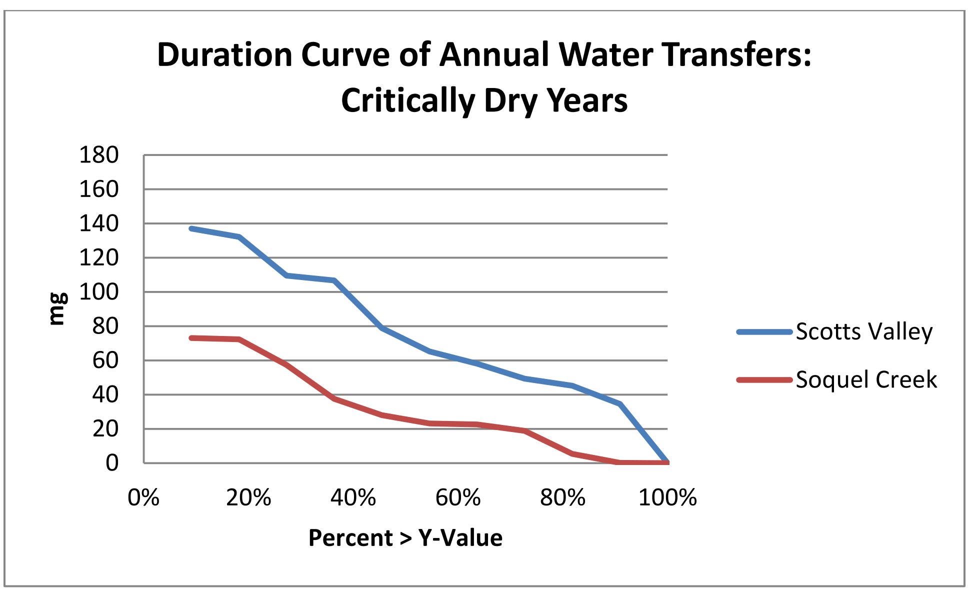


Figure 3

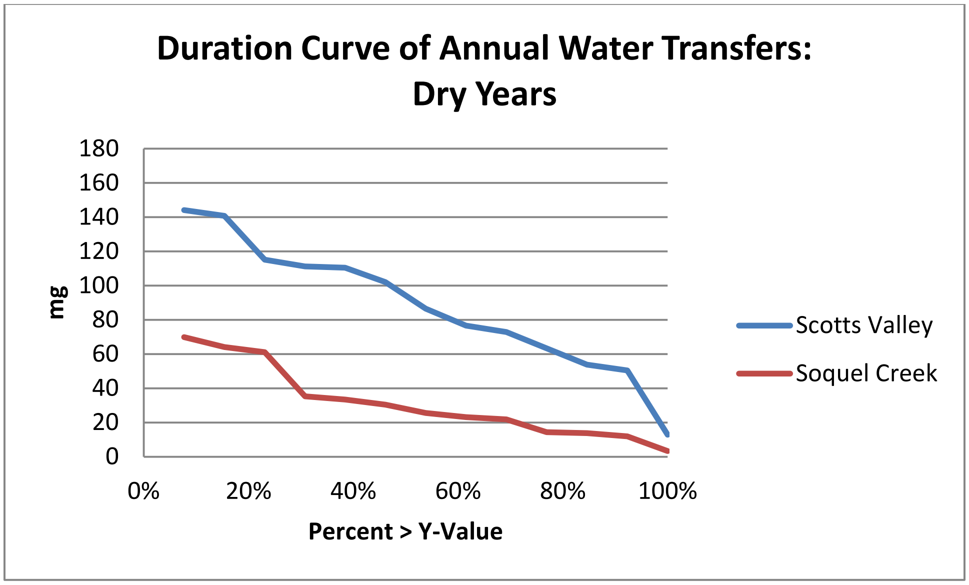


Figure 4

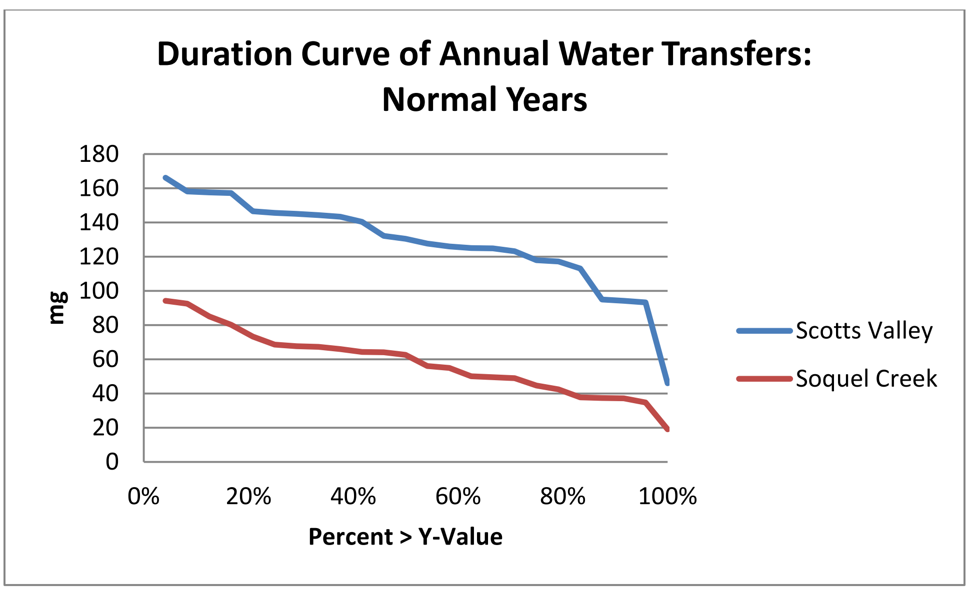
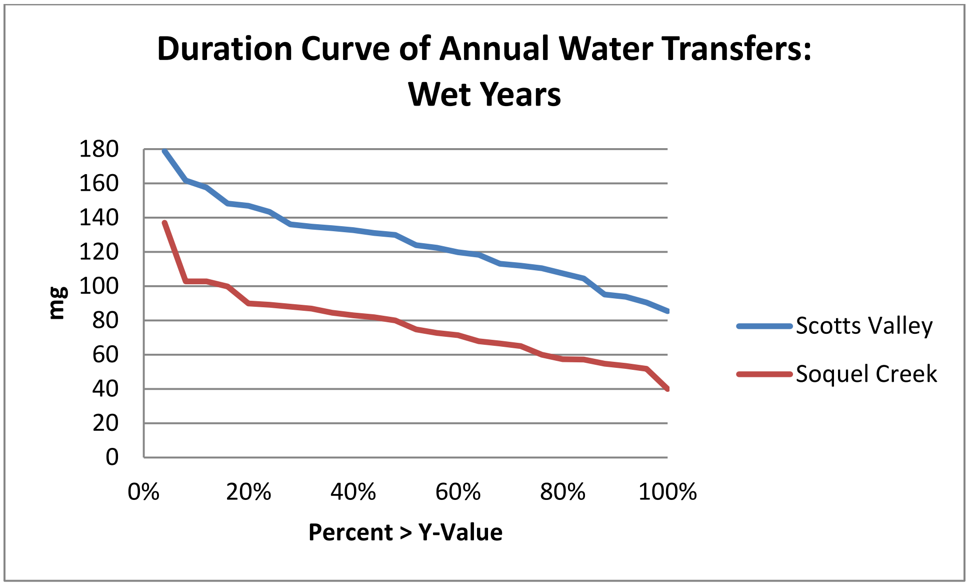


Figure 5



Source Production

Table 4 shows the monthly average added production at Tait Street required to serve Scotts Valley and Soquel Creek demands.[3]

Table 4. 2030 Monthly Average Added Production at Tait Street to Serve Scotts Valley and Soquel Creek (millions of gallons)

Month	Base	With Transfers	Added Tait St. Production
November	140.8	164.6	23.8
December	127.3	144.7	17.4
January	126.4	149.0	22.5
February	106.7	133.2	26.5
March	121.0	159.6	38.6
April	152.4	187.1	34.7
TOTAL	**774.7**	**938.2**	**163.6**

[3] As explained in the April 26 memo, the slight differences between the added Tait St production of this table and the transfer volumes of Table 2**Error! Reference source not found.** are due to local storage fill.

Surplus Supply

Given these production levels, how much surplus supply is there available at Tait Street to potentially meet other external demands? For our purposes, surplus supply on any day is defined as:

> *The excess of the maximum potential Tait Street diversion over the volume that has already been diverted to meet Santa Cruz, Scotts Valley, and Soquel Creek demands. The maximum potential diversion is the minimum of the available flow at Tait Street and the capacity of the Tait Street diversion (11.52 cfs). On days when there are no turbidity constraints at Tait St., the available flow at Tait Street is the Tier 3 Big Trees flow less the diversion at Felton plus the Tier 3 tributary inflows between Felton and Tait Street. On days when Tait St. is shut down due to turbidity, the Tait St. available flow is zero.*

Based on this definition, Table 5 shows the expected November-April surplus supply.

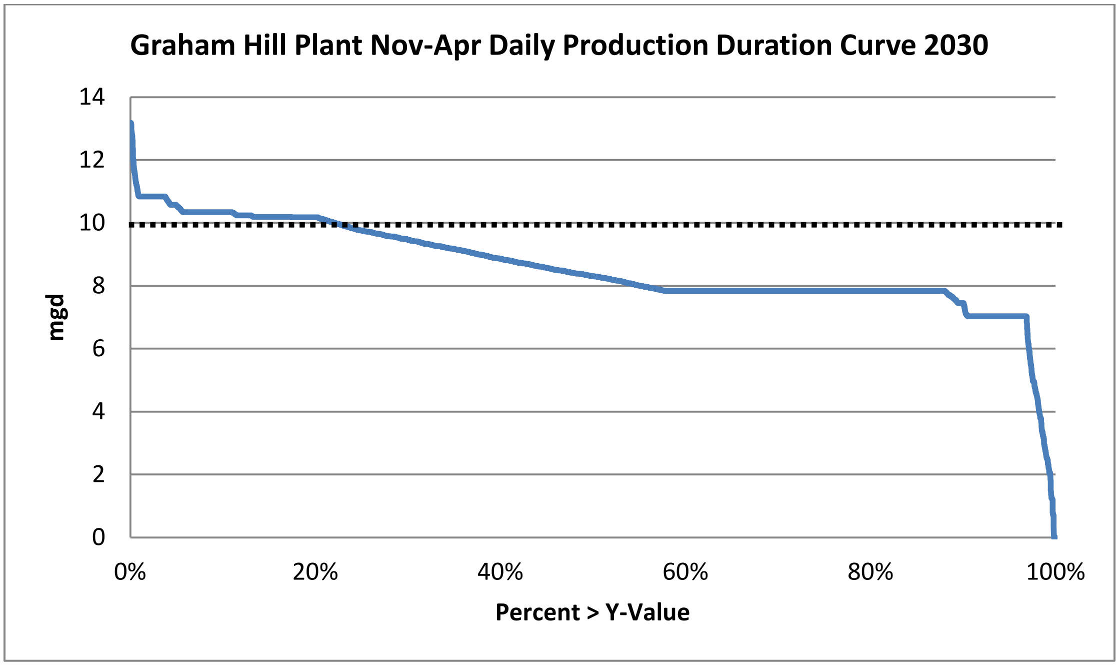
Table 5. Expected 2030 November-April Surplus Supply at Tait Street (millions of gallons)

Year Type	Surplus Supply
Critically Dry	14
Dry	18
Normal	44
Wet	83
Average	**48**

Treatment Plant Capacity Requirements

Figure 6 shows the duration curve of the Graham Hill treatment plant production required to accomplish the transfers depicted in the tables and charts above.

Figure 6



The chart shows that treatment plant usage exceeds the current 10 mgd capacity on approximately 20% of days. The key question is the extent to which the total 167 mg average annual transfer shown in Table 2 is reduced due to this constraint. It turns out that the expected annual transfer is reduced by about 9% to 151 mg. Put another way, an investment in treatment plant expansion would, at most, result in added annual transfers of about 16 million gallons.

Transmission Capacity Requirements

Figure 7 shows the duration curve for the transmission loadings to move water from the treatment plant to yield the combined transfer volumes discussed above. Figure 8 shows the duration curve for the transmission loadings to Scotts Valley, while Figure 9 shows the loadings to Soquel Creek.[4]

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[4] The duration curve in Figure 7 is less than the sum of the two district-specific curves due to the non-coincidence of the daily demands.

Figure 7

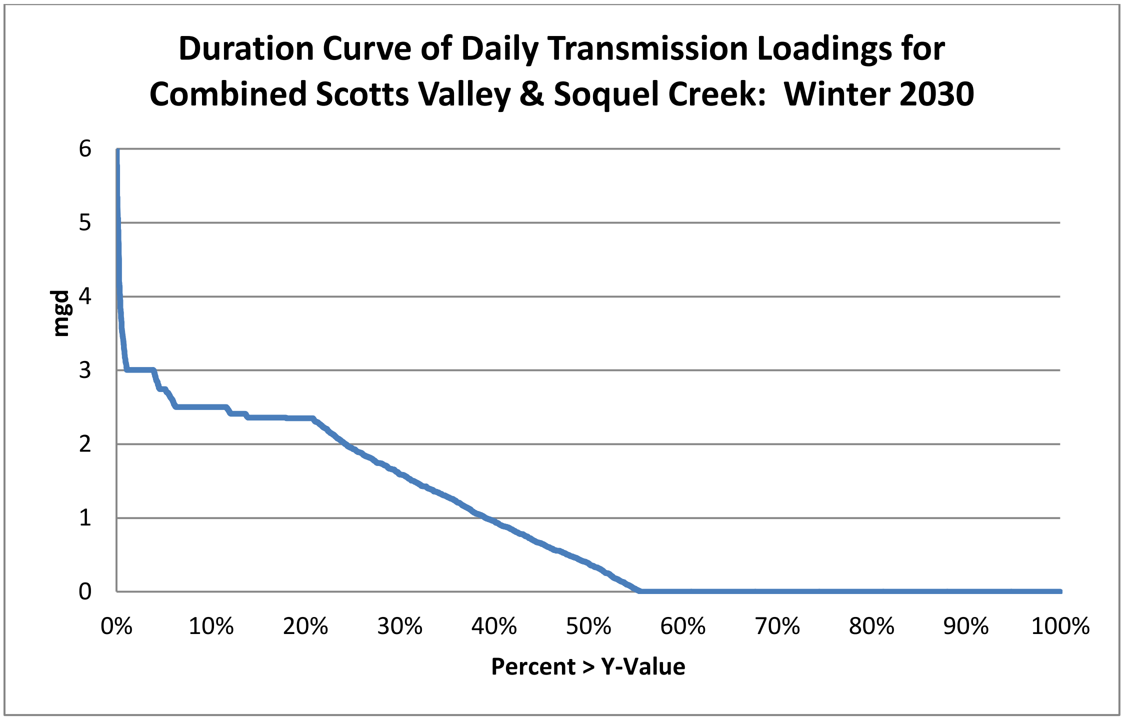


Figure 8

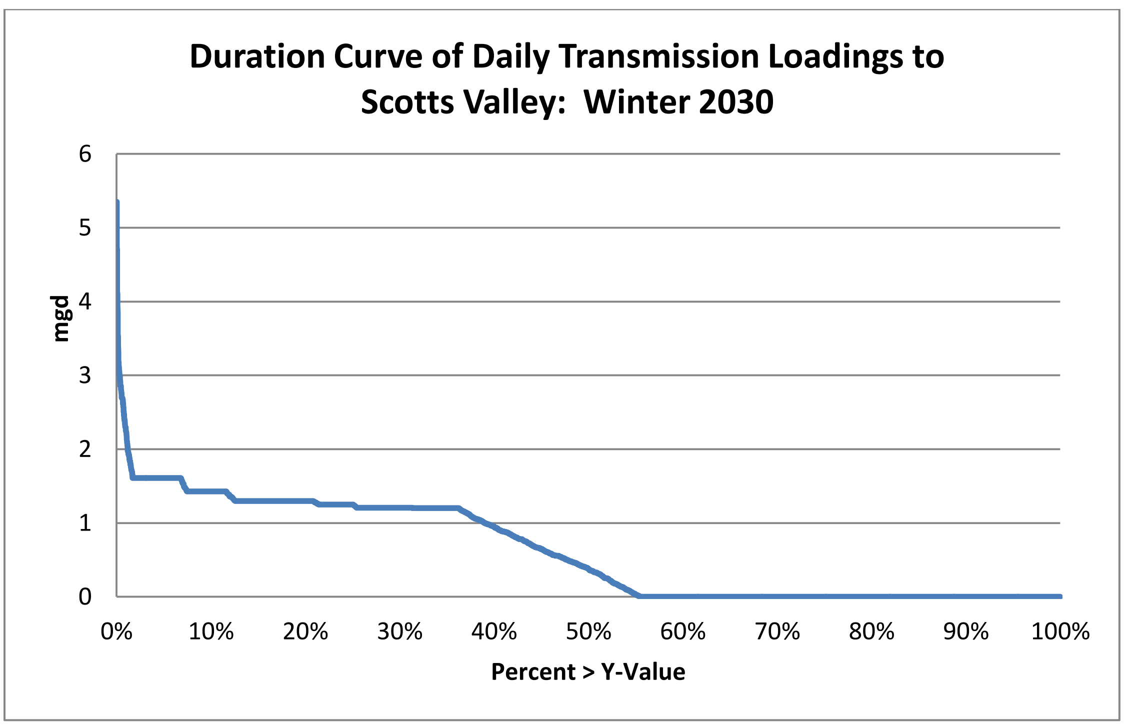
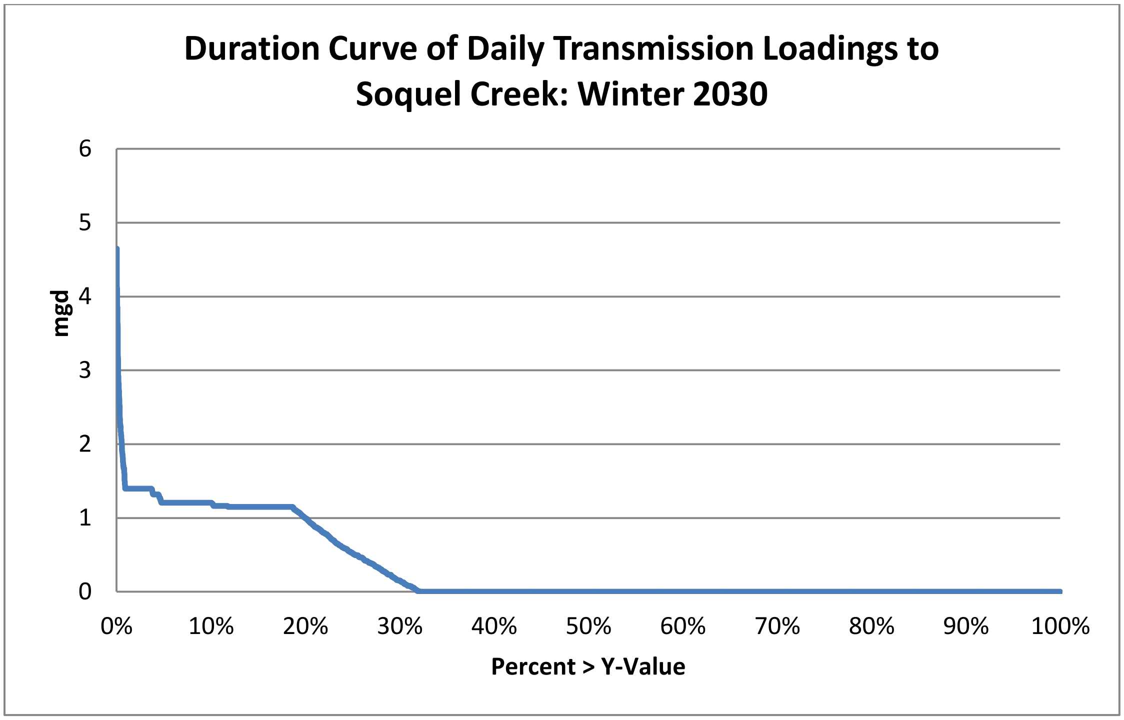


Figure 9


Duration Curve of Daily Transmission Loadings to Soquel Creek: Winter 2030
mgd
6
5
4
3
2
1
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent > Y-Value

GARY FISKE AND ASSOCIATES, INC.
Water Resources Planning and Management

Date: June 11, 2013
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity

This memorandum reports on the results of the Task 2 analysis. Task 2 breaks down the utilization of the current 7.44 mgd Tait Street diversion into off-peak season production to serve Santa Cruz Water Department demands and to serve district transfers. The results that follow are all based on Scenario 1a (current infrastructure and water rights) and Tier 3 available flows.

Tait Street Production: All Hydrologic Years

Figures 1-5 show duration curves of daily Tait St. production in the off-peak months (November-April) over all years of the 73-year hydrologic record. Each figure shows the distribution of daily production required to serve the different demands as follows:

- Figure 1: Santa Cruz Water Department (SCWD) only
- Figure 2: SCWD demand plus both districts
- Figure 3: Both districts only
- Figure 4: Scotts Valley only
- Figure 5: Soquel Creek only

Note that the curves are not additive because of non-coincidence.

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Figure 1

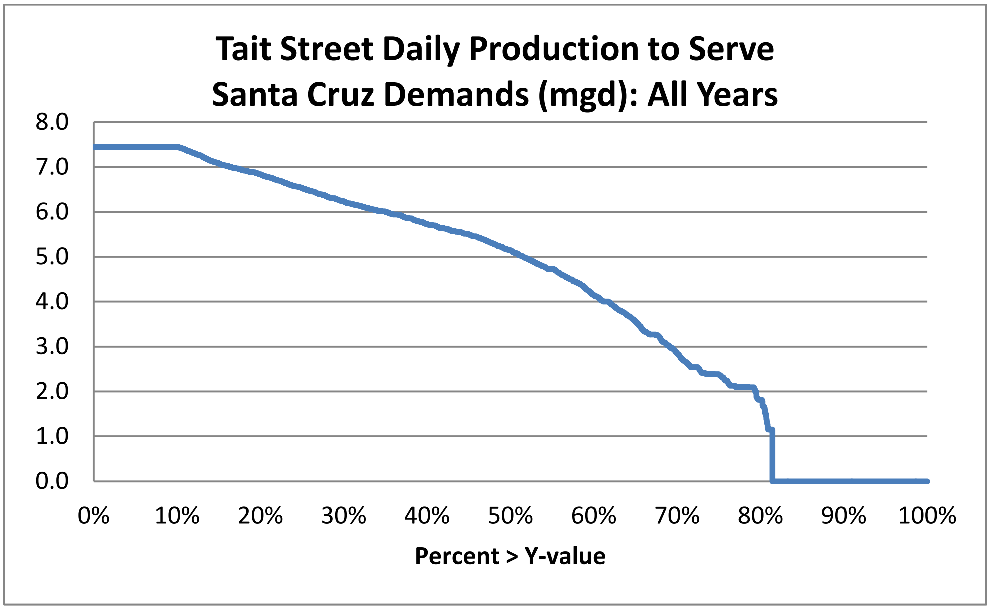


Figure 2

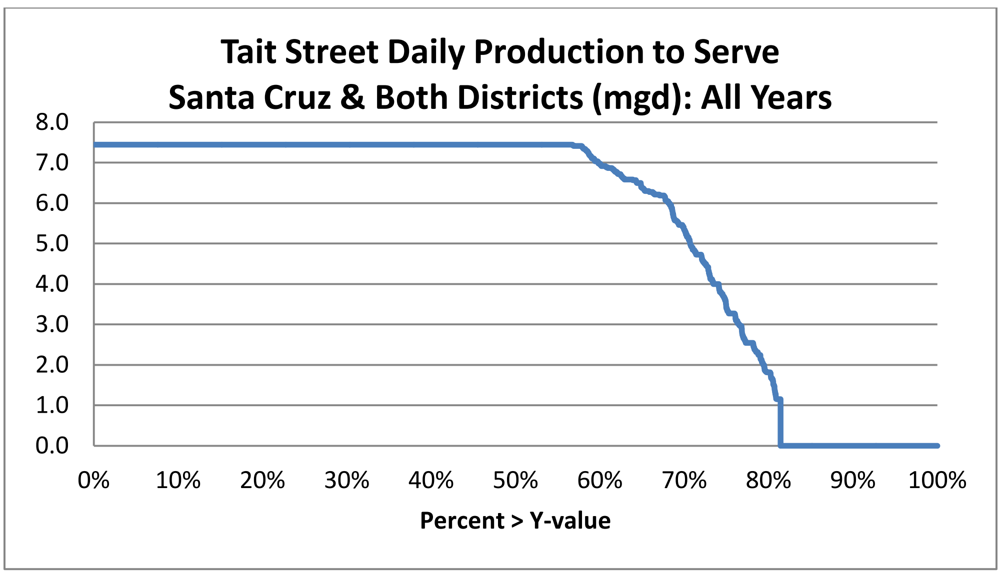


Figure 3

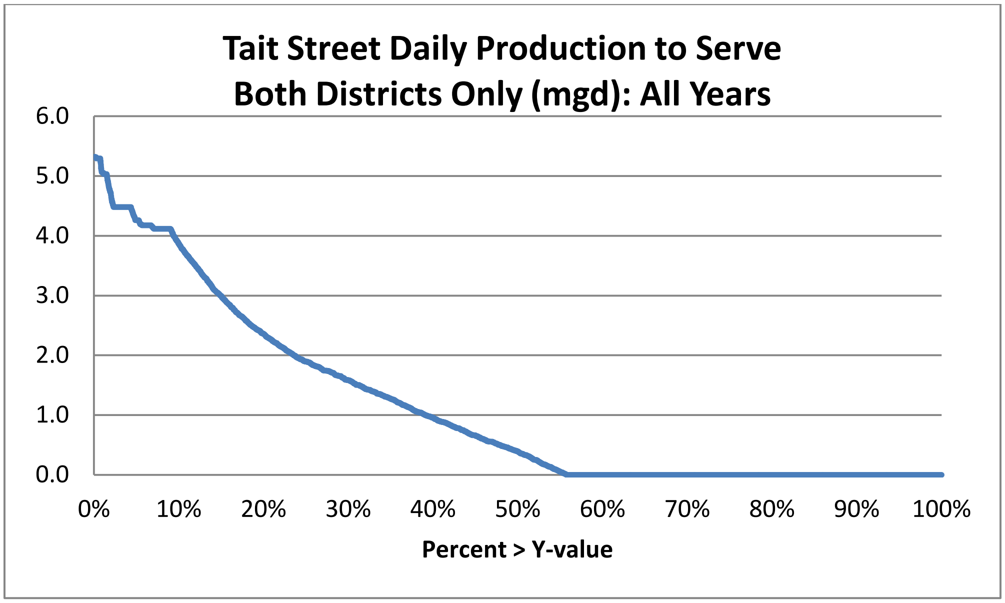


Figure 4

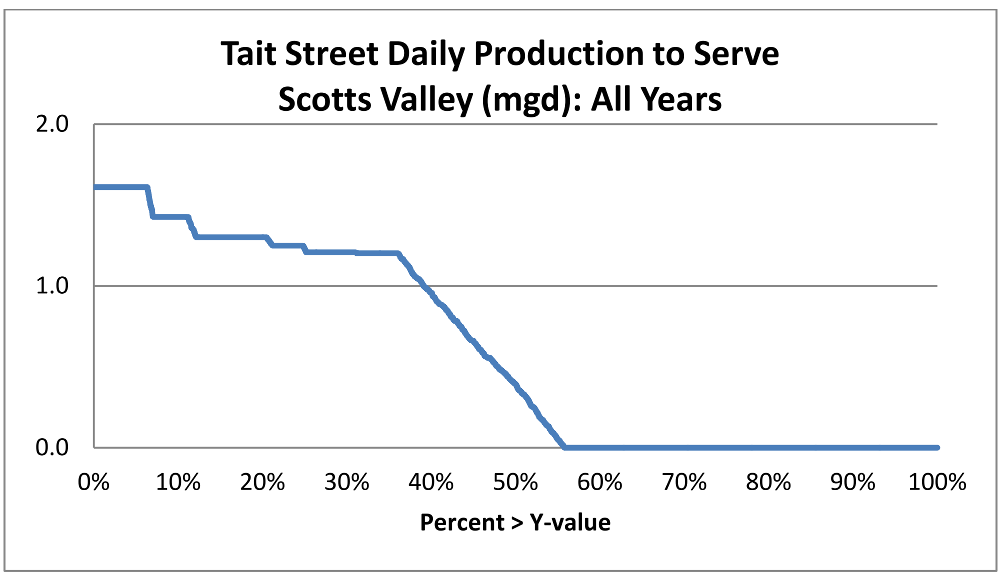
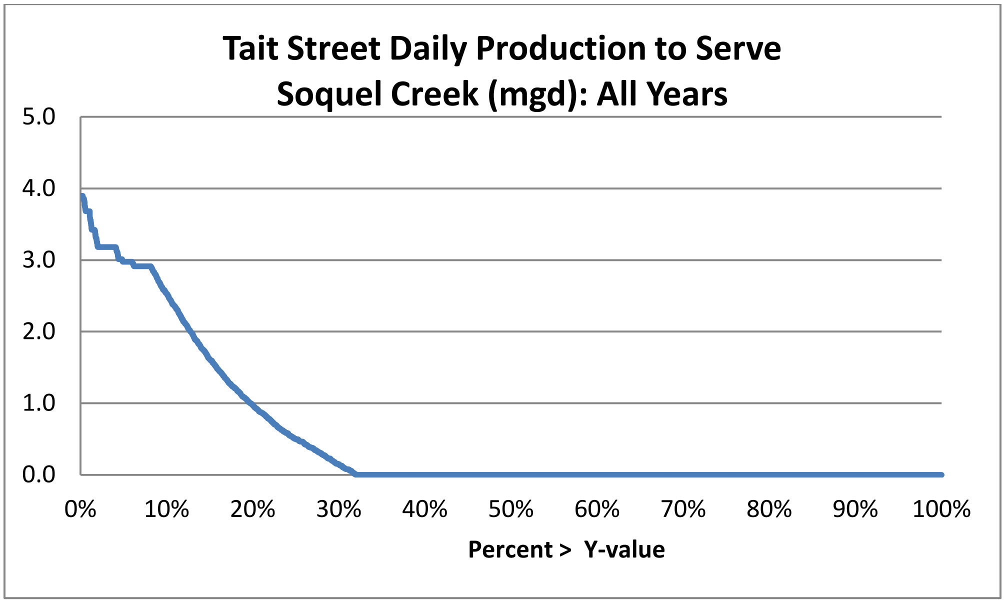


Figure 5



One thing that stands out from the above charts is that, while Tait Street operates at full capacity on only about 10% of the winter days if only Santa Cruz demand must be served, that figure shoots up to 57% if water is also being transferred to the districts. This suggests that transfers are constrained by the current Tait capacity and could be increased if that capacity was increased. This issue will be explicitly addressed in Task 3.

In addition, with current Tait capacity, no Scotts Valley demand is served on 45% of days; for Soquel Creek, that figure rises to 68%.

Tait Street Production by Year Type

This section presents charts that compare the distributions of off-peak season Tait daily production for each of the four hydrologic year types.

Figure 6

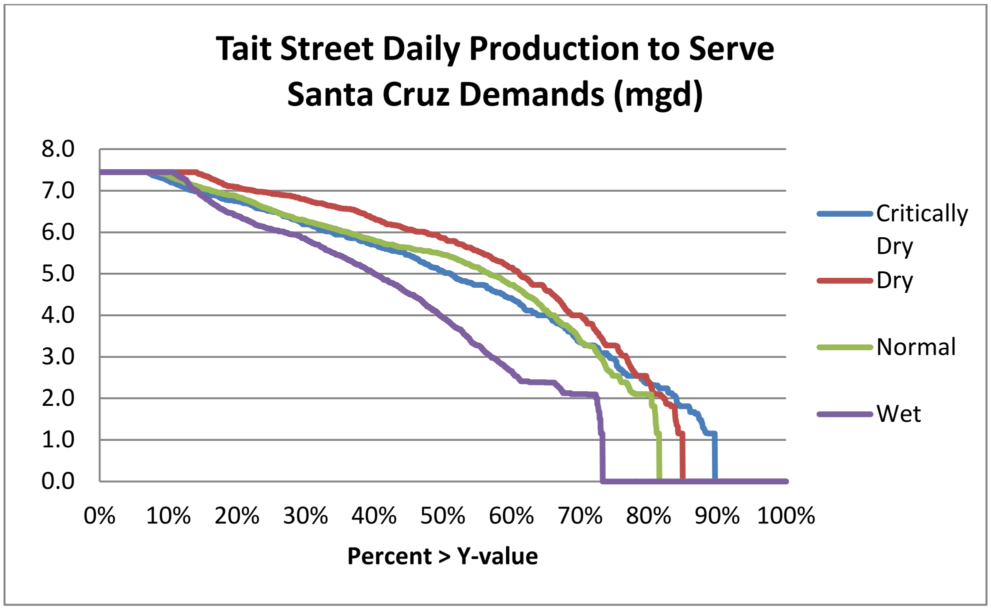


Figure 7

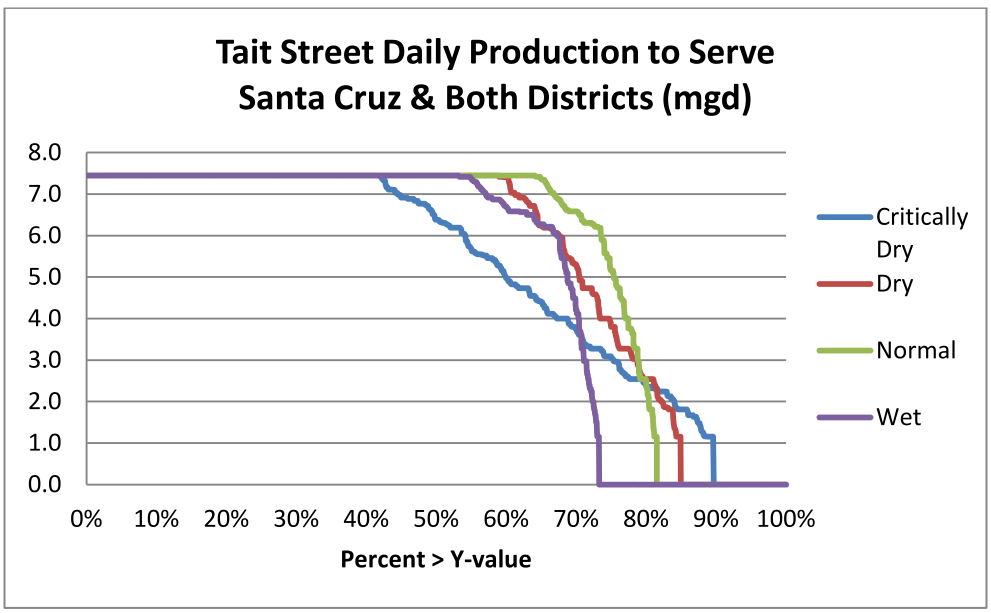


Figure 8

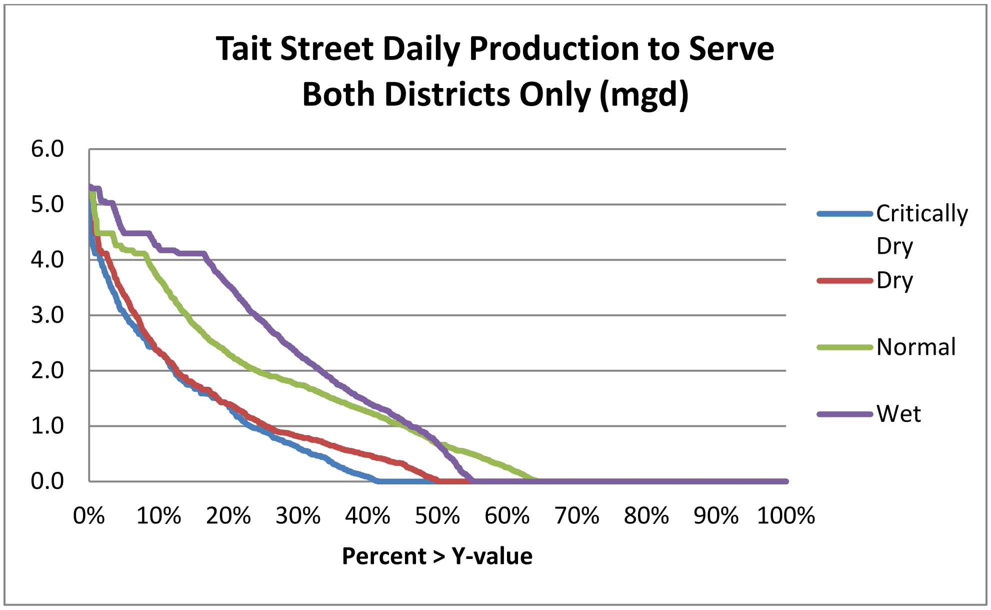


Figure 9

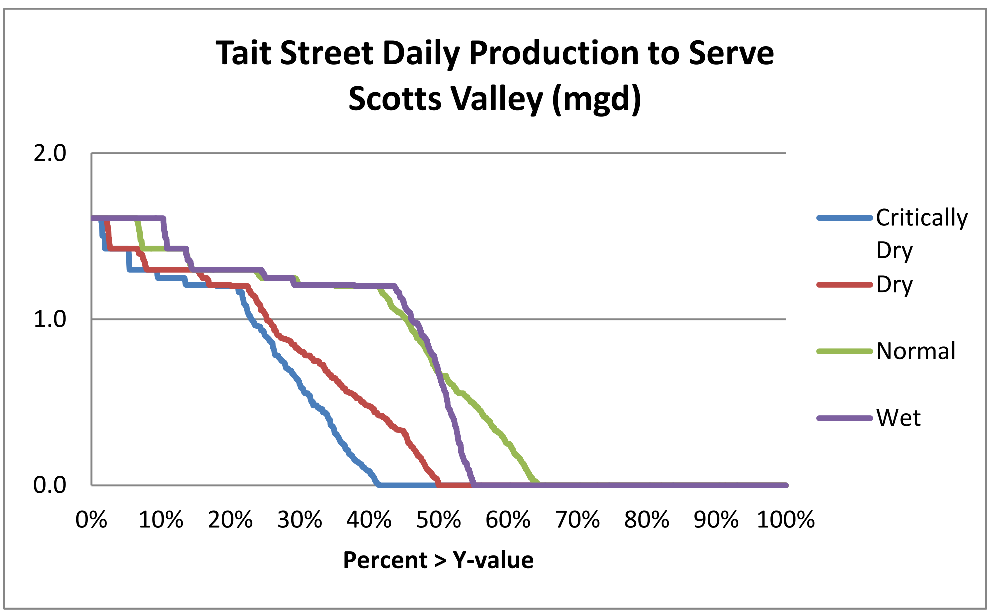
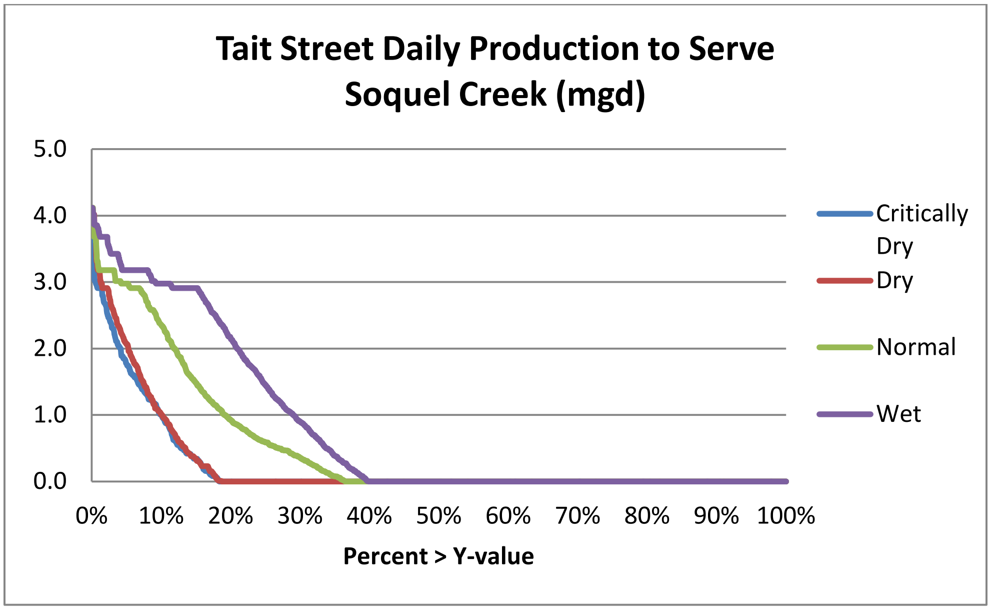


Figure 10



The patterns are similar to what we see in Figures 1-5. It is, however, interesting to compare the year-type distributions as we move from serving only Santa Cruz demands (Figure 6) through the other figures. When only Santa Cruz demands are being served, Tait production is smallest in wet years because more demand is met from the North Coast supplies. As the charts incorporate district demands, which can only be served from Tait, the relative position of the curves moves more toward replicating the San Lorenzo River availability in the four year types. Thus, Figure 10 shows that Soquel Creek is best served in wet years and receives the least supply in dry and critically-dry years (in 80% of those years, Soquel Creek receives no supply).

These relationships are also illustrated in Table 1, which compares the average off-peak season Tait production to serve different demands across the year types.

Table 1. Average Off-Peak Season Tait Street Production (mg)

DEMAND SERVED	HYDROLOGIC YEAR TYPE				
	Critically Dry	Dry	Normal	Wet	All
Santa Cruz Only	823	879	812	663	**775**
Santa Cruz & Both Districts	936	1010	1033	930	**979**
Both Districts Only	112	131	221	267	**204**
Scotts Valley	70	84	125	121	**108**
Soquel Creek	41	46	95	144	**95**

GARY FISKE AND ASSOCIATES, INC.
Water Resources Planning and Management

Date: June 20, 2013
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Phase 2 Water Transfer Project Draft Task 3 Technical Memorandum: Potential Transfers with Unlimited Tait Street Capacity

This memorandum reports on the results of the Task 3 analysis. Recall that Task 2 broke down the utilization of the current 7.45 mgd Tait Street diversion into production to serve Santa Cruz Water Department demands and to serve district transfers. Task 3 extends that analysis by relaxing the Tait Street capacity constraint, and examining the off-peak-season volumes that could be transferred to Scotts Valley and Soquel Creek if the capacity of the Tait Street diversion was unlimited.

This task addresses the following questions:

- If Tait Street capacity were not limited to the current level, what is the distribution of daily Tait Street production in the off-peak months (November-April) to serve Santa Cruz demands and to serve the demands of each of the two districts?

- How do these distributions differ for the four year-type categories?

- How much would the Tait Street capacity have to increase to serve the maximum possible portion of off-peak season demands of the two districts?

Note that it is assumed that, as Tait Street capacity is increased, so also are the water rights and the transmission capacity between Tait Street and the treatment plant. In addition, the current assumed 10 mgd off-peak capacity of the Graham Hill plant would also have to increase. (The final section of this memo shows the distribution of required daily treatment plant production.)

As was the case for Task 2, the results that follow all assume Tier 3 available flows.

Tait Street Production: All Hydrologic Years

Figures 1-5 compare the duration curves of daily off-peak season Tait St. production over all years of the 73-year hydrologic record to the analogous curves developed in Task 2. Each figure shows the distribution of daily production required to serve different demands as follows:

- Figure 1: Santa Cruz Water Department (SCWD) only
- Figure 2: SCWD plus both districts
- Figure 3: Both districts only
- Figure 4: Scotts Valley only
- Figure 5: Soquel Creek only

Note that the curves are not additive because of non-coincidence.

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Figure 1

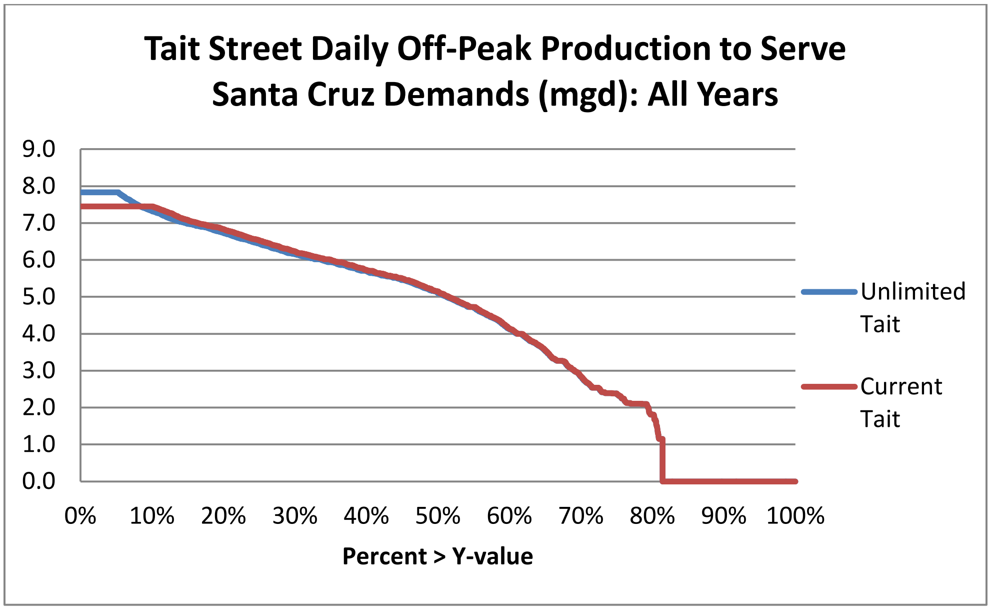


Figure 2

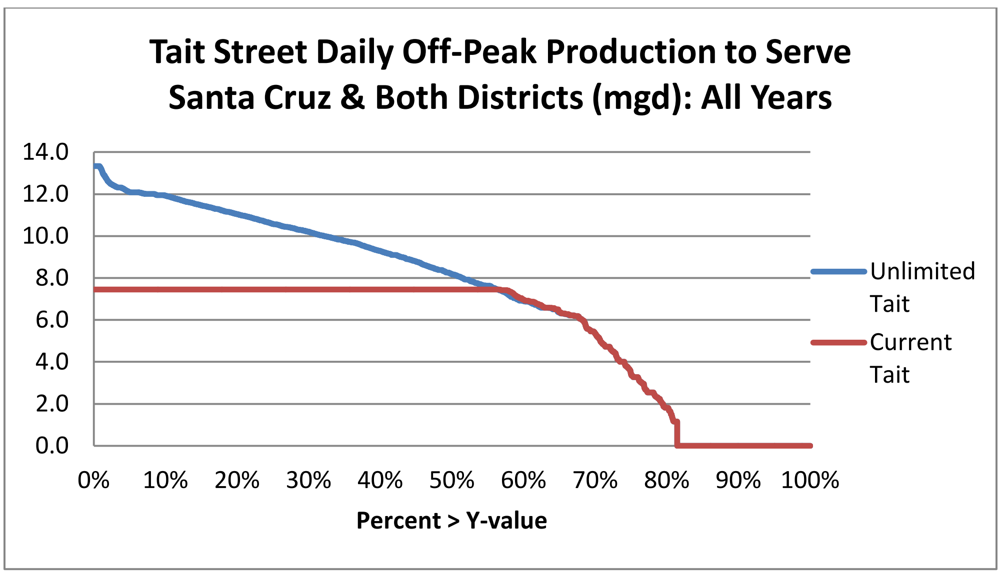


Figure 3

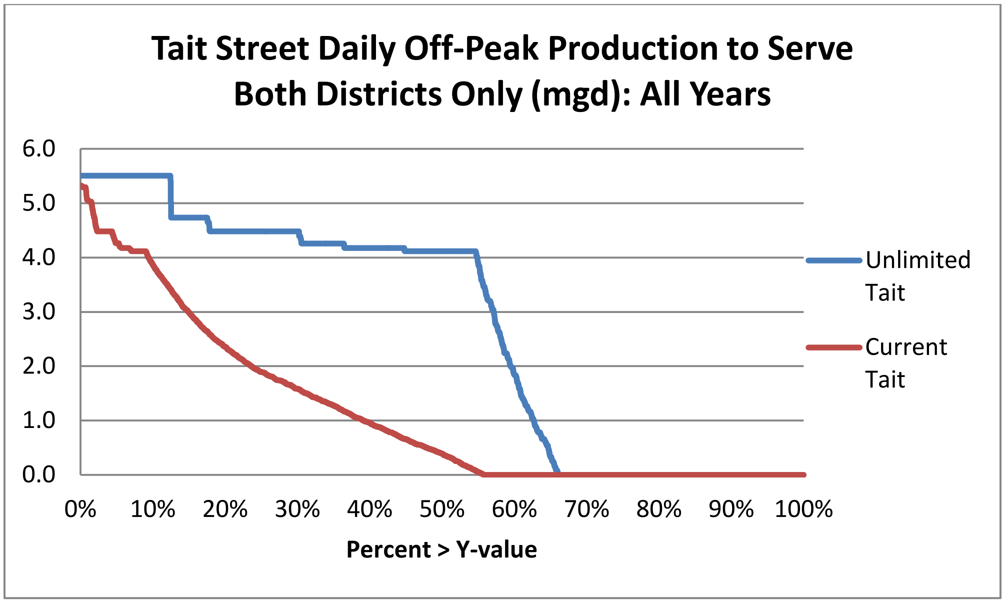


Figure 4

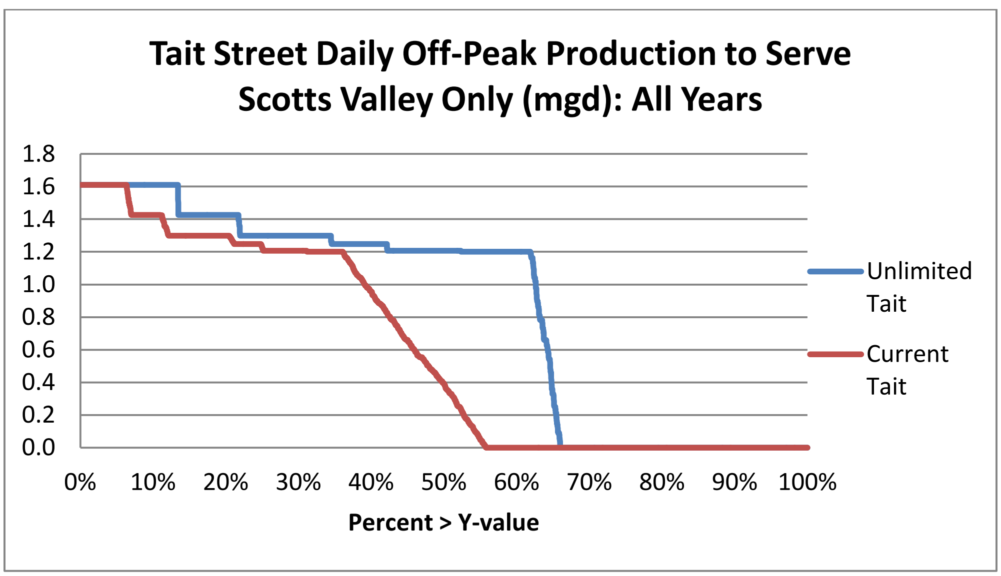
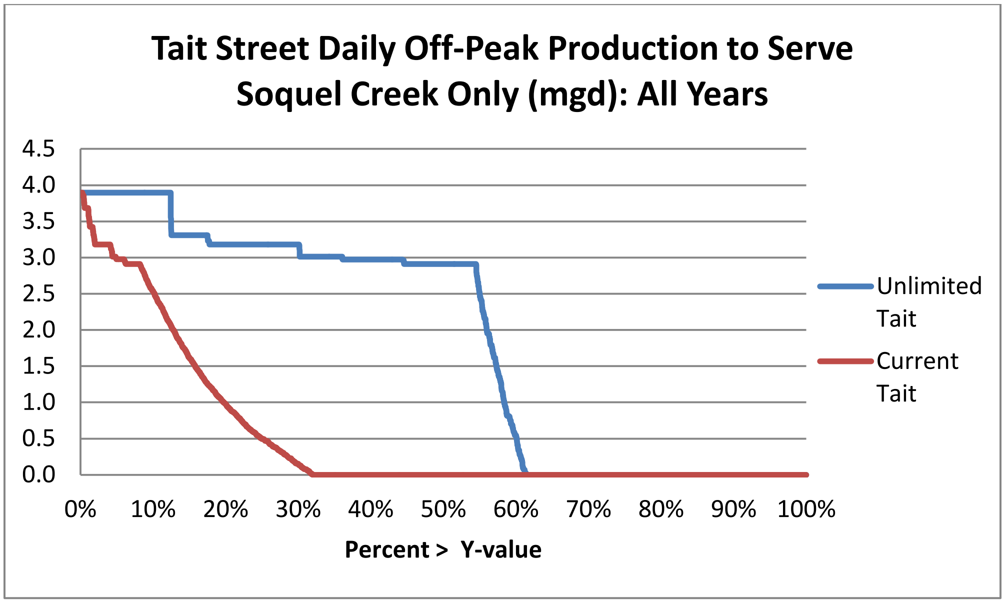


Figure 5



Added Tait Street capacity has very little impact on production to meet Santa Cruz demands. The Santa Cruz off-peak season demand in 2030 is 7.83 mgd, which is not much higher than the current 7.45 mgd capacity. Moreover, the only days on which Tait Street may produce that much are those days when there is no North Coast production.

However, added capacity at Tait Street does result in significantly higher transfer volumes. As Figure 2 shows, the Tait Street capacity would need to increase to about 13.3 mgd (20.6 cfs) to serve the maximum possible portion of district demands. The marked increase in Tait production to serve the different demands is illustrated in Table 1. The last two rows of the table also show the percent of total seasonal demand for each district that is served.

Table 1. Average Annual Tait Street Production (mg)

DEMAND SERVED	Current Tait Capacity (7.4 mgd)	Increased Tait Capacity (13.3 mgd)
Santa Cruz Only	775	778
Santa Cruz & Both Districts	979	1266
Both Districts Only	204	488
Scotts Valley	108 (45%)	154 (64%)
Soquel Creek	95 (16%)	333 (57%)

Tait Street Production by Year Type

The charts of this section compare the distributions of off-peak season Tait daily production for each of the four hydrologic year types, assuming the added Tait Street capacity. Since showing the comparable

Task 2 distributions on the same charts would render the charts unreadable, each of the Task 2 charts is displayed directly under the comparable Task 3 chart to facilitate comparison.

Figure 6 (Increased Tait Capacity)

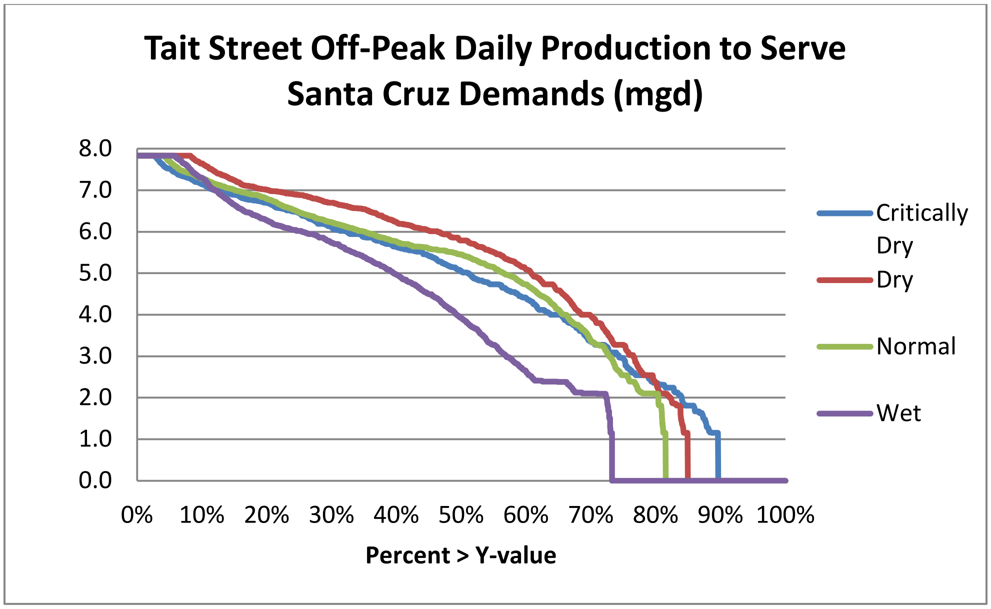


Figure 6a (Current Tait Capacity)

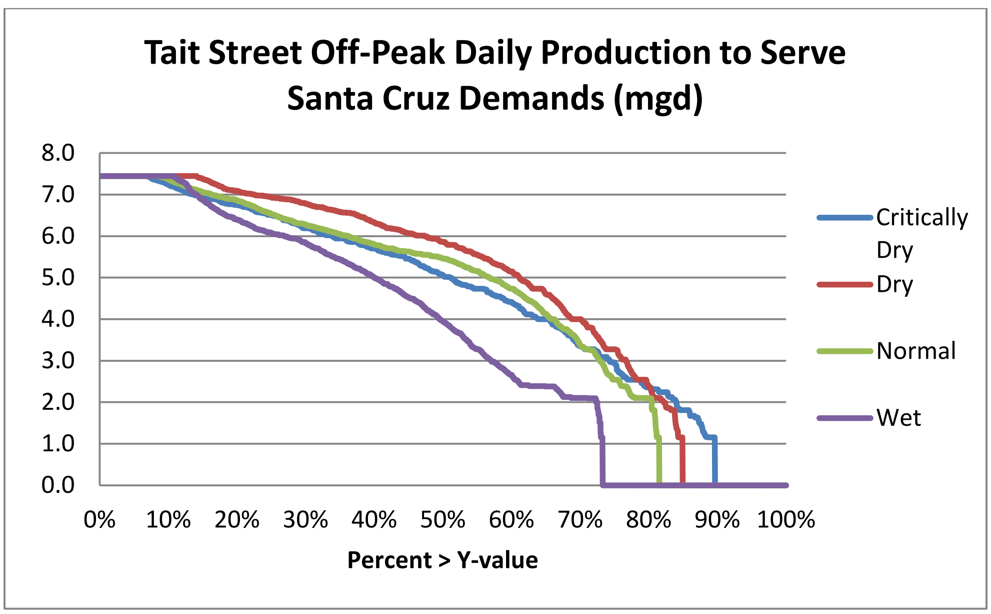


Figure 7 (Increased Tait Capacity)

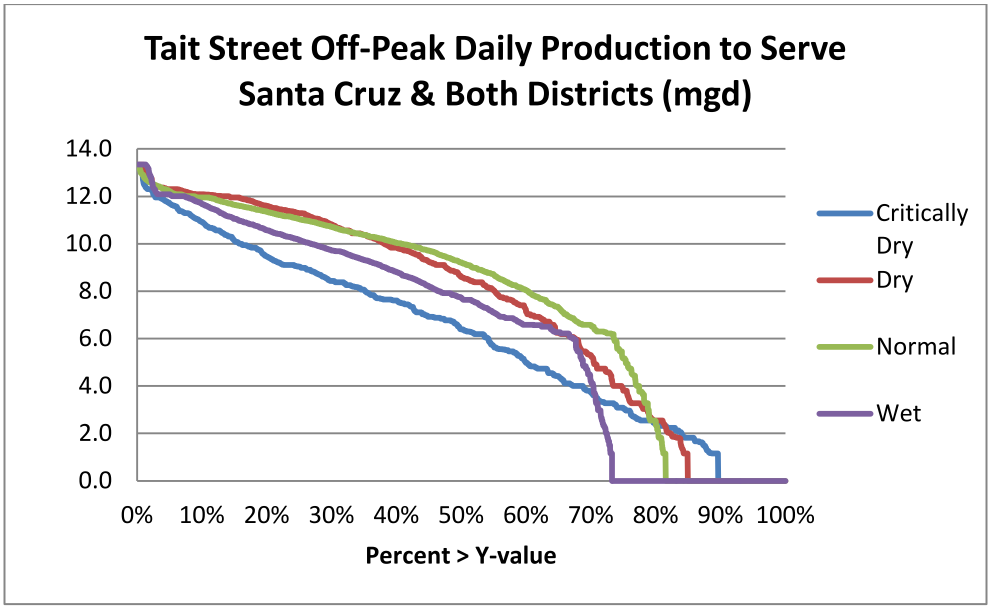


Figure 7a (Current Tait Capacity)

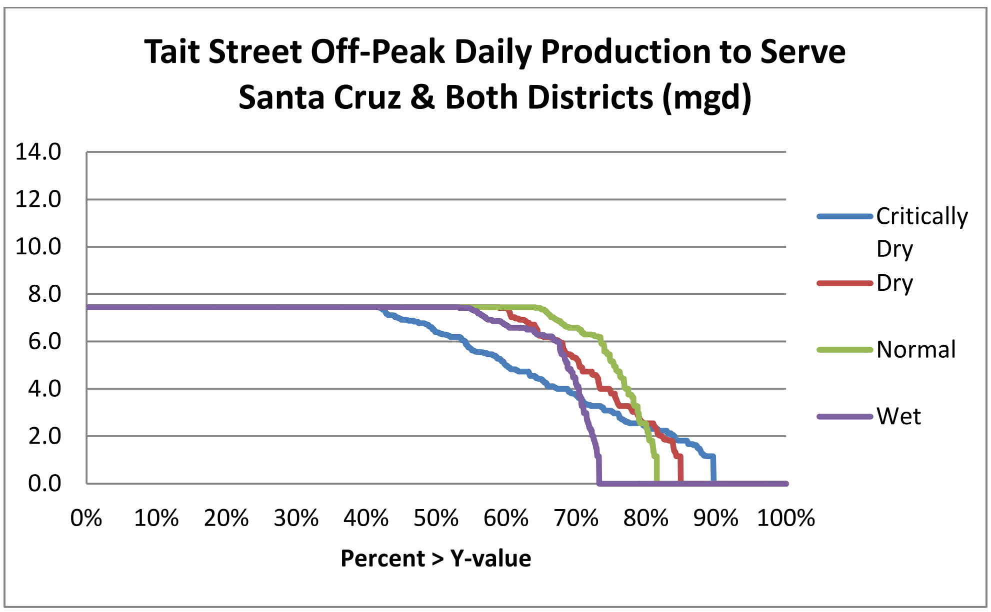


Figure 8 (Increased Tait Capacity)

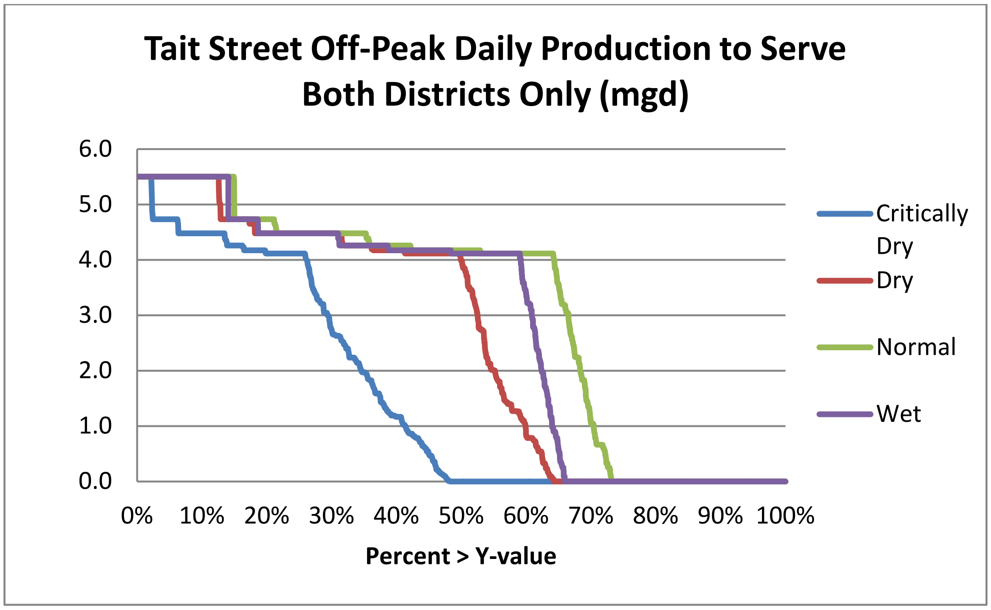


Figure 8a (Current Tait Capacity)

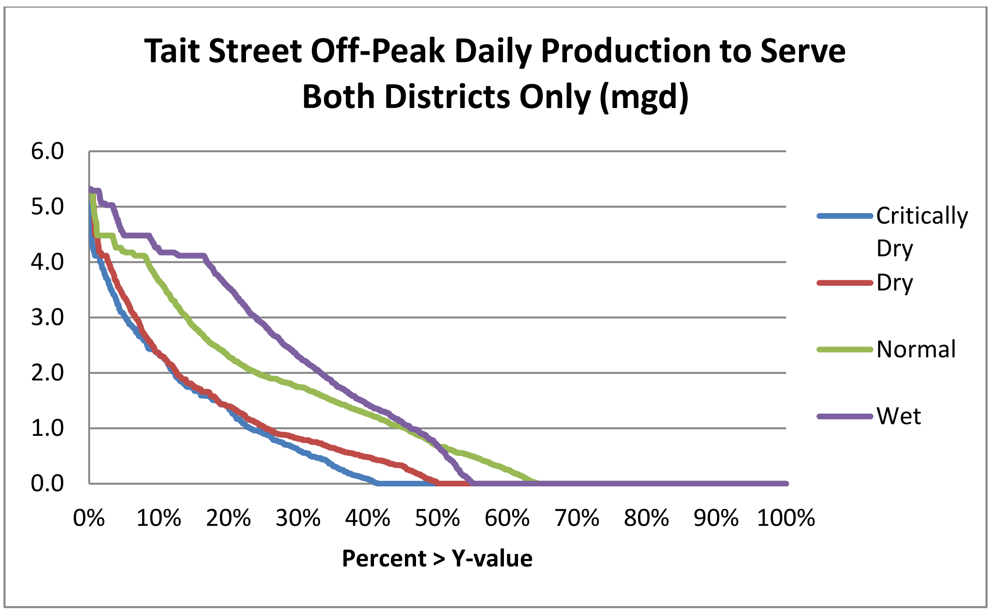


Figure 9 (Increased Tait Capacity)

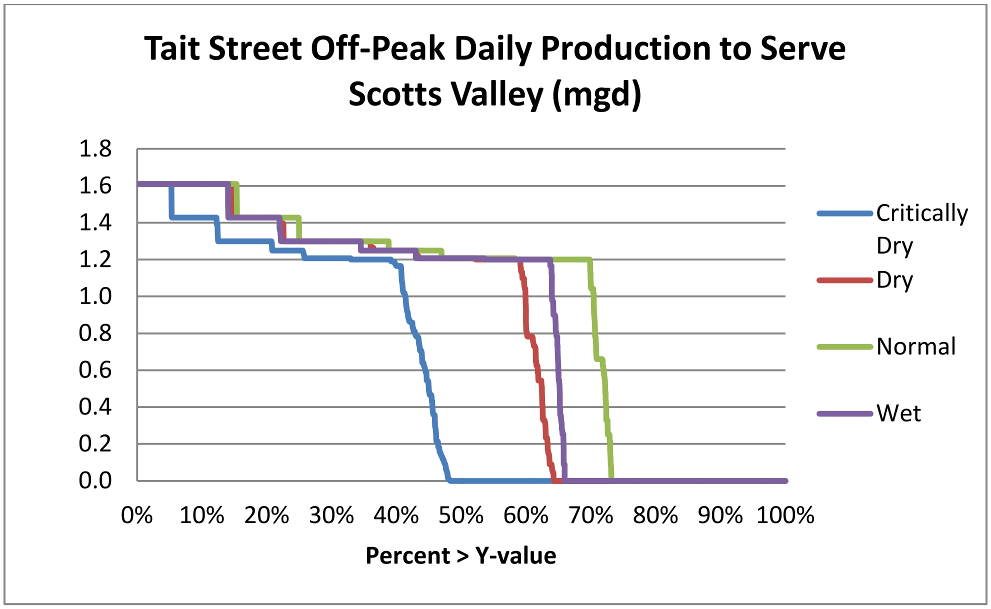


Figure 9a (Current Tait Capacity)

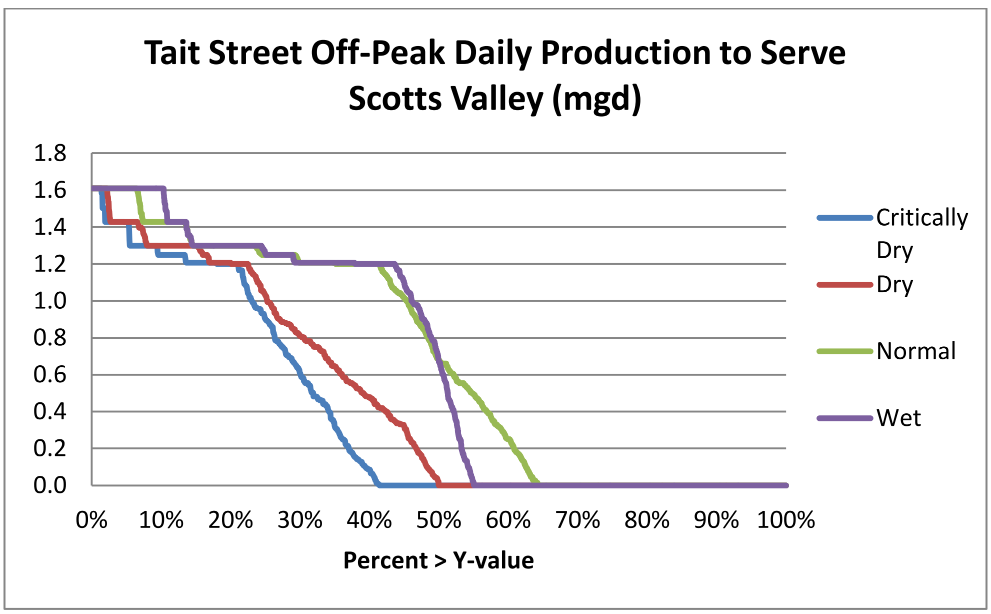


Figure 10 (Increased Tait Capacity)

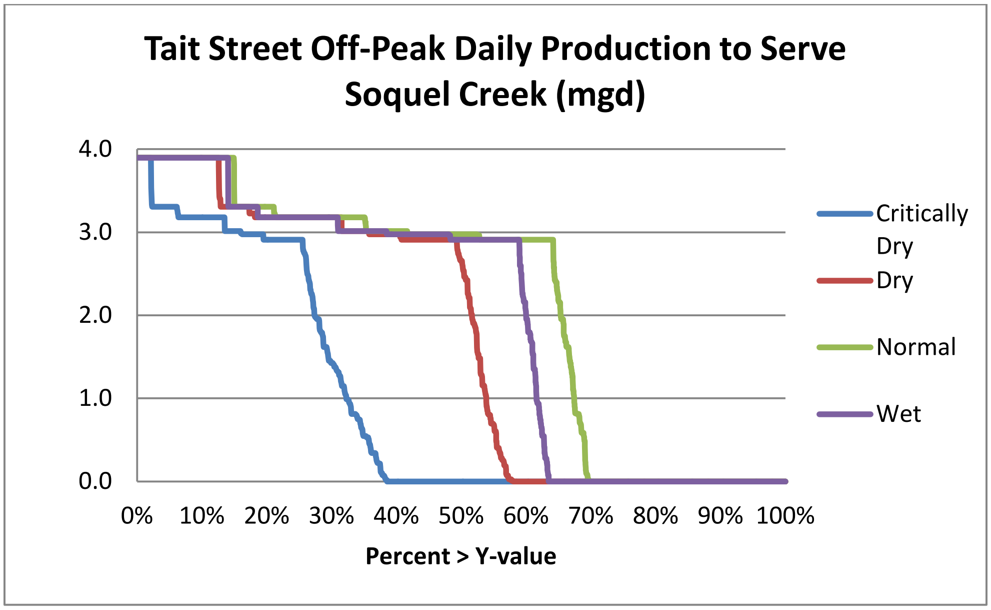


Figure 10a (Current Tait Capacity)

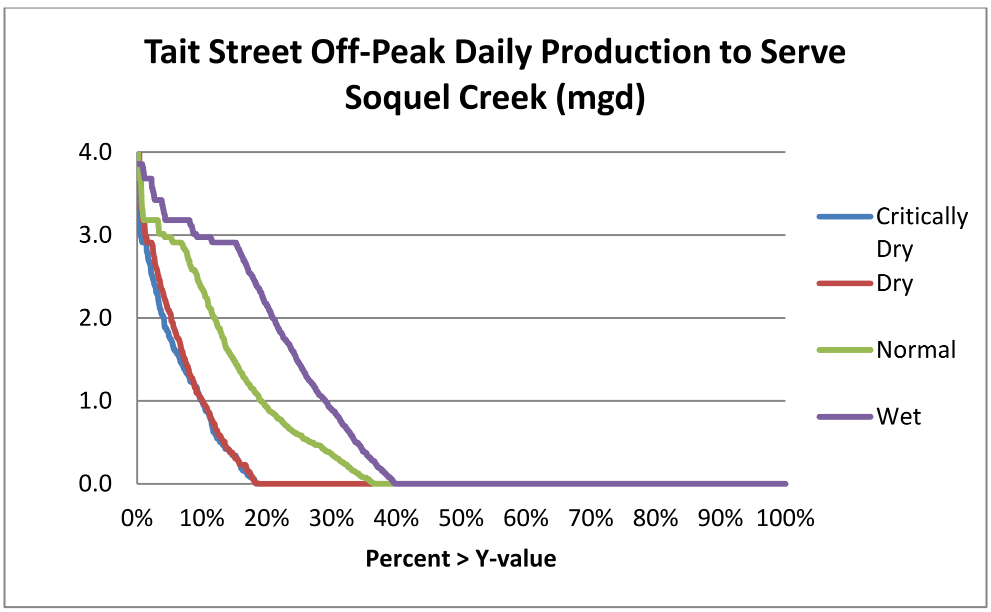


Table 2 compares the average off-peak season Tait production to serve different demands across the year types. Table 2a shows the comparable figures from Task 2.

Table 2. Average Off-Peak Season Tait Street Production (mg) (Increased Tait Capacity)

DEMAND SERVED	HYDROLOGIC YEAR TYPE				
	Critically Dry	Dry	Normal	Wet	All
Santa Cruz Only	823	879	812	663	**778**
Santa Cruz & Both Districts	1102	1345	1378	1179	**1262**
Both Districts Only	278	464	566	517	**488**
Scotts Valley	105	151	174	158	**154**
Soquel Creek	173	313	392	358	**333**

Table 2a. Average Off-Peak Season Tait Street Production (mg) (Current Tait Capacity)

DEMAND SERVED	HYDROLOGIC YEAR TYPE				
	Critically Dry	Dry	Normal	Wet	All
Santa Cruz Only	823	879	812	663	**775**
Santa Cruz & Both Districts	936	1010	1033	930	**979**
Both Districts Only	112	131	221	267	**204**
Scotts Valley	70	84	125	121	**108**
Soquel Creek	41	46	95	144	**95**

GHWTP Production

The added production at Tait Street requires increased utilization of the treatment plant. Figure 11 compares the distributions of off-peak season daily production at the treatment plant with current and increased Tait Street capacity. The current 10 mgd off-peak season GHWTP capacity is shown on the chart.

Figure 11

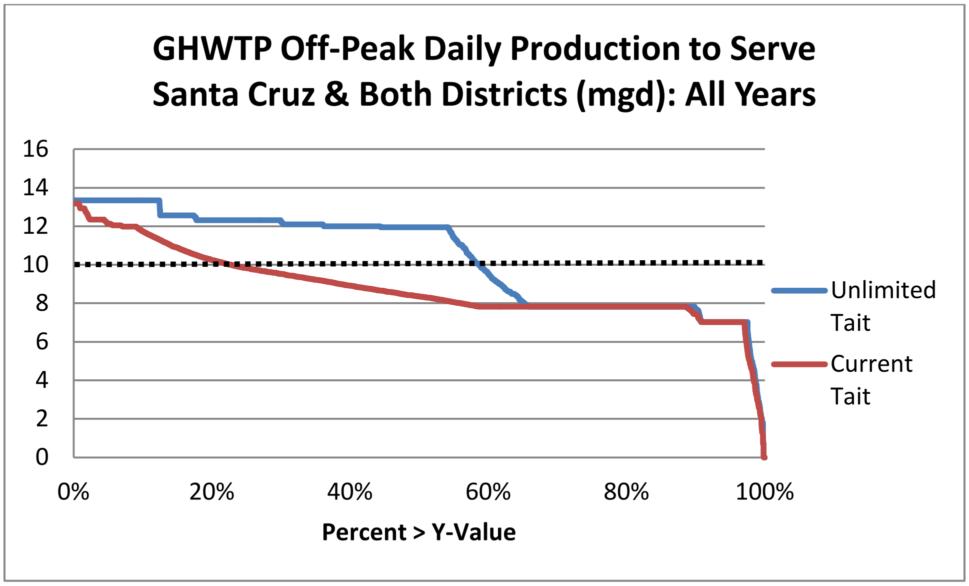


Table 3 shows the percentage of days that the current 10 mgd winter plant capacity limits transfers and the expected volume reduction in the annual combined transfer to the two districts due to this capacity limitation.

Table 3. Impacts of Current GHWTP Capacity on Potential Transfer Volumes

Scenario	Percentage of Days Exceeding 10 mgd	Expected Reduction in Expected Annual Transfer	
		Volume (mg)	Percentage of Potential Transfer
Current Tait Capacity	22%	59	28%
Unlimited Tait Capacity	59%	246	50%

If the Tait Street capacity was increased without a concurrent increase of the off-peak treatment plant capacity, the potential transfer volumes would be limited by the plant on almost 3 of 5 off-peak season days, and the average annual transfer volume would be reduced by half.

GARY FISKE AND ASSOCIATES, INC.

Water Resources Planning and Management

Date: June 22, 2012
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Water Transfer Project: Long-Term Analysis Scenario 2 (REVISED)

This memo reports the results of the second of 4 scenarios to be analyzed as part of Task 2, the long-term analysis. Whereas Scenario 1 assumed current infrastructure and water rights, Scenario 2 assumes the necessary changes in infrastructure and water rights to enable direct diversion from Felton to the Graham Hill Water Treatment Plant. This includes lifting the 3,000 AF annual diversion limit at Felton.

The analysis and other key assumptions are substantially the same as described in the June 1 Scenario 1 memo; the key difference is that the Scotts Valley and Soquel Creek demands can now be served from Felton as well as Tait Street. This memo is in much the same format as the earlier one, with many of the tables directly comparing the Scenario 1 and 2 results in order to highlight the changes attributable to allowing Felton direct diversion. The Scotts Valley and Soquel Creek Service Area 1 demands are once again as shown in Table 1.

Table 1. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek (SA1)
November	42.8	39.6
December	38.7	36.1
January	37.2	35.6
February	33.8	32.2
March	40.3	37.4
April	48.3	41.9
TOTAL	**241.1**	**222.7**

Averages and Distributions of Water Transfer Volumes

Table 2 compares the Scenario 2 2030 monthly average Scotts Valley and Soquel Creek transfers across all hydrologic years to the corresponding transfers under Scenario 1. Not surprisingly, the Scenario 2 transfers are significantly higher. Table 3 shows the average transfers for each hydrologic year type.

Figure 1 shows the duration curves across all hydrologic years for the Scenario 2 annual transfers, and Figures 2-5 show the transfer duration curves for each year type.

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Table 2. 2030 Monthly Average Transfers Across All Hydrologic Years (millions of gallons)

Month	Scotts Valley Transfer Volume		Soquel Creek Transfer Volume		Total Transfer Volume	
	Scen 1	Scen 2	Scen 1	Scen 2	Scen 1	Scen 2
November	21.4	21.4	6.0	8.5	27.4	29.9
December	11.9	19.0	5.5	13.8	17.4	32.8
January	14.0	22.5	8.5	18.5	22.5	40.9
February	15.9	21.6	10.6	20.6	26.5	42.2
March	23.6	29.9	15.0	27.0	38.6	56.9
April	25.0	38.9	10.0	32.3	35.0	71.2
TOTAL	**111.8**	**153.3**	**55.6**	**120.7**	**167.4**	**274.0**

Table 3. 2030 Annual Average Transfers by Hydrologic Year Type (mg)

Year Type	Scotts Valley		Soquel Creek		Total	
	Scen 1	Scen 2	Scen 1	Scen 2	Scen 1	Scen 2
Critically Dry	74.5	109.3	30.7	67.1	105.2	176.5
Dry	87.7	150.3	31.4	112.0	119.1	262.3
Normal	127.9	169.9	58.2	139.2	186.1	309.1
Wet	125.3	156.1	76.7	133.3	202.0	289.3
Average	**111.8**	**153.3**	**55.6**	**120.7**	**167.4**	**274.0**

Figure 1

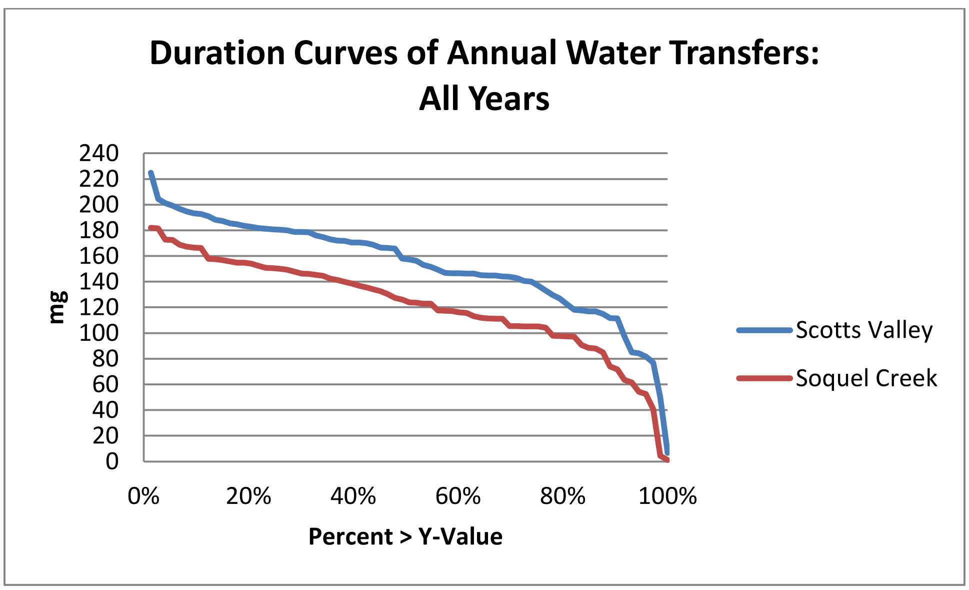


Figure 2

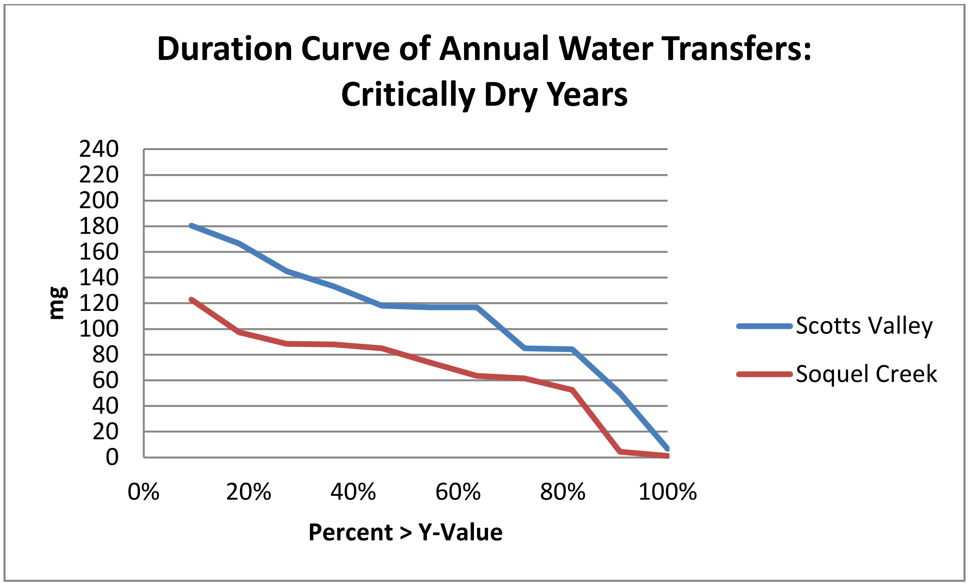


Figure 3

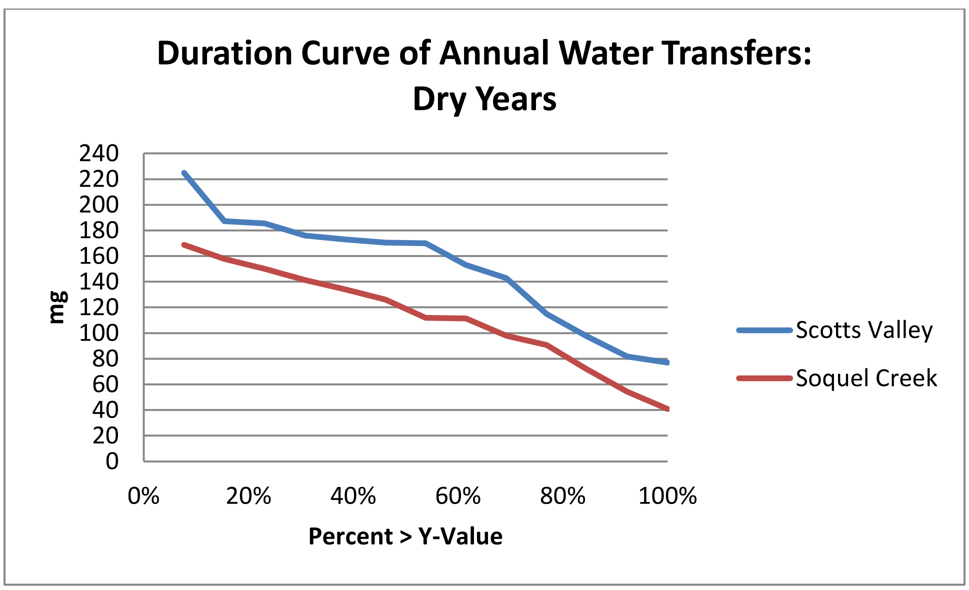


Figure 4

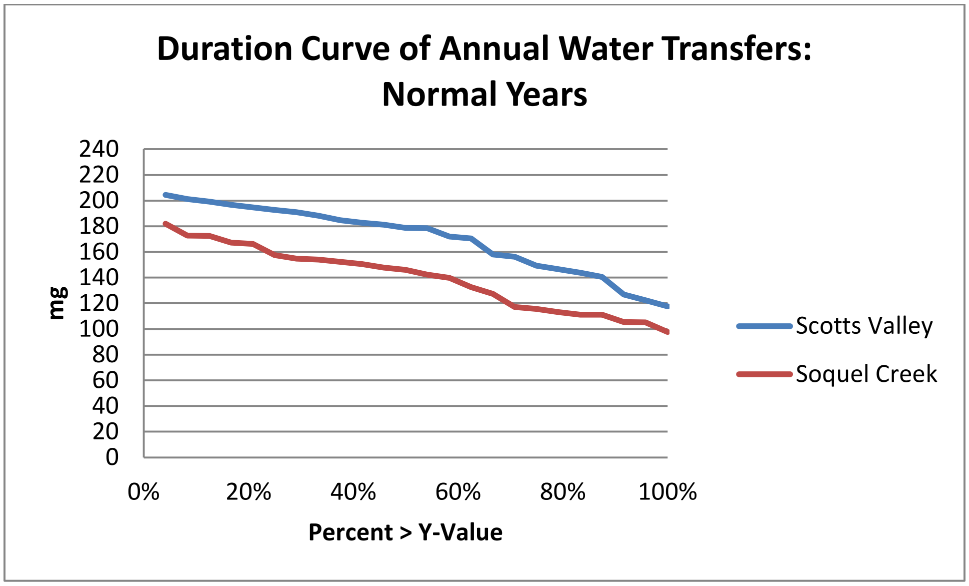
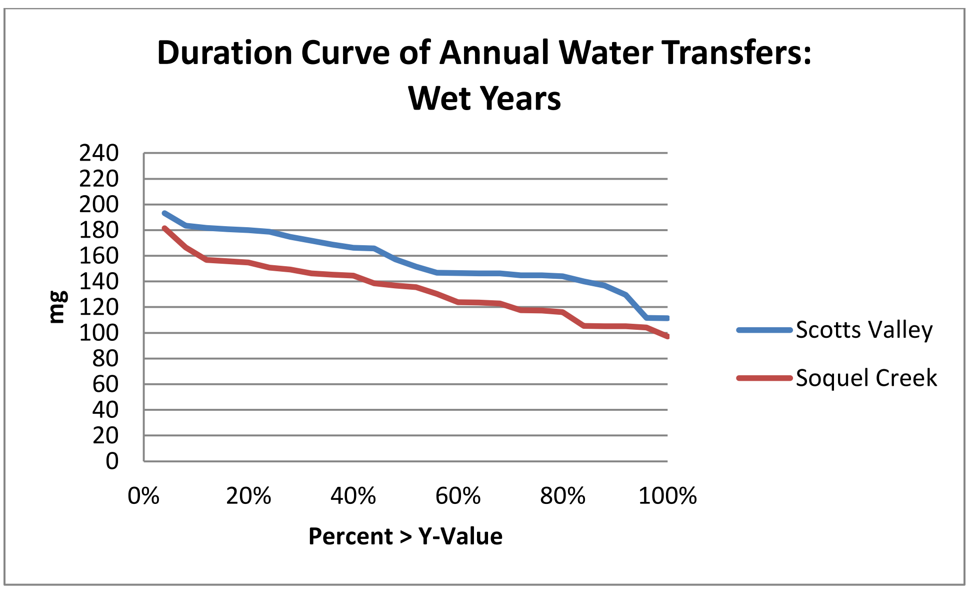


Figure 5



Source Production

Table 4 shows the monthly average combined added production at Tait Street and Felton required to serve Scotts Valley and Soquel Creek demands.

Table 4. 2030 Monthly Average Added Production at Tait Street & Felton to Serve Scotts Valley and Soquel Creek (millions of gallons)

Month	Base (No Direct Div)	With Transfers		Added Production	
		Scen 1	**Scen 2**	**Scen 1**	**Scen 2**
November	157.9	181.1	187.9	23.1	29.9
December	158.4	174.1	191.1	15.7	32.8
January	158.6	180.3	199.6	21.7	40.9
February	134.3	160.2	176.5	25.9	42.2
March	151.2	189.8	208.2	38.5	56.9
April	173.5	208.0	244.7	34.6	71.2
TOTAL	**933.9**	**1093.5**	**1208.0**	**159.6**	**274.0**

Surplus Supply

Given these production levels, how much surplus supply is there available at Tait Street and/or Felton to potentially meet other external demands? For our purposes, surplus supply at Tait Street on any day is defined as:

> *The excess of the maximum potential Tait Street diversion over the volume that has already been diverted to meet Santa Cruz, Scotts Valley, and Soquel Creek demands. The maximum potential diversion is the minimum of the available flow at Tait Street and the capacity of the Tait Street diversion (11.52 cfs). On days when there are no turbidity constraints at Tait St., the available flow at Tait Street is the Tier 3 Big Trees flow less the diversion at Felton plus the tributary inflows between Felton and Tait Street. On days when Tait St. is shut down due to turbidity, the Tait St. available flow is zero.*

To this must be added the daily incremental surplus available at Felton, which is defined as:

> *The minimum of the excess net flow at Tait Street and the unused Felton capacity. The excess net flow at Tait St. is the amount (if any) by which the Tait St. available flow, as defined above, exceeds the Tait Street diversion capacity (11.52 cfs). The unused Felton capacity is the difference between the Felton capacity (13.7 cfs) and the daily Felton diversion.*

Based on this definition, Table 5 shows the expected November-April surplus supply. The additional diversion capacity at Felton ensures that there is substantial unused capacity at Felton and Tait Street which, on days of sufficient flow, would be available to serve other demand. The Scenario 2 surplus is thus substantially larger than Scenario 1.

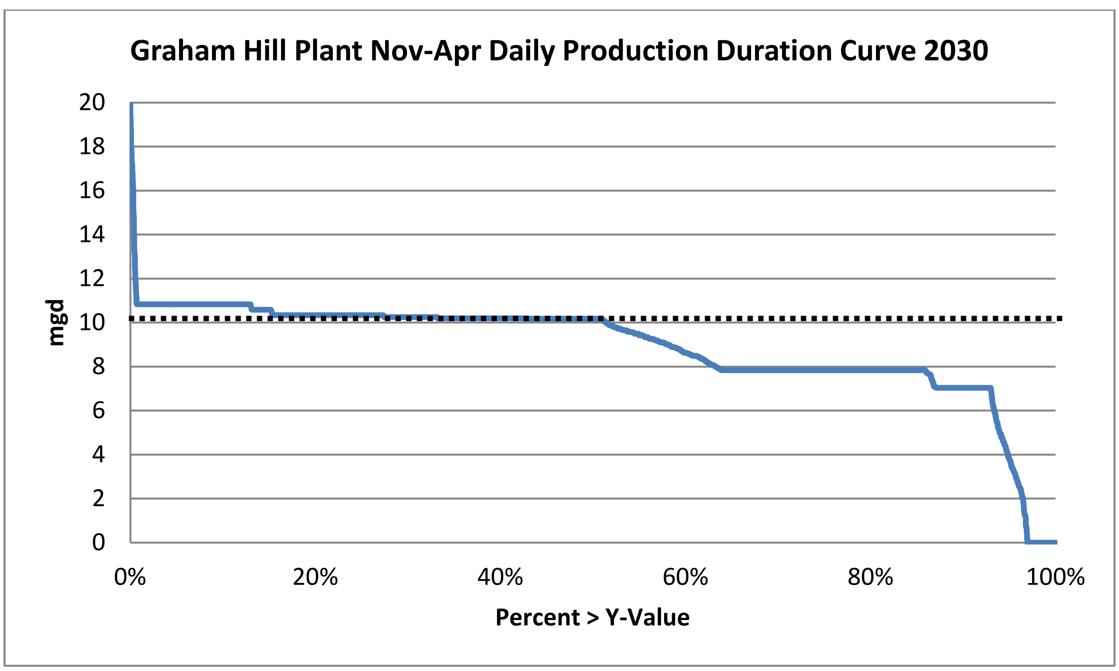
Table 5. Expected 2030 November-April Surplus Supply at Tait Street (millions of gallons)

Year Type	Surplus Supply	
	Scen 1	Scen 2
Critically Dry	14	270
Dry	18	555
Normal	44	838
Wet	83	890
Average	**48**	**720**

Treatment Plant Capacity Requirements

Figure 6 shows the Scenario 2 duration curve of Graham Hill treatment plant production required to accomplish the transfers depicted in the tables and charts above. The chart shows that treatment plant usage exceeds the current 10 mgd capacity on more than 50% of days. Constraining the plant capacity to this level would reduce the total 274 mg average annual transfer shown in Table 2 by about 16% to 230 mg. Put another way, an investment in treatment plant expansion would, at most, result in additional average annual transfers of about 44 million gallons.

Figure 6



Transmission Capacity Requirements

Figure 7 shows the Scenario 2 duration curve for the required transmission capacity to move water from the treatment plant to yield the combined transfer volumes discussed above. Figure 8 shows the duration curve for the required transmission capacity to Scotts Valley, while Figure 9 shows the required capacity to Soquel Creek.

Figure 7

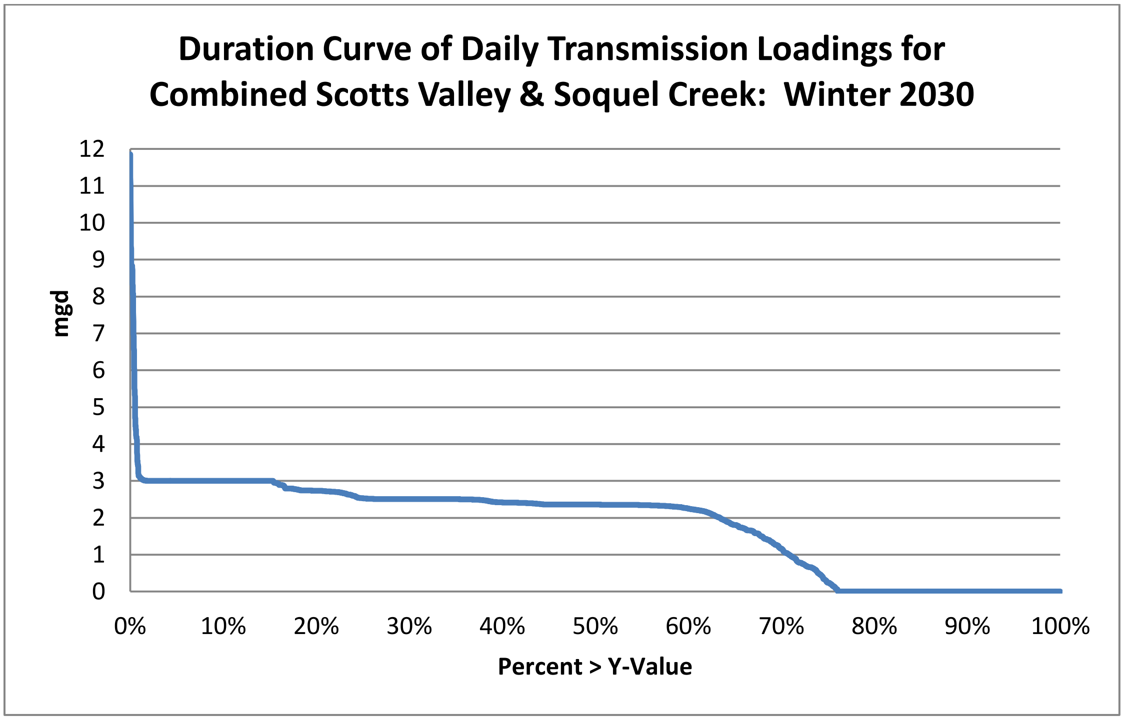


Figure 8

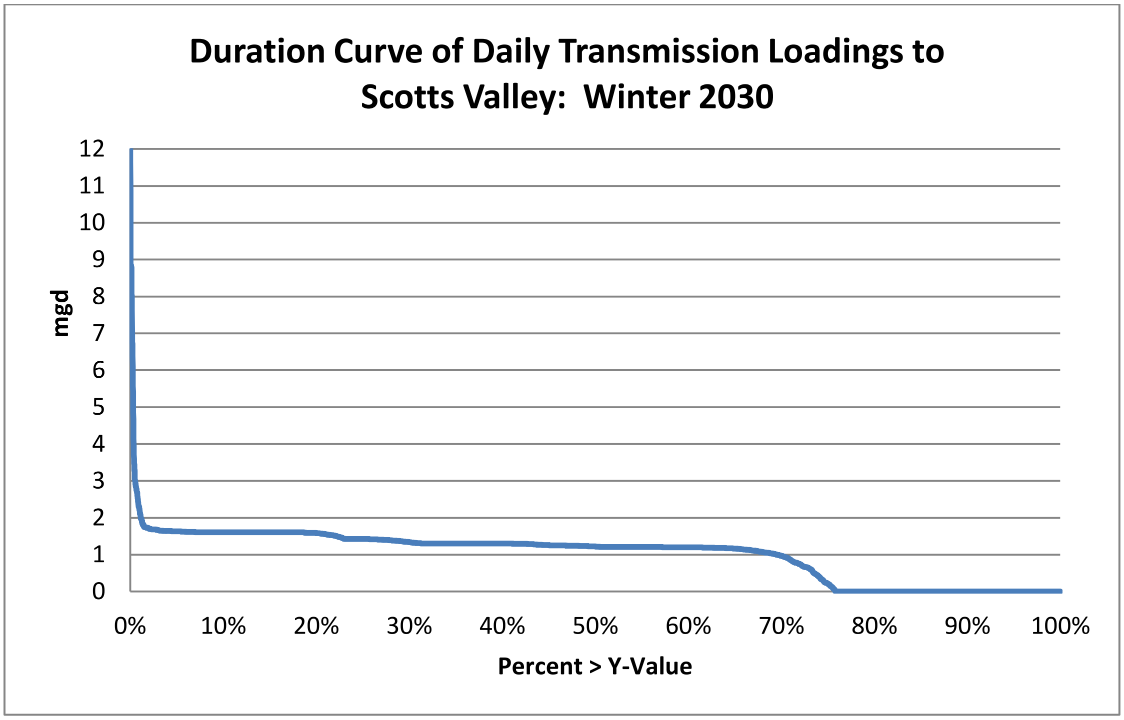
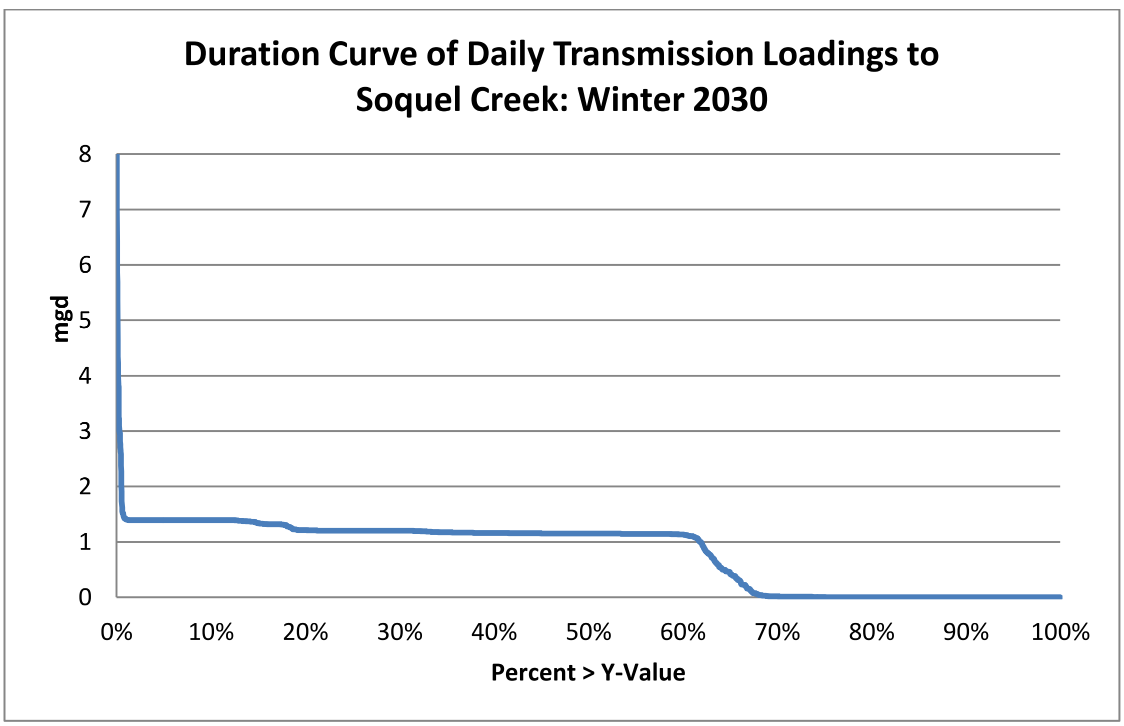


Figure 9



G A R Y F I S K E A N D A S S O C I A T E S , I N C .
Water Resources Planning and Management

Date: June 25, 2012
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Water Transfer Project: Long-Term Analysis Scenarios 3 and 4

This memo reports the results of the third and fourth scenarios to be analyzed as part of Task 2, the long-term analysis. Originally, Scenario 3 was to examine "remov[ing] water rights constraints at Felton and Loch Lomond." However, Scenario 2 has already removed the water right constraint that limits annual Felton diversions to 3,000 AF. Moreover, the diversion rights at Felton exceed the physical diversion capacity in all but one month (September), so removing them would have no impact on water transfers to Scotts Valley and Soquel Creek. The only other water right that is feasible to remove is the 3,200 AF annual Loch Lomond withdrawal limit. But that would also have no impact on transfers.

Therefore, based on discussions with Linette, Scenario 3 was redefined as a modification of Scenario 2 which increased the Felton diversion capacity from its current 13.7 cfs to match the 20 cfs water right.[1]

It turns out that, on all winter days, there is currently more than sufficient combined capacity at Felton and Tait Street to serve Santa Cruz, Scotts Valley, and Soquel Creek Service Area 1 demands. So increasing that capacity does not enable transfer of additional water. Thus, the results of Scenario 3 are virtually identical to those of Scenario 2, with the possible exception of the surplus supplies which may be somewhat higher.

Thus, the remainder of this memo is devoted to reporting the results of Scenario 4. Scenario 4 modifies Scenario 2 by adding infrastructure to provide a second transmission line to the lake and to allow the Felton diversion to operate at any level up to its maximum capacity, thus eliminating the capacity steps assumed in the IWP and in our previous scenarios. In addition, the annual lake withdrawal limit is assumed to be removed.

The elimination of the Felton capacity steps will improve the ability to divert at Felton and might therefore be expected to somewhat increase transfers to Scotts Valley and Soquel Creek. On the other hand, the enhanced ability to divert from Felton to the lake might be expected to somewhat reduce transfers since the added water diverted from Felton to the lake makes less water available for transfers.

All three changes will tend to improve the reliability of service to Santa Cruz customers. This is in contrast to Scenarios 1 and 2 in which the Santa Cruz reliability is essentially unchanged. This memo therefore begins with a section that shows the extent of these reliability improvements. To maintain the numbering system for the other tables and charts for the sake of comparability to previous memos, the table and chart numbers in this new section begin with "R".

[1] The September diversion right is 7.8 cfs.

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The Scotts Valley and Soquel Creek Service Area 1 demands are once again as shown in Table 1.

Table 1. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek (SA1)
November	42.8	39.6
December	38.7	36.1
January	37.2	35.6
February	33.8	32.2
March	40.3	37.4
April	48.3	41.9
TOTAL	**241.1**	**222.7**

Impacts on City of Santa Cruz Reliability

Figure R-1 compares the 2030 peak-season shortage duration curves for Scenarios 2 and 4. Table R-1 compares key peak-season reliability indices for the two scenarios. As expected, there are clear improvements in reliability, although not in the driest years.

Figure R-1

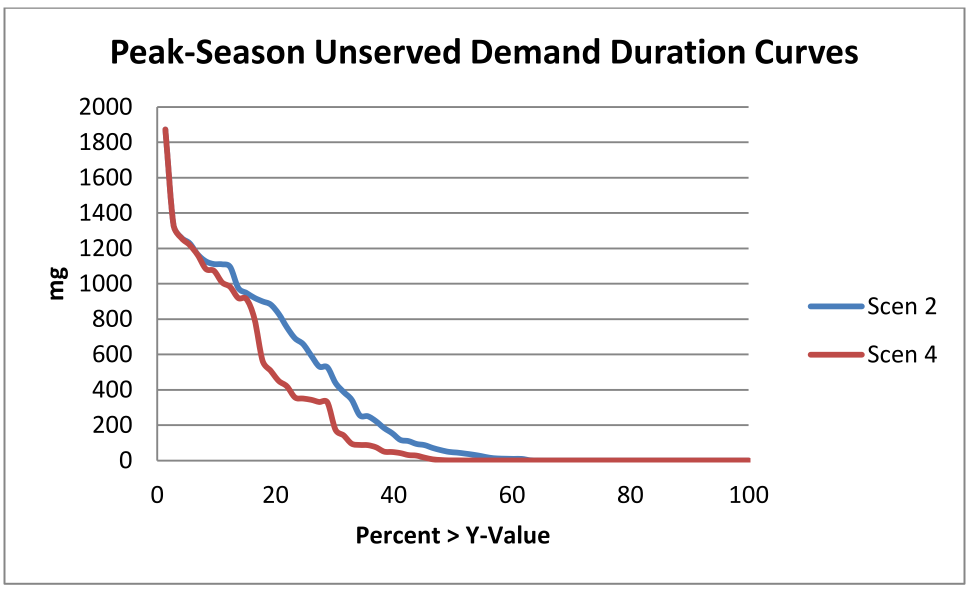


Table R-1. Comparison of Key Peak-Season 2030 Reliability Indicators

	Scenario 2	Scenario 4
Expected PS Shortage (mg)	349	266
Likelihood of PS Shortage:		
Likelihood of 5% PS Shortage	40%	32%
Likelihood of 15% PS Shortage	30%	22%
Likelihood of 25% PS Shortage	25%	16%

Averages and Distributions of Water Transfer Volumes

Table 2 compares the Scenario 4 2030 monthly average Scotts Valley and Soquel Creek transfers across all hydrologic years to the corresponding transfers under Scenario 2. Table 3 shows the average transfers for each hydrologic year type. There is very little difference between the two scenarios.

Figure 1 shows the duration curves across all hydrologic years for the Scenario 4 annual transfers, and Figures 2-5 show the transfer duration curves for each year type.

Table 2. 2030 Monthly Average Transfers Across All Hydrologic Years (millions of gallons)

Month	Scotts Valley Transfer Volume		Soquel Creek Transfer Volume		Total Transfer Volume	
	Scen 2	Scen 4	Scen 2	Scen 4	Scen 2	Scen 4
November	21.4	21.4	8.5	6.9	29.9	28.3
December	19.0	18.9	13.8	14.1	32.8	33.0
January	22.5	22.4	18.5	18.5	40.9	40.9
February	21.6	21.9	20.6	20.3	42.2	42.1
March	29.9	30.5	27.0	26.8	56.9	57.3
April	38.9	40.0	32.3	32.2	71.2	72.2
TOTAL	**153.3**	**155.1**	**120.7**	**118.8**	**274.0**	**273.9**

Table 3. 2030 Annual Average Transfers by Hydrologic Year Type (mg)

Year Type	Scotts Valley		Soquel Creek		Total	
	Scen 2	Scen 4	Scen 2	Scen 4	Scen 2	Scen 4
Critically Dry	109.3	102.9	67.1	66.7	176.5	169.7
Dry	150.3	153.7	112.0	114.4	262.3	268.1
Normal	169.9	173.7	139.2	138.7	309.1	312.3
Wet	156.1	154.4	133.3	131.5	289.3	285.9
Average	**153.3**	**152.9**	**120.7**	**121.0**	**274.0**	**273.9**

Figure 1

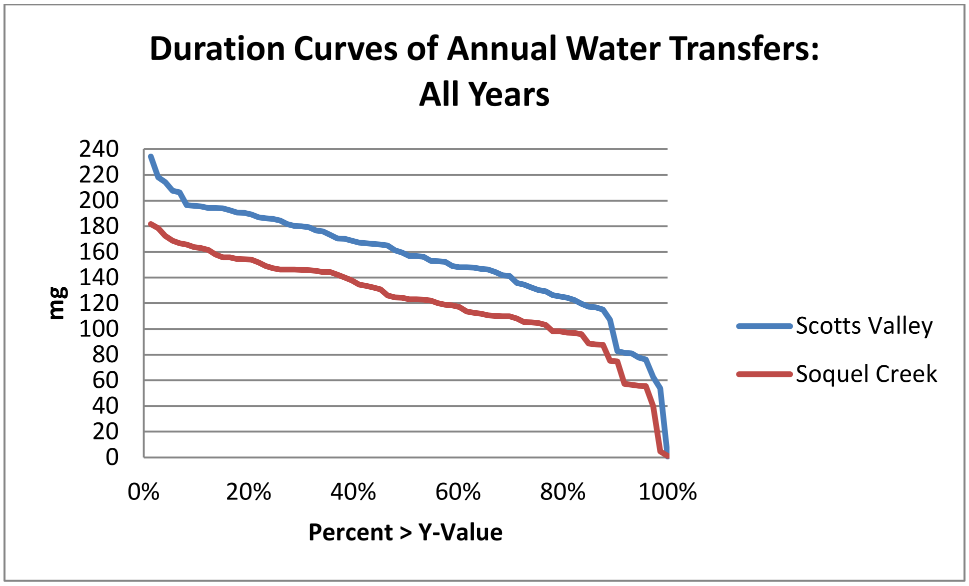


Figure 2

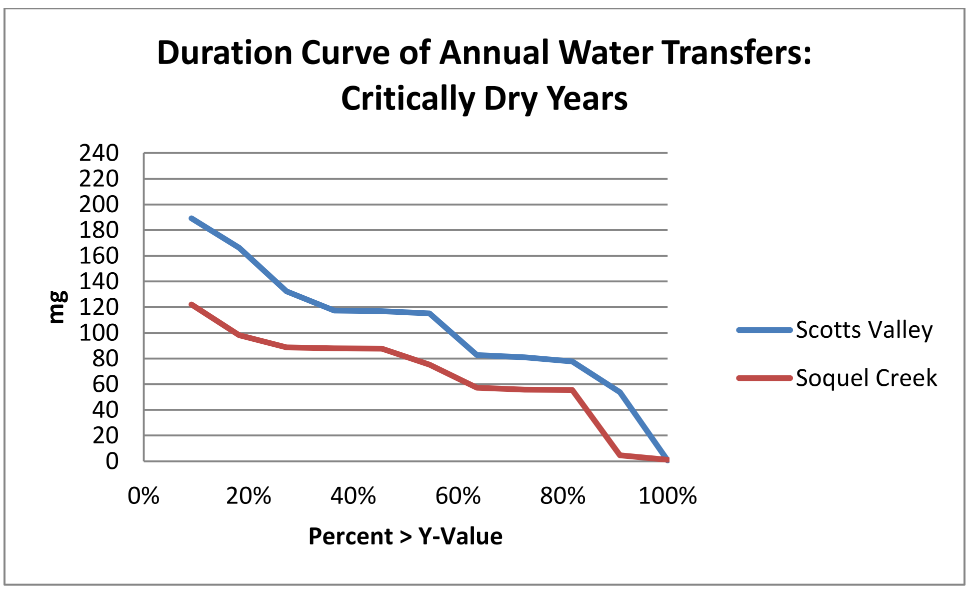


Figure 3

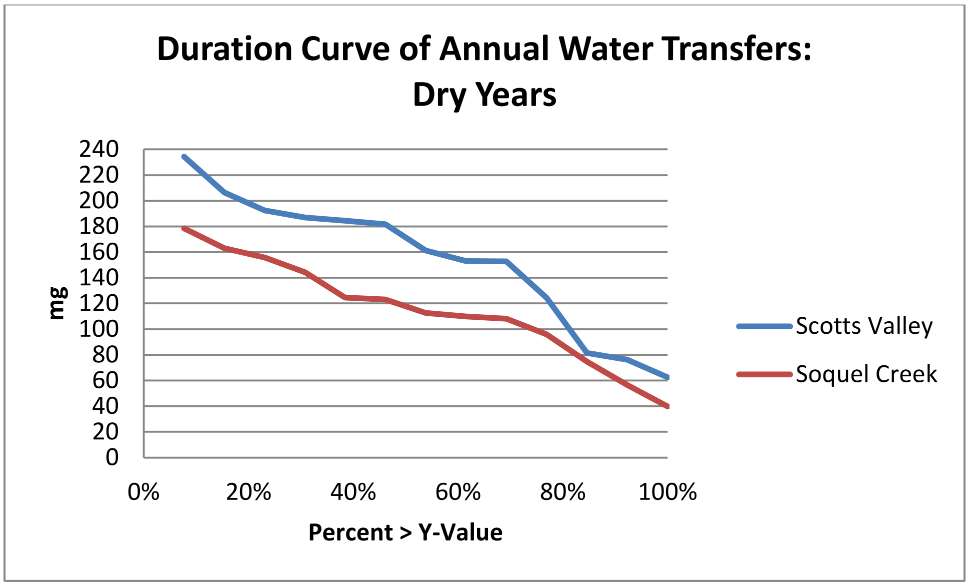


Figure 4

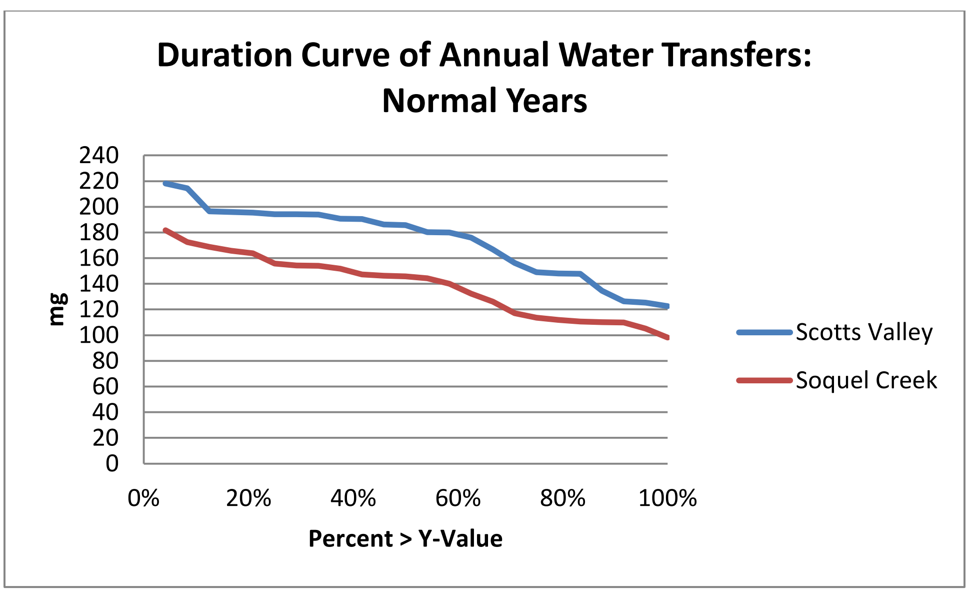
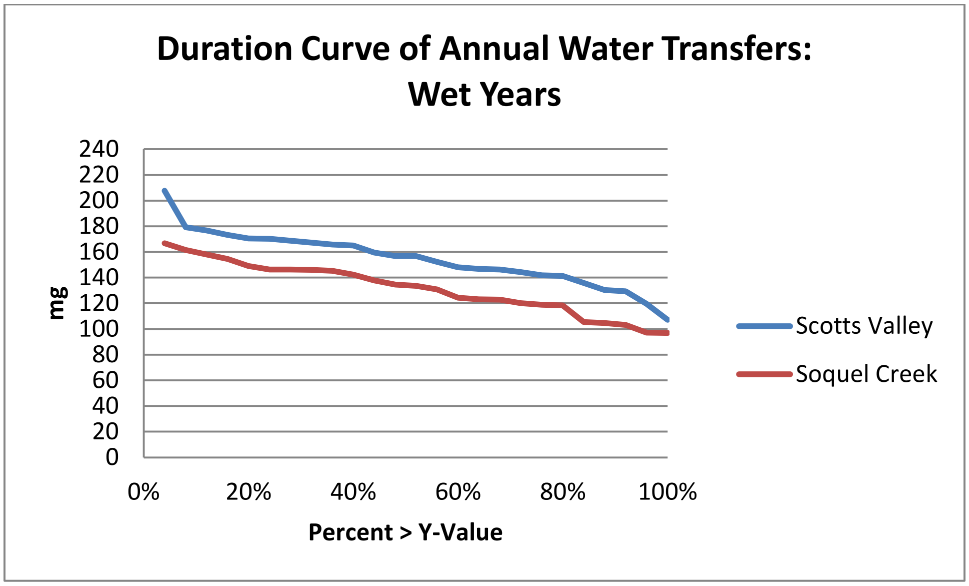


Figure 5



Surplus Supply

Using the same approach that was used to calculate surplus supply in my revised Scenario 2 memo, dated June 22, Table 4[2] shows the expected November-April surplus supply. Because of the added ability to divert from Felton to the lake as a result of the second pipeline, the Scenario 4 transfer, while still substantial, is less than in Scenario 2.

Table 4. Expected 2030 November-April Surplus Supply at Tait Street and Felton (millions of gallons)

Year Type	Surplus Supply	
	Scen 2	**Scen 4**
Critically Dry	270	77
Dry	555	222
Normal	838	676
Wet	890	755
Average	**720**	**532**

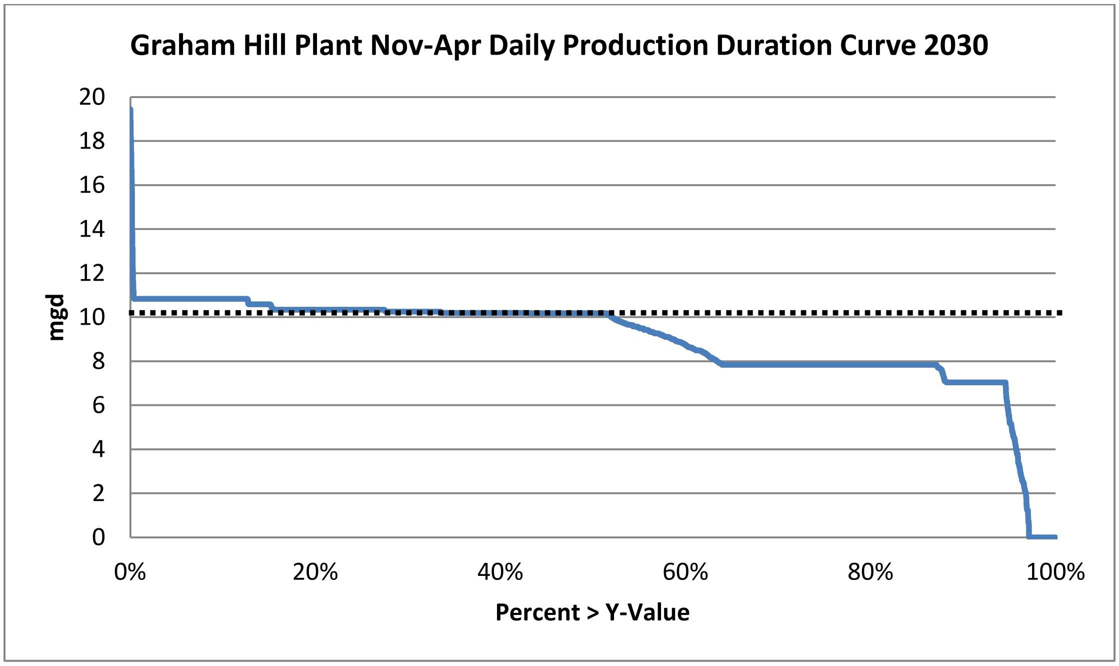
Treatment Plant Capacity Requirements

Figure 6 shows the Scenario 4 duration curve of Graham Hill treatment plant production required to accomplish the transfers depicted in the tables and charts above. The chart is virtually identical to the corresponding chart for Scenario 2. Once again, treatment plant usage exceeds the current 10 mgd

[2] Table 4, which in prior memos shows added Felton and Tait production, is intentionally omitted, since much of added Felton production in this scenario is due to additional diversion to the lake rather than to transfers to Scotts Valley and Soquel Creek.

capacity on more than 50% of days. Constraining the plant capacity to this level would reduce the total 274 mg average annual transfer shown in Table 2 by about 15% to 232 mg. Put another way, an investment in treatment plant expansion would, at most, result in additional average annual transfers of about 42 million gallons.

Figure 6



Transmission Capacity Requirements

Figure 7 shows the Scenario 4 duration curve for the required transmission capacity to move water from the treatment plant to yield the combined transfer volumes discussed above. Figure 8 shows the duration curve for the required transmission capacity to Scotts Valley, while Figure 9 shows the required capacity to Soquel Creek. Once again, these are almost indistinguishable from Scenario 2.

Figure 7

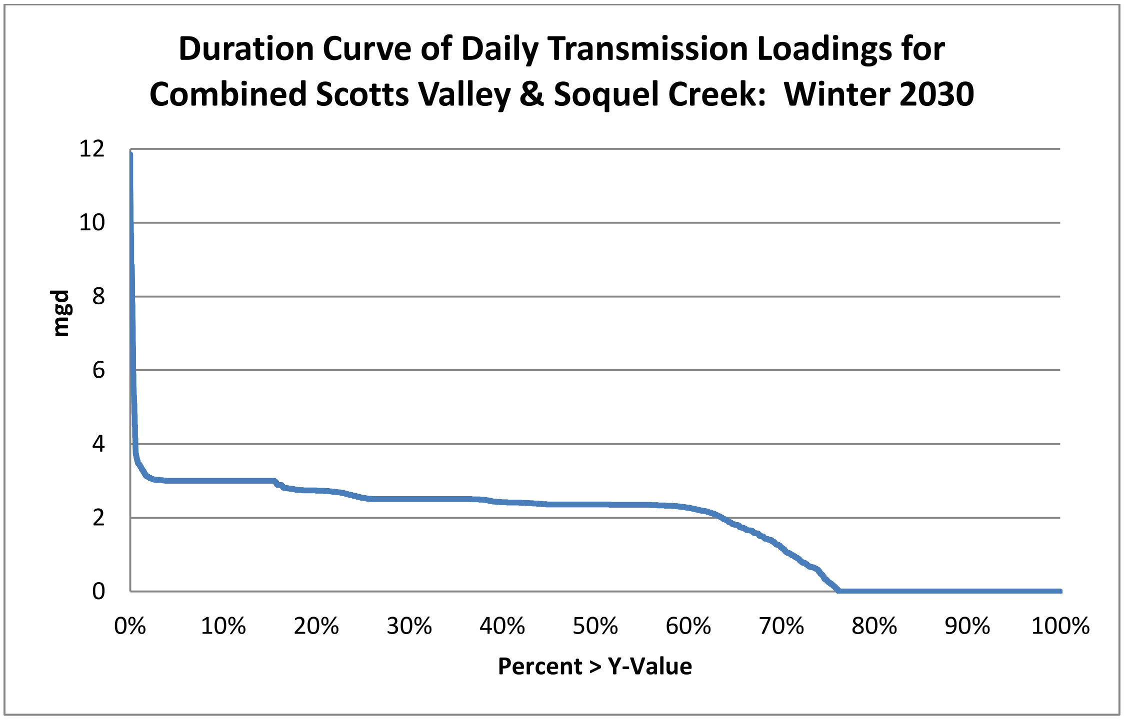


Figure 8

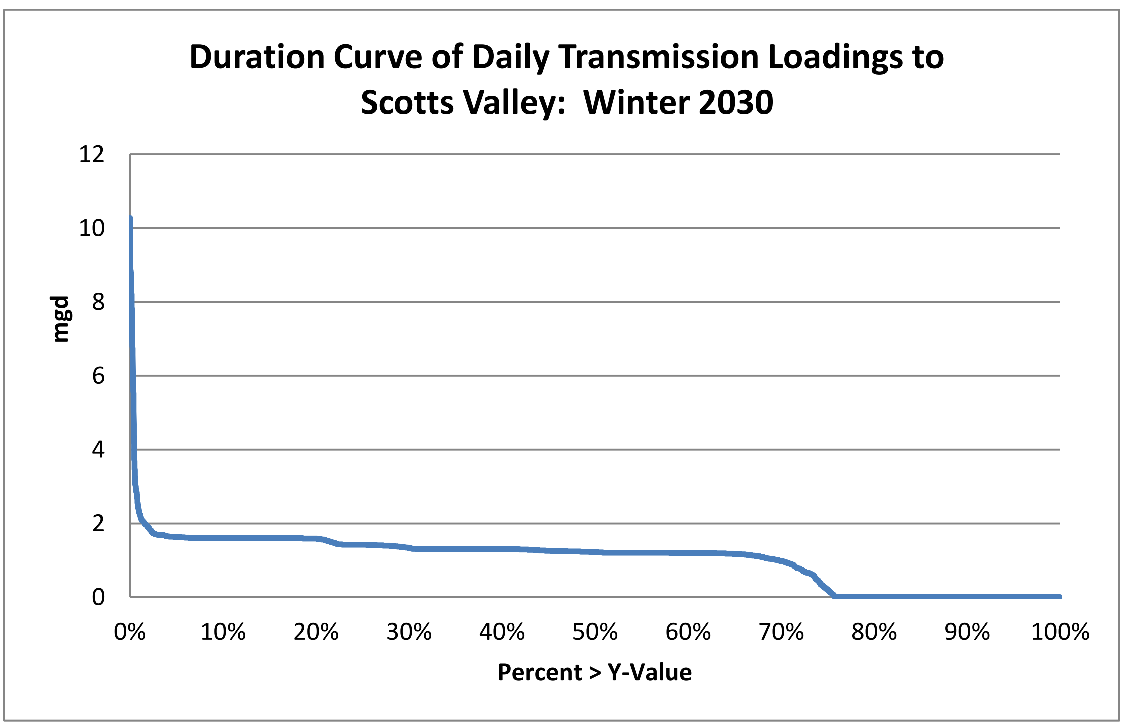
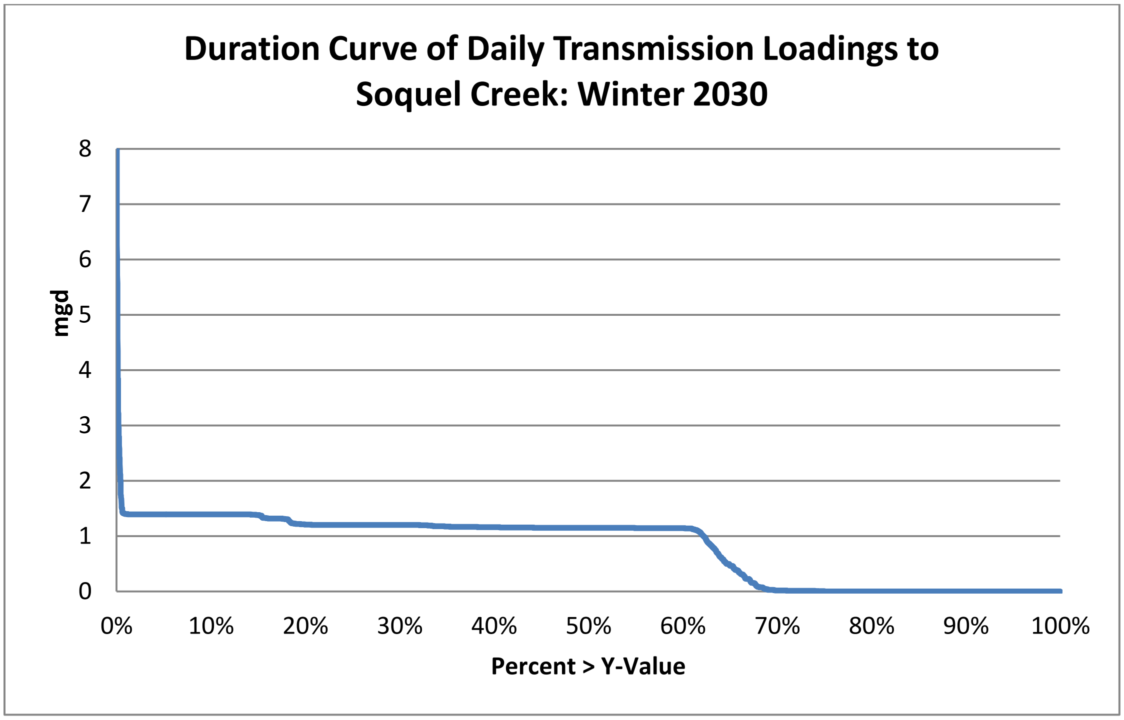


Figure 9


Duration Curve of Daily Transmission Loadings to Soquel Creek: Winter 2030
mgd
8
7
6
5
4
3
2
1
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent > Y-Value

GARY FISKE AND ASSOCIATES, INC.
Water Resources Planning and Management

Date: July 2, 2012
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Water Transfer Project Long-Term Analysis Scenario 5: GHWTP Improvements

The final long-term scenario of the Water Transfer Project examines the impacts of improving the Graham Hill Water Treatment Plant (GHWTP) to allow it to treat more turbid water. This reduces the number of days on which the Tait Street diversion must be shut down, which in turn can improve the water supply reliability for Santa Cruz retail customers and also allow more water to be transferred to Scotts Valley and Soquel Creek. The purpose of the analysis reported on here is to estimate the magnitude of these impacts. (The improvements at GHWTP do not affect the North Coast; the turbidity constraints for those diversions remain unchanged due to the need to avoid frequent and disruptive flushes of the North Coast pipeline.)

Background

The Confluence model will shut down a diversion on days on which the water at that diversion is deemed to be too turbid. For modeling purposes, those days are defined as a function of rainfall. The current rule for Tait Street, as set forth in the IWP Update, is as follows:

> *On any day that the rainfall at the weather station exceeds 0.67 inches, the diversion is shut down on that day plus two additional days, or three days total.*

This rule is intended to not allow raw water with turbidity above 25 NTU, which is the limit of the current treatment process at GHWTP, to reach the plant. By changing treatment processes at Graham Hill Water Treatment Plant to membrane treatment, the plant could treat water with turbidity as high as several hundred NTU. This allows modification of the turbidity constraint at Tait Street to:

> *On any day that the rainfall at the weather station exceeds 1.25 inches, the diversion is shut down on that day plus 1 additional day, or two days total.*

This relaxation of the turbidity constraint reduces the average annual number of Tait shutdown days over the November-April period from 35 to 11.

To assess the degree to which this reduced number of shutdown days affects both Santa Cruz supply reliability and external water transfers, this Scenario 5 modifies the Tait Street turbidity constraint as above for our long-term Scenario 1, which includes no water right or infrastructure changes at Felton or Loch Lomond. We would expect the impact of the turbidity modification to be similar for the other long-term scenarios.

The Scotts Valley and Service Area 1 Soquel Creek demands are shown in **Error! Not a valid bookmark self-reference.**.

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Table 1. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek (SA1)
November	42.8	39.6
December	38.7	36.1
January	37.2	35.6
February	33.8	32.2
March	40.3	37.4
April	48.3	41.9
TOTAL	**241.1**	**222.7**

Impacts on City of Santa Cruz Reliability

Figure R-1 and Table R-1 show the small improvements in peak-season reliability to Santa Cruz customers due to the reduction in the number of turbidity turn-outs at Tait Street.

Figure R-1

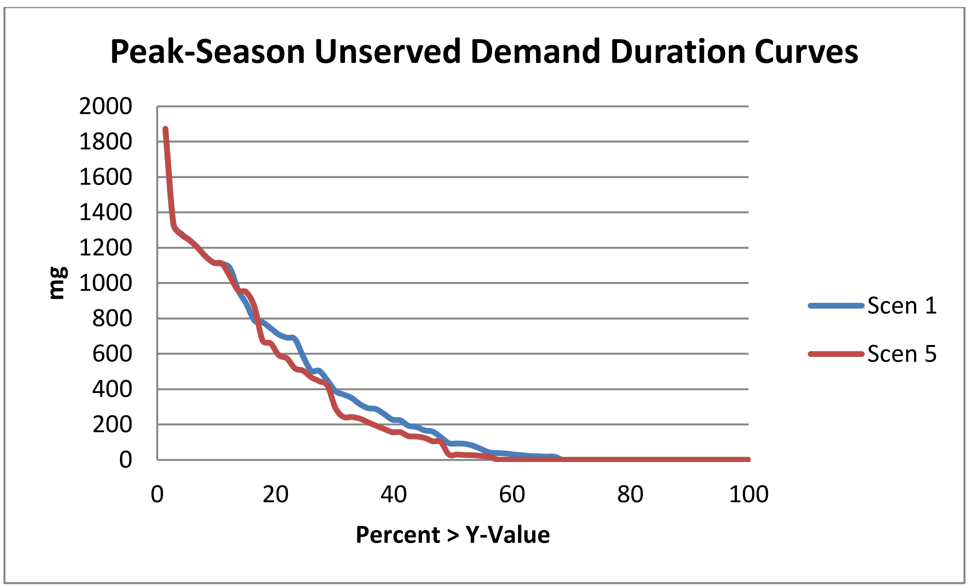


Table R-1. Comparison of Key Peak-Season 2030 Reliability Indicators

	Scen 1	Scen 5
Expected PS Shortage (mg)	327	296
Likelihood of PS Shortage:		
Likelihood of 5% PS Shortage	48%	45%
Likelihood of 15% PS Shortage	31%	29%
Likelihood of 25% PS Shortage	24%	20%

Averages and Distributions of Water Transfer Volumes

Table 2 compares the Scenario 5 2030 monthly and annual average Scotts Valley and Soquel Creek transfers across all hydrologic years to the corresponding transfers under Scenario 1. The Scenario 5 transfers are about 30 mg higher. Table 3 shows the average annual transfers for each hydrologic year type.

Figure 1 shows the duration curves across all hydrologic years for the Scenario 5 annual transfers, and Figures 2-5 show the transfer duration curves for each year type.

Table 2. 2030 Monthly Average Transfers Across All Hydrologic Years (millions of gallons)

Month	Scotts Valley Transfer Volume		Soquel Creek Transfer Volume		Total Transfer Volume	
	Scen 1	**Scen 5**	**Scen 1**	**Scen 5**	**Scen 1**	**Scen 5**
November	21.4	23.9	6.0	6.9	27.4	30.9
December	11.9	17.3	5.5	6.8	17.4	24.1
January	14.0	20.0	8.5	10.2	22.5	30.1
February	15.9	20.1	10.6	12.6	26.5	32.7
March	23.6	26.6	15.0	16.9	38.6	43.5
April	25.0	26.6	10.0	10.6	35.0	37.2
TOTAL	**111.8**	**134.6**	**55.6**	**64.0**	**167.4**	**198.6**

Table 3. 2030 Annual Average Transfers by Hydrologic Year Type (mg)

Year Type	Scotts Valley		Soquel Creek		Total	
	Scen 1	**Scen 5**	**Scen 1**	**Scen 5**	**Scen 1**	**Scen 5**
Critically Dry	74.5	82.6	30.7	34.2	105.2	116.8
Dry	87.7	102.7	31.4	36.9	119.1	139.6
Normal	127.9	151.5	58.2	65.9	186.1	217.4
Wet	125.3	157.8	76.7	89.3	202.0	247.1
Average	**111.8**	**134.6**	**55.6**	**64.0**	**167.4**	**198.6**

Figure 1

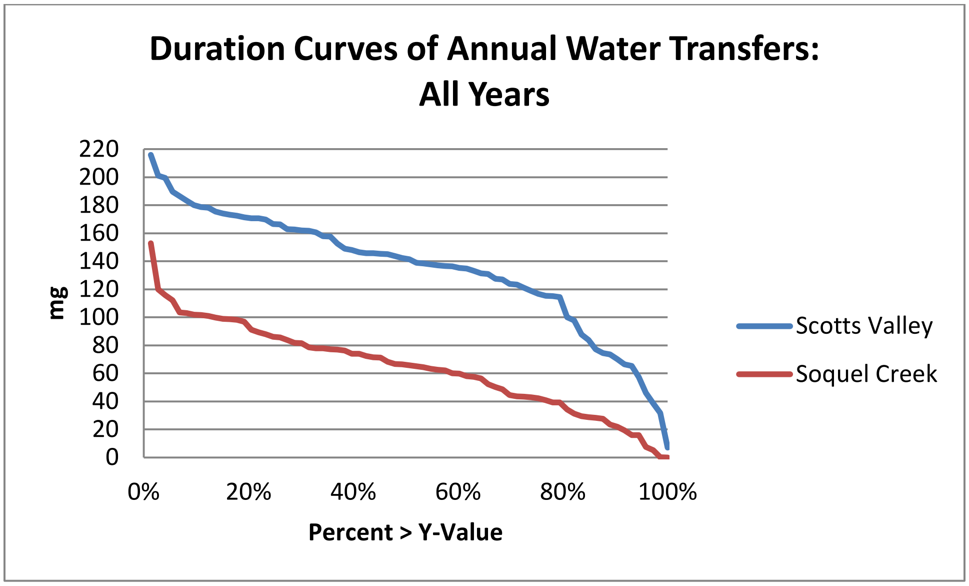


Figure 2

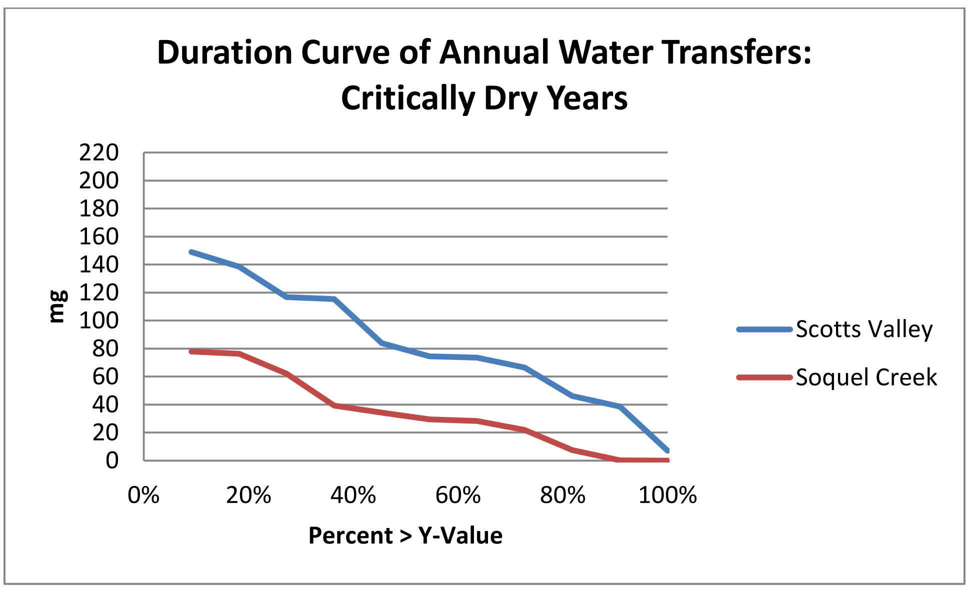


Figure 3

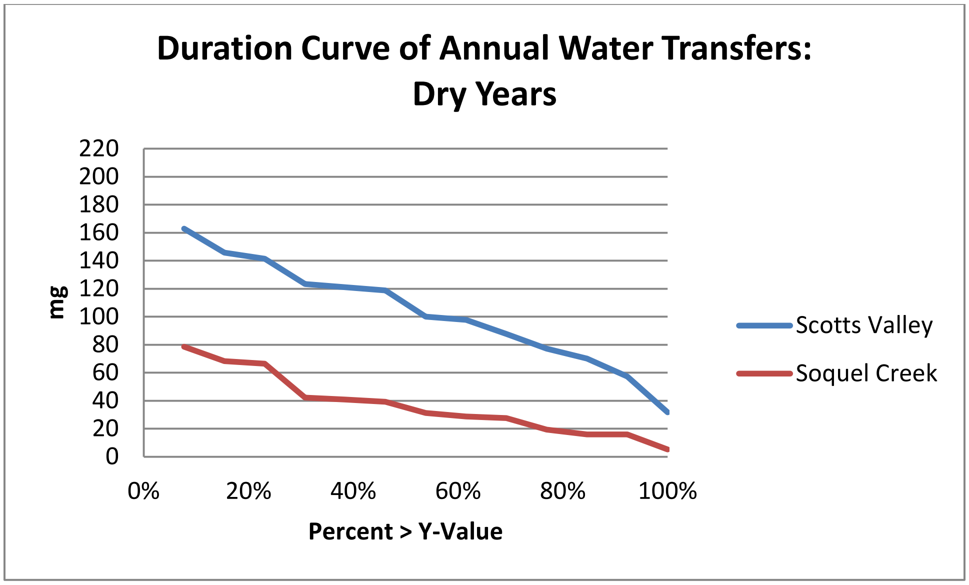


Figure 4

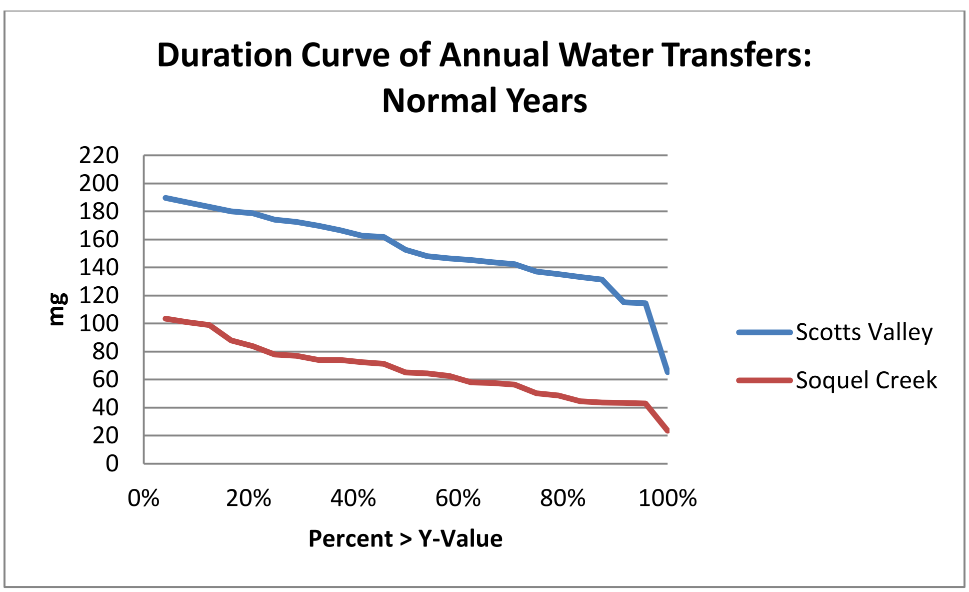
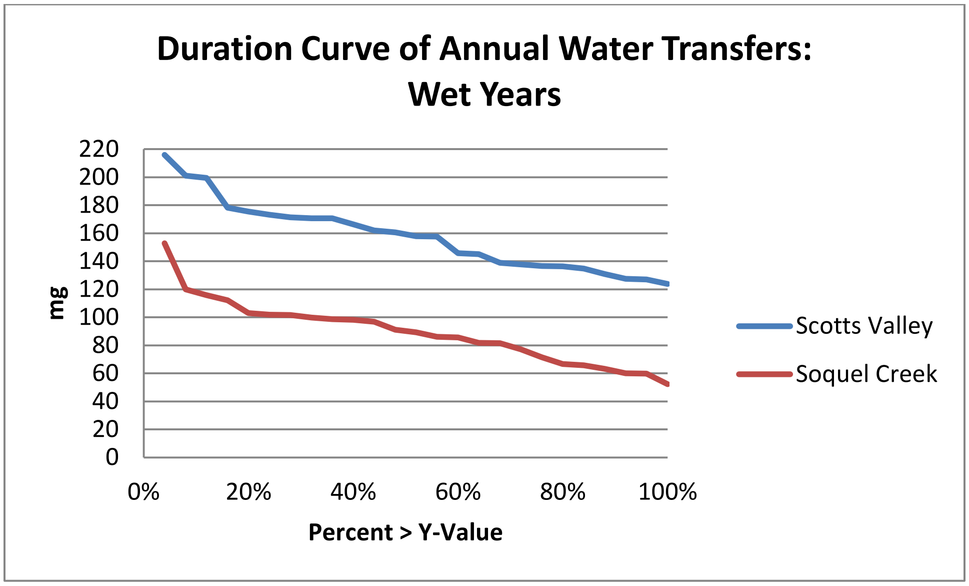


Figure 5



Source Production

Table 4 shows the monthly average added production at Tait Street required to serve Scotts Valley and Soquel Creek demands.

Table 4. 2030 Monthly Average Added Production at Tait Street to Serve Scotts Valley and Soquel Creek (millions of gallons)

Month	Base	With Transfers		Added Production	
		Scen 1	Scen 5	Scen 1	Scen 5
November	157.9	181.1	186.0	23.1	28.1
December	158.4	174.1	182.5	15.7	24.1
January	158.6	180.3	188.7	21.7	30.1
February	134.3	160.2	167.0	25.9	32.7
March	151.2	189.8	194.7	38.5	43.5
April	173.5	208.0	210.7	34.6	37.2
TOTAL	**933.9**	**1093.5**	**1129.7**	**159.6**	**195.8**

Surplus Supply

Given these production levels, how much surplus supply is there available at Tait Street to potentially meet other external demands? For our purposes, surplus supply on any day is defined as:

> *The excess of the maximum potential Tait Street diversion over the volume that has already been diverted to meet Santa Cruz, Scotts Valley, and Soquel Creek demands. The maximum potential diversion is the minimum of the available flow at Tait Street and the capacity of the Tait Street*

diversion (11.52 cfs). On days when there are no turbidity constraints at Tait St., the available flow at Tait Street is the Tier 3 Big Trees flow less the diversion at Felton plus the tributary inflows between Felton and Tait Street. On days when Tait St. is shut down due to turbidity, the Tait St. available flow is zero.

Based on this definition, Table 5 shows the expected November-April surplus supply. Because of the additional days of Tait Street operation, the Scenario 5 surplus is 25% larger than Scenario 1.

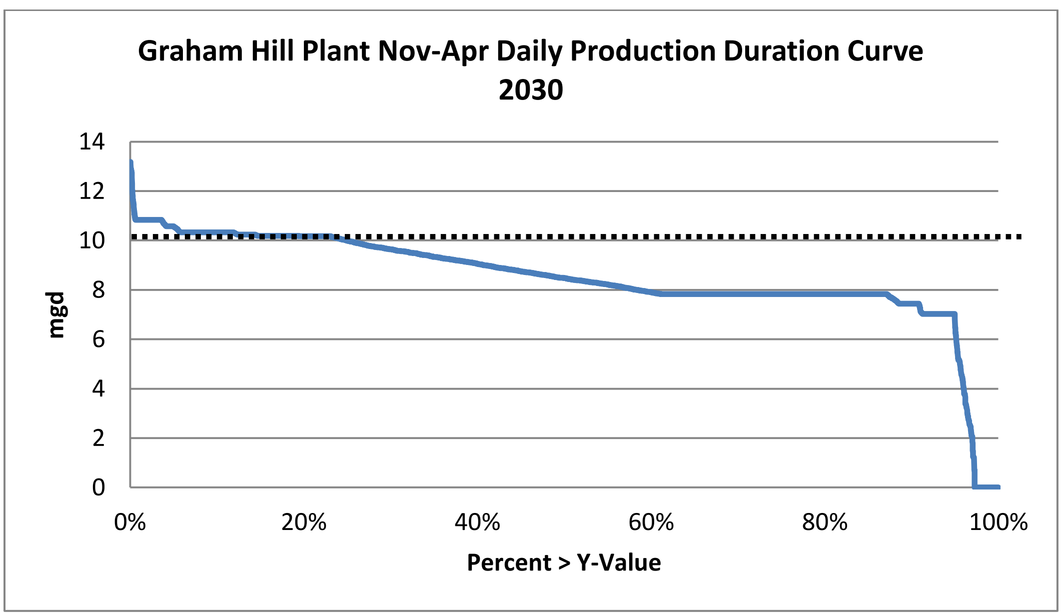
Table 5. Expected 2030 November-April Surplus Supply at Tait Street (millions of gallons)

Year Type	Surplus Supply	
	Scen 1	**Scen 5**
Critically Dry	14	16
Dry	18	22
Normal	44	55
Wet	83	103
Average	**48**	**60**

Treatment Plant Capacity Requirements

Figure 6 shows the Scenario 5 duration curve of Graham Hill treatment plant production required to accomplish the transfers depicted in the tables and charts above. The chart shows that treatment plant usage exceeds the current 10 mgd capacity on 25% of days. Constraining the plant capacity to this level would reduce the total 199 mg average annual transfer shown in Table 2 by about 9% to 182 mg. Put another way, an investment in treatment plant expansion would, at most, result in additional average annual transfers of about 17 million gallons.

Figure 6



Transmission Capacity Requirements

Figure 7 shows the Scenario 5 duration curve for the required transmission capacity to move water from the treatment plant to yield the combined transfer volumes discussed above. Figure 8 shows the duration curve for the required transmission capacity to Scotts Valley, while Figure 9 shows the required capacity to Soquel Creek.

Figure 7

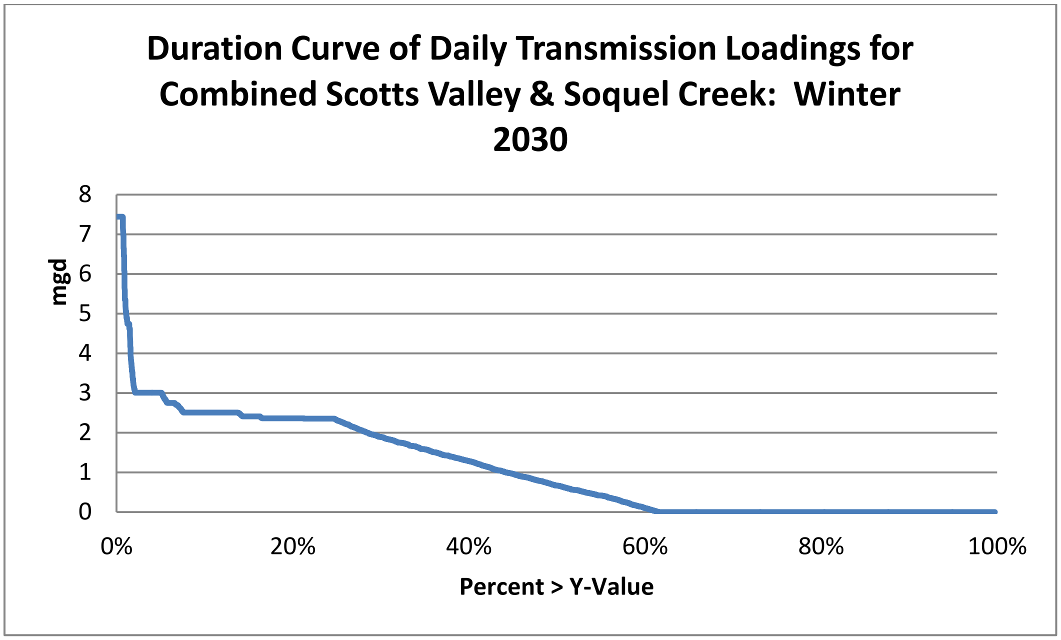


Figure 8

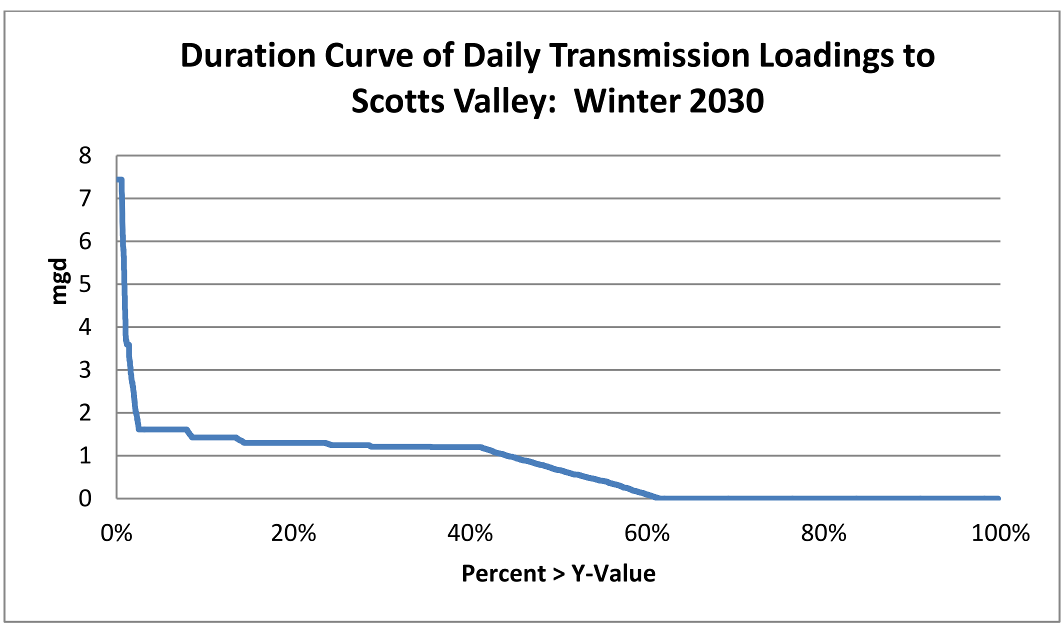
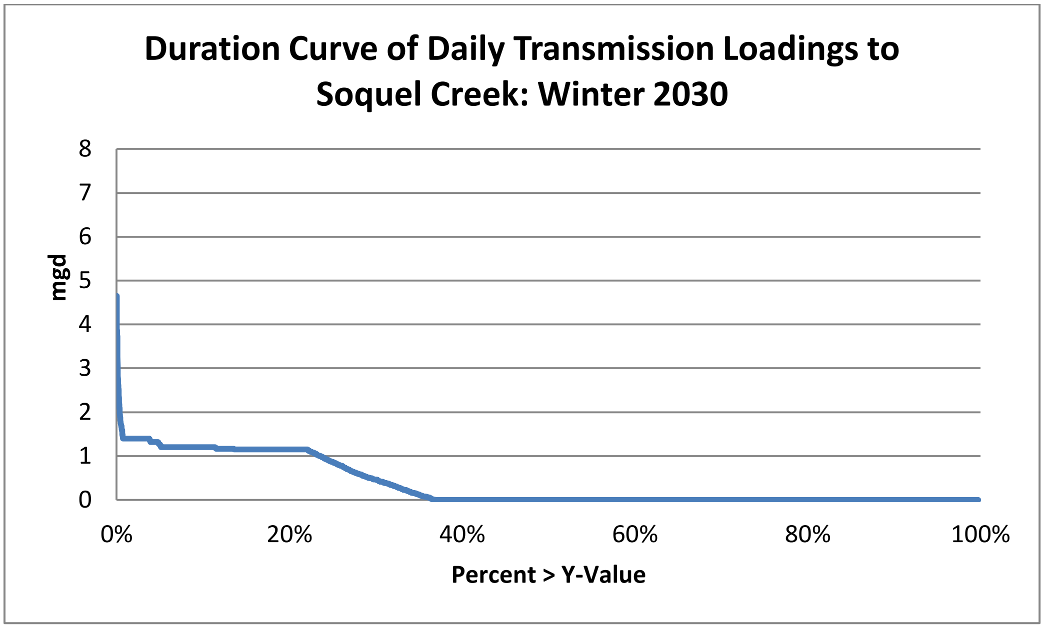


Figure 9



Additional Improvements at GHWTP

By adding two pretreatment processes to the membrane process in order to handle higher organic loads, GHWTP could possibly be upgraded to treat turbidity up to 1000 NTU. This would further relax the turbidity constraint at Tait Street to:

> *On any day that the rainfall at the weather station exceeds 2 inches, the diversion is shut down on that day only.*

While this rule further reduces the number of turbidity days at Tait Street, on all of those days, the North Coast streams would be shut down. All Tait capacity would therefore be needed to meet Santa Cruz demands, so no additional transfers to Scotts Valley or Soquel Creek could be made. The transfer volumes therefore remain unchanged, as do the surplus volumes.

G A R Y F I S K E A N D A S S O C I A T E S , I N C .
Water Resources Planning and Management

Date: June 27, 2013
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Water Transfer Phase 2 Summary

This memorandum presents tables and charts that compare the volumes that can be transferred to Scotts Valley and Soquel Creek under each of the scenarios analyzed in Phase 2. Recall that Phase 2 assumes that the total Soquel Creek demand for all service areas could potentially be served by transferred water.

Specifically, the following infrastructure/water rights scenarios are compared:

- Current infrastructure and water rights
  - With current and unlimited GHWTP capacity
- GHWTP improvements to treat more turbid supplies (current water rights)
  - With current and unlimited GHWTP capacity
- Unconstrained Tait St. capacity and water rights, with unlimited transmission and GHWTP capacity

Table 1 compares the expected annual transfer volumes across scenarios.

Table 1. Comparison of Expected Annual Transfer Volumes (mg)

Scenario	GHWTP Capacity	Scotts Valley	Soquel Creek	Total
1a. Current Infrastructure/ Water Rights	**Current (10 mgd)**	106	39	**145**
	Unlimited	108	95	**204**
5a. GHWTP Improvements to Treat 200 ntu Water	**Current (10 mgd)**	123	55	**178**
	Unlimited	124	136	**260**
Unconstrained Tait St. Capacity	**Unlimited**	154	333	**488**

The table tells us that improving the treatment process at Graham Hill to treat more turbid water has the potential to increase transfers to Soquel Creek by about 40% (either with the current assumed 10 mgd plant capacity or with expanded capacity).

The table also shows that the current 10 mgd plant capacity limits transfers and that augmenting that capacity can increase the expected annual transfer to Soquel Creek by a factor of almost 2.5, with or without treatment process improvements. (Transfers to Scotts Valley are little affected by either treatment plant improvements or capacity expansion.)

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When the capacities of both the Tait Street diversion and the treatment plant are unconstrained, the expected transfer to Soquel Creek is even more substantially increased (by a factor of about 8.5).[1]

Figures 1 and 2 show the distributions of annual transfers to each district over the 73 hydrologic years, assuming unconstrained treatment plant capacity.

Figure 1

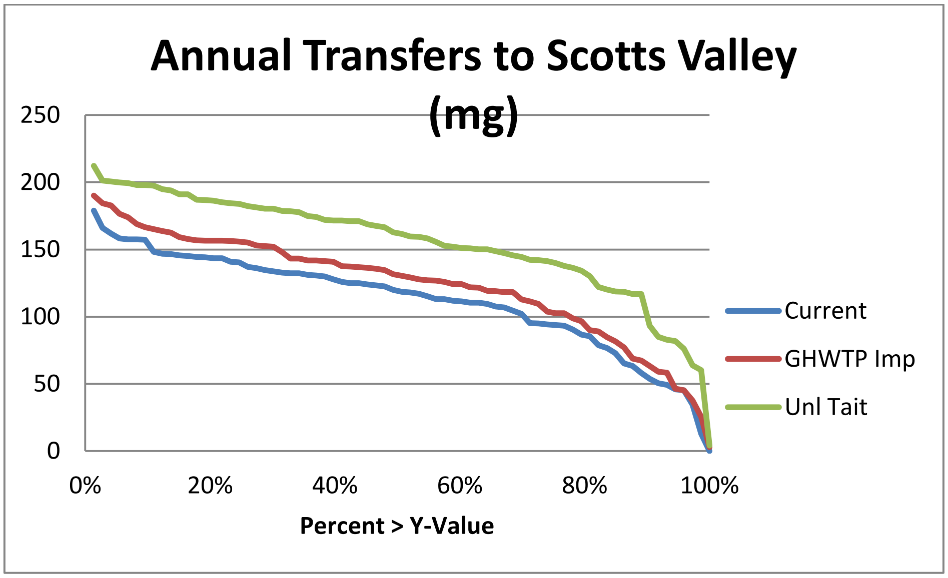
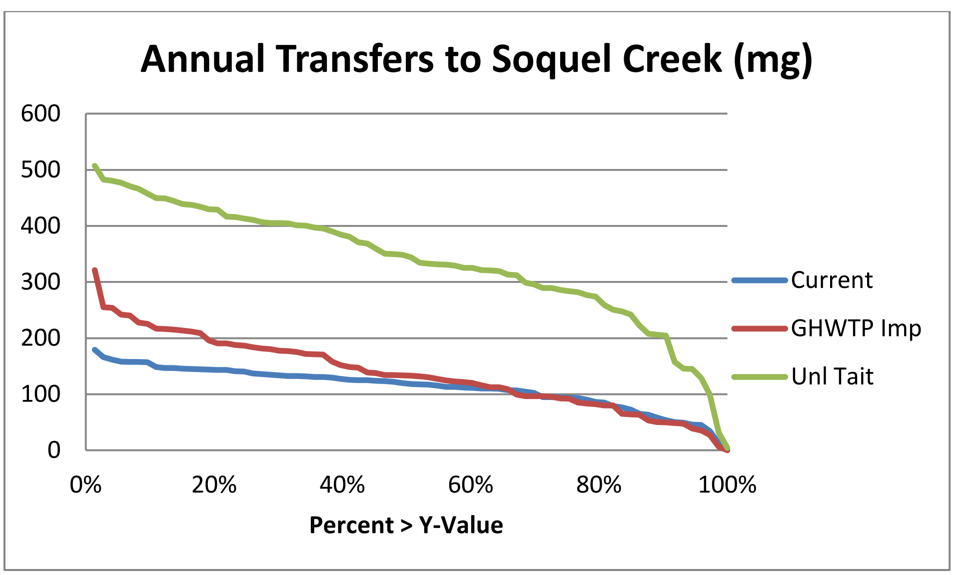


Figure 2



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[1] We did not analyze the case in which Tait Street capacity was increased and GHWTP was simultaneously upgraded to treat more turbid water.

GARY FISKE AND ASSOCIATES, INC.
Water Resources Planning and Management

Date: May 22, 2013
From: Gary Fiske
To: Linette Almond, John Ricker
Re: Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision)

INTRODUCTION

Phase 2 of the analysis of potential water transfers from the Santa Cruz system to Scotts Valley and Soquel Creek assumes that, rather than limiting the Soquel Creek demand that could be served by such transfers to Service Area 1, we will assume that the total Soquel Creek demand for all service areas could potentially be served by transferred water. Task 1 calls for the analysis of two infrastructure/water rights configurations, corresponding to two of the cases analyzed in Phase 1:

- 1a. Current infrastructure and water rights.
- 5a. GHWTP improvements to treat more turbid water.

Aside from the higher Soquel Creek demands, all other Phase 2 assumptions are the same as Phase 1, with the exception of the specification of the turbidity constraint at Tait Street in Scenario 5a. Based on analysis done by Santa Cruz Water Department staff since the Phase 1 report regarding reasonable turbidity constraints, the parameters at Tait Street are set to approximate a 200 ntu turnout threshold.

Discussion of the results and relevant comparisons to the Phase 1 results follow.

DEMANDS

Table 1 shows the assumed monthly demands for the two districts, and compares the Soquel Creek demands to those used in Phase 1. In this and all tables, figures are in millions of gallons.

Table 1. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek Phase 2	Soquel Creek Phase 1
November	42.8	99.2	39.6
December	38.7	93.4	36.1
January	37.2	92.2	35.6
February	33.8	81.5	32.2
March	40.3	98.6	37.4
April	48.3	116.9	41.9
TOTAL	**241.1**	**581.8**	**222.7**

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TRANSFER VOLUMES

Base Case

Tables 2 and 3 compare the monthly average transfers for the Base Case scenarios in Phases 1 and 2.

Table 2. 2030 Monthly Average Transfers Across All Hydrologic Years: Base Case (mg)

Month	Scotts Valley		Soquel Creek		Total	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
November	19.0	19.0	6.0	5.8	25.0	24.8
December	11.5	11.5	5.5	8.1	17.0	19.6
January	13.6	13.6	8.5	14.5	22.1	28.1
February	17.0	17.0	10.6	22.3	27.6	39.3
March	22.8	22.8	15.0	27.8	37.8	50.6
April	25.0	25.0	10.0	16.4	35.0	41.4
TOTAL	**108.9**	**108.9**	**55.6**	**94.9**	**164.5**	**203.7**

Table 3. 2030 Annual Average Transfers by Hydrologic Year Type: Base Case (mg)

Year Type	Scotts Valley		Soquel Creek		Total	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
Critically Dry	70.6	70.6	30.7	41.3	101.3	111.9
Dry	85.1	85.1	31.4	45.9	116.5	131.0
Normal	125.1	125.1	58.2	94.3	183.3	219.4
Wet	122.5	122.5	76.7	144.4	199.2	266.9
AVERAGE	**108.9**	**108.9**	**55.6**	**94.9**	**164.5**	**203.7**

Figures 1-5 show the duration curves by year type for the Base Case transfer volumes.

Figure 1

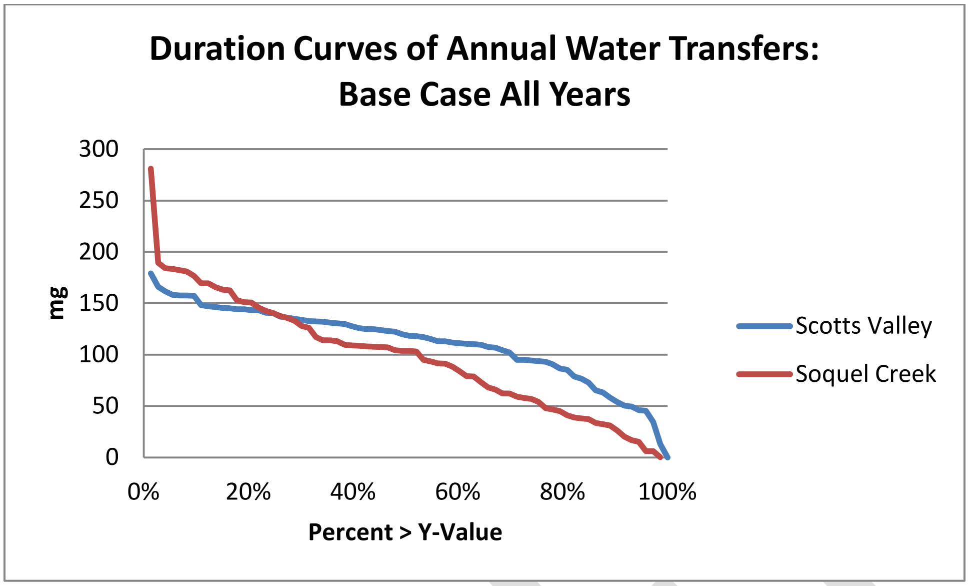


Figure 2

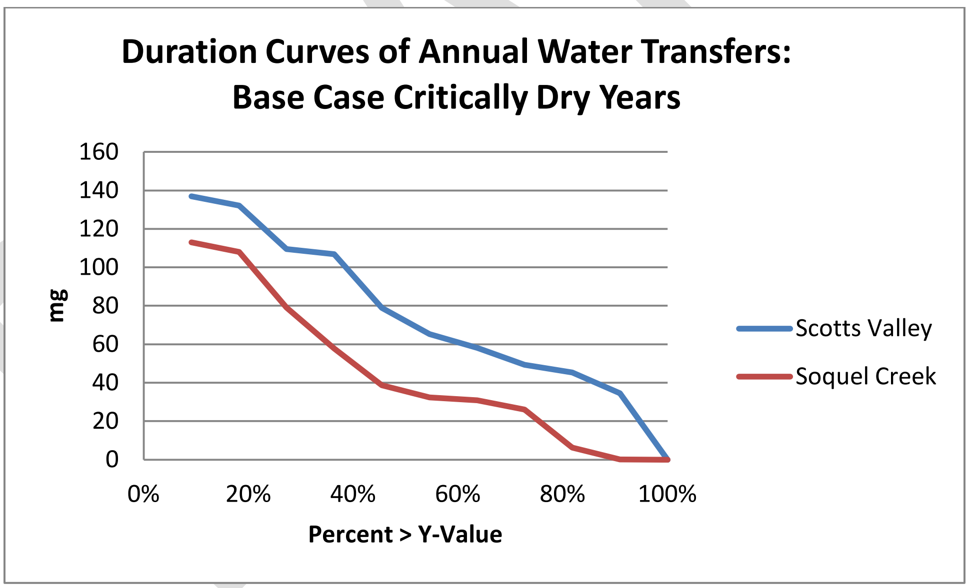


Figure 3

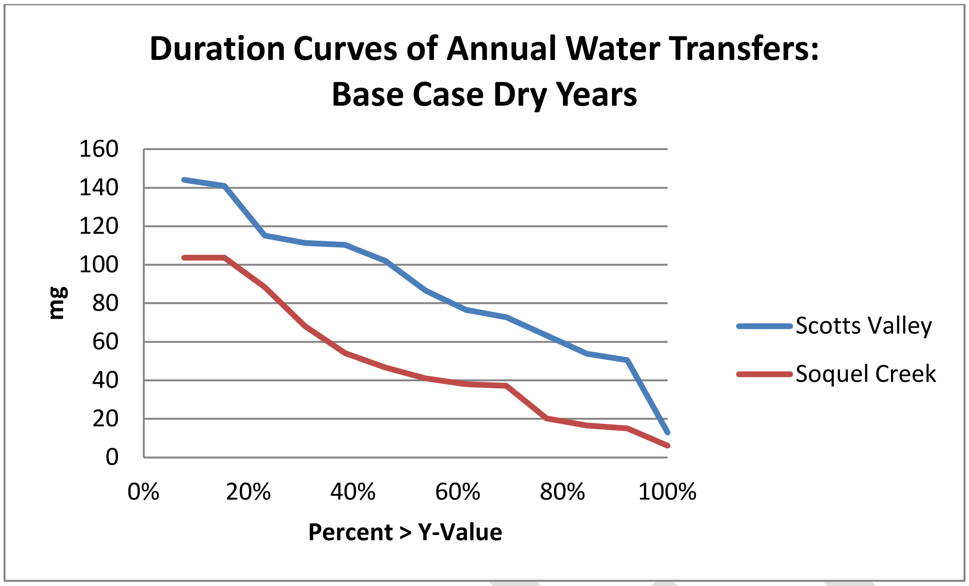


Figure 4

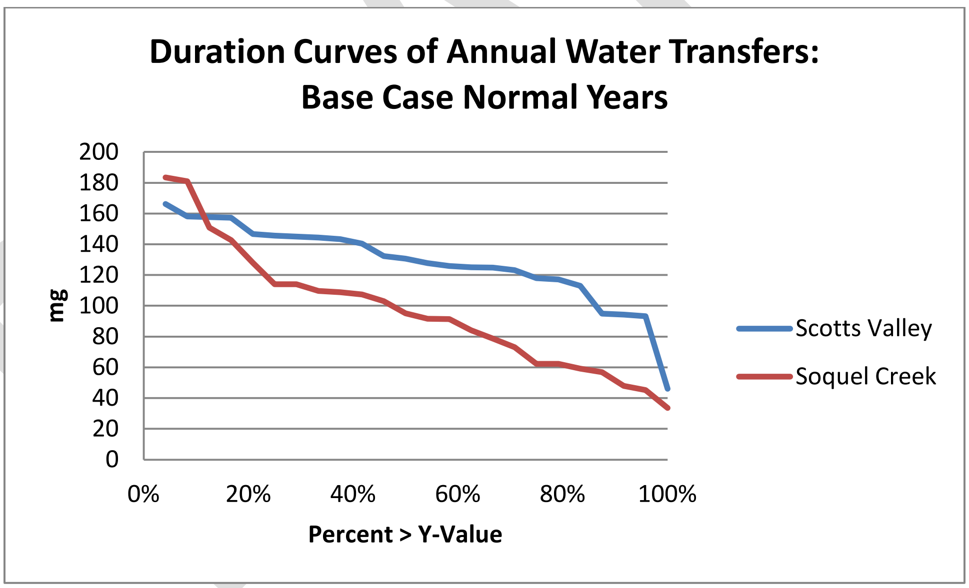
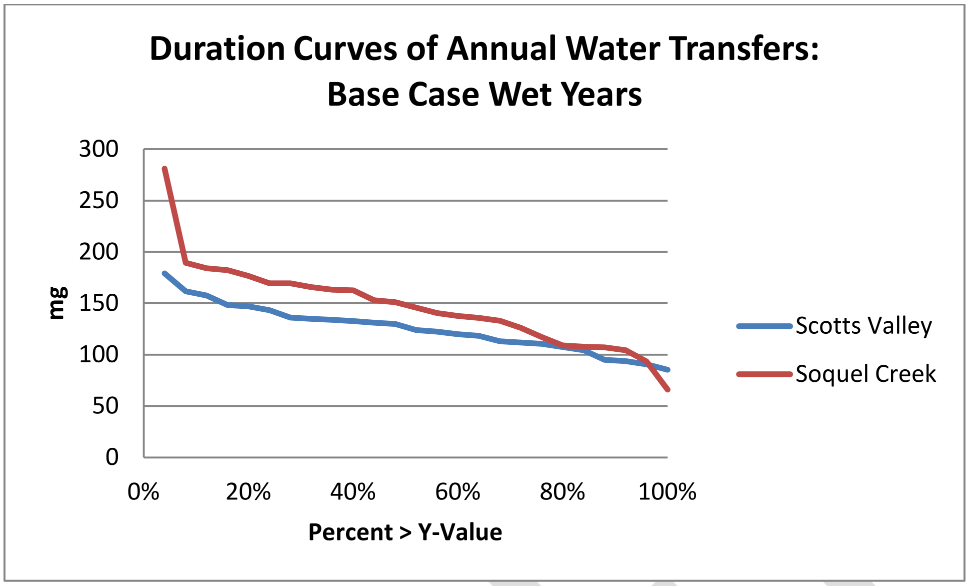


Figure 5



GHWTP Improvements

Tables 4 and 5 compare the monthly average transfers for the Graham Hill treatment plant improvement scenarios in Phases 1 and 2.

Table 4. 2030 Monthly Average Transfers Across All Hydrologic Years: GHWTP Improvements (mg)

Month	Scotts Valley Transfer Volume		Soquel Creek Transfer Volume		Total Transfer Volume	
	Phase 1 [1]	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
November	20.3	20.4	6.5	13.1	26.8	33.5
December	13.8	14.2	7.3	14.9	21.1	29.1
January	16.3	16.4	10.5	21.7	26.8	38.1
February	17.9	18.4	12.4	27.5	30.3	45.9
March	25.8	27.4	16.8	38.5	42.6	65.9
April	26.2	26.8	10.6	20.8	36.8	47.6
TOTAL	**120.3**	**123.6**	**64.2**	**136.5**	**184.4**	**260.1**

[1] The Phase 1 results have been revised to be consistent with methodological changes made in Phase 2.

Table 5. 2030 Annual Average Transfers by Hydrologic Year Type: GHWTP Improvements (mg)

Year Type	Scotts Valley		Soquel Creek		Total	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
Critically Dry	75.5	79.0	33.1	66.8	108.6	145.7
Dry	93.2	98.6	36.8	87.0	130.0	185.7
Normal	136.8	140.9	66.5	135.7	203.3	276.6
Wet	138.2	139.6	89.7	193.8	227.9	333.4
AVERAGE	**120.3**	**123.6**	**64.2**	**136.5**	**184.4**	**260.1**

Figures 6-10 show the duration curves by year type for the transfer volumes with the GHWTP improvements.

Figure 6

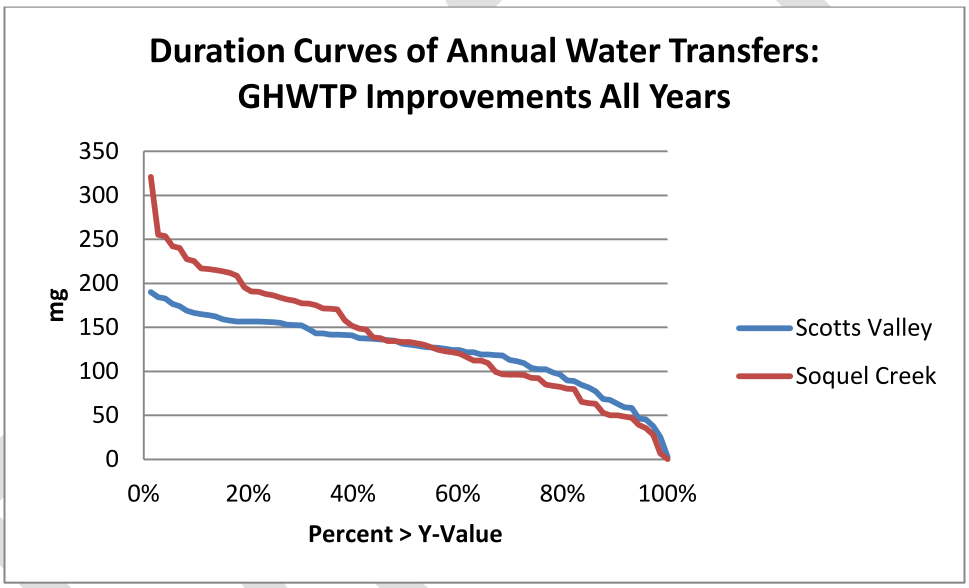


Figure 7

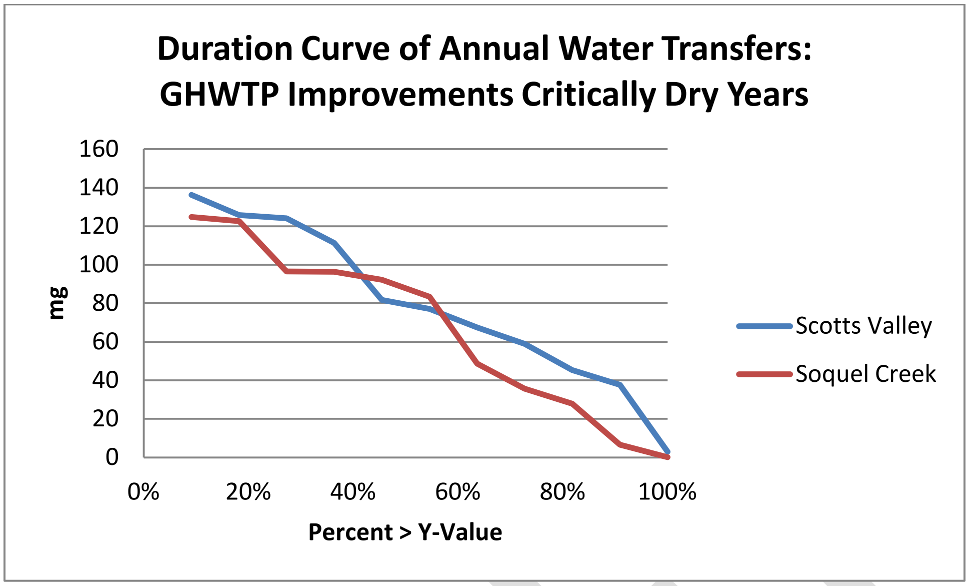


Figure 8

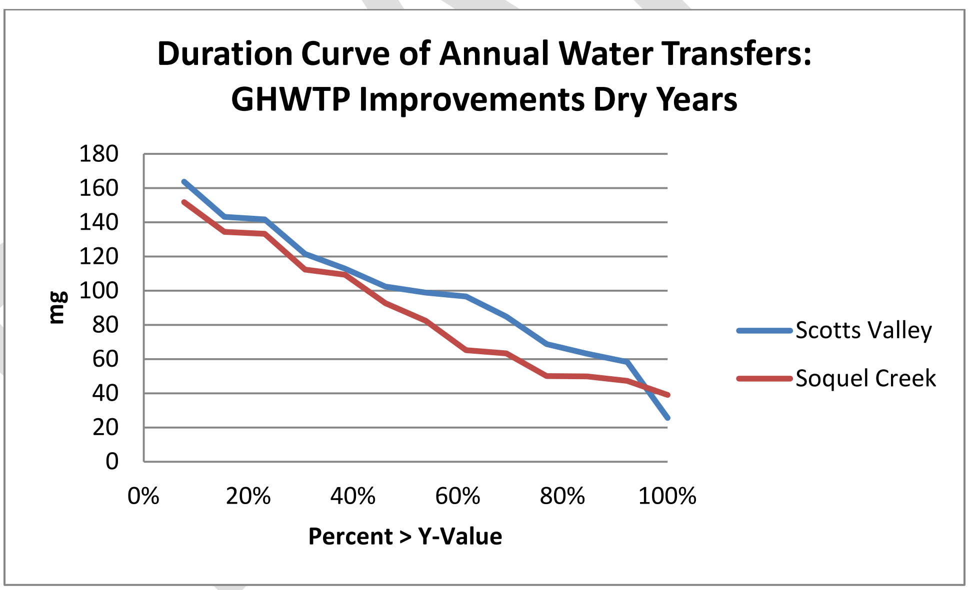


Figure 9

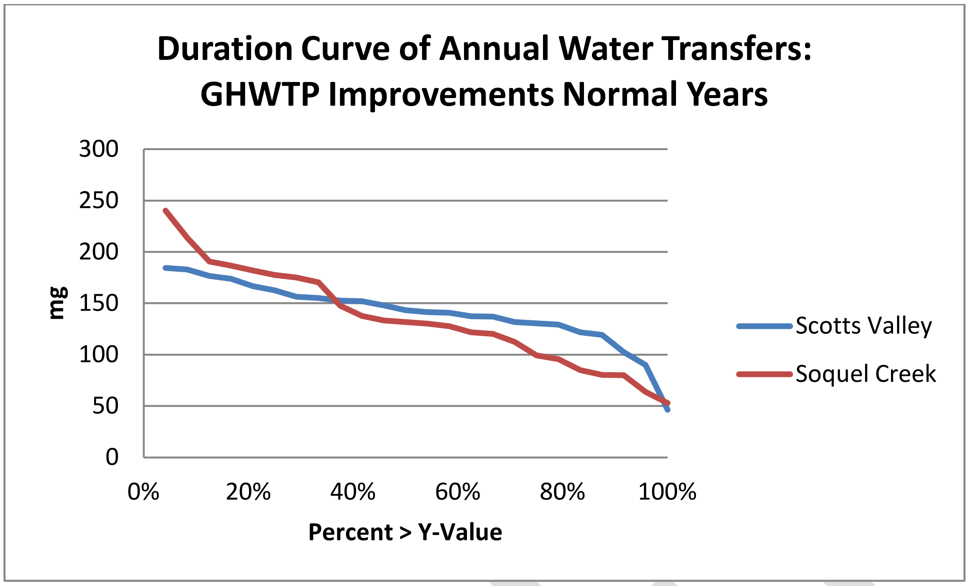
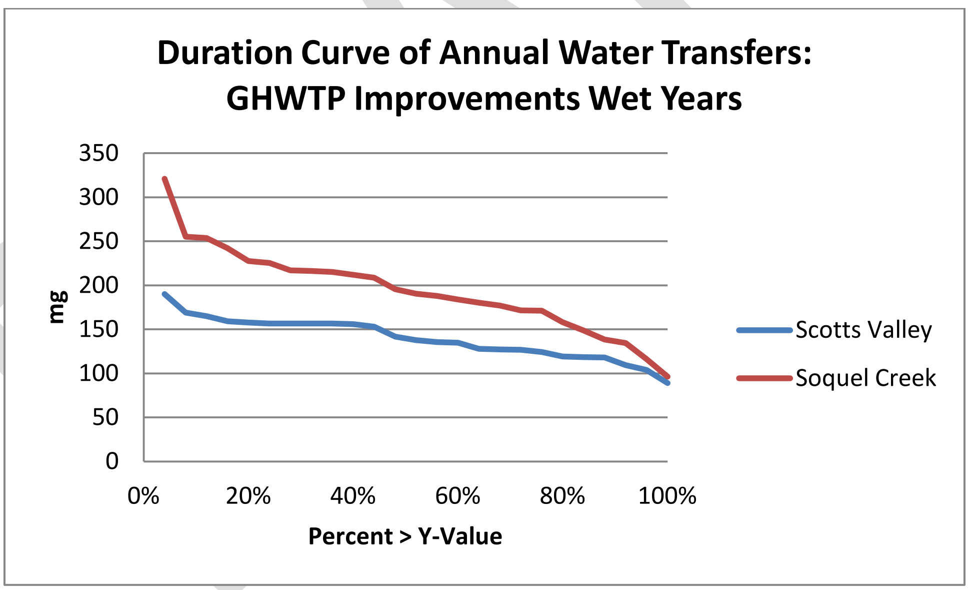


Figure 10



SOURCE PRODUCTION

Table 6 compares the combined expected Tait Street monthly production to the expected production without any transfers.

Table 6. Combined Expected Monthly Tait Street Production (mg)

Month	Without Transfers	With Transfers	
		Base Case (Scen 1a)	GHWTP Imp (Scen 5a)
November	141	166	174
December	127	148	156
January	126	155	165
February	107	143	153
March	121	173	187
April	152	194	200
TOTAL	**775**	**979**	**1035**
INCREMENT	**--**	**204**	**260**

TREATMENT PLANT CAPACITY REQUIREMENTS

Figures 11 and 12 show the duration curves of the Graham Hill treatment plant production required to serve Santa Cruz demand and accomplish the combined transfers to both districts depicted in the tables and charts above.

Figure 11

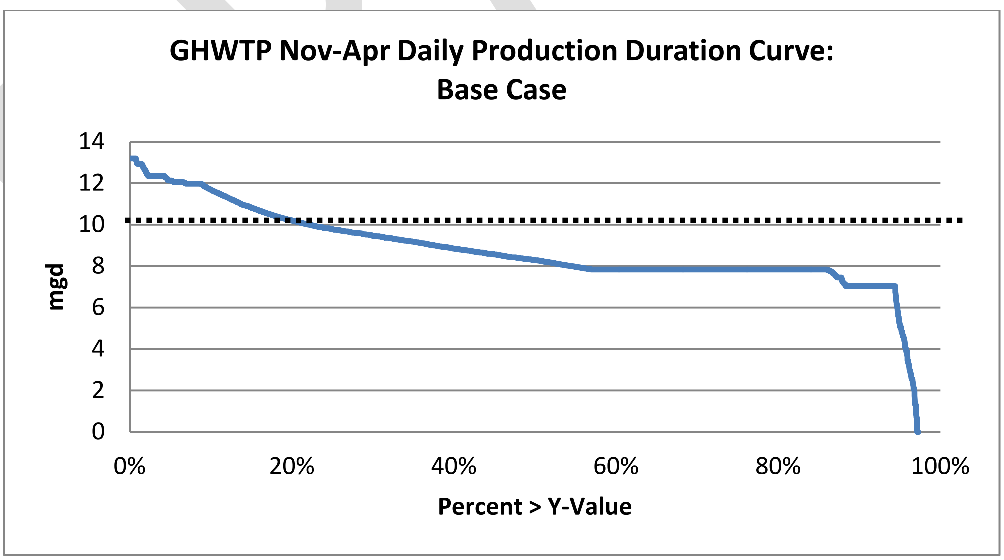


Figure 12

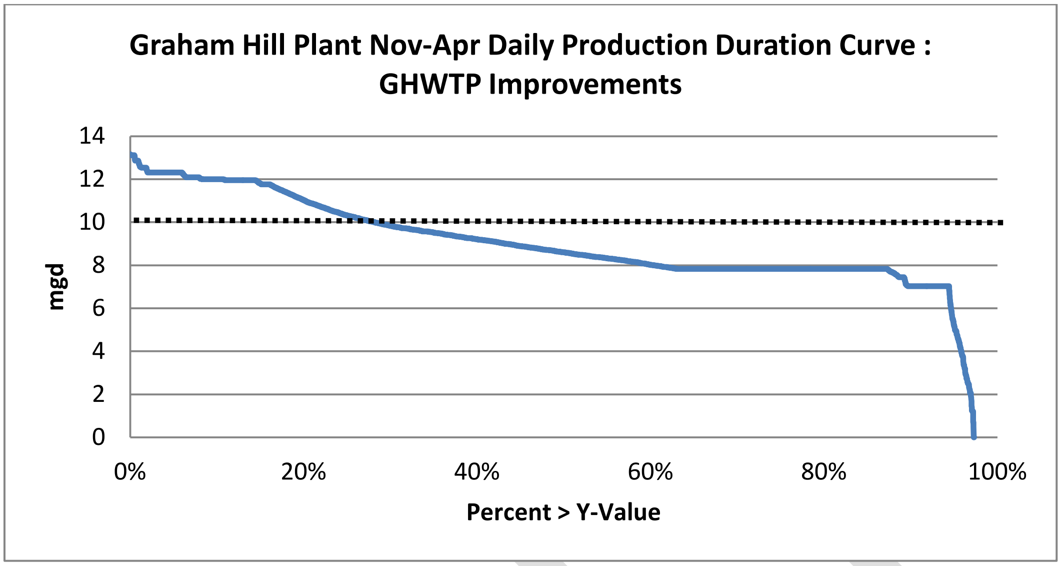


Table 7 shows the percentage of days that the current 10 mgd winter plant capacity limits transfers and the expected volume reduction in the annual combined transfer to the two districts due to this capacity limitation.

Table 7. Impacts of Current GHWTP Capacity on Potential Transfer Volumes

Scenario	Percentage of Days Exceeding 10 mgd	Expected Reduction in Expected Annual Transfer	
		Volume (mg)	Percentage of Potential Transfer
Base	22%	59	28%
GHWTP Improvements	28%	82	31%

The current assumed 10 mgd winter capacity of the treatment plant significantly limits the ability to transfer water to the districts.

TRANSMISSION CAPACITY REQUIREMENTS

Base Case

Figure 13 shows the duration curve for the transmission loadings to move water from the treatment plant to yield the combined transfer volumes discussed above for the Base Case. Figure 14 shows the duration curve for the transmission loadings to Scotts Valley, while Figure 15 shows the loadings to Soquel Creek.[2]

Figure 13

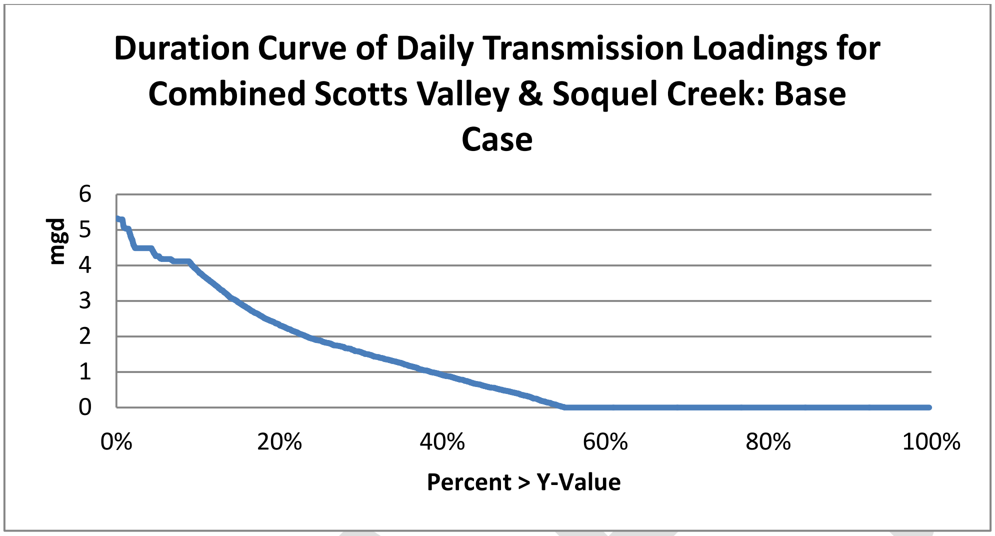
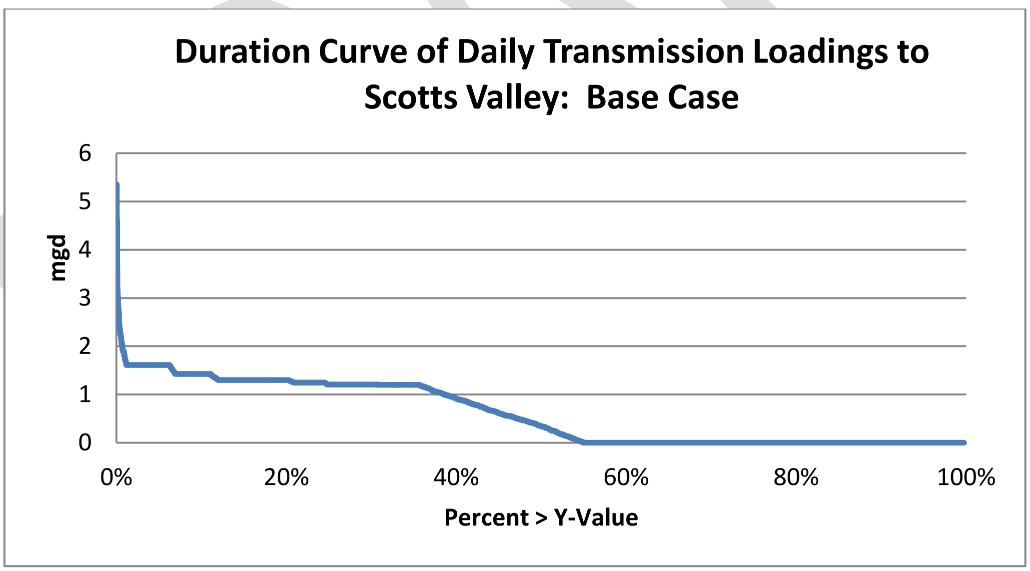
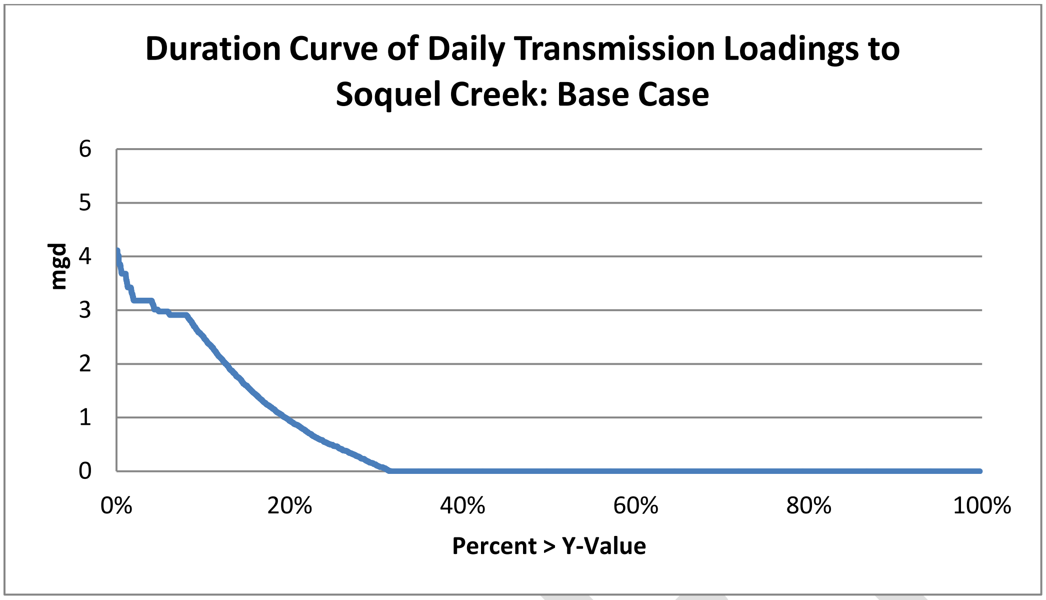


Figure 14



[2] The duration curve in Figure 13 is less than the sum of the two district-specific curves due to the non-coincidence of the daily demands.

Figure 15



GHWTP Improvements

Figure 16 shows the duration curve for the transmission loadings to move water from the treatment plant to yield the combined transfer volumes discussed above for the case of GHWTP improvements. Figure 17 shows the duration curve for the transmission loadings to Scotts Valley, while Figure 18 shows the loadings to Soquel Creek.

Figure 16

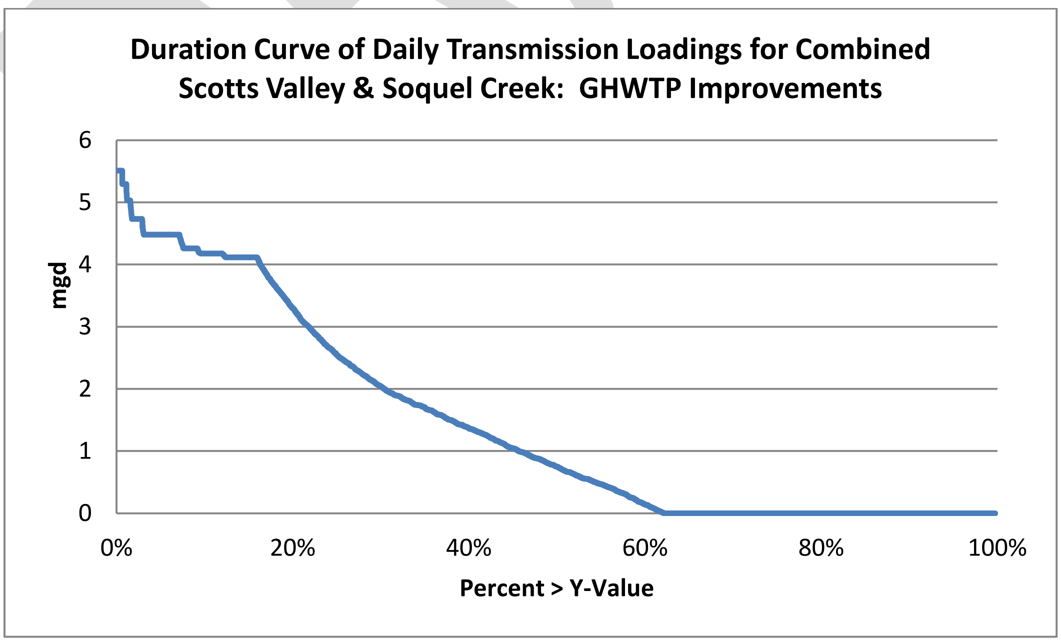


Figure 17

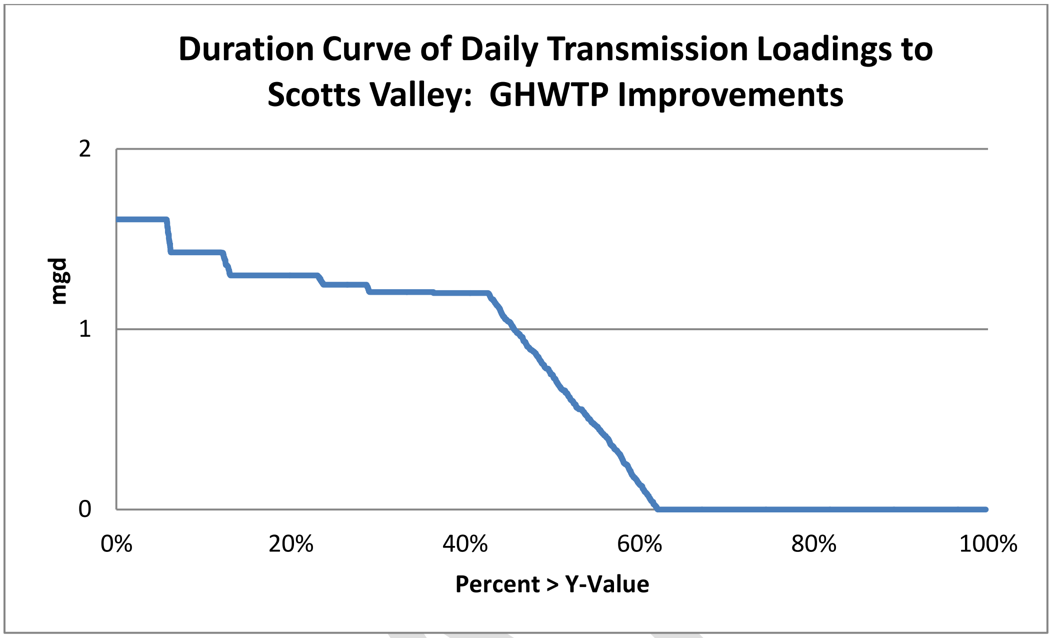
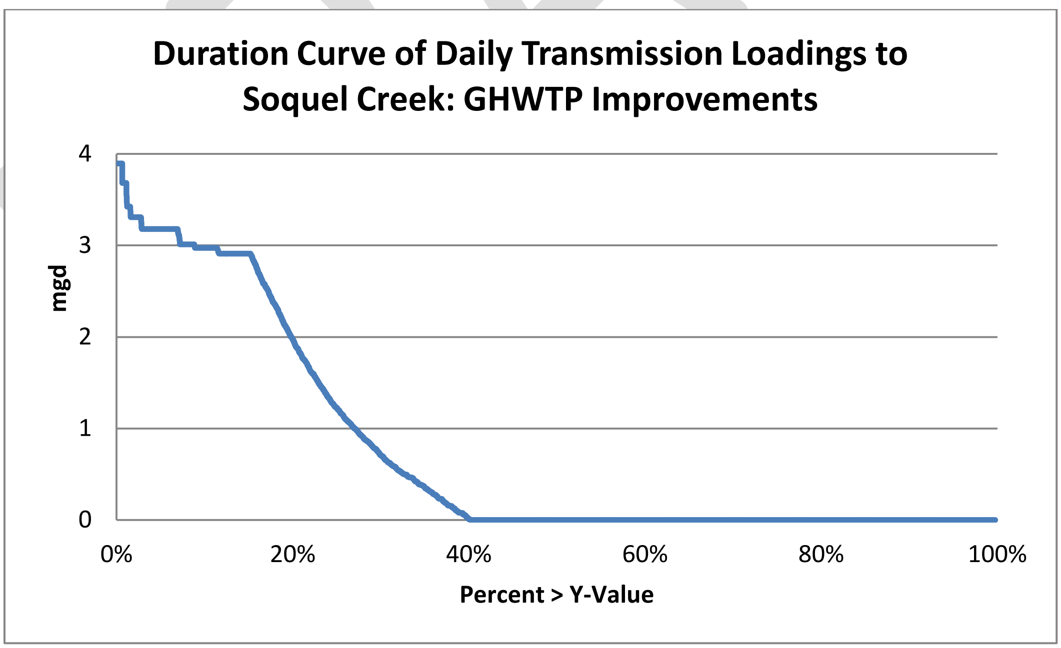


Figure 18



G A R Y F I S K E A N D A S S O C I A T E S , I N C .
Water Resources Planning and Management

Date: February 12, 2014
From: Gary Fiske
To: Kevin Crossley
Cc: Heidi Luckenbach
Re: Volumetric Shortage Analysis for Water Transfer Project

As we discussed, this memorandum contains charts and tables that specify the distributions of total volumetric peak-season shortages. Consistent with the earlier short-term analysis, these distributions assume Tier 3 flows, current infrastructure, and 3500 MG annual demand.

Table 1 shows the peak-season shortage for the 25 hydrologic years for which there is any shortage. All of the other hydro years show a zero peak-season shortage.

Figure 1 shows the corresponding peak-season shortage duration curve over all years and Figure 2 depicts the shortages in these 25 years.

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Table 1. Volumetric Peak-Season Shortages

Hydro Year	Peak Season Shortage (MG)
1977	1,580
1976	1,100
1988	1,045
1961	1,009
1991	897
1972	878
1992	874
1990	807
1989	730
1939	680
1987	633
1994	431
2009	387
1981	373
2008	373
1947	294
1966	261
1962	249
1948	240
1960	193
1964	182
1993	72
1986	61
1971	57
1949	5
All other yrs	0
Mean over all years	**184**

Figure 1. Peak-Season Shortage Duration Curve Over All Hydrologic Years

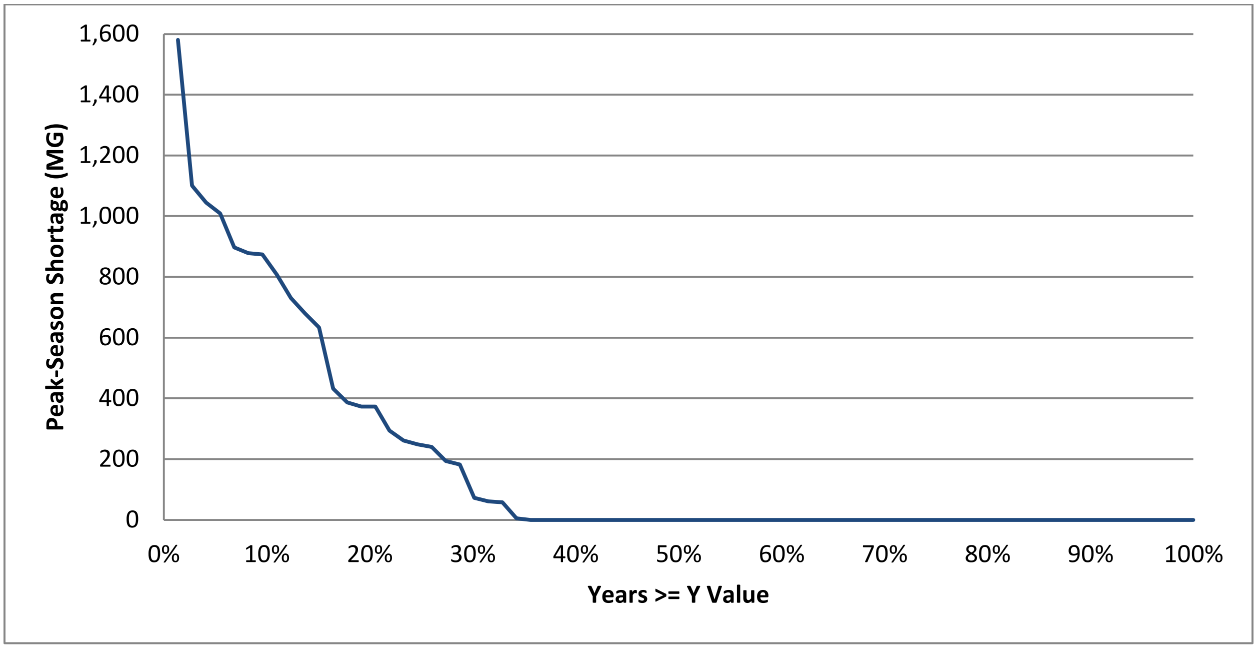
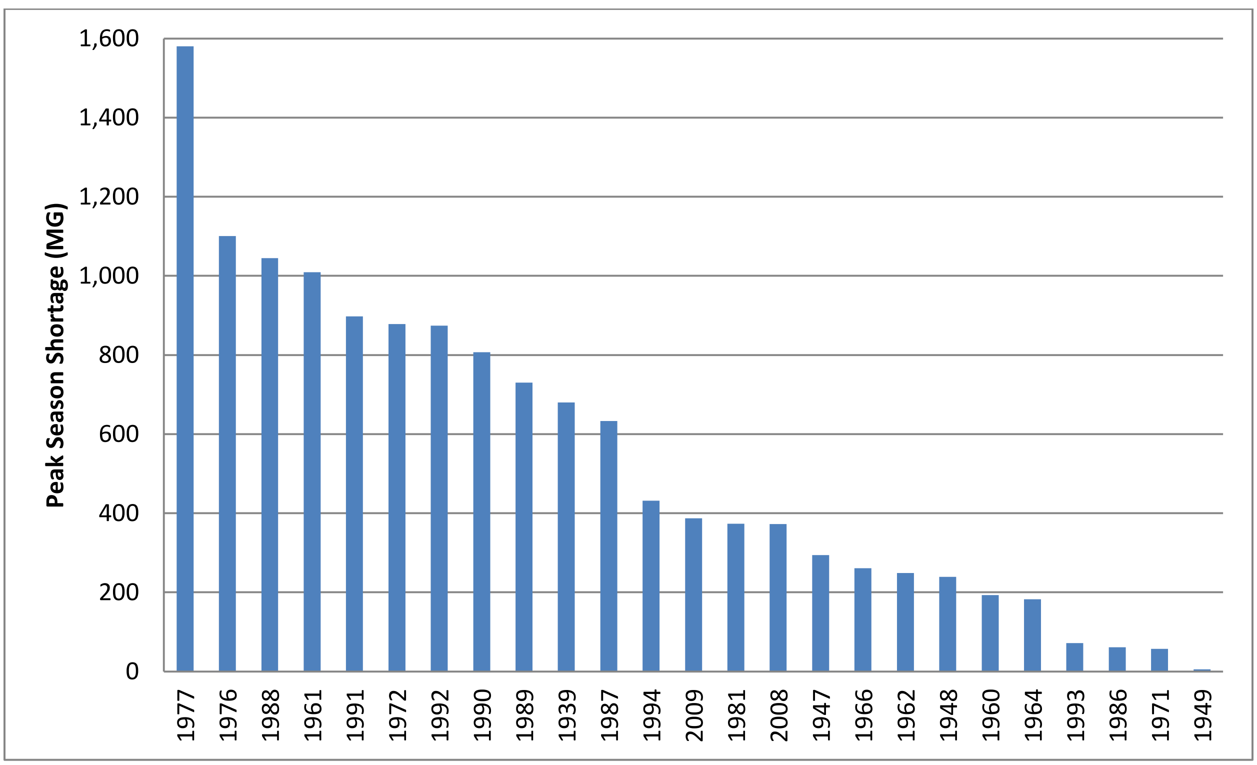


Figure 2. Hydrologic Years with Non-Zero Peak Season Shortages



CITY OF SANTA CRUZ WATER DEPARTMENT

AND

SOQUEL CREEK WATER DISTRICT

INTERTIE CAPACITY ANALYSIS

FINAL

February 19, 2014

AKEL
ENGINEERING GROUP, INC.

Table 1 Intertie Analysis Results
Existing City / District Intertie Capacities
City of Santa Cruz Water Department / Soquel Creek Water District

Assumptions

Analysis Scenarios: Run No.	Run Description	Demand Condition	City: Existing Demands	City Supply Sources: GHWTP	City Supply Sources: Beltz Wells	City Supply Sources: Transfer Pump from District	City Supply Sources: Total Available Supply	District: Existing Demands	District: Total Demand in SA1 and SA2	Active Wells - SA 1: New Cunnison Lane	Garnet	Main Street	New O'Neill Ranch	Rosedale	Tannery II	Active Wells - SA 2: Aptos Creek	New Austrian Way Tank Site	Estates	New Granite Way	Ledyard	Madeline	T. Hopkins	McGregor Pump Station Active (SA1 to SA2)
			(MGD)	(MGD)	(MGD)		(MGD)	(MGD)		(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)	(Y/N)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Transfer from City to District																							
1-1		Min Month (Nov. - April)	6.8	6.8	0	0	6.8	3.2	1.48	-	Y	Y	Y	Y	N	N	-	N	-	Y	N	N	Y
1-2		Min Month (Nov. - April)	6.8	6.8	0	0	6.8	3.2	1.48	-	N	Y	Y	Y	N	N	-	N	-	Y	N	N	Y
1-3		Min Month (Nov. - April)	6.8	6.8	0	0	6.8	3.2	1.48	-	Y	Y	N	Y	N	N	-	N	-	Y	N	N	Y
1-4		Min Month (Nov. - April)	6.8	6.8	0	0	6.8	3.2	1.48	-	N	Y	N	Y	Y	N	-	N	-	Y	N	N	Y
1-5		Min Month (Nov. - April)	6.8	6.8	0	0	6.8	3.2	1.48	-	N	N	N	Y	Y	N	-	N	-	Y	N	N	Y
1-0	**Existing System Operation (Baseline)**	Min Month (Nov. - April)	6.8	6.8	0	0	6.8	3.2	1.48	-	Y	Y	Y	Y	N	N	-	N	-	Y	N	N	Y
1-6 and 1-7	**System Operation with Existing System Interties Active**	Min Month (Nov. - April)	6.8	6.8	0	0	8.28	3.2	1.48	-	N	N	N	N	N	N	-	N	-	N	N	N	Y
1-8	**System Operation with Upsized Existing Interties**	Min Month (Nov. - April)	6.8	6.8	0	0	8.28	3.2	1.48	-	N	N	N	N	N	N	-	N	-	N	N	N	Y
1-9	**System Operation with 8-inch Intertie at Soquel**	Min Month (Nov. - April)	6.8	6.8	0	0	8.28	3.2	1.48	-	N	N	N	N	N	N	-	N	-	N	N	N	Y
Transfer from District to City																							
2-1		Max Month	1.25	12.0	0.8	0	12.8	5.3	3.58	-	Y	Y	Y	Y	Y	N	-	Y	-	Y	N	N	Y
2-2		Max Month	1.25	12.0	0.8	0	12.8	5.3	3.58	-	Y	Y	Y	Y	Y	N	-	Y	-	Y	N	N	Y
2-3		Max Month	1.25	12.0	0.8	0	12.8	5.3	3.58	-	Y	Y	N	Y	Y	N	-	Y	-	Y	N	N	Y
2-0	**Existing System Operation (Baseline)**	Max Month	1.25	12.0	0.8	0	12.8	5.3	3.58	-	Y	Y	Y	Y	Y	N	-	N	-	Y	N	N	Y
2-4 and 2-5	**System Operation with Transfer Pump**	Max Month	12.5	10.2	0.8	1.5	12.5	5.3	3.58	-	Y	Y	N	Y	Y	Y	-	Y	-	Y	Y	Y	N

Analysis Results

Run No.	41st Ave and Soquel Dr Intertie: Daily Average Flow	Max Daily Flow	Peak Hour Flow	Average Headloss Through Valve	Average City Pressure	Average District Pressure	41st Ave and Jade St Intertie: Daily Average Flow	Max Daily Flow	Peak Hour Flow	Average Headloss Through Valve	Average City Pressure	Average District Pressure	41st Ave and Bain Ave Intertie: Daily Average Flow	Max Daily Flow	Peak Hour Flow	Average Headloss Through Valve	Average City Pressure	Average District Pressure	Total Daily Flow	Max Daily Flow	Figures	Analysis Comments
	(gpm)	(gpm)	(gpm)	(ft)	(psi)	(psi)	(gpm)	(gpm)	(gpm)	(ft)	(psi)	(psi)	(gpm)	(gpm)	(gpm)	(ft)	(psi)	(psi)	(gpm)	(gpm)		
1	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Transfer from City to District																						
1-1	64	-		8	65	55	32	-		8	85	75	2	-		11	90	80	98	-	Figure 1	Analysis used the existing intertie sizes (6, 4, and 2 inches)
1-2	95	-		8	65	55	39	-		10	85	75	8	-		11	90	80	142	-	Figure 2	Analysis used the existing intertie sizes (6, 4, and 2 inches)
1-3	106	-		7	65	55	24	-		8	85	75	7	-		12	90	81	137	-	Figure 3	Analysis used the existing intertie sizes (6, 4, and 2 inches)
1-4	89	-		8	65	55	24	-		11	85	74	5	-		11	90	79	118	-	Figure 4	Analysis used the existing intertie sizes (6, 4, and 2 inches)
1-5	209	-		8	65	55	60	-		9	84	75	10	-		11	90	80	279	-	Figure 5	Analysis used the existing intertie sizes (6, 4, and 2 inches)
1-0	-	-	-	-	66	55	-	-	-	-	86	75	-	-	-	-	91	80	-	-	**Figure 9:** Existing MinMD City System Headlosses **Figure 10:** Existing MinMD District System Headlosses **Figure 11:** MinMD Tank, Pump, and Well operations	System headlosses and tank operation during Minimum Month Demands for comparison purposes.
	6 -inch						**4 -inch**						**2 -inch**									
1-6 and 1-7	669	902	1023	7	61	55	298	403	451	6	81	76	61	83	92	4	87	80	1,028	1,388	**Figure 12:** City Headlosses with Interties Active **Figure 13:** District Headlosses with Interties Active **Figure 14:** Tank, Pump, and Well operations with Interties Active	Hydraulic analysis indicates the City system can provide the total zone demands for SA1 and SA2 (1.48 MGD or 1,028 gpm) through the existing interties, however headlosses in the City's and the District's system can increase up to 4 ft/1,000ft.
	8 -inch						**6 -inch**						**6 -inch**									
1-8	640	1,058	1,199	3	60	55	221	366	400	1	81	76	167	277	307	1	87	81	1,028	1,701	**Figure 15:** City Headlosses with 8-inch Intertie **Figure 16:** District Headlosses with 8-inch Intertie **Figure 17:** Tank, Pump, and Well operations with 8-inch Intertie	Hydraulic analysis indicates the City system can provide the total zone demands for SA1 and SA2 (1.48 MGD or 1,028 gpm) through the upsized interties, however headlosses in the City's and the District's system can increase up to 5 ft/1,000ft.
	8 -inch						**4 -inch**						**2 -inch**									
1-9	726	1,103	1,260	3	60	55	250	351	430	5	81	76	52	79	90	4	87	81	1,028	1,533		

Run No.	Transfer Pump Flow (gpm)	Pressures (41st Ave and Soquel Dr): City (psi)	Pressures (41st Ave and Soquel Dr): District (psi)	Figures	Analysis Comments
Transfer from District to City					
2-1	0	64	55	Figure 6	City unable to receive water through interties due to head difference during MMD
2-2	786 (O'Neill well)	64	-	Figure 7	Water transferred via O'Neill Well pumping directly to City
2-3	1,000	66	53	Figure 8	Water transferred via new transfer pump station at O'Neill Well site.
2-0	-	64	55	**Figure 18:** Existing MDD City System Headlosses **Figure 19:** Existing MDD District System Headlosses **Figure 20:** MDD Tank, Pump, and Well operations	System headlosses and tank operation during Maximum Month Demands for comparison purposes.
2-4 and 2-5	1,000	69	53	**Figure 21:** City Headlosses with Transfer Pump **Figure 22:** District Headlosses with Transfer Pump **Figure 23:** Tank, Pump, and Well operations with Transfer Pump	Hydraulic analysis indicates the District system can provide approximately 1,000 gpm through a transfer pump near 41st Ave and Soquel Dr, however headlosses in the City's and District's system can increase up to 4 ft/1,000ft. District well production and operation time in SA1 increases due to the transfer pump.

2/14/2014

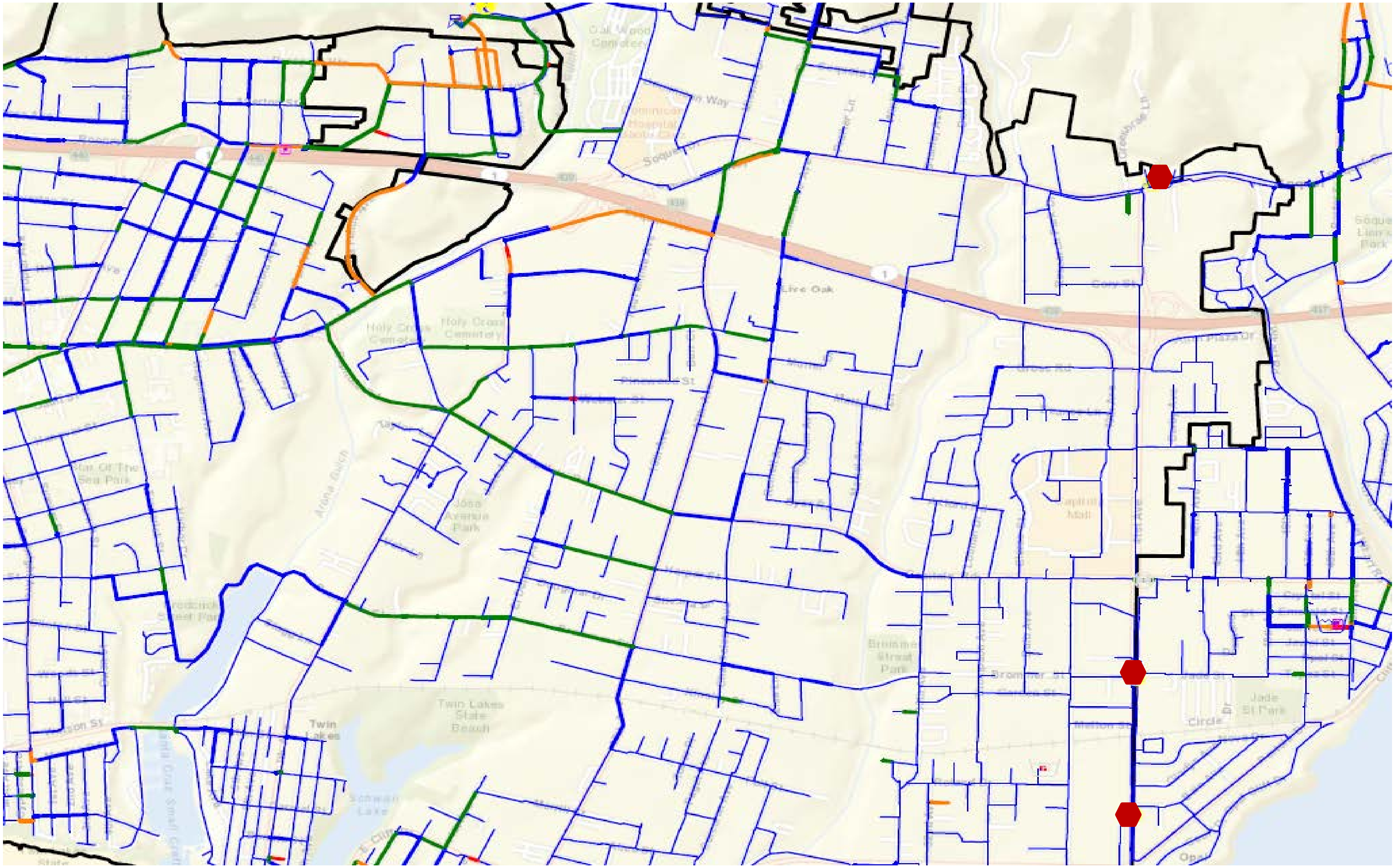
Table 2 District Well Run Times

Existing City / District Intertie Capacities
City of Santa Cruz Water Department / Soquel Creek Water District

	Existing Maximum Month Demands			Scenario 2-4 and 2-5 Maximum Month Demands plus 1,000 gpm Transfer to City		
	Run Time[1] (hr)	Max Flow (gpm)	Daily Average (gpm)	Run Time[2] (hr)	Max Flow (gpm)	Daily Average (gpm)
SA1 - 244						
Garnet	8	636	212	8	644	214
Rosedale	16	927	604	21	935	812
Main Street	16	876	569	21	883	767
Tannery II	16	1,020	662	21	1,024	895
O'Neill	-	-	-	-	-	-
SA2 - 244						
Madeline	4	203	37	9	203	78
Aptos/T-Hopkins	0	0	0	4	420	72
Estates	11	630	283	18	655	480
SA2 - 420						
Ledyard	8	194	61	8	194	61
SA3 - 359						
Aptos	11	377	173	11	377	173
Country Club	10	360	149	10	360	149
Bonita	11	927	427	11	927	427
San Andreas	11	956	440	11	956	440
Seascape	-	-	-	-	-	-
SA4 - 244						
Altivo	-	-	-	-	-	-
Sells	-	-	-	-	-	-

Notes: 2/19/2014

1. The well run times listed are with the McGregor pump station active (run time: 11 hrs)
   If the McGregor pump station is inactive the well run times in SA1 are reduced to 8, 13, 13, and 13 hours respectively, and SA2 well run times will increase to approximately 9, 4, and 18 respectively
2. The McGregor pump station is inactive during this scenario



LEGEND

Intertie Locations

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Minimum Month Demands
- No intertie flow
- Beltz Wells inactive

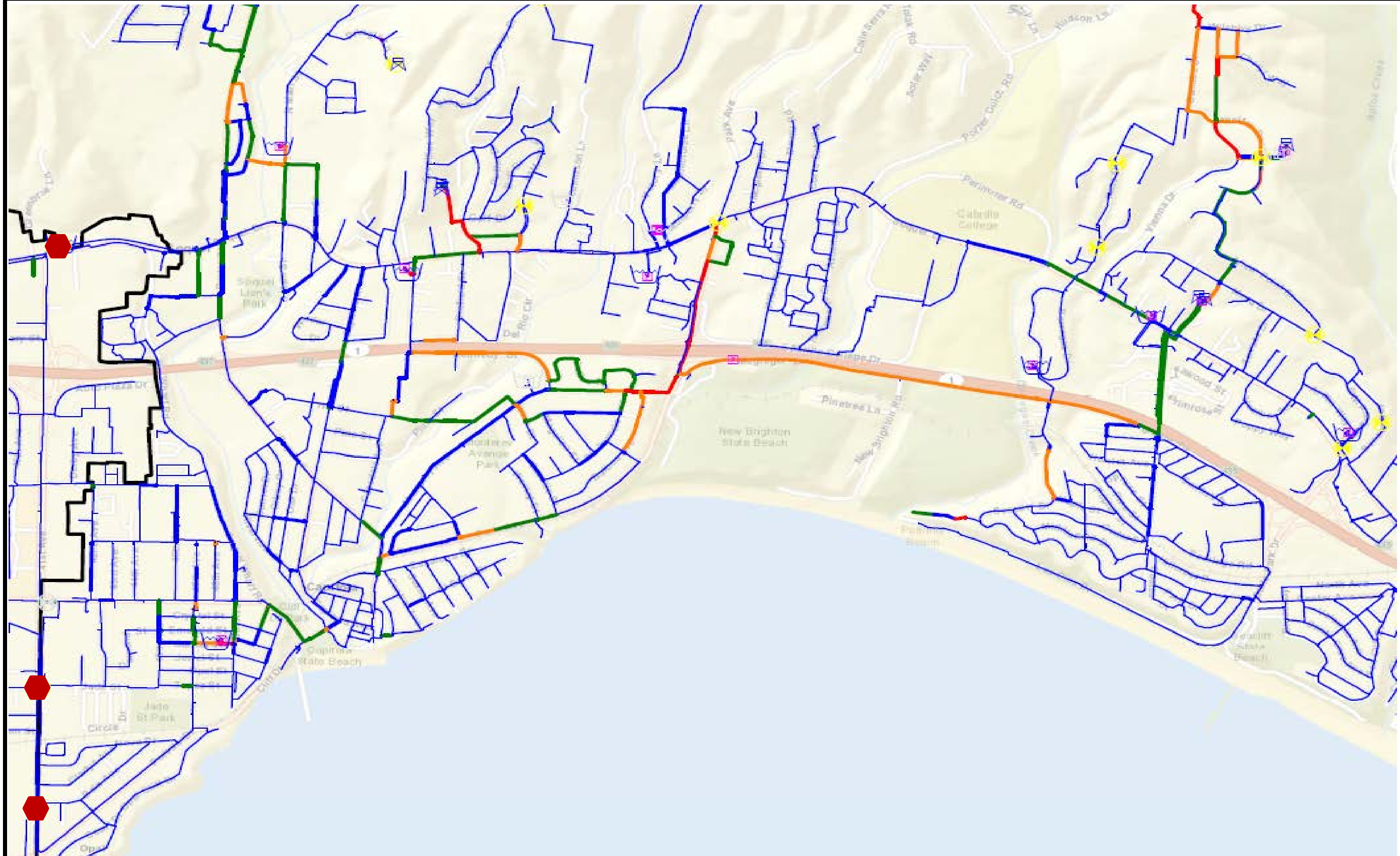
February 7, 2014

Figure 9

City of Santa Cruz
Existing MinMD Headlosses

Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

Intertie Locations

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Minimum Month Demands
- No intertie flow

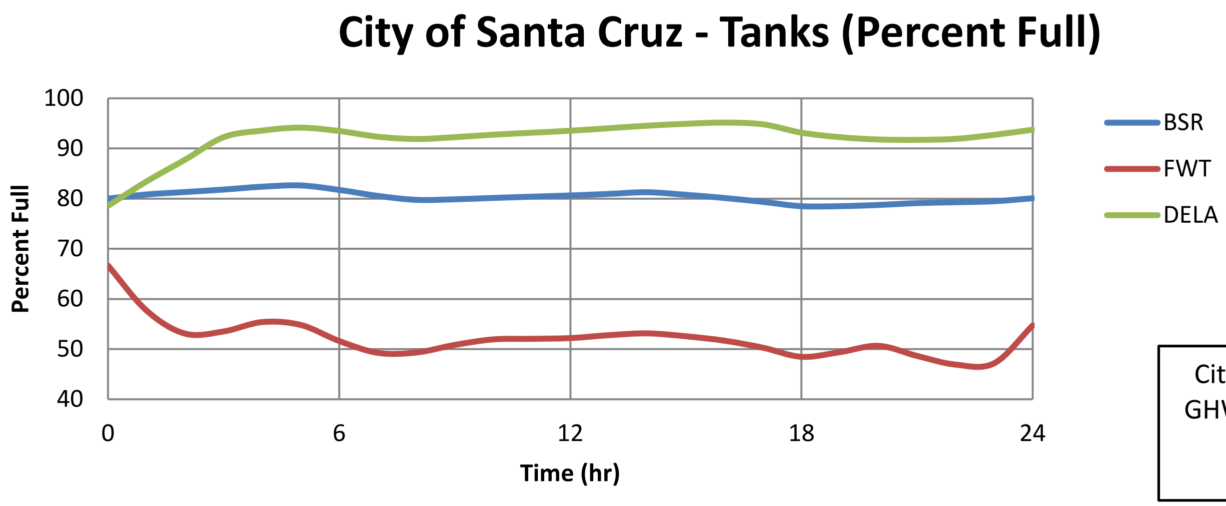
February 7, 2014

Figure 10

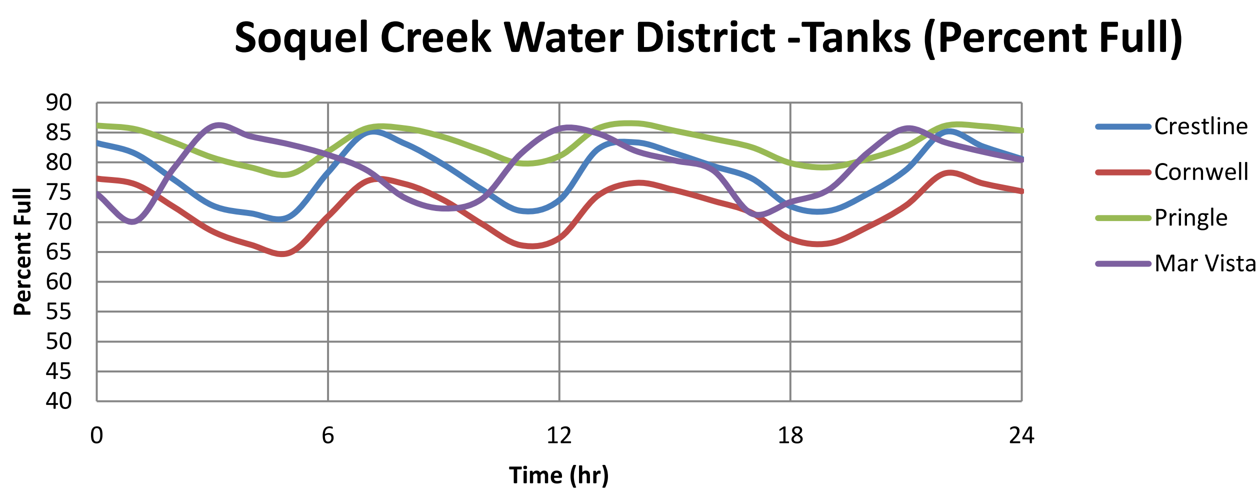
Soquel Creek Water District
Existing MinMD Headlosses

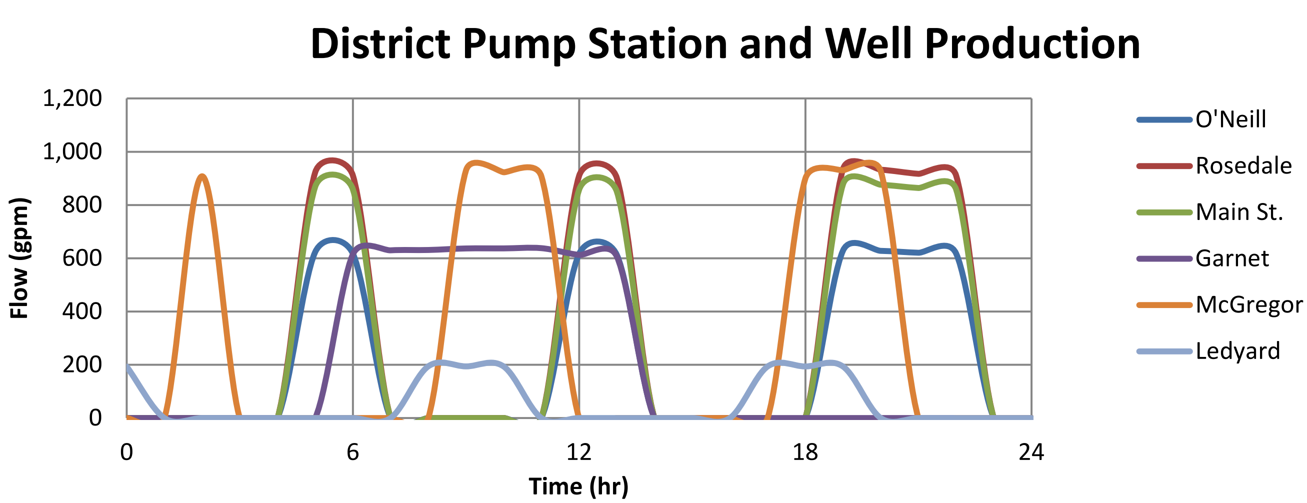
Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

AKEL ENGINEERING GROUP, INC.



City Production:
GHWTP: 6.8 MGD
Beltz: 0





NOTES:

February 11, 2014

Figure 11

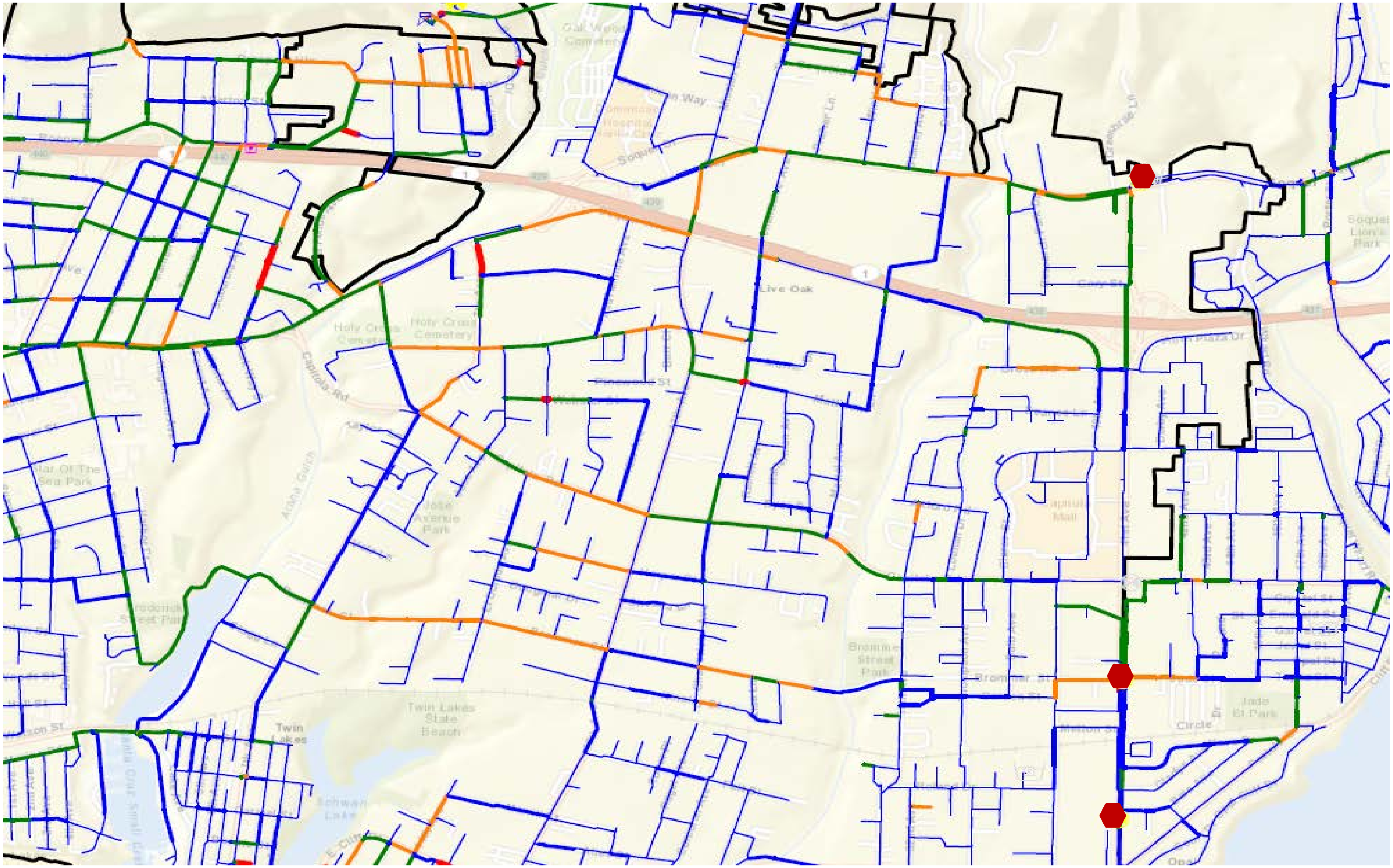
MinMD Existing System Operation

Existing Intertie Capacities

SANTA CRUZ

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.



LEGEND

- Intertie Locations

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Minimum Month Demands
- Interties supplying District SA1 and SA2 demands (1.48 MGD)
- Beltz Wells inactive

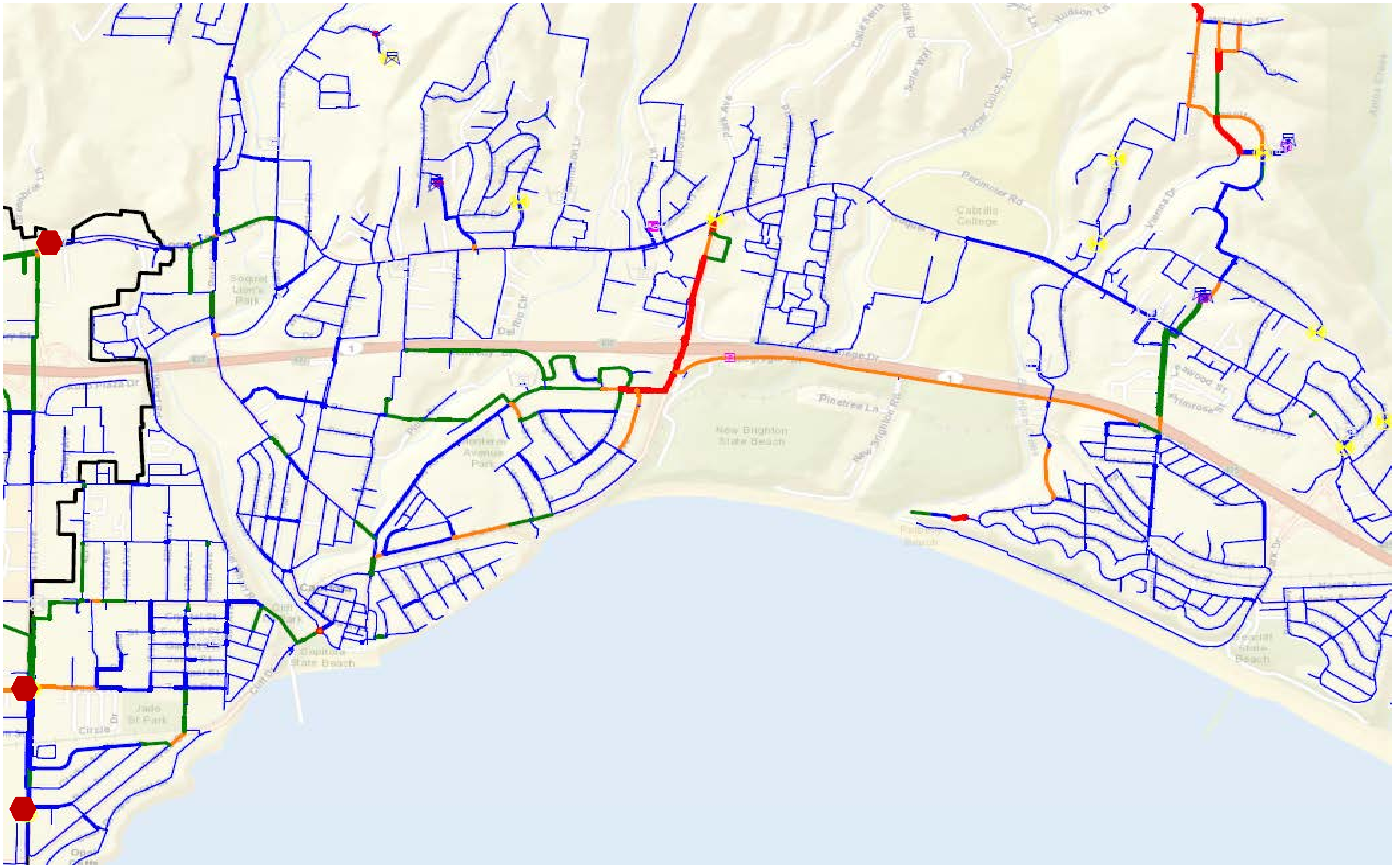
February 7, 2014

Figure 12

City of Santa Cruz
MinMD Headlosses with Interties Active
Scenario 1-6

Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

Intertie Locations

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Minimum Month Demands
- SA1 or SA2 wells are inactive
- Interties supplying SA1 and SA2 zone demands (1.48 MGD)

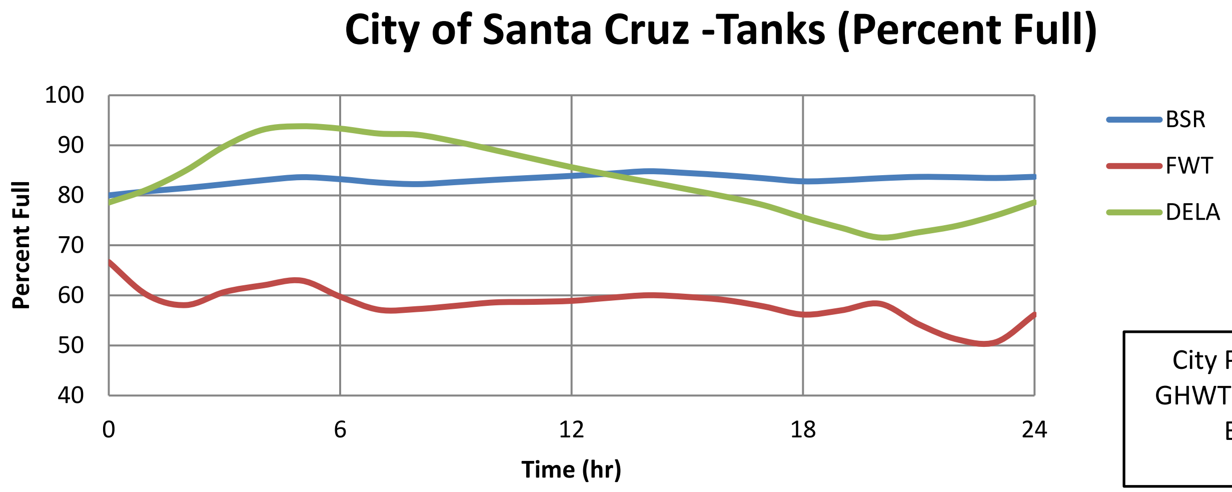
February 7, 2014

Figure 13

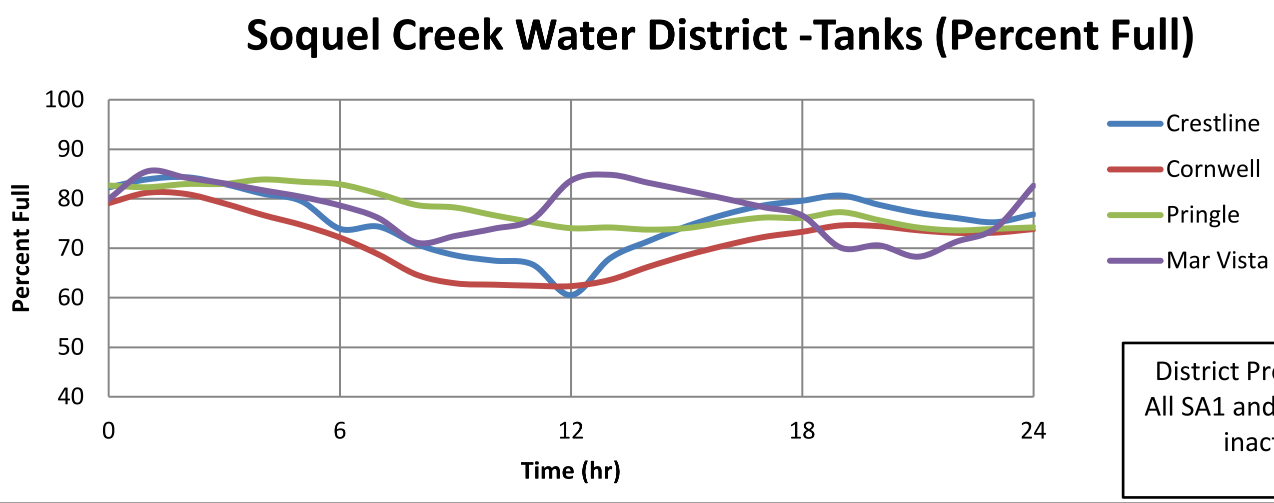
Soquel Creek Water District
MinMD Headlosses with Interties Active
Scenario 1-7

Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

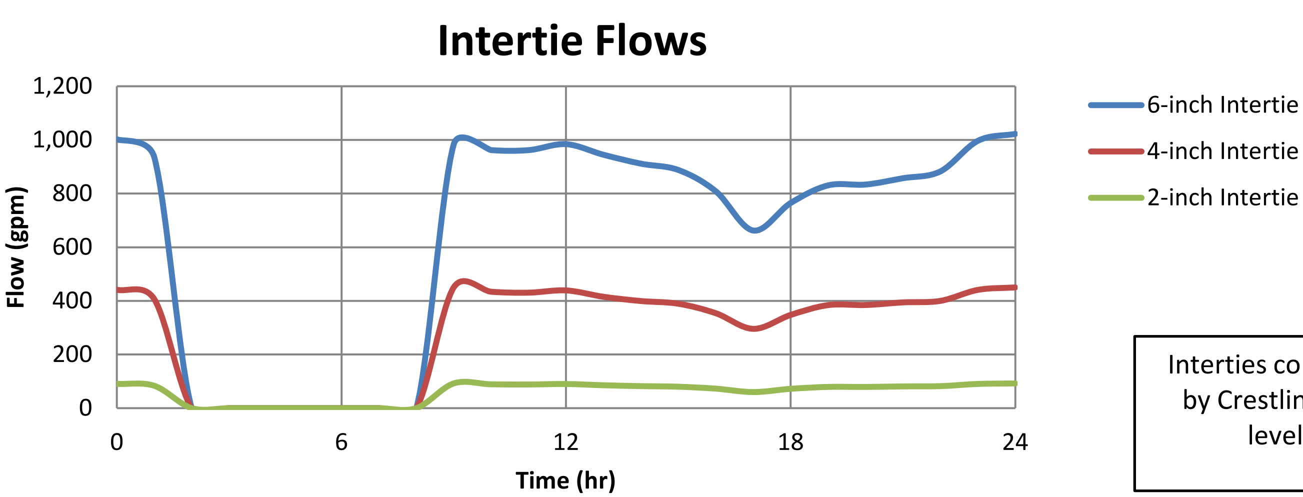
AKEL ENGINEERING GROUP, INC.



City Production:
GHWTP: 8.28 MGD
Beltz: 0



District Production:
All SA1 and SA2 wells inactive



Interties controlled by Crestline tank levels

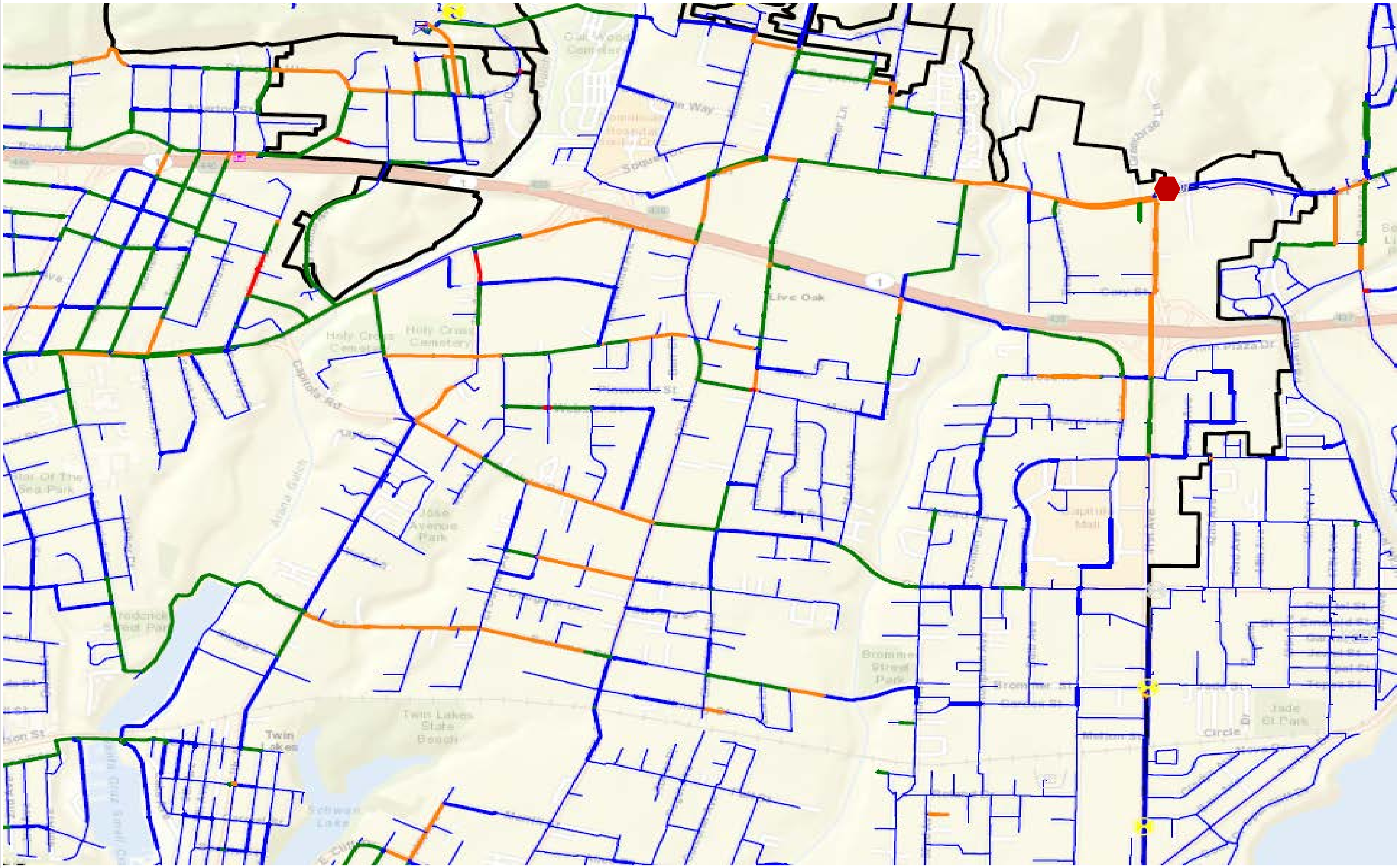
NOTES:
1. District zones SA1 and SA2 MinMD is 1.48 MGD.
2. SA1 and SA2 demands are supplied by the intertie flows

February 7, 2014

Figure 14
System Operation with Active Interties
Scenario 1-6, 1-7
Existing Intertie Capacities

SANTA CRUZ
SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.



LEGEND

Intertie Location

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Minimum Month Demands
- Intertie supplying District SA1 and SA2 demands (1.48 MGD)
- Beltz Wells inactive
- Single 8-inch intertie located near 41st Ave and Soquel Dr

February 7, 2014

Figure 15

City of Santa Cruz

MinMD Headlosses with a Single 8" Intertie Active

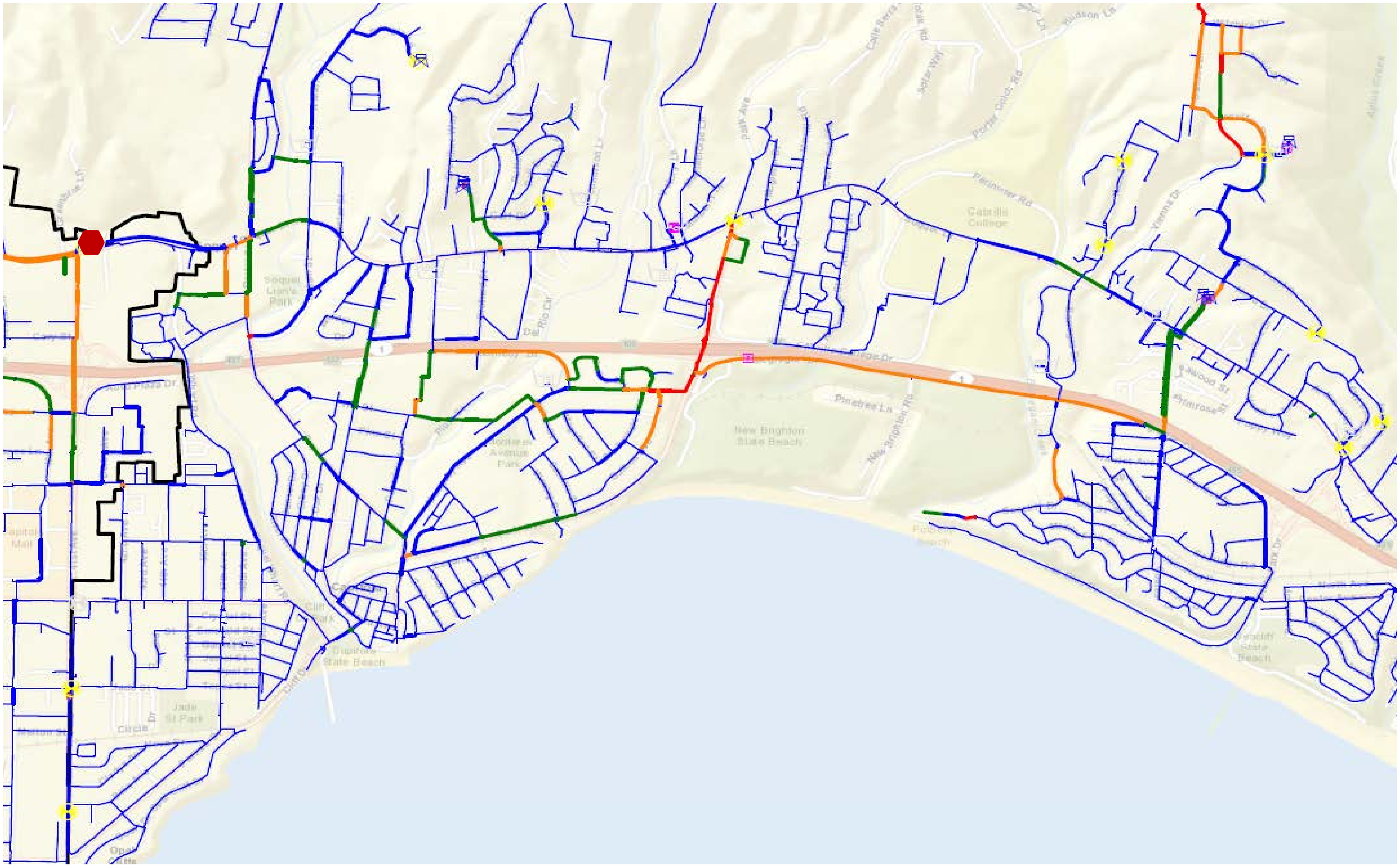
Scenario 1-8

Existing Intertie Capacities

City of Santa Cruz Water Department

Soquel Creek Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

Intertie Location

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Minimum Month Demands
- SA1 or SA2 wells are inactive
- Intertie supplying District SA1 and SA2 demands (1.48 MGD)
- Single 8-inch intertie located near 41st Ave and Soquel Dr

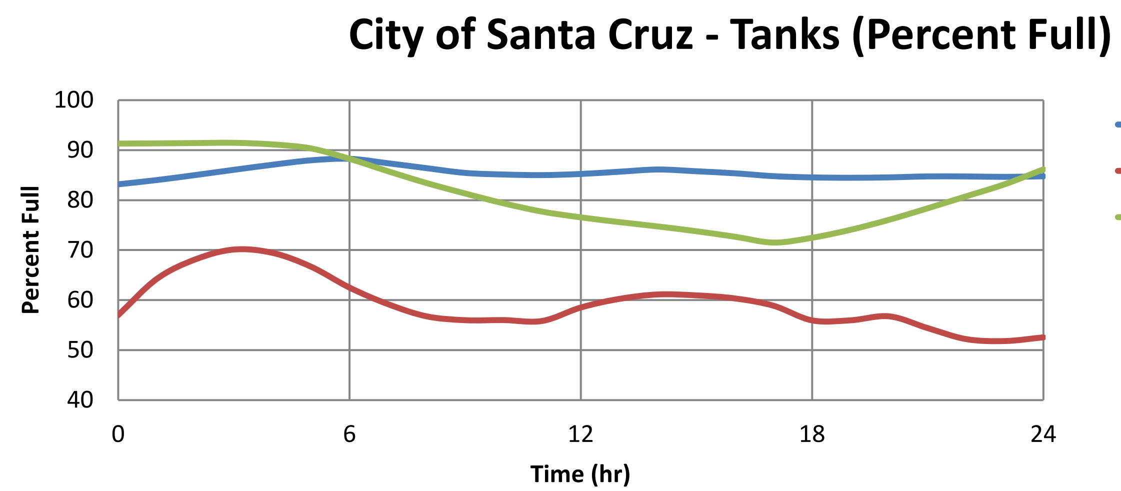
February 7, 2014

Figure 16

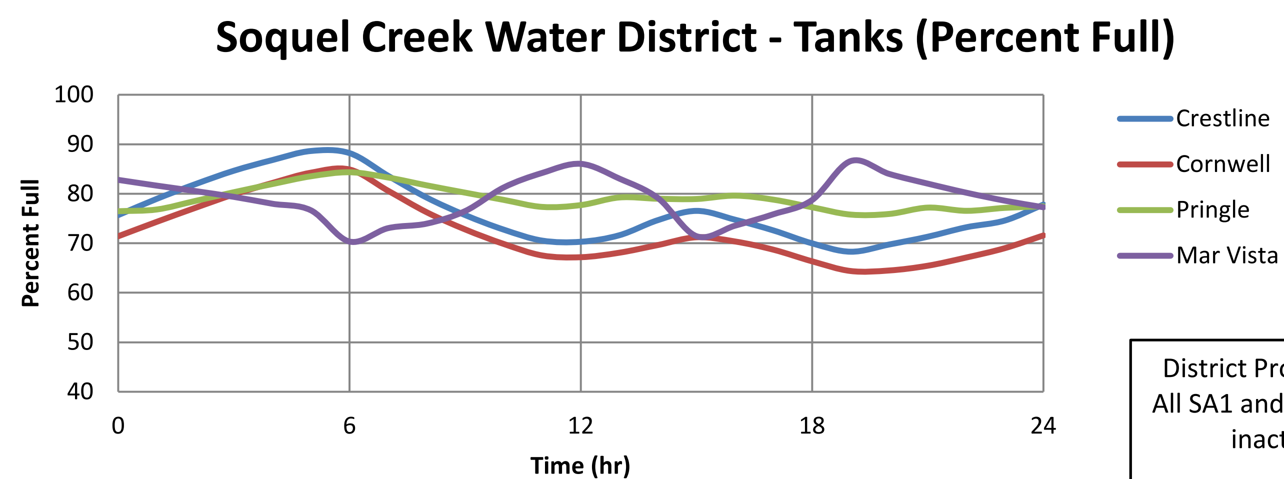
Soquel Creek Water District
MinMD Headlosses with a Single 8" Intertie Active
Scenario 1-8

Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

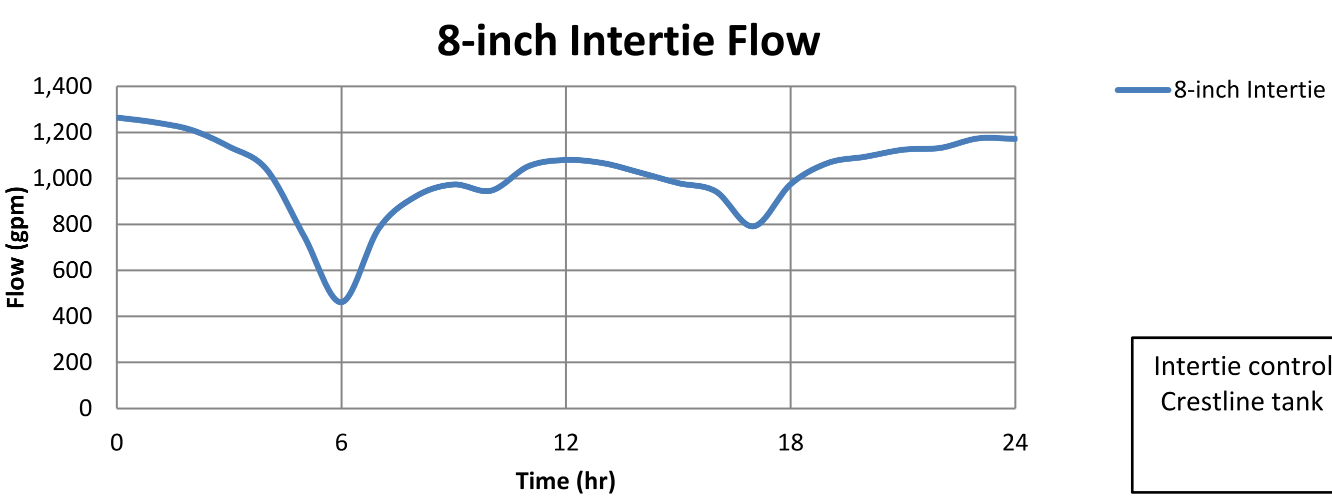
AKEL ENGINEERING GROUP, INC.



City Production:
GHWTP: 8.28 MGD
Beltz: 0



District Production:
All SA1 and SA2 wells inactive



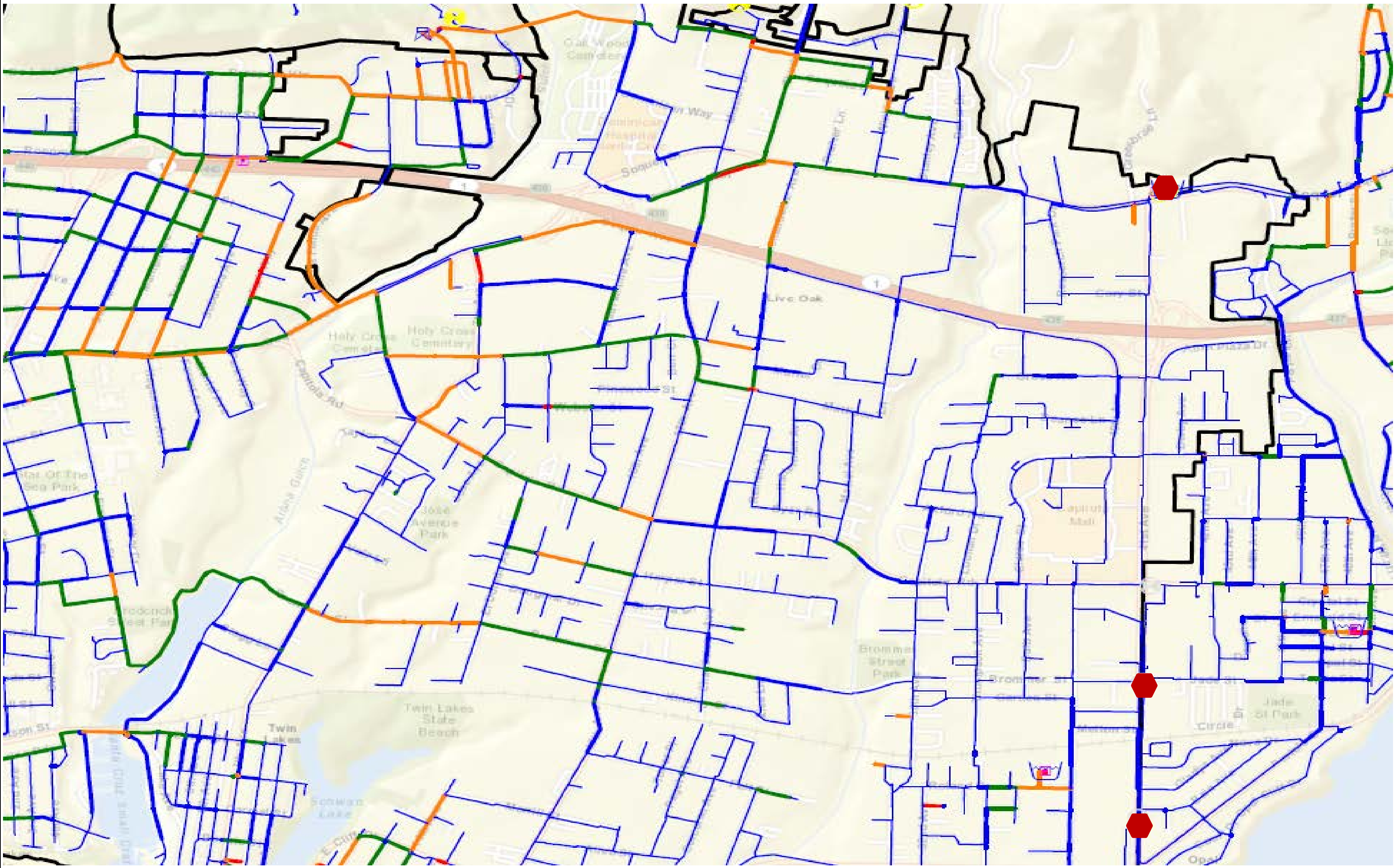
Intertie controlled by Crestline tank levels

NOTES:
1. The 8-inch intertie can provide the required 1.48 MGD, however the HGL in zone SA1 is reduced by approximately 1-2ft.

February 7, 2014

Figure 17
System Operation with a 8-inch Intertie
Scenario 1-8
Existing Intertie Capacities

AKEL ENGINEERING GROUP, INC.



LEGEND

Intertie Locations

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Maximum Month Demands
- Beltz Active (0.8 MGD)
- No Intertie Flow

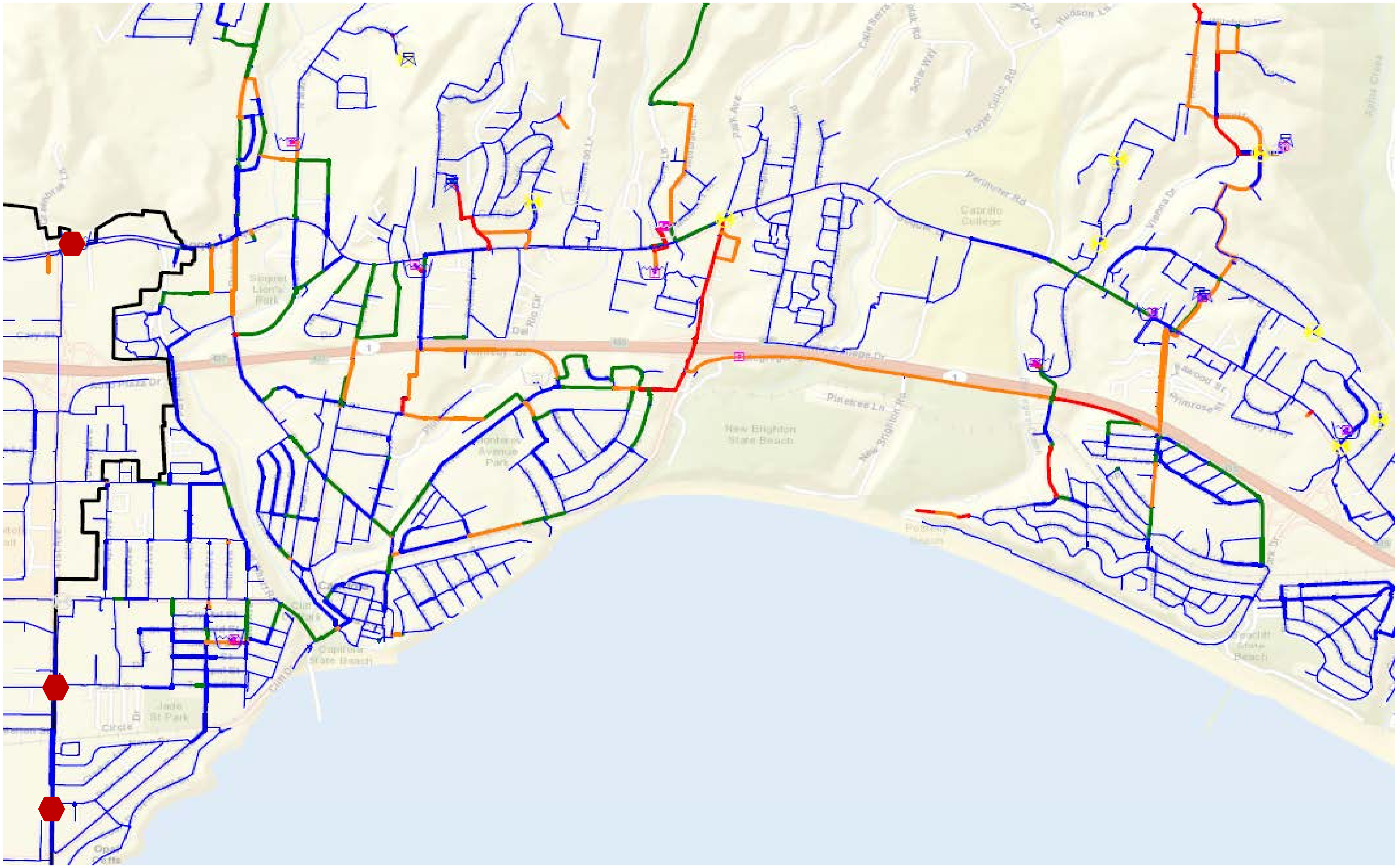
February 11, 2014

Figure 18

City of Santa Cruz
Existing MMD Headlosses

Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

AKEL ENGINEERING GROUP, INC.



LEGEND
Intertie Locations

HEADLOSS (ft/kft)
less than 0.5
0.5-1
1-2
2-5
greater than 5

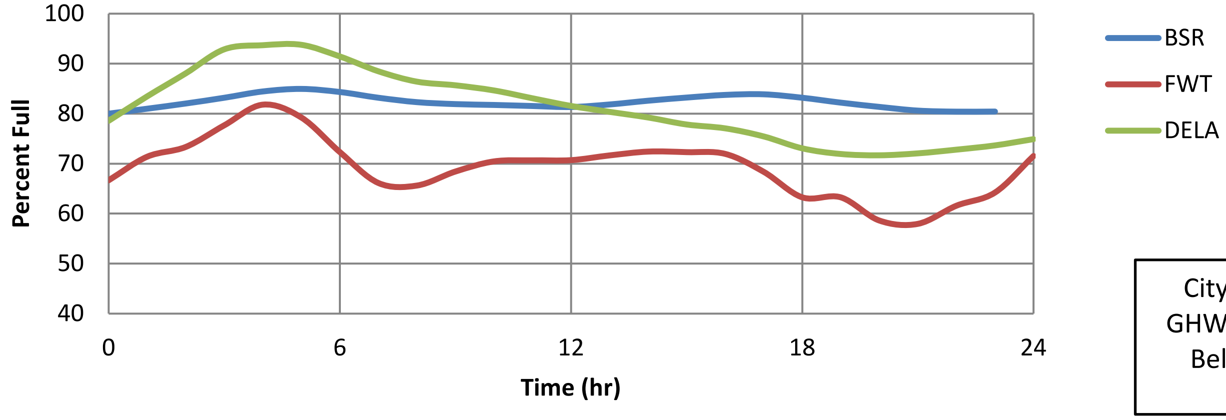
ASSUMPTIONS
- Maximum Month Demands
- No Intertie Flow

February 11, 2014

Figure 19
Soquel Creek Water District
Existing MMD Headlosses
Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

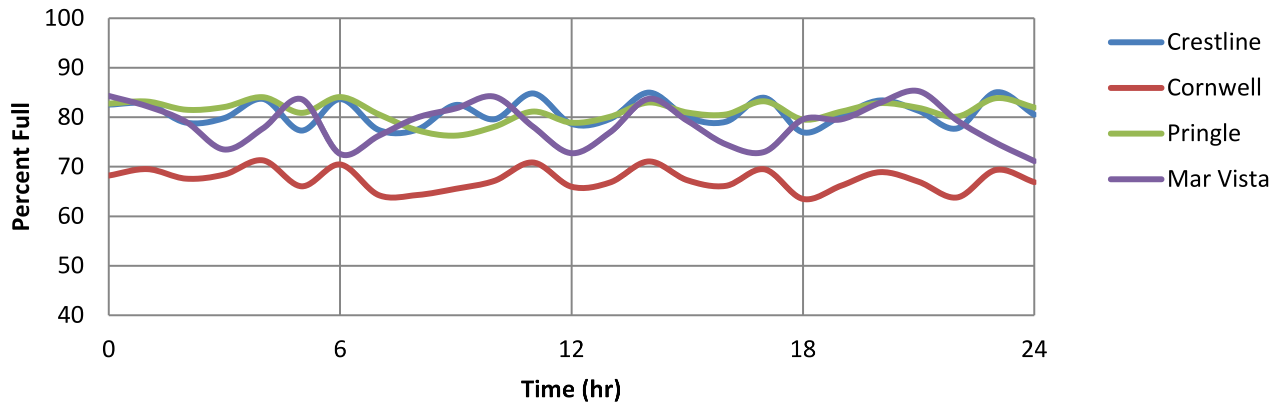
AKEL ENGINEERING GROUP, INC.

City of Santa Cruz -Tanks (Percent Full)

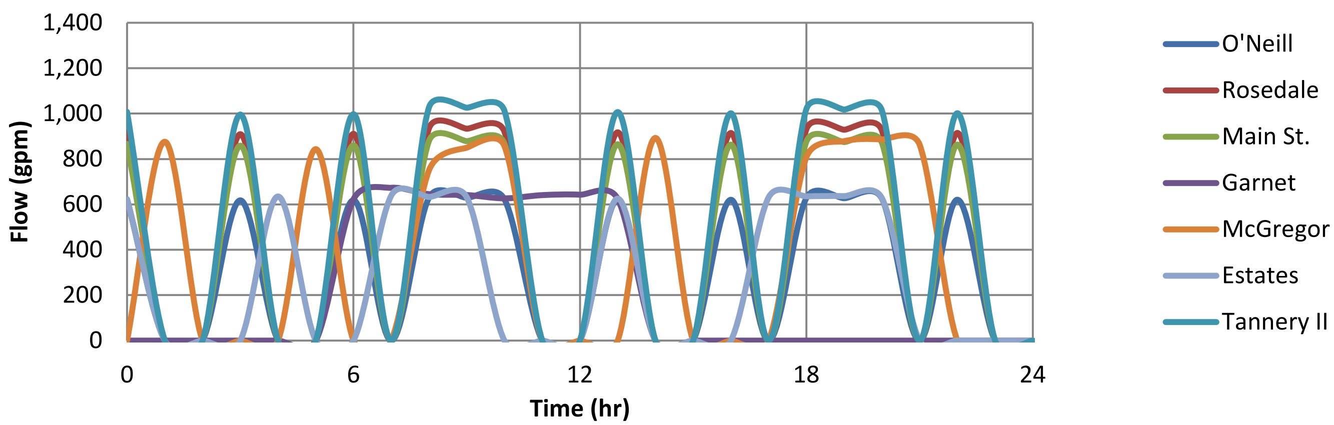


City Production:
GHWTP: 12.0 MGD
Beltz: 0.8 MGD

Soquel Creek Water District -Tanks (Percent Full)



District Pump Station and Well Flows



NOTES:

February 11, 2014

Figure 20

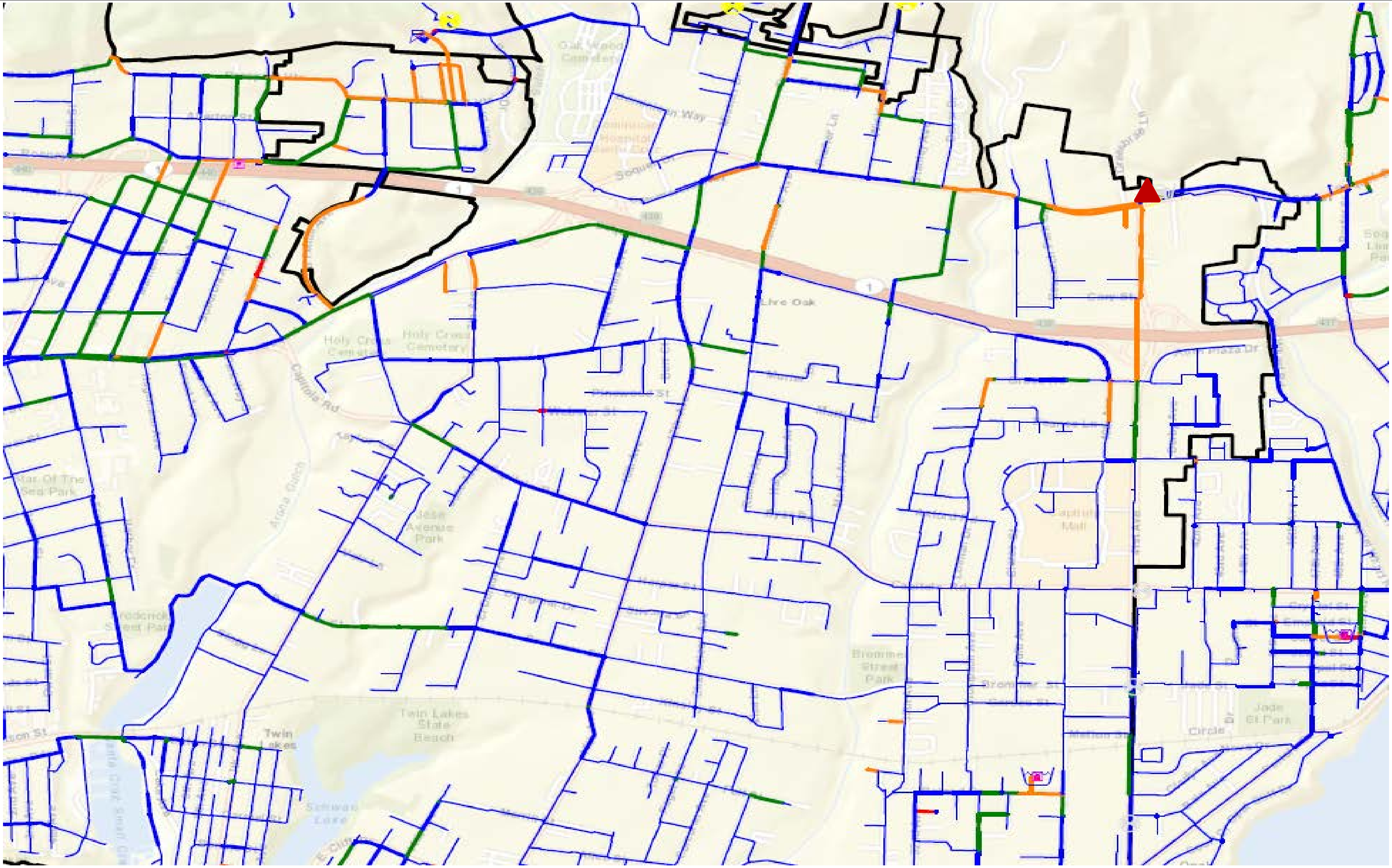
MMD Existing System Operation

Existing Intertie Capacities

CITY OF SANTA CRUZ

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.



LEGEND

▲ Transfer Pump

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Maximum Month Demands
- No Intertie Flow
- Beltz Wells active (0.8 MGD)
- 1,000 gpm transfer pump station located near 41st Ave and Soquel Dr

February 11, 2014

Figure 21

City of Santa Cruz

MMD Headlosses with 1,000gpm Transfer Pump

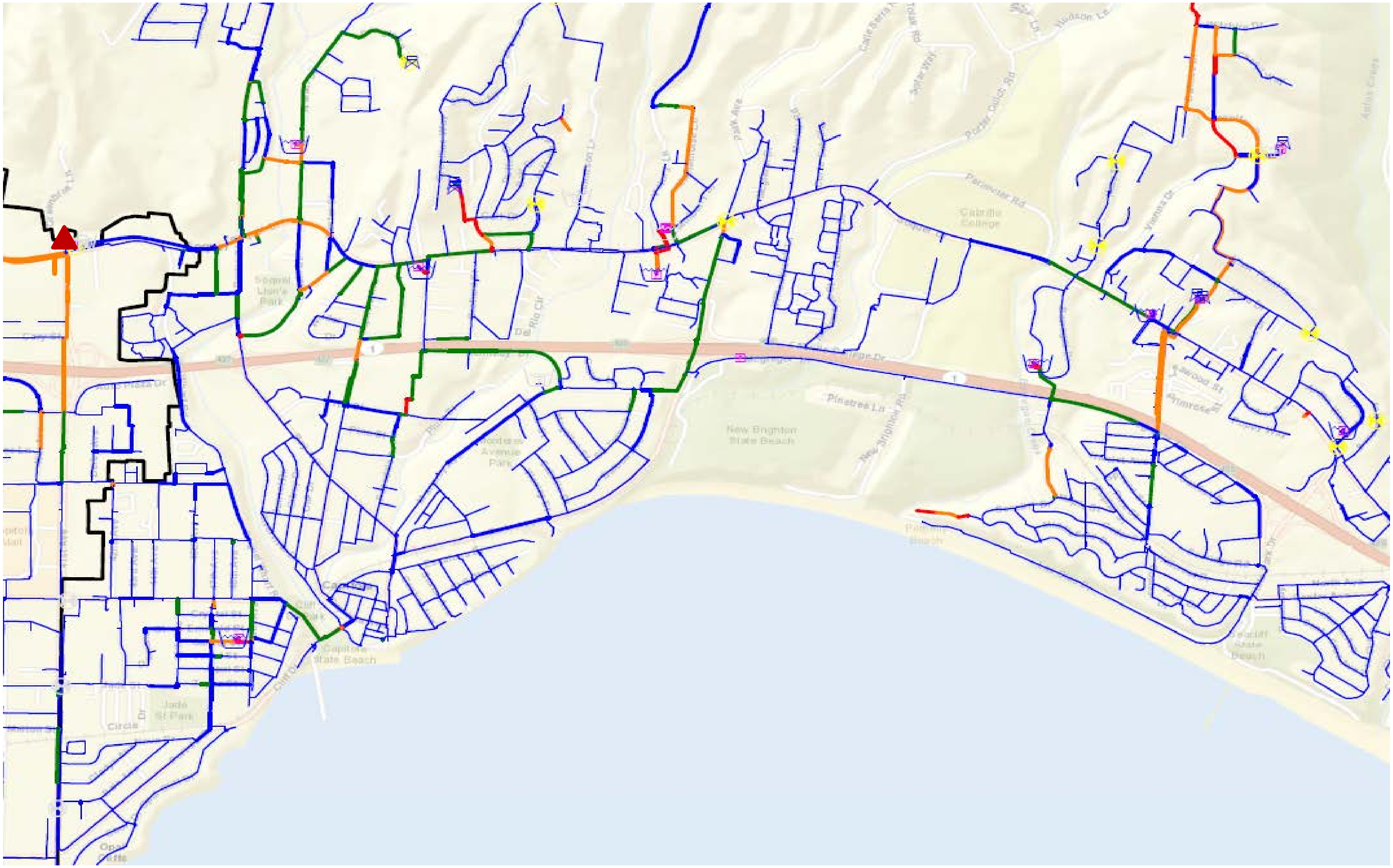
Scenario 2-4

Existing Intertie Capacities

City of Santa Cruz Water Department

Soquel Creek Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

▲ Transfer Pump

HEADLOSS (ft/kft)

- less than 0.5
- 0.5-1
- 1-2
- 2-5
- greater than 5

ASSUMPTIONS

- Maximum Month Demands
- No Intertie Flow
- 1,000 gpm transfer pump station located near 41st Ave and Soquel Dr

February 11, 2014

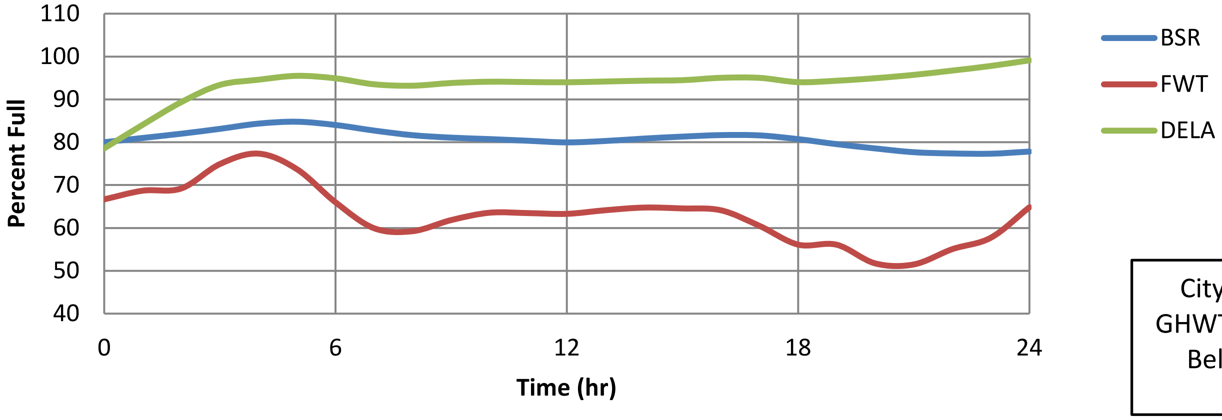
Figure 22

Soquel Creek Water District
MMD Headlosses with 1,000gpm Transfer Pump
Scenario 2-5

Existing Intertie Capacities
City of Santa Cruz Water Department
Soquel Creek Water District

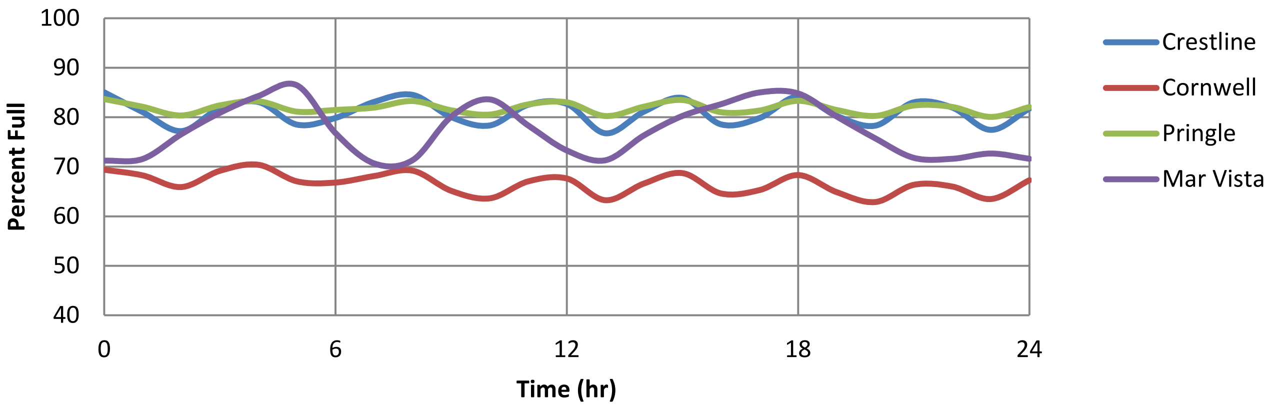
AKEL ENGINEERING GROUP, INC.

City of Santa Cruz - Tanks (Percent Full)

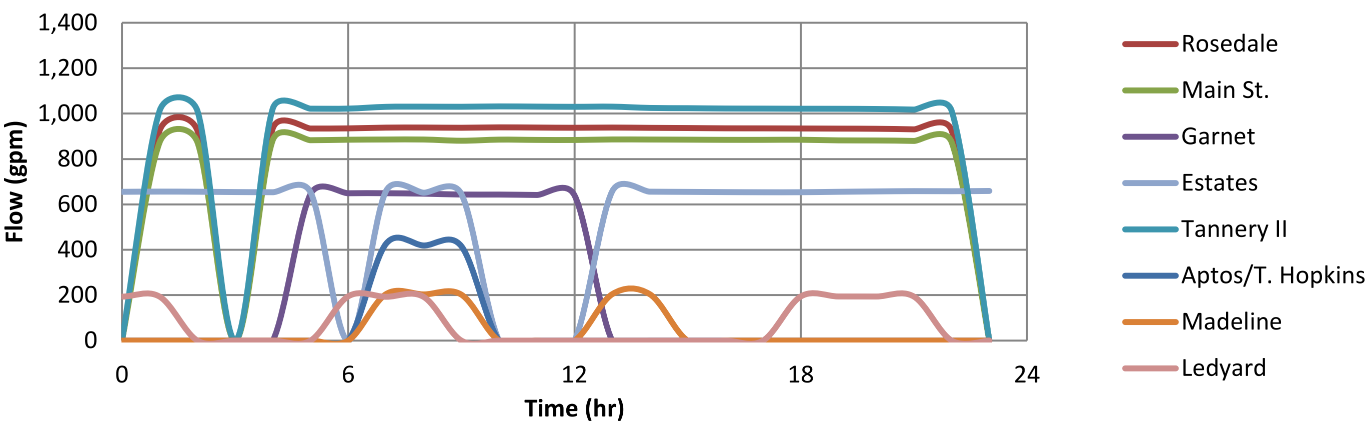


City Production:
GHWTP: 10.26 MGD
Beltz: 0.8 MGD

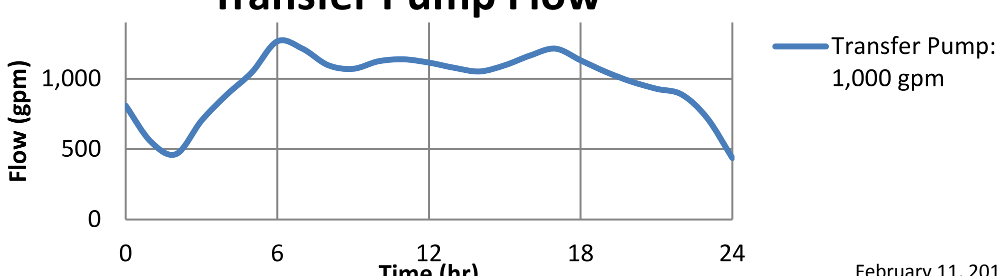
Soquel Creek Water District - Tanks (Percent Full)



District Pump Station and Well Flows



Transfer Pump Flow



February 11, 2014

Figure 23

MMD System Operation with a 1,000 gpm Transfer Pump Station Scenarios 2-4, 2-5

Existing Intertie Capacities

AKEL ENGINEERING GROUP, INC.

APPENDIX C – Infrastructure and Costs

CONJUNCTIVE USE AND WATER TRANSFERS – PHASE II (TASK 6)

Proposition 84

Department of Water Resources

Integrated Regional Water Management Planning Grant

Northern Santa Cruz County Integrated Regional Water Management

Agreement No. 4600009400

May 2015

Prepared by:

Santa Cruz County Environmental Health Services

Submitted to:

Regional Water Management Foundation

Department of Water Resources

Appendix C – Infrastructure and Costs

- Kennedy/Jenks. October 25, 2013. *Water Transfer Infrastructure Summary Report.* Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation.

Kennedy/Jenks Consultants

303 Second Street, Suite 300 South
San Francisco, California 94107
415-243-2150
FAX: 415-896-0999

Water Transfer Infrastructure Summary Report

25 October 2013

Prepared for

Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation, with funding provided by the California Department of Water Resources for Integrated Regional Water Management (IRWM) Planning California Public Resources Code 75026

K/J Project No. 1368009*00

Table of Contents

List of Tables

List of Figures

List of Appendices

Section 1: Introduction

1.1 Introduction

The City of Santa Cruz Water Department (City or SCWD) is working with the County of Santa Cruz, Scotts Valley Water District, San Lorenzo Valley Water District, and the Soquel Creek Water District, to evaluate the potential for winter-time water transfers from the City to the neighboring water agencies. The winter-time water transfer concept proposes treating potentially available surface water in the San Lorenzo River, through the City's Graham Hill Water Treatment Plant (GHWTP) in the winter (November through April), and sending the water to neighboring water agencies to offset groundwater pumping. The additional surface water for the neighboring agencies would be in addition to the winter-time water demands of the City.

The winter-time water transfer concept would benefit the Scotts Valley Water District, San Lorenzo Valley Water District, and the Soquel Creek Water District by providing the potentially available surface water to meet a portion of their winter-time demands. This could permit them to reduce groundwater pumping in the winter and allow their groundwater levels to slowly rise to more sustainable levels. The surface water available to be treated depends on the amount of winter-time rain and runoff, the demands of City customers, and the requirements to leave water in the river for the protection of endangered species. In the summer months, there is not additional water in the San Lorenzo River available for transfer.

The amount of additional surface water available for potential transfer is based on hydrological flows in the San Lorenzo River and demands from the City and neighboring agencies, and does not account for water rights restrictions. This study evaluates the infrastructure requirements assuming that the legal water rights restrictions could be overcome. The expected amounts of additional winter-time water that could be available and the winter-time water demands of the neighboring water agencies were developed by the County of Santa Cruz. (Fiske, 2013)

1.2 Potential Water Transfer Scenarios

The water transfer analysis conducted for the County of Santa Cruz developed a number of potential water transfer scenarios that provide different potential average annual transfer volumes based on assumptions of facility and system improvements (Fiske, Summary 2013). Table 1 presents a summary of the different water transfer scenarios and assumptions associated with the scenarios from the Fiske Study summary. The facility and system improvements to accomplish these scenarios are described in this Report.

In the scenarios below, the City would continue to meet City drinking water demands with the following current priority of water supply:

- North Coast Sources – highest quality water source.
- San Lorenzo River (Tait Street Diversion) – lower quality water source.
- Loch Lomond (Newell Creek) – lower water quality and minimize use to reserve water for stream releases and drought supply.

Only when there was additional water in the San Lorenzo River, that was not needed to meet City demands, would that water be available for transfer. Furthermore, it is assumed that the City would not withdraw extra water from the North Coast or Loch Lomond to facilitate water transfers. All potential water transfer supply would come from the San Lorenzo River.

Note also that the production capacity values for the GHWTP are maximum possible daily production values, not necessarily continuous production values. Since the water available for water transfer would come from Tait Street Diversion, this water source could be operating at the maximum production whenever there is sufficient water in the San Lorenzo River. Also, in each scenario, new system intertie infrastructure is also required.

Table 1: Potential Water Transfer Scenarios

No.	Scenario Name	Source Water Turbidity, NTU	Max. Tait Capacity, mgd	Max. GHWTP Winter Capacity, mgd	Potential Annual Transfer to Scotts Valley, MG	Potential Annual Transfer to Soquel Creek, MG	Potential Total Annual Transfer, MG
1	Current Tait & GHWTP Capacity	<15	7.8	Up to 10	106	39	145
2	Increase GHWTP Capacity	<15	7.8	Up to 16	108	95	204
3	Increase Tait & GHWTP Capacity	<15	14	Up to 16	154	333	488
4	Increase GHWTP Capacity & Treatment	~200	7.8	Up to 16	124	136	260
5	Increase Tait & GHWTP Capacity and Treatment	~200	14	Up to 16	174	384	558

In Scenario No.1, some additional water could be available for transfer by operating the current Tait Street Diversion and GHWTP up to the approximate 10-mgd winter-time capacity limitation when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 2 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer.

In Scenario No.2, additional water could be available for transfer by some improvements to increase the capacity of the GHWTP up to 16 mgd, but still operating when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer.

In Scenario No.3, additional water could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 mgd. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer. This scenario still assumes that the turbidity levels are relatively low in the San Lorenzo River.

In Scenario No.4, additional water could be available for transfer by improvements to the GHWTP up to 16 mgd, and improvements to permit operating when turbidity levels are approximately 200 NTU, such as immediately following storm events. In this scenario, Tait Street capacity is not increased. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer.

In Scenario No.5, additional water could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 MGD, and improvements to permit operating when turbidity levels are approximately 200 NTU, such as immediately following storm events. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer.

1.3 Overview of Infrastructure Improvements

To accomplish the winter-time water transfer concept, a number of infrastructure improvements would need to be implemented to permit treating and transferring the potential additional water. The GHWTP would need to be upgraded to handle the additional winter-time water capacity and the more challenging winter-time water quality from the San Lorenzo River. Distribution system inter-ties would need to be constructed and other surface water supply infrastructure would need to be upgraded.

The City's GHWTP was commissioned in 1960 and has a current target capacity of approximately 18 to 20 million gallons per day (mgd). The GHWTP is a conventional surface water treatment plant with conventional pre-treatment flocculation and sedimentation, granular media filtration, and disinfection. The current GHWTP treatment process can meet the stringent treated water quality requirements of today when the source waters have low levels of turbidity and organics. However, the system was not designed for the higher turbidity and organics from winter-time flows in the San Lorenzo River, and is also challenged by the colder winter-time temperatures.

The current treatment process at the GHWTP is limited to treating source water with turbidity levels less than approximately 10 to 15 NTU and organics levels of approximately 3 to 4 mg/l. To provide source water that the GHWTP can successfully treat, the City uses the high quality

North Coast sources to blend with and improve the overall water quality into the plant when they are also taking in San Lorenzo River water. During winter-time storms and high flows in the San Lorenzo River, the turbidity and organics levels increase significantly above the approximately 10 to15 NTU limit for the GHWTP, and the GHWTP must limit or stop production from the river sources completely until the turbidity levels drop. For the SCWD to be able to transfer excess winter-time water, the GHWTP would need to be upgraded to be able to treat source waters with higher turbidities and organics levels.

The winter-time capacity of the GHWTP is also limited by operational maintenance requirements. In the winter-time, each of the three flocculation and sedimentation basins are sequentially taken out of service, for several weeks to a month, for cleaning and maintenance. The capacity of the flocculation and sedimentation basins would need to be increased to permit additional water for winter-time water transfers, and still permit taking basins out of service for maintenance.

In addition to improvements to the GHWTP, improvements to the San Lorenzo source water intake structure, pumping stations and to the treated water delivery system would also be required to transfer winter-time water.

1.4 Purpose and Structure of Report

This Water Transfer Infrastructure Summary Report evaluates and describes the technical and infrastructure improvements that would be required, and the planning level costs to implement the proposed winter-time water transfer concept.

The report evaluates the following potential system improvements needed to implement winter-time water transfers:

- Pumping capacity from the San Lorenzo River Tait Street diversion
- Increased capacity at GHWTP for a higher winter production rates
- Improved treatment processes at GHWTP to address increased pathogen levels, organics, and tastes and odors, associated with increased use of the San Lorenzo River source
- Improved treatment processes at GHWTP to treat higher turbidly source water
- Improved solids handling system to accommodate the increased solids from treating higher turbidity water
- Improved disinfection processes to meet treated water requirements with more challenging winter time source water quality
- Intertie pipelines to distribute water to the neighboring water agencies

The Water Transfer Infrastructure Summary Report first summarizes the current capabilities and treatment requirements for the SCWD surface water supply, treatment and distribution system. The report then lists the assumptions for increased water capacity and treatment levels for the potential winter-time water transfers. The report describes the infrastructure improvements to accomplish the winter-time water transfers, and presents the capital, operating and lifecycle costs for the improvements.

This report does not evaluate whether there are appropriate water rights to transfer the water volumes discussed, herein. This report also does not evaluate whether the Scotts Valley Water

District or the Soquel Creek Water District would be able to return any water back to the City during a drought.

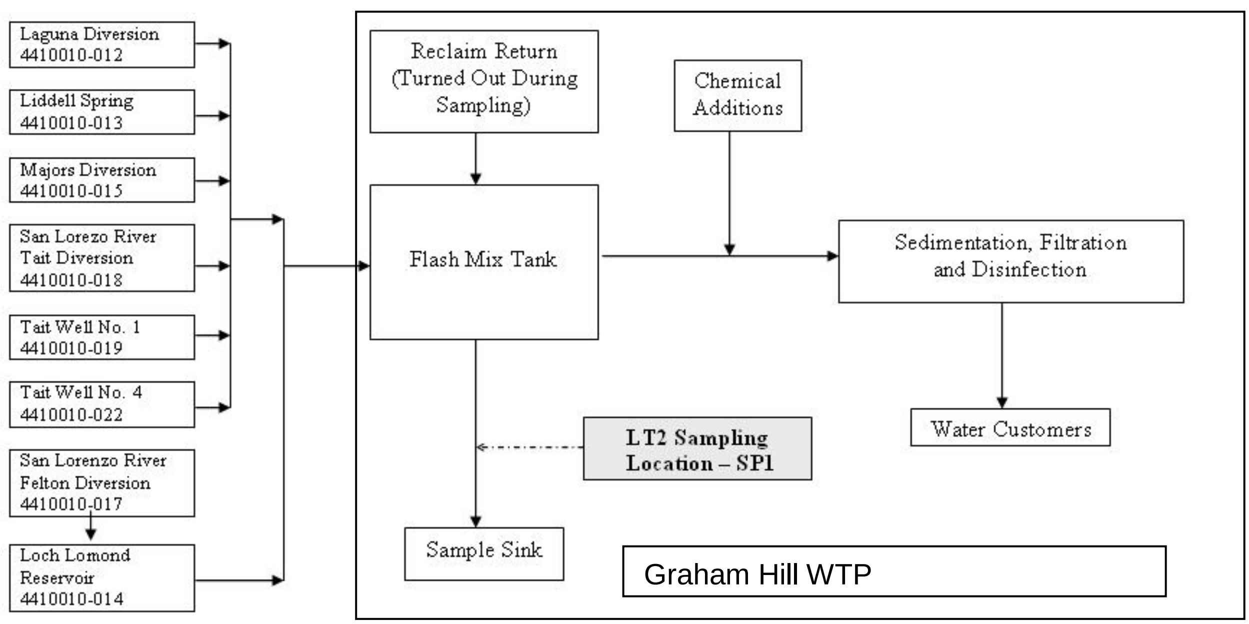
Section 2: Existing Surface Water System

The existing SCWD surface water treatment systems include surface water supply diversions, source water pump stations, source water pipelines, the Graham Hill Water Treatment Plant (GHWTP), treated water distribution pipelines, treated water pump stations and storage tanks. This section describes the current components, operational requirements and constraints of the systems.

2.1 Surface Water Supply Sources

The GHWTP receives source water supplies from three North Coast sources (Laguna Diversion, Liddell Springs, and Majors Diversion), the San Lorenzo River (Tait St Diversion and Felton Diversion), and Newell Creek (Loch Lomond Reservoir). The untreated source water entering the GHWTP for treatment is often a blend of the different sources. Figure 1 shows a schematic of the source water supplies to the GHWTP.

Figure 1: Source Water Supplies to the GHWTP



The City operates their water system to meet City drinking water demands with the following current priority of water supplies to the GHWTP:

- North Coast Sources – highest quality water source.
- San Lorenzo River (Tait Street Diversion) – lower quality water source.
- Loch Lomond (Newell Creek) – lower water quality and minimize use to reserve water for stream releases and drought supply.

The San Lorenzo River source typically has higher levels of bacteria, suspended solids (turbidity) and natural organic matter (organics) year around, as compared to the North Coast sources. These constituents require greater levels of treatment to meet drinking water requirements and can also create aesthetic issues, such as tastes and odors in the water. To provide source water that the GHWTP can successfully treat, the City uses the high quality North Coast sources as a first priority and will use this water to blend with and improve the overall water quality into the plant when they are also taking in San Lorenzo River water. Therefore, with the water transfer concept, the GHWTP would need to be able to treat the overall lower quality water with the greater blend of San Lorenzo River water.

The San Lorenzo River is the proposed source of additional winter-time surface water that could be used for potential water transfers (County, 2011). Surface water from the San Lorenzo River would be diverted through the Tait Street Diversion.

2.1.1 Tait Street Diversion

The Tait Street Diversion delivers San Lorenzo River surface water directly to the GHWTP. The diversion is located on the San Lorenzo River near Tait Street in Santa Cruz, and has a design capacity of up to approximately 12.2 cubic feet per second (cfs) (approximately 7.8 mgd). The Tait Street Diversion includes a diversion structure in the river, a diversion inlet structure with narrow-slot screens for fish protection, an intake sump with three multi-stage vertical turbine pumps, pump station building, a standby power generator, and associated piping, valves, instrumentation and controls. Water is pumped via a 24-inch pipeline from the diversion to the inlet of the GHWTP

Because the additional surface water for transfer would come from the San Lorenzo River, the capacity of the Tait Street Diversion may need to be increased to accommodate the winter-time water transfers.

2.1.2 Felton Diversion

The Felton Diversion is used by the SCWD to transfer water from the San Lorenzo River into the Newell Creek Reservoir (Loch Lomond) for storage. Water can then be brought down from Newell Creek Reservoir to the GHWTP.

The Felton Diversion provides water for storage in Loch Lomond (Newell Creek Reservoir) and is not permitted to provide surface water directly to the GHWTP. Therefore, direct diversion from the Felton Diversion is not considered as an intake source for the additional winter-time surface water transfer concept.

2.2 Graham Hill Water Treatment Plant

The City's GHWTP was commissioned in 1960, modified in 1986, and has a current summer-time target capacity of approximately 18 mgd and a winter-time capacity of approximately 10 mgd. The GHWTP is a conventional surface water treatment plant with pre-oxidation, periodic powdered activated carbon addition, rapid mix (flash) coagulation, flocculation, gravity sedimentation, granular media filtration and free chlorine disinfection. The GHWTP has washwater recovery and solids residuals handling and disposal systems that are required to handle, treat and dispose of the silts and particles removed from the source water as part of the water treatment process. Descriptions of the current GHWTP treatment processes and selected design and operational parameters for the GHWTP are summarized in the subsections below.

Regulatory and treatment challenges for the SCWD and the GHWTP include treating variable quality (turbidity, temperature, alkalinity and organics) source water; achieving compliance with California Department of Public Health (CDPH) increased pathogen removal-inactivation requirements; and reducing disinfection by-products (DBP) to meet State and Federal requirements.

For the SCWD to be able to treat a greater percentage of the San Lorenzo River water and transfer winter-time water, and still meet the State and Federal requirements, the GHWTP must be upgraded to be able to treat source waters with higher pathogens, organics and turbidities, and to handle the additional solids produced from the treatment processes.

2.2.1 Production and Hydraulic Capacity

The GHWTP has a current summer-time target peak production capacity of approximately 18 mgd and a winter-time production capacity of approximately 10 mgd. These production capacities are based on meeting State and Federal drinking water regulations with the current treatment process. Winter-time water quality challenges and maintenance requirements also limit the reliable capacity of the plant to approximately 10 mgd.

The hydraulic capacity of the existing GHWTP structures and pipelines would permit higher production with improvements to the treatment process. The reliable hydraulic capacity of the GHWTP is approximately 24 mgd or more.

The current winter-time demands at the GHWTP typically range from approximately 8 mgd to 10 mgd. The winter-time water transfers would be in addition to the current SCWD water demands served by the GHWTP.

Table 2 below summarizes the current GHWTP production capacities.

Table 2: Current GHWTP Production Capacities

Design Parameter	Units	Current Summer	Current Winter
Maximum Plant Production	mgd	18	~10
Average Plant Production	mgd	12	~9
Plant Hydraulic Capacity	mgd	24	24

2.2.2 CDPH Treatment Requirements

The GHWTP produces water that complies with both federal and State rules, regulations, and guidelines established under the Federal and State Safe Drinking Water Acts, including the requirements in the Surface Water Treatment Rule (SWTR), Interim Enhanced SWTR (IESWTR), and Long Term 2 Enhanced SWTR (LT2ESWTR) for systems serving more than 100,000 people.

2.2.2.1 Turbidity

To meet the requirements of the California SWTR, the GHWTP must maintain filtered water turbidity less than or equal to 0.3 NTU in at least 95 percent of the filtered water samples collected during each month.

In addition, both the settled water turbidity and recycled water turbidity objective is to be less than 2 NTU in accordance with the California Cryptosporidium Action Plan (CAP).

As described below, the current treatment process at the GHWTP is limited to treating source water with turbidity levels less than approximately 10 to 15 NTU. During winter-time storms and high flows in the San Lorenzo River and the North Coast sources, the turbidity levels increase significantly above the 10 NTU limit for the GHWTP, and the GHWTP must limit or stop water withdrawal from the San Lorenzo River until the turbidity levels drop.

2.2.2.2 Microbial Removal and Disinfection

A typical surface water treatment plant is required to provide filtration removal and disinfection to achieve a 3-log *Giardia* and 4-log virus removal/inactivation performance standard. Since 1998, CDPH has required an increased level of 4-log *Giardia* cyst and 5-log virus removal/inactivation through the filtration and disinfection processes at the SCWD's GHWTP to be in compliance with the SWTR. The basis for the increased removal-inactivation requirements was elevated levels of total coliform in the San Lorenzo River source waters to the GHWTP.

This additional removal/inactivation requirement places constraints on the GHWTP production capacity. To accomplish the winter-time water transfers, an additional and more robust disinfection process such as ozone or ultraviolet light could be required.

2.2.3 Gravity Sedimentation and Filtration

The GHWTP removes suspended solids, particles and pathogens (measured and described collectively as turbidity) through chemical conditioning of the source water, flocculation and gravity sedimentation and granular media filtration. The sedimentation basins are relatively large basins where solids settle to the bottom of the basin by gravity and the lower-turbidity settled water is collected and sent on to the filters. Figure 2 shows the sedimentation basins at the GHWTP, and Table 3 summarizes the sedimentation basin design and operation criteria. Figure 3 shows the granular media filters at the GHWTP, and Table 4 summarizes the filter design and operation criteria.

Figure 2: Existing Sedimentation Basins at the GHWTP

Table 3: Current GHWTP Sedimentation Basin Design and Operation Criteria

Design Parameter	Units	Current Summer	Current Winter
Number of Basins	number	3	3
Number of Basins Available for Production	number	3	2 [(1)]
Number of Basins in Maintenance (winter)	number	0	1
Production Capacity per Basin	mgd	6 [(2)]	~5 [(2)]
Type of Sedimentation Process	--	Gravity	Gravity
Settling Area Process	--	Tube Settlers	Tube Settlers
Maximum Design Source Water Turbidity	NTU	20 to 30	20 to 30

Notes:
1. Basins are taken out of service for up to a month for maintenance. During this time, capacity is limited.
2. Production capacity depends on the performance of the basins. If performance cannot be met, then production would decrease to help improve performance. In the winter, production drops to treat more challenging source water.

Figure 3: Existing Filters at the GHWTP

Table 4: Current GHWTP Granular Media Filter Design and Operation Criteria

Design Parameter	Units	Current Summer	Current Winter
Number of Filters	number	6	6
Number of Filters Available for Production	number	5	5
Number of Filters in Standby or Maintenance	number	1	1
Area per Filter	sf	700	700
Typical Production Per Filter	mgd	3.6	2.0
Maximum Design Source Water Turbidity	NTU	0.5 to 1	1 to 2

In this type of conventional water treatment process, the flocculation and gravity sedimentation process typically removes the majority of the turbidity. The objective of the "pre-treatment process" ahead of the filters is to reduce the turbidity to between 1 to 2 NTU or lower.

City staff indicate that the performance of the existing flocculation-sedimentation pre-treatment process is significantly challenged when the source water turbidity starts to increase above approximately 7 to 10 NTU and/or when the GHWTP flow rate is greater than approximately 12 to 15 mgd. When the pre-treatment process performance decreases, more solids are sent to the granular media filters, and the GHWTP has more difficulty meeting its production and filtered water quality requirements.

2.2.4 Treated Water Disinfection

Many modern WTPs include a treated water tank (or clearwell) that is used for chlorine disinfection of the treated water after the water has been settled and filtered. Modern treated water disinfection clearwells have an efficient flow-through design to achieve the disinfection contact time before the water leaves the WTP. The existing GHWTP treated water tank has a single inlet-and-outlet pipeline and is not designed for disinfection. The tank serves as a distribution system storage tank at the WTP site. Disinfection at the GHWTP is currently accomplished in the sedimentation basins.

Table 5 summarizes the current GHWTP disinfection design criteria. The GHWTP treated water disinfection is accomplished through the addition of chlorine ahead of the large gravity sedimentation basins. The sedimentation basins provide the contact time needed to achieve the required concentration-contact time (CT) for meeting CDPH pathogen inactivation requirements.

Table 5: Current GHWTP Disinfection Design Criteria

Design Parameter	Units	Current Summer	Current Winter
DPH Inactivation Requirement[(a)]	log *Giardia*	1.5[(b)]	1.5[(b)]
Design Temp-pH	--	8^{o}C - 7.5 pH	8^{o}C - 7.5 pH
Required Free Chlorine CT (for 1.5 *Giardia* inactivation)	mg/L-min	79	79
Contactor Type	--	Sedimentation Basins	Sedimentation Basins
Contactor Volume	MG	2.9 (3 basins)	1.9 (2 basins)
Hydraulic Detention Time	min	239	287
Hydraulic Efficiency	--	0.44	0.44
Contact Time (T_{10})	min	106	127
Chlorine Residual	mg/L	1.0	1.0
Free Chlorine CT Achieved	mg/L-min	106	127
$CT_{Achieved}/CT_{Required}$ (safety factor)	--	1.3	1.6

Notes:

(a) Only the *Giardia* inactivation requirement is listed, since the virus inactivation goal is achieved in achieving the required *Giardia* inactivation.

(b) CDPH requires that the GHWTP provides 4-log *Giardia* (and 5-log virus) reduction. The GHWTP treatment process (conventional pretreatment and filtration) currently provides 2.5-log *Giardia* removal. Therefore, the *Giardia* inactivation requirement is 1.5-log to meet the overall removal and inactivation requirements.

The addition of chlorine ahead of the pretreatment process provides disinfection, but can also create challenges with regulated disinfection byproducts (DBPS) when the levels of natural organic matter in the source water increases.

2.2.5 Washwater and Solids Handling Capacity

The GHWTP solids residual handling facilities capture and treat the waste flow streams containing solids that settle out in the flocculation and sedimentation treatment basins and that are removed by the filters. The existing washwater and solids residual handling facilities and a brief description of their functions are provided below.

- Washwater Reclamation Tank – Serves as an equalization tank for the solids flow stream from the sedimentation basins and the spent backwash water from the filters.
- Reclaimed Washwater Pumps – Transfers the combined solids and spent backwash water residual stream in the washwater reclamation tank to the clarifier/thickeners.
- Reclaimed Water Clarifier/Thickeners – Clarifies the water and thickens the solids in the residual stream with anionic polymer addition, and high rate settling with lamella plates. The clarified washwater is returned to the WTP influent and blended with the raw water supply.
- The thickened solids are disposed to the sanitary sewer system for treatment at the City of Santa Cruz Wastewater Treatment Plant. The GHWTP has a storage tank that can be used in emergencies only, if solids production is greater than the discharge limits for a short period. However, this tank is not designed for solids storage, and would require rehabilitation or replacement to properly function as a solids holding tank.

Table 6 summarizes the current washwater and solids handling facilities design criteria and Figure 4 shows the existing reclaimed water clarifier/thickeners at the GHWTP.

Table 6: Current GHWTP Washwater and Solids Handling Facilities Design Criteria

Design Parameter	Units	Current Summer	Current Winter
Washwater Reclamation Tank			
Number of Tanks	number	1	1
Tank Capacity	gallons	750,000	750,000
Reclaimed Washwater Pumps			
Number of Pumps	number	3	3
Reclaimed Water Clarifier/Thickeners			
Number of Units	number	2	2
Type	--	Lamella Plate Settler	Lamella Plate Settler
Design Flow Rate, Each	gpm	400	400
Clarification Area, Each	sf	908	908
Hydraulic Loading Rate	gpm/sf	0.44	0.44
Solids Disposal			
Approach		Sanitary Sewer	Sanitary Sewer
Solids Disposal Pipeline Size	inches	4	4
Typical Solids Flowrate Range	gpm	30 to 125 gpm	30 to 125 gpm
Typical Solids Discharge	lbs/day	1,000 to 2,000	1,500 to 2,000
Solids Discharge Limit	lbs/day	2,085	2,085

The mass of solids produced depends on the production rate of the GHWTP, the amount of solids in the source water and the chemicals used in the treatment process. The GHWTP is currently limited in the disposal of solids to the sanitary sewer to 2,085 pounds per day.

Figure 4: Existing Reclaimed Water Clarifier/Thickeners at the GHWTP

2.3 Treated Water Distribution

Treated drinking water from the GHWTP flows by gravity and/or is pumped to various storage tanks throughout the City's drinking water distribution system. The existing distribution system pipes and storage tanks have a hydraulic capacity of up to approximately 24 mgd of production from the GHWTP.

Section 3: Assumptions for Potential Water Transfers

The surface potentially water available to be treated and transferred in the winter-time depends on the amount of winter-time rain and runoff, the demands of City and other agency customers, the requirements to leave water in the river for the protection of endangered species, and available water rights. The expected amounts of additional winter-time water that could be available and the winter-time water demands of the neighboring water agencies are based on information from the County of Santa Cruz. (Fiske, 2013).

This section outlines assumptions and objectives, used in this report to develop the treatment approach for the potential winter-time water transfers.

3.1 Surface Water Source for Additional Production

The source of the winter-time water transfers would be from the San Lorenzo River at the Tait Street Diversion (Fiske, 2013).

Based on Figure 2 in the County of Santa Cruz, Phase 2 Water Transfer Analysis (Fiske, June 2013) the potential maximum surface water available at the Tait Street Diversion to meet both the demands of the City and the neighboring water agencies is approximately 13.3 mgd. This is almost double the current capacity of the diversion (7.8 mgd). Therefore, for the purposes of this study, the Tait Street Diversion improvements are assumed to increase the design production capacity to 14 mgd to meet the maximum production requirements for water transfers.

3.2 Additional Production Objectives

The Phase 2 Water Transfer Analysis (Fiske, May 2013) evaluated the winter-time demands of the City and neighboring agencies and developed annual, monthly and daily estimates of additional water available for transfer based on a range of hydrologic conditions. For sizing the improvements to the Tait Street Diversion and the GHWTP, the maximum daily flow rate of surface water transfers is the controlling variable. For example, the average daily flow rate of additional water for transfer could be 2 to 3 mgd, but the maximum could be 5 to 6 mgd. The improved facilities would need to be able to handle the higher maximum instantaneous flow rates.

Based on the Phase 2 Water Transfer Analysis (Fiske, May 2013), the additional maximum likely demands from the neighboring agencies to provide for winter-time water transfers could reach approximately 5.5 mgd. If this occurred at the same time as typical maximum demands from the City customers, the GHWTP would need to produce approximately 15.5 mgd. Therefore, the design maximum winter-time production for the GHWTP, for this study, is 16 mgd. The average winter-time production with both water transfer demands and City demands is estimated at 11 mgd. Table7 shows how these additional water transfer production rates compare to current summer and winter GHWTP production rates.

Table 7: Additional GHWTP Production Objectives

DESIGN PARAMETER	Current GHWTP Summer, mgd	Current GHWTP Winter, mgd	Transfer to Scotts Valley, mgd	Transfer to Soquel Creek, mgd	Potential Total Transfer, mgd	GHWTP Winter-Time Production Objective, mgd
PLANT FLOW RATES						
Maximum Plant Production	18	~10	~2	~3.5	~5.5	16
Average Plant Production	12	~9	~1	~1	~2	11
Plant Hydraulic Capacity	24	24	NA	NA	NA	24

3.3 Winter-Time Water Quality

Typical coastal California watershed streams experience rapid increases in turbidity during and shortly after storm events. The turbidity level can spike up to several hundred NTU in a matter of hours, but will often drop back to levels of 40 to 50 NTU or lower relatively quickly. The organics level in the water will also rise during storm runoff periods. The turbidity and organics levels will then slowly drop over a period of days or weeks back to normal levels, unless another storm event occurs in the watershed. Operating experience indicates that the GHWTP sources can take several days for the turbidity to drop to 10 to 15 NTU and up to a week for the turbidity to return to average low levels after a storm event.

Rainfall and source water data from Kennedy/Jenks pilot testing experience in wet weather seasons for streams the Santa Cruz Mountain watersheds, as shown in Figure 5, indicate that the stream's and river's source water turbidity spikes are closely related to rainfall intensity. Figure 6 shows the turbidity profile at the San Jose Water Company's Ostwald Intake in the Santa Cruz Mountain during a storm event. During storm events, stream water turbidity rises rapidly and is followed by a smaller rapid drop and then a more gradual exponential-shaped decrease in turbidity as the stream flow decreases after a storm. Stream-borne debris can also contribute to the turbidity by scouring the stream bottom.

Figure 5: Measured Rainfall at Lake Elsman and Measured Water Turbidity at Stream Intakes in the Santa Cruz Mountain Watershed.

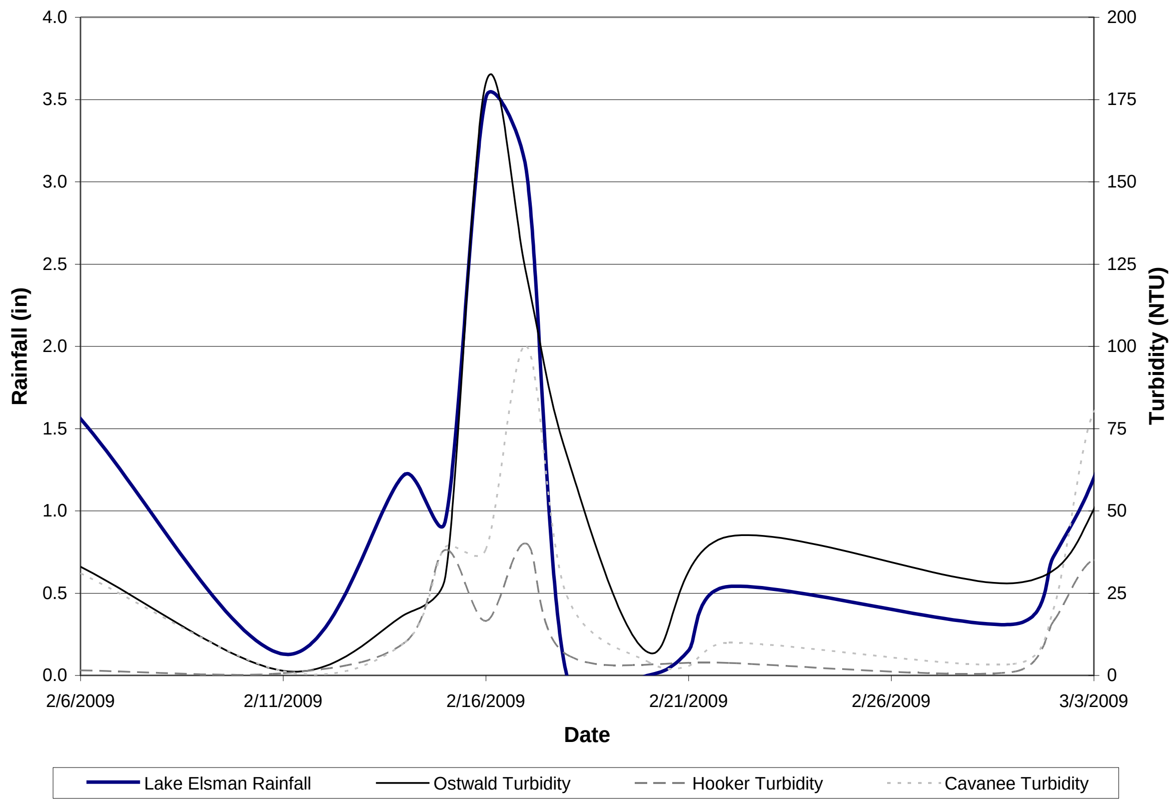
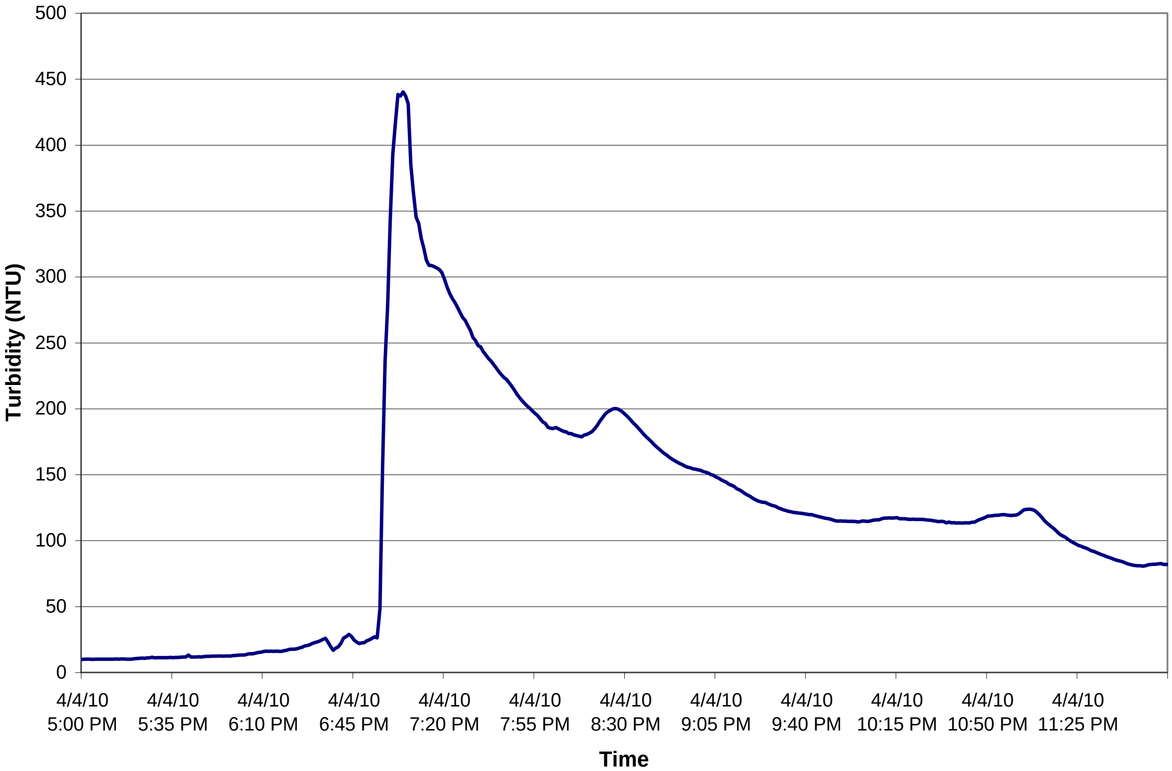


Figure 6: Turbidity Profile of a Santa Cruz Mountain Watershed Stream during and after a Storm Event



Based on this piloting data from similar streams in the Santa Cruz Mountain watershed, the improvements to the GHWTP for winter-time water transfers should be able to handle turbidity events over several hundred NTU. The Phase 2 Water Transfer Analysis (Fiske, 2013) used a source water value of 200 NTU in the analysis of potential water transfers. The winter-time storm water also contains elevated levels of natural organic matter as compared to typical summer and winter non-storm source water quality.

3.4 CDPH Treatment Requirements

Based on source water *coliform* data in the San Lorenzo River source, the CDPH-requires that the GHWTP provide 4-log *Giardia* and 5-log virus reduction (removal and inactivation). The CDPH credits the GHWTP conventional filtration treatment process with 2.5-log *Giardia* removal credit as long as the filtered water turbidity is less than 0.3 NTU in at least 95 percent of the combined filter effluent samples analyzed at 15 minute intervals during each month. Therefore, 1.5-log disinfection inactivation is required to meet the overall requirements.

The treatment processes at the GHWTP and the improvements to permit winter-time water transfers will need to address both the higher pathogen levels, turbidity levels and organics levels in the source water to meet the 4-log *Giardia* and 5-log virus removal/inactivation requirements. With the increased percentages of San Lorenzo River water that would be required for winter-time water transfers, additional and more robust disinfection processes, such as ozone or ultraviolet light, may be required to meet the CDPH requirements.

3.5 System Operations and Maintenance

The City staff performs annual maintenance of the GHWTP treatment process equipment and infrastructure during the winter, when water demands are lower and treatment processes can be taken off-line. During the winter-time maintenance period, each of the flocculation-sedimentation basins and each of the filters are taken out of service sequentially for cleaning and maintenance. The basin maintenance period typically lasts from 2 to 4 weeks. As a result, over the winter maintenance period, only two flocculation-sedimentation basins would be available for operation. Filters are also taken out of service for maintenance that could last several days to weeks. During this period, only 5 filters would be available for operation.

The new treatment processes at the GHWTP will need to have the ability to accommodate the facility annual maintenance requirements, while meeting the system production objectives during the maintenance period.

Section 4: Infrastructure Improvements and Operational Changes to Accomplish Water Transfers

The infrastructure improvements are required to permit diverting and treating the higher turbidity San Lorenzo River source water and transferring the excess water to the neighboring water agencies. This section describes conceptual level improvements to the Tait Street Diversion and the GHWTP to accomplish the winter-time water transfer concept.

4.1 Surface Water Supply

The Tait Street Diversion would need to be upgraded to handle the additional winter-time water capacity and increased grit loading and debris that accompany winter-time flows and storm events. The general elements of the Tait Street Diversion that would need to be improved include:

- Intake Structure, Bar Screens and Debris Removal and Haul-Away System
- Fish Screen System
- Grit Settling and Removal System
- Surface Water Pump Station
- Facility Support Systems

4.1.1 Tait Street Diversion Improvements

The improvements recommended for the Tait Street Diversion are based on a study conducted for the City in 2009 titled “Tait Street Diversion Sanding Study, Alternative Evaluation Report” (Wood Rodgers, 2009). The Tait Street Diversion Sanding Study evaluated a number of alternatives including improvements to the existing 7.5-mgd intake systems as well as replacing the existing system with a new 7.5-mgd intake system.

Depending on the different potential water transfer scenarios, different levels of improvements would be required for the Tait Street Diversion. The assumptions for these improvements are described below. Because the San Lorenzo River source water is a secondary source, (the City first takes higher quality water from the North Coast sources), in any of the potential water transfer scenarios, there would be increased use of the Tait Street Diversion. Increased operation of the Tait Street Diversion in the winter-time will require additional sand, and silt removal, haul away and disposal, as well as increased maintenance of the facility.

The different potential water transfer scenarios are described in more detail in Section 5. In Scenarios 1 and 2 where turbidities are low and water is withdrawn up to the current capacity of the Tait Street Diversion, upgrades include improvements to the grit settling and removal system to handle the additional sand loads from more winter-time operations. Additional upgrades to other diversion systems would not be required.

In Scenario 3 where turbidities are low and water is withdrawn up to 14 mgd at the Tait Street Diversion, upgrades include improvements to the grit settling and removal system to handle the additional sand loads from more winter-time operations, and increasing the diversion capacity.

The capacity of the Tait Street Diversion would need to be expanded from the current 7.5 mgd to approximately 14 mgd. This would require expanding all of the elements listed above. The improvements would need to be constructed in a manner that keeps the Tait Street Diversion in operation during construction.

In Scenario 4 where there are high flows and turbidities, upgrades include improvements to the screens and debris removal as well as grit settling and removal system to handle the additional debris and sand loads from winter-time storm flow type operations.

In Scenario 5 where there are high flows and turbidities, and increased capacity of the diversion, upgrades include both improvements to screens and debris removal as well as grit settling and removal system, and increasing the diversion capacity.

For scenarios that would involve expanding the capacity, the current Tait Street Diversion would operate to maintain water supply while a new approximately 7-mgd capacity intake system would be constructed in parallel with the operating system. Then, the existing system elements would be upgraded to accommodate the higher grit and debris loadings. The new facilities would require use of the adjacent City storage site and/or acquisition of additional property near the Tait Street Diversion.

The pipeline from the Tait Street Diversion to the GHWTP is 24-inch diameter. At 7.5 mgd, the flow velocity in the pipeline is approximately 3.7 feet per second (fps). At 14 mgd, the flow velocity in the pipeline is approximately 6.9 fps. This higher flow velocity is on the high end for typical pipeline design parameters; however, because the 14 mgd flow rates would occur less than 5 percent of the time and flow rates above 11 mgd would occur less than 20 percent of the time (Fiske, June 2013), these flows could be accommodated in the 24-inch pipeline. Larger horsepower pumps would be used to overcome the increased friction from the higher flow rates.

Therefore, this study assumes that the existing pipeline would not need to be replaced to accommodate the periodic higher flow rates from the Tait Street Diversion. If the higher flowrates occur more frequently, then a second pipeline would be recommended to reduce the flow rates and friction losses in the pipeline.

4.2 Graham Hill Water Treatment Plant

The GHWTP would need to be upgraded to handle the additional winter-time water capacity and more challenging San Lorenzo River winter-time water quality. The treatment processes that would require improvements to handle higher turbidity and more challenging winter-time source water include:

- New Pre-treatment Flocculation and Sedimentation Basins
- Chemical Feed System Improvements
- New Ozone Oxidation and Disinfection Process
- Treated Water Tank Improvements
- Washwater and Solids Handling Systems

To permit operating the GHWTP at winter-time flow rates up to 16 mgd when the source water turbidity is as high as 200 NTU, the existing flocculation and gravity sedimentation pre-treatment process should be replaced. A robust pretreatment process, such as ballasted flocculation and clarification process, can consistently produce clarified water with turbidity less than 2 NTU with source waters in excess of 200 NTU. This is necessary to ensure that the granular media filters can consistently and reliably produce individual filtered water and a CFE with turbidities less than or equal to 0.3 NTU to meet the SWTR, and potentially less than or equal to 0.15 NTU so that the additional 1.0-log *Giardia* removal credit could be achieved. The current chemical feed systems would need to be improved along with the new pre-treatment system and to permit enhanced coagulation.

The GHWTP treated water disinfection contact time is currently accomplished in the large gravity sedimentation basins. The replacement of the existing sedimentation basins with a new pretreatment process requires that the disinfection contact time be provided elsewhere in the treatment process. A new Ozone oxidation and disinfection process is recommended to oxidize the increased levels of organics, tastes and odors in the San Lorenzo River water, and to provide additional disinfection. The existing GHWTP treated water tank should also be modified for improved performance and disinfection.

In addition, if the GHWTP treats higher turbidity source water at higher flow rates, the solids production and waste water stream from the pre-treatment process will increase. Based on the GHWTP's current operations and the limits on solids discharged from the GHWTP to the sanitary wastewater collection system, improvements would be required to the solids handling system. The GHWTP will have to handle much higher levels of solids and a greater flow rate during periods that high turbidity source water is being treated.

The improvements to the GHWTP would be constructed in a manner to keep the facility in partial operation during the construction.

4.2.1 Production and Hydraulic Capacity

The winter-time water transfer production objectives were identified in Section 3 and are shown in Table 8. The winter-time production values are within the overall hydraulic capacity (the through-flow of water that the facility can accommodate without consideration of the treatment performance of the systems) of the GHWTP.

Table 8: Winter-Time GHWTP Production Objectives

DESIGN PARAMETER	UNITS	Current Summer	Current Winter	GHWTP Winter-Time Production Objective (1)
PLANT FLOW RATES				
Maximum Plant Production	mgd	18	~10	16
Average Plant Production	mgd	12	~9	11
Plant Hydraulic Capacity	mgd	24	24	24

Notes: 1. Includes winter-time water transfer capacity

The hydraulic profile for the GHWTP (shown on Sheet G-7 in the 1986 Design Drawings) indicates that the process unit headloss, between the flash mixing tank and the settled water channel after the sedimentation basins (at the hydraulic capacity 24-mgd flow rate) is 1.39 feet. The available hydraulic grade line would permit replacing the three existing flocculation-sedimentation pretreatment units with three new ballasted-flocculation (Actiflo) pre-treatment trains (described below), and providing an intermediate ozone contactor for advanced oxidation and disinfection.

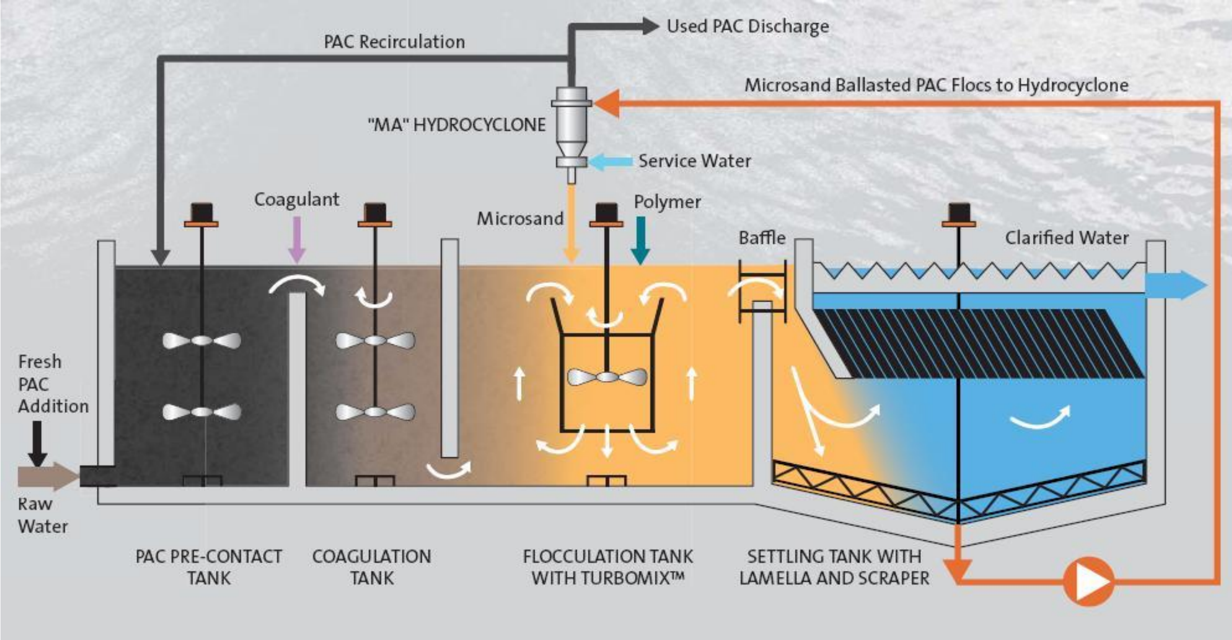
4.2.2 Pre-Treatment System Improvements

The ballasted floc pretreatment process (Actiflo or Actiflo-Carb) would permit treatment of source water with turbidity levels up to 200 NTU or more. The process is capable of producing clarified water with turbidities of less than 2 NTU, thereby decreasing the loading on the media filters. The ballasted floc pretreatment system would replace the existing flocculation-sedimentation basins and would be downstream of the existing carbon contact basins and upstream of the media filters. Three 8-mgd capacity pretreatment trains would be installed. Each train would consist of a coagulation tank, a flocculation (maturation) tank and a clarifier/thickener tank.

The ballasted floc pretreatment process achieves high turbidity removal through the addition of microsand and polymer. After the particles are destabilized through coagulation, the polymer forms bridges between the microsand and suspended solids. The microsand provides surface area to enhance flocculation and acts as a ballast or weight so that the ballasted floc has a higher settling velocity than conventional floc. The sand-solids floc settles out in the clarifier/thickener tank, and the sand-solids slurry at the bottom of the tank is removed. The slurry is pumped to the hydrocyclone, which separates the micro sand from solids. The microsand is recycled back into the ballasted floc pretreatment process. A small portion of the microsand is wasted with the solids, and replacement microsand must be periodically added to the system.

The ballasted flocculation process can also be used to recycle powdered activated carbon (PAC), if desired to enhance the removal of organic matter. Figure 7 shows a schematic of the ballasted floc pretreatment process with the optional PAC recycle system.

Figure 7: Ballasted Floc (Actiflo CARB) Pretreatment Process



Graphic provided by Kruger, Inc. (subsidiary of Veolia Water)

Table 9 provides a comparison of the current and proposed pre-treatment system design criteria for the GHWTP.

Table 9: Improved GHWTP Pre-Treatment Design Criteria

DESIGN PARAMETER	UNITS	Current Summer	Current Winter	Proposed for Winter-Time Water Transfer
PRETREATMENT FLOCCULATION AND SEDIMENTATION				
Number of Basins	number	3	3	3
Number of Basins Available for Production	number	3	2	2
Number of Basins in Maintenance (winter)	number	0	1	1
Production Capacity per Basin	mgd	~6	~5	8
Type of Sedimentation Process	--	Gravity	Gravity	Ballasted
Settling Area Process	--	Tube Settlers	Tube Settlers	Plate Settlers
Maximum Design Source Water Turbidity	NTU	20 to 30	20 to 30	> 500

The ballasted floc pretreatment trains could be constructed in the area currently occupied by the three existing flocculation-sedimentation basins. It is anticipated that to meet current structural codes and operational conditions, the existing basin concrete structures would be completely replaced with new basins and an ozone contactor. The existing flocculation-sedimentation basins could be demolished one at a time for the construction of the ballasted floc pretreatment trains so that the WTP can remain operational during the construction period

The ballasted floc pretreatment system would require less space than the current sedimentation basins. The remaining space could be available for installation of the ozone contactor and a more robust solids handling system. Figure 8 shows a proposed layout for the ballasted floc pretreatment units on the GHWTP site.

4.2.3 Disinfection System Improvements

The GHWTP treated water disinfection is currently accomplished through the addition of chlorine ahead of the large gravity sedimentation basins. The smaller ballasted flocculation and clarification units will not have as much contact time for chlorine disinfection.

The proposed overall improved disinfection process at the GHWTP would include both ozone and free chlorine disinfection. The ozone would provide oxidation and disinfection. The free chlorine would provide additional disinfection and is also required to maintain a disinfectant residual in the treated water distribution system. An intermediate ozone contactor is recommended after the ballasted flocculation pretreatment to:

- Oxidize the increased levels of organics associated with the increased percentage of San Lorenzo River Water
- Oxidize the increased levels of taste and odor constituents associated with the increased percentage of San Lorenzo River Water, and
- Provide increased disinfection to provide the required inactivation for the higher levels of pathogens associated with the increased percentage of San Lorenzo River Water.

An ozone advanced oxidation and disinfection process would include a below-grade concrete ozone contact structure, where the ozone is added to the water and contact time is provided for oxidation and disinfection. The ozone generation equipment would be housed in a building above the contact structure. Liquid oxygen would be used to produce the ozone.

To provide additional disinfection contact time for free chlorine addition after the filters, the existing GHWTP treated water tank could be modified from a side-stream storage tank to a baffled flow-through disinfection contactor. This would improve the efficiency of the tank for disinfection and could permit maintaining a lower free chlorine residual in the distribution system.

It should be noted that the overall GHWTP disinfection system must have the capacity to provide the required *Giardia* inactivation at the maximum plant production of 18 mgd and not just at the winter-time water transfer maximum plant production of 16 mgd.

The treated water supply to the Pasatiempo Pump Station may also have to be relocated so that all of the filtered water passes through the treated water tank and is fully disinfected to meet the inactivation requirement prior to leaving the GHWTP site. Alternatively, a separate disinfection system, such as ultraviolet light, could be provided for the Pasatiempo Pump Station.

4.2.4 Spent Washwater and Solids Handling System Improvements

The washwater recovery system that handles and treats the spent washwater from the filters would not be significantly impacted by the additional winter-time water transfer production. The pretreatment systems would treat and remove the higher turbidity, and the turbidity loading onto the filters would be similar to current operations. The solids handling systems, however, would be significantly impacted by the additional winter-time water transfer production.

Table 10 summarizes solids loading calculations for a storm event over a 24-hour period and for more typical average solids loading through a winter season. The volume of residuals and mass of solids removed are calculated based on turbidity, chemical coagulant and polymer dosages, and the flow rate through the treatment process. The turbidity levels and chemical doses from a similar analysis completed for the SJWC Montevina WTP, which treats water from the same watershed as the GHWTP, were used to determine the conceptual level solids loading.

Table 10: Solids Loading Calculations

Solids Handling Treatment Criteria	Unit	24-hour Storm Event	Typical Average Winter Season
Design Season		Wet Season	Wet Season
Design Plant Flow	MGD	16	12
Source Water Turbidity (Peak/Average)	NTU	200 / 100	30 / 30
Coagulant Dosage	mg/l	60	40
Polymer Dosage	mg/l	3	2
Total Solids Generated from Maximum Hourly Influent Turbidity [(a)]	lb/hr	1,000	250
Total Solids Generated from Winter Storm Turbidity [(a)]	lb/day	24,000	6,000

Notes:

(a) A ratio of 1.5 to 1 was used to estimate the mg/l of solids associated with 1 NTU of turbidity.
(b) A ratio of 0.44 to 1 was used to calculate the mg/l of $Al(OH)_3$ solids generated per 1 mg/l of alum dosage.
(c) A ratio of 1 to 1 was used to calculate the mg/l of polymer solids generated with 1 mg/l of polymer dosage.
(d) Storm event turbidity was estimated to rise rapidly and then decrease over a 24-hour period.

The solids generated during winter-time water transfer operation (from 6,000 to 24,000 lbs per day) would greatly exceed the current discharge limit for solids from the GHWTP of 2,085 lbs per day. Therefore, to maintain plant water production and process the solids generated during the winter-time water transfers and through storm events, new solids thickeners and mechanical dewatering equipment are required. The solids thickeners would be used to concentrate the solids stream. The mechanical dewatering equipment would be used to dewater the solids for landfill disposal. The mechanical dewatering equipment would be used during the winter when solids are generated at a rate faster than the allowable rate of sludge disposal into the sewer. The mechanical dewatering could also be used in the summer or solids could be discharged to the sewer. Pump stations would be needed for the transfer of waste streams to the treatment processes.

Table 11 provides a comparison of the current and proposed solids handling and disposal system design criteria for the GHWTP.

Table 11: Improved GHWTP Solids Handling Facilities Design Criteria

Design Parameter	Units	Current Summer	Current Winter	Proposed for Winter-Time Water Transfer
Solids Handling and Disposal				
Approach		Sanitary Sewer	Sanitary Sewer	Mechanical Dewatering
Solids Disposal Pipeline Size	inches	4	4	4
Typical Solids Flowrate Range	gpm	30 to 125 gpm	30 to 125 gpm	30 to 200 gpm
Typical Solids Production	lbs/day	1,000 to 2,000	1,500 to 2,000	6,000 to 24,000
Solids Discharge Limit	lbs/day	2,085	2,085	2,085
Solids Storage Tank	gal	NA	NA	500,000
Solids Thickeners	number	--	--	2
Thickener Type	--			Reactor Thickener
Solids Dewatering	number	--	--	2
Dewatering System	--	--	--	Belt Press
Solids Disposal	--	Landfill via WWTP	Landfill via WWTP	Direct to Landfill

The proposed solids handling system would consist of the following components:

- Two reactor-type solids thickeners, each equipped with tube or plate settlers, would be provided to separate and thicken the solids from the primary treatment process. The thickeners would be sized to also have solids storage capacities to accumulate and equalize solids loading to the dewatering system. The decant water from the solids thickeners would be further treated in the washwater handling system.

- A solids equalization storage and thickening tank to permit handling large volumes of solids during storm events. The current emergency solids tank would be replaced with an appropriately designed tank for solids handling. The solids would then be dewatered over a period of time following the storm event.

- A solids transfer pump station to pump solids from the solids thickener units to the mechanical dewatering units.

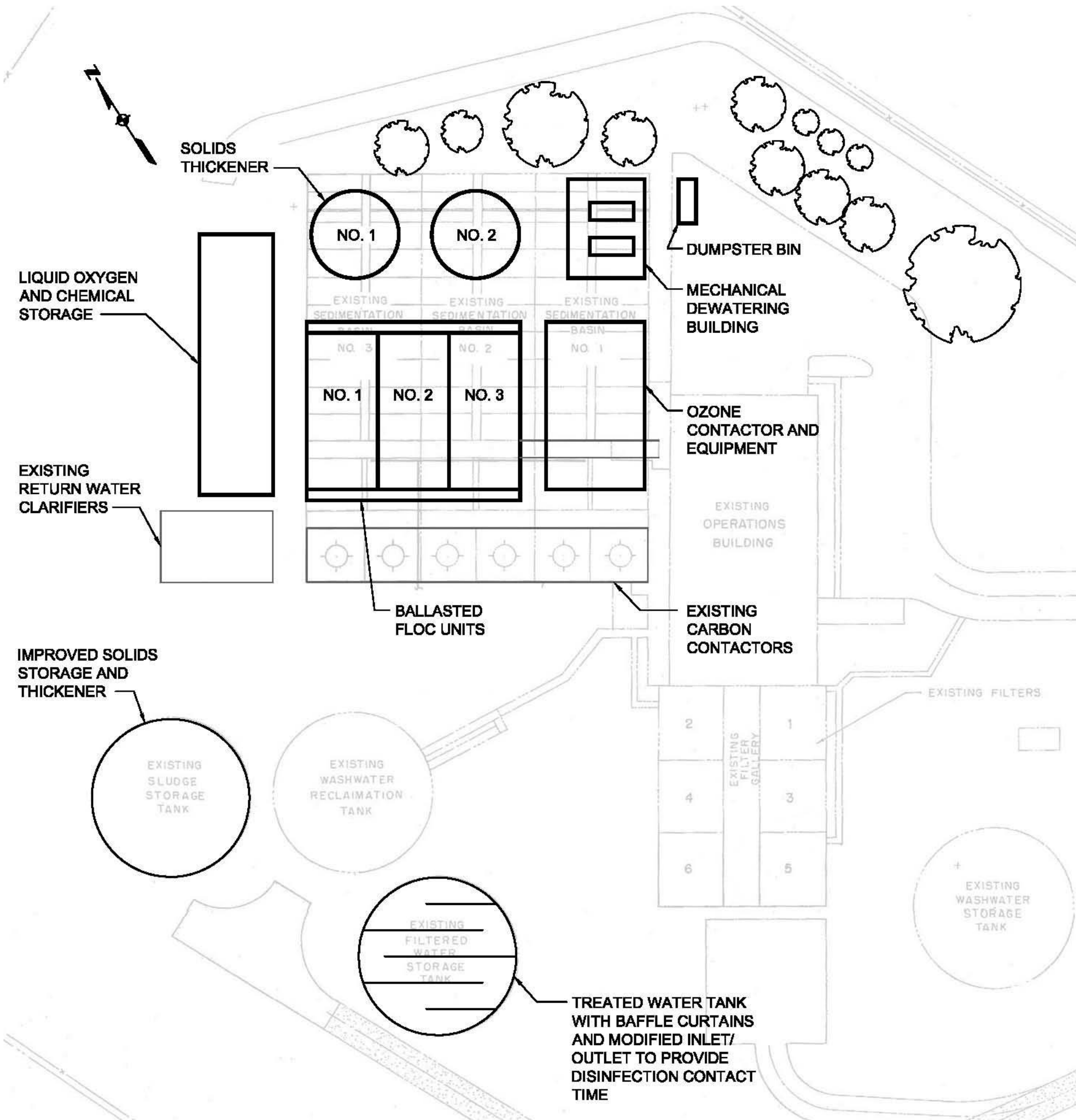
- Two belt press or centrifuge type mechanical dewatering systems with associated polymer feed systems.

- A screw conveyor to transport dewatered solids to a dump truck for off-site disposal. The offsite disposal is assumed to be at the same Kern County landfill that the Santa Cruz WWTP solids are disposed off. The solids produced may require one truck week or less during average winter operations and one truck per day during storm events with high turbidities.

- A building or covered area to house the mechanical dewatering units, conveyor, and chemical storage and feed equipment.

Two 40-foot-diameter reactor clarifier/thickeners could be located near the ballasted floc units in the area currently occupied by the existing sedimentation basins. The mechanical dewatering building could be located in a 50-foot by 50-foot area next to the ballasted floc units currently occupied by the existing flocculation basins. Existing trailers and storage units would be relocated to provide truck access to the dewatering area. Figure 8 shows the proposed conceptual layout for the new pre-treatment processes and solids handling equipment at the GHWTP site.

Figure 8: Conceptual Layout of Proposed Improvements to GHWTP



4.2.5 Winter-Time Maintenance Operations

The City staff perform annual maintenance on the GHWTP treatment process equipment and infrastructure during the winter. The proposed improvements to permit winter-time water transfers account for the winter-time maintenance period. The water-transfer production can be accommodated with one of the ballasted floc pretreatment processes and one of the filters out of service sequentially for cleaning and maintenance.

Additional labor and maintenance would be required for the winter-time water transfers and is described in Section 5 below.

4.3 Treated Water Distribution

Treated drinking water from the GHWTP flows by gravity and/or is pumped to various storage tanks throughout the City's drinking water distribution system. The existing distribution system pipes and storage tanks have a hydraulic capacity of up to approximately 24 mgd of production from the GHWTP. Therefore, the current distribution system does not need upgrade to accommodate winter-time flow rates of up to 16 mgd. However, connections from the City distribution system to the neighboring water agencies distribution systems would be required to accomplish the water transfers.

4.3.1 Distribution System Connection to Scotts Valley Water District

A distribution system connection between the City and Scotts Valley Water District (SVWD) would consist of approximately 8,200 feet of 12-inch pipe, running from the City distribution pipeline at the intersection of Sims Road and Brook Knoll Drive to the SVWD distribution connection along La Madrona Drive north of Silverwood Drive. The distribution system intertie would have an average capacity of 1-mgd but could have a maximum capacity of approximately 2-mgd to meet maximum SVWD water transfer demands (Fiske, May 2013).

The SVWD distribution system connection would also require a pump station located near the SVWD connection along La Madrona Drive. The pump station would lift the water from the City distribution system into the water storage tanks in the SVWD system.

4.3.2 Distribution System Connection to Soquel Creek Water District

Water transfer from the City to SqCWD would require replacement of portions of both the City's and SqCWD's existing water distribution pipelines with larger pipelines or installation of new pipelines. Upgrades to the City's distribution system would consist of approximately 5,200 feet of pipe between Morrissey Boulevard and the De Laveaga Tanks and approximately 10,200 feet from the De Laveaga Tanks to the Soquel Drive Intertie on Soquel Drive and 41st Avenue. In addition, the existing Morrissey pump station must be upgraded to provide a firm capacity of 5-mgd.

Upgrades to SqCWD's distribution system would include replacement of approximately 3,600 feet of pipe partly along Soquel Drive between the Soquel Drive Intertie and East Walnut Street and installation of approximately 2,300 feet of new pipe on Soquel Drive and Park Avenue between East Walnut Street and McGregor Drive.

The City and SqCWD distribution system upgrades and the Soquel Drive Intertie would have an average capacity of 1.5 mgd but could have a maximum capacity of approximately 3.5 mgd to meet maximum SqCWD water transfer demands (Fiske, May 2013).

Section 5: Planning Level Costs for Potential Water Transfers

This section presents planning level capital expenditures, annual operations and maintenance (O&M) costs and annualized costs for the improvements to the surface water supply systems, the GHWTP, and treated water delivery system that would be required to accomplish the winter-time water transfers.

5.1 Potential Water Transfer Scenarios

As described earlier, the water transfer analysis from the Fiske Study (Fiske, 2013), evaluated a number of potential water transfer scenarios that provide different potential annual transfer volumes based on the maximum production whenever there is sufficient water in the San Lorenzo River. In each scenario, new system intertie infrastructure is required. These scenarios are presented in Table 12 below with the water transfer volumes shown in acre-feet per year instead of millions of gallons, as shown in Table 1.

Table 12: Potential Water Transfer Scenarios in AFY

No.	Scenario Name	Source Water Turbidity, NTU	Max. Tait Capacity, mgd	Max. GHWTP Winter Capacity, mgd	Potential Annual Transfer to Scotts Valley, AFY	Potential Annual Transfer to Soquel Creek, AFY	Potential Total Annual Transfer, AFY
1	Current Tait & GHWTP Capacity	<15	7.8	Up to 10	325	120	445
2	Increase GHWTP Capacity	<15	7.8	Up to 16	331	292	623
3	Increase Tait & GHWTP Capacity	<15	14	Up to 16	473	1,022	1,495
4	Increase GHWTP Capacity & Treatment	~200	7.8	Up to 16	381	417	798
5	Increase Tait & GHWTP Capacity and Treatment	~200	14	Up to 16	534	1,178	1,712

In Scenario No.1, some additional water could be available for transfer by operating the current Tait Street Diversion and GHWTP up to the approximate 10 MGD winter-time capacity limitation when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 2 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer.

In Scenario No.2, additional water could be available for transfer by some improvements to increase the capacity of the GHWTP up to 16 MGD, but still operating when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer.

In Scenario No.3, additional water could be available for transfer by improvements to increase the capacity of the the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 MGD. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer, assuming the water rights permit transfer. This scenario still assumes that the turbidity levels are relatively low in the San Lorenzo River.

In Scenario No.4, additional water could be available for transfer by improvements to the GHWTP up to 16 MGD, and improvements to permit operating when turbidity levels are approximately 200 NTU, such as immediately following storm events. In this scenario, Tait Street capacity is not increased. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street with low or high turbidity could be treated for transfer, assuming the water rights permit transfer.

In Scenario No.5, additional water could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 MGD, and improvements to permit operating when turbidity levels are approximately 200 NTU, such as immediately following storm events. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street with low or high turbidity could be treated for transfer, assuming the water rights permit transfer.

5.2 Level and Basis of Cost Estimates

The planning level costs of the project elements presented are based on information and costs developed by Kennedy/Jenks for this and other technical studies, and supplemented with budgetary cost estimates from equipment manufacturers, and from similar projects and professional experience. Table 13 presents a summary of standard cost estimating level descriptions, accuracy and recommended contingencies based on the development level of the project. These data were compiled from the Association for the Advancement of Cost Engineering (AACE).

Table 13: Standard AACE Cost Estimating Guidelines

Cost Estimate Class[(a)]	Project Level Description	Estimate Accuracy Range	Recommended Estimate Contingency
Class 5	Planning	-30 to +50%	30 to 50%
Class 4	Conceptual (1 to 5% Design)	-15 to +30%	25 to 30%
Class 3	Preliminary (10 to 30% Design)	-10 to +20%	15 to 20%
Class 2	Detailed (40 to 70% Design)	-5 to +15%	10 to 15%
Class 1	Final (90 to 100% Design)	-5 to +10%	5 to 10%

Notes:

(a) Association for the Advancement of Cost Engineering, 1997. International Recommended Practices and Standards.

The proposed concepts and improvements to accomplish the winter-time water transfers have been developed to a planning level, with conceptual design criteria, site locations and a basic understanding of project elements and limitations. Therefore, the level of accuracy for the capital and operating cost estimates presented should be considered to represent a Class 5 estimate with an estimate contingency of 40 percent. The capital expenditure estimates also include planning level markups for taxes, Contractor overhead and profit, mobilization and bonding, engineering and construction management, and legal, permitting, and administrative costs.

5.3 Conceptual Level Project Costs

Table 14 presents conceptual level project costs for the different potential water transfer scenarios in the Fiske study summary and described above. The costs for improvements to the intake system, GHWTP and distribution system are separated out to permit building the costs for overall scenarios. More detailed cost development spreadsheets for the various project elements are provided in the appendix.

Table 14: Conceptual Level Project Costs for Potential Water Transfer Scenarios

Project Component	Scenario No.1: Current Tait & GHWTP Capacity, New Interties	Scenario No.2: Increase GHWTP Capacity	Scenario No.3: Increase Tait & GHWTP Capacity	Scenario No.4: Increase GHWTP Capacity & Treatment	Scenario No.5: Increase Tait & GHWTP Capacity and Treatment
Tait Street Diversion Improvements					
Improvements for existing 7.8 MGD systems	$2,770,000	$2,770,000	$2,770,000	$3,840,000	$3,840,000
Expansion to 14 MGD capacity	--	--	$5,950,000	--	$5,950,000
GHWTP Improvements					
Pre-treatment Improvements	--	$24,800,000	$24,800,000	$24,800,000	$24,800,000
Oxidation and Disinfection Improvements	--	$20,240,000	$20,240,000	$20,240,000	$20,240,000
Solids Handling Improvements	--	$5,538,400	$12,670,000	$12,670,000	$12,670,000
Distribution System Improvements					
Connection to Scotts Valley Water District	$5,770,000	$5,770,000	$5,770,000	$5,770,000	$5,770,000
Connection to Soquel Creek Water District	$18,410,000	$18,410,000	$18,410,000	$18,410,000	$18,410,000
Total Scenario Project Cost	**$26,950,000**	**$77,528,400**	**$90,610,000**	**$85,730,000**	**$91,680,000**

In Scenario No.1, the current GHWTP would operate up to the full winter-time capacity approximately 10 mgd when turbidity and organics levels are appropriate for the current facility processes. Improvements to the Tait Street Diversion are recommended to handle additional sand loading at the intake from increased winter use. New distribution system connection pipelines and pump stations would be required to deliver the additional water to Scotts Valley and Soquel Creek Water Districts.

In Scenario No.2, improvements to GHWTP pre-treatment system and disinfection systems would permit the GHWTP to operate above 10 mgd and up to 16 mgd in the winter-time with increased pathogen and organics loading from the higher percentages of San Lorenzo River water. The GHWTP would still be limited to operating when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). Improvements to the solids handing system include the solids storage tank, but not the mechanical dewatering systems. Improvements to the Tait Street Diversion are recommended to handle additional sand loading at the intake from increased winter use. New distribution system connections permit transferring the additional water.

In Scenario No.3, improvements to GHWTP pre-treatment system and disinfection systems would permit the GHWTP to operate above 10 mgd and up to 16 mgd in the winter-time with increased pathogen and organics loading from the higher percentages of San Lorenzo River water. The GHWTP would still be limited to operating when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). Improvements to the solids handing system include the solids storage tank, and would include the mechanical dewatering systems to handle the increase solids from the increased winter production. Improvements to the Tait Street Diversion are required to handle additional sand loading at the intake from increased winter use and increase the capacity up to 14 mgd. New distribution system connections permit transferring the additional water.

In Scenario No.4, improvements to GHWTP pre-treatment system and disinfection systems would permit the GHWTP to operate above 10 mgd and up to 16 mgd in the winter-time. The GHWTP pretreatment and solids handling system improvements would permit operating when turbidity levels are approximately 200 NTU. Improvements to the Tait Street Diversion are required to handle additional sand loading at the intake from increased winter use and the storm loadings. New distribution system connections permit transferring the additional water.

In Scenario No.5, improvements to GHWTP pre-treatment system and disinfection systems would permit the GHWTP to operate above 10 mgd and up to 16 mgd in the winter-time. The GHWTP pretreatment and solids handling system improvements would permit operating when turbidity levels are approximately 200 NTU. Improvements to the Tait Street Diversion are required to handle additional sand loading at the intake from increased winter use and the storm loadings and increase the capacity up to 14 mgd. New distribution system connections permit transferring the additional water.

5.4 Conceptual Level Operating Costs

The conceptual level operating and maintenance (O&M) costs for the winter time water transfers were developed on a unit-of-water cost basis to determine the additional cost of treating and transferring water above what is currently done at the GHWTP. The unit-cost in dollars per acre foot ($/AF) is then applied to the expected average volume of water for each scenario, to determine the O&M cost to treatment and transfer the winter-time water for that scenario.

The O&M costs elements for the winter time water transfers include:

- Pumping costs from the Tait Street Diversion up to the GHWTP
- Tait Street Diversion Sand and Debris Removal, Hauling and Disposal
- Pre-Treatment, Oxidation and Disinfection

- Solids Handling costs at the GHWTP
- GHWTP Solids Dewatering, Hauling and Disposal
- Additional pumping costs to transfer the water from the City's distribution system pressures to the Scotts Valley and Soquel Creek Water District Systems.

The energy and O&M costs for the Tait Street Diversion are estimated at approximately $103 per acre-foot (AF) for the current 7.8-mgd capacity and increased production from the diversion. At 14-mgd capacity and increased winter-time production, the cost would increase to approximately $122 per acre-foot (AF) due to increase friction losses in the pipeline and increased solids and debris removal.

The energy cost for pumping from City's distribution system pressures to the Scotts Valley and Soquel Creek Water District Systems is estimated at a combined average of approximately $50 per acre-foot (AF). The energy cost for pumping to Scotts Valley would likely be higher than for pumping to Soquel Creek Water District.

Table 15, below, summarizes the engineer's opinion of probable operations and maintenance costs for the GHWTP when operating with increased San Lorenzo River water for winter-time water transfers at average production in current (< 15 NTU) turbidity conditions and the potential higher turbidity (~200 NTU) water conditions that would occur during some of the winter-time water transfer scenarios. The O&M costs are presented for the winter-time (November to April) time period when additional water could be produced.

Table 15: Conceptual Winter Water Transfer O&M Costs of GHWTP

Component	GHWTP Winter-Water Transfer (15 NTU Turbidity) Operations	GHWTP Winter-Water Transfer (High Turbidity) Operations
Power	$145,000	$216,000
Chemicals	$209,000	$327,000
Sand for Pretreatment	$2,000	$4,000
Solids Hauling	$50,000	$198,000
Solids Disposal	$31,000	$122,925
Maintenance Materials	$228,000	$418,000
Labor	$250,000	$350,000
Total Estimate	**$915,000**	**$1,636,000**
$/AF	**165**	**245**

The O&M costs were developed based on the following assumptions:

- O&M costs were developed for the 181-day winter period (November to April).

- Power rate of $0.16/kWh. Power use includes energy to operate ballasted pretreatment, ozone system equipment, and solids handling systems.
- Alum coagulant applied at a dose of 40mg/L for normal operations and at a dose of 60 mg/l during winter higher turbidity and organics loadings, at a cost of $0.25/pound.
- Pretreatment polymer applied at a dose of 2 mg/L for normal operations and at a dose of 3 mg/l during winter higher turbidity and organics loadings, at cost of $1.01/ pound
- Solids conditioning polymer applied at dose of 1 mg/L at cost of $1.01/ pound
- Volume of solids requiring hauling and disposal computed based on 75 days of storm, average WTP flow rate of 12 mgd, average raw water turbidity during storm of 50 NTU, average coagulant dose during storm of 60 mg/L, average polymer dose of 3 mg/L, and 20-percent solids concentration for solids processed through dewatering equipment.
- Solids hauling rate of $40/cubic yard.
- Solids disposal (tipping cost) of $130 per ton.
- Maintenance materials estimated at 5 percent of equipment costs
- The winter water transfers would require additional operations and maintenance personnel for the new processes and equipment at the Tait Street Diversion and the GHWTP. For winter water transfers at lower turbidities, one additional operator and one maintenance staff were assumed. For winter water transfers at higher turbidities, one additional operator and two maintenance staff were assumed.

5.5 Life-cycle Unit Water Costs for Potential Water Transfers

The conceptual level life-cycle unit water cost for the different water transfer scenarios is presented in Table 16 below. The life-cycle unit water cost in $/AF is the sum of the annualized capital costs for the improvements, plus the operating costs to treat and transfer the water, divided by the total potential additional production from winter-time water transfers. The annualized capital cost is calculated based on a project life of 30 years and an interest rate of five percent.

Table 16: Conceptual Life-Cycle Unit Water Costs for Potential Water Transfer Scenarios

Project Cost Component	Scenario No.1: Current Tait & GHWTP Capacity	Scenario No.2: Increase GHWTP Winter Capacity	Scenario No.3: Increase Tait & GHWTP Capacity	Scenario No.4: Increase GHWTP Capacity & Treatment	Scenario No.5: Increase Tait & GHWTP Capacity and Treatment
Scenario Capital Cost	$26,950,000	$77,528,400	$90,610,000	$85,730,000	$91,680,000
Annualized Water Transfer Capital Cost	$1,754,400	$5,047,100	$5,898,700	$5,581,000	$5,968,400
Additional Tait Street O&M Costs, $/yr	$45,000	$63,100	$182,700	$97,500	$209,200
Additional GHWTP O&M Costs, $/yr	$73,300	$102,600	$246,300	$195,800	$420,000
Additional Water Transfer Pumping Cost, $/yr	$22,300	$31,200	$74,800	$39,900	$85,600
Total Water Transfer Life-Cycle Cost, $/yr	$1,895,100	$5,244,000	$6,402,500	$5,914,200	$6,683,200
Potential Scotts Valley Water Transfer, AF/yr	325	331	473	381	534
Potential Soquel Creek Water Transfer, AF/yr	120	292	1022	417	1178
Life-Cycle Unit Water Cost for Water Transfers, $/AF	$4,260	$8,420	$4,280	$7,410	$3,900

References

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Gary Fiske and Associates, 2013. Supplemental Analysis of Water Transfer Volumes; July 24, 2013.

Gary Fiske and Associates, 2013. Water Transfer Phase 2 Summary; June 25, 2013.

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Gary Fiske and Associates, 2013. Phase 2 Water Transfer Project Draft Task 2 TM: Utilization of Tait Street Capacity; June 11, 2013.

Gary Fiske and Associates, 2013. Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision), May 2013.

Kennedy/Jenks Consultants, 2010. San Jose Water Company, Montevina Water Treatment Plant Facilities Plan, July 2010.

Wood Rogers, 2009. City of Santa Cruz, Tait Street Diversion Sanding Study, Alternatives Evaluation Report, May 2009.

Appendix A:

Cost development spreadsheets for the various water transfer scenario elements are provided in the appendix.

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Tait Street Improvements (Grit Removal Only)

Prepared By: --
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:
- [X] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		TAIT STREET IMPROVEMENTS (from 2009 Tait Street Diversion Standing Study by Wood Rogers)	1	LS	480,375	480,375	480,375	480,375			960,750
		Improvements to Grit removal system and Civil work at site.									
		from Alt 1 of Wood Rogers report.									
		Location Multiplier (10%)	1	LS							
		Escalation to 2013 Costs (6.75%)	1	LS							
		Subtotals				480,375		480,375			960,750
		Division 1 Costs	@	10%		48,038		48,038			96,075
		Subtotals				528,413		528,413			1,056,825
		Taxes - Materials Costs	@	8.75%		46,236					46,236
		Subtotals				574,649		528,413			1,103,061
		Contractor OH&P	@	15%		86,197		79,262			165,459
		Subtotals				660,846		607,674			1,268,520
		Estimate Contingency	@	40%							507,408
		Construction Cost									**1,775,928**
		Legal/Permitting	@	10%							177,593
		Subtotals									1,953,521
		Engineering and CM	@	15%							293,028
		Subtotals									2,246,549
		SCWD Admin	@	5%							112,327
		Total Project Cost									**2,358,877**
		Total Project Estimate									**2,400,000**

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS

Project: Water Transfer Infrastructure Summary Report

Building, Area: Tait Street Improvements (Full Upgrade)

Prepared By: --
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:

- [X] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
			0		0	0	0	0	0	0	0
		TAIT STREET IMPROVEMENTS (from 2009 Tait Street Diversion Standing Study by Wood Rogers)	1	LS	665,375	665,375	665,375	665,375		0	1,330,750
		Location Multiplier (10%)	1	LS	66,538	66,538	66,538	66,538		0	133,075
		Escalation to 2013 Costs (6.75%)	1	LS	49,404	49,404	49,404	49,404		0	98,808
						0		0		0	0
		Full improvements from Alternative 1.				0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
						0		0		0	0
		Subtotals				781,317		781,317		0	1,562,633
		Division 1 Costs	@	10%		78,132		78,132		0	156,263
		Subtotals				859,448		859,448		0	1,718,897
		Taxes - Materials Costs	@	8.75%		75,202					75,202
		Subtotals				934,650		859,448		0	1,794,098
		Contractor OH&P	@	15%		140,197		128,917			269,115
		Subtotals				1,074,847		988,365		0	2,063,213
		Estimate Contingency	@	40%							825,285
		Construction Cost									**2,888,498**
		Legal/Permitting	@	10%							288,850
		Subtotals									3,177,348
		Engineering and CM	@	15%							476,602
		Subtotals									3,653,950
		SCWD Admin	@	5%							182,698
		Total Project Cost									**3,836,648**
		Total Project Estimate									**3,900,000**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Tait Street Upgrades (Additional 7 MGD Capacity)

Prepared By: --
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:
- [X] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		TAIT STREET UPGRADES FOR WATER TRANSFER(from 2009 Tait Street Diversion Standing Study by Wood Rogers)	1	LS	733,750	733,750	733,750	733,750			1,467,500
		Location Multiplier (10%)	1	LS	73,375	73,375	73,375	73,375			146,750
		Escalation to 2013 Costs (6.75%)	1	LS	54,481	54,481	54,481	54,481			108,962
		Property Aqusition for New Facilities	1	LS					750,000	750,000	750,000
		New 7 MGD Intake from Alterntive 2 in the Wood Rodgers report.									
		Subtotals				861,606		861,606		750,000	2,473,212
		Division 1 Costs	@	10%		86,161		86,161		75,000	247,321
		Subtotals				947,767		947,767		825,000	2,720,533
		Taxes - Materials Costs	@	8.75%		82,930					82,930
		Subtotals				1,030,696		947,767		825,000	2,803,463
		Contractor OH&P	@	15%		154,604		142,165			296,769
		Subtotals				1,185,301		1,089,932		924,000	3,199,232
		Estimate Contingency	@	40%							1,279,693
		Construction Cost									**4,478,925**
		Legal/Permitting	@	10%							447,892
		Subtotals									4,926,817
		Engineering and CM	@	15%							739,023
		Subtotals									5,665,840
		SCWD Admin	@	5%							283,292
		Total Project Cost									**5,949,132**
		Total Project Estimate									**6,000,000**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: **Water Transfer Infrastructure Summary Report**

Prepared By: **CMT/ANK**
Date Prepared: **24-Oct-13**
K/J Proj. No. **1368009*00**

Building, Area: **Graham Hill WTP Pre-Treatment Improvements**

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:
- [X] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		SITE WORK									
		Demo Existing Pre-treatment Basins	1	LS			295,000	295,000			295,000
		Demo Existing Basins' Electrical Systems	1	LS			35,000	35,000			35,000
		Excavation	1,600	CY			20	32,000			32,000
		Fill and Compaction	6,500	CY	10	65,000	15	97,500			162,500
		Yard Piping	1	LS	50,000	50,000	50,000	50,000			100,000
		Relocate Existing trailers and equipment	1	LS	50,000	50,000	100,000	100,000			150,000
		CHEMICAL SYSTEM IMPROVEMENTS									
		Coagulant System Improvements	1	LS	150,000	150,000	75,000	75,000			225,000
		PAC System Improvements	1	LS	200,000	200,000	100,000	100,000			300,000
		BALLASTED FLOC TANKS									
		Slab on-grade	185	CY	250	46,250	150	27,750			74,000
		Walls	900	CY	600	540,000	400	360,000			900,000
		Suspended Slabs	220	CY	1,100	242,000	700	154,000			396,000
		Grout	220	CY	200	44,000	100	22,000			66,000
		Grating	3,000	SF	15	45,000	12	36,000			81,000
		Guardrails	275	LF	75	20,625	60	16,500			37,125
		Stairway	76	RISERS	300	22,800	200	15,200			38,000
		Stair Landing	2	EA	1,500	3,000	1,500	3,000			6,000
		Slide Gates	3	EA	12,000	36,000	3,000	9,000			45,000
		Equipment Pads	10	CY	250	2,500	150	1,500			4,000
		BALLASTED FLOC EQUIPMENT									
		Ballasted Floc Equipment	3	EA	1,400,000	4,200,000	280,000	840,000			5,040,000
		Ballasted Floc Piping, Valves, and Accessories	1	LS	150,000	150,000	150,000	150,000			300,000
		ELECTRICAL AND INSTRUMENTATION (20%)	1	LS	830,000	830,000	830,000	830,000			1,660,000
		Subtotals				6,697,175		3,249,450			9,946,625

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Graham Hill WTP Pre-Treatment Improvements

Prepared By: CMT/ANK
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ________
Escalated to ENR ________
Months to Midpoint of Construct ________

Estimate Type: [X] Conceptual [ ] Construction
[ ] Preliminary (w/o plans) [ ] Change Order
[ ] Design Development @ ________ % Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Division 1 Costs	@	10%		669,718		324,945			994,663
		Subtotals				7,366,893		3,574,395			10,941,288
		Taxes - Materials Costs	@	8.75%		644,603					644,603
		Subtotals				8,011,496		3,574,395			11,585,891
		Contractor OH&P	@	15%		1,201,724		536,159			1,737,884
		Subtotals				9,213,220		4,110,554			13,323,774
		Estimate Contingency	@	40%							5,329,510
		Construction Cost									**18,653,284**
		Legal/Permitting	@	10%							1,865,328
		Subtotals									20,518,612
		Engineering and CM	@	15%							3,077,792
		Subtotals									23,596,404
		SCWD Admin	@	5%							1,179,820
		Total Project Cost									**24,776,224**
		Total Project Estimate									**24,800,000**

OPINION OF PROBABLE CONSTRUCTION COST | **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Building, Area: Graham Hill WTP Disinfection System Improvements

Current at ENR ________
Escalated to ENR ________
Months to Midpoint of Construct ________

Estimate Type: [X] Conceptual [ ] Construction
[ ] Preliminary (w/o plans) [ ] Change Order
[ ] Design Development @ ________ % Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		SITE WORK									
		Demo Existing Filtered Water Storage Tank	1	LS			64,000	64,000			64,000
		Demo Existing Basins' Electrical Systems	1	LS			15,000	15,000			15,000
		Excavation	1,000	CY			20	20,000			20,000
		Fill and Compaction	1,000	CY	10	10,000	15	15,000			25,000
		OZONE CONTACTOR AND EQUIPMENT									
		Slab-on-grade	150	CY	250	37,500	150	22,500			60,000
		Walls	700	CY	600	420,000	400	280,000			700,000
		Suspended Slabs	200	CY	1,100	220,000	700	140,000			360,000
		Grout	150	CY	200	30,000	100	15,000			45,000
		Grating	500	SF	15	7,500	12	6,000			13,500
		Guardrails	100	LF	75	7,500	60	6,000			13,500
		Ozone Equipment	1	LS	3,500,000	3,500,000	700,000	700,000			4,200,000
		Ozone Destruct and Quench Equipment	1	LS	400,000	400,000	80,000	80,000			480,000
		LOX System	1	LS	500,000	500,000	125,000	125,000			625,000
		TREATED WATER TANK IMPROVEMENTS									
		New Concrete or Steel Tank (1 MG)	1	LS	667,000	667,000	333,000	333,000			1,000,000
		Tank Inlet/Outlet Reconfiguration	1	LS	30,000	30,000	90,000	90,000			120,000
		Pasatiempo Piping Reconfiguration	1	LS	20,000	20,000	20,000	20,000			40,000
		Baffle Curtains	7,500	SF	8	60,000	8	60,000			120,000
		Disinfect Tank	1	LS	2,000	2,000	10,000	10,000			12,000
		ELECTRICAL AND INSTRUMENTATION (10%)	1	LS	400,000	400,000	400,000	400,000			800,000
		Subtotals				6,311,500		2,401,500			8,713,000
		Division 1 Costs	@	10%		631,150		240,150			871,300
		Subtotals				6,942,650		2,641,650			9,584,300
		Taxes - Materials Costs	@	8.75%		607,482					607,482
		Subtotals				7,550,132		2,641,650			10,191,782
		Contractor OH&P	@	15%		1,132,520		396,248			1,528,767
		Subtotals				8,682,652		3,037,898			11,720,549

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Graham Hill WTP Disinfection System Improvements

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:
- [X] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Estimate Contingency*	@	30%							3,516,165
		Construction Cost									**15,236,714**
		Legal/Permitting	@	10%							1,523,671
		Subtotals									16,760,385
		Engineering and CM	@	15%							2,514,058
		Subtotals									19,274,443
		SCWD Admin	@	5%							963,722
		Total Project Cost									**20,238,165**
		Total Project Estimate									**20,300,000**

*Contingency reduced to 30% due to less uncertainty for project.

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13

Building, Area: Graham Hill WTP Solids Handling System Improvements for High Turbidity

K/J Proj. No. 1368009*00

Current at ENR ____________
Escalated to ENR ____________
Months to Midpoint of Construct ____________

Estimate Type:
- [X] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ________ % Complete
- [ ] Construction
- [ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		SITE WORK									
		Excavation	1,900	CY			20	38,000			38,000
		Fill and Compaction	1,900	CY	10	19,000	15	28,500			47,500
		Yard Piping	1	LS	50,000	50,000	50,000	50,000			100,000
		REACTOR CLARIFIER/THICKENER EQUIPMENT									
		Concrete Foundation	215	CY	250	53,750	150	32,250			86,000
		Structural Fill/CLSM	700	CY	12	8,400	8	5,600			14,000
		Sloped Bottom	100	CY	250	25,000	150	15,000			40,000
		Swept In Grout	300	SF	3	900	5	1,500			2,400
		Concrete Walls	290	CY	600	174,000	400	116,000			290,000
		Launders	5	CY	1,100	5,500	700	3,500			9,000
		Stair Landing	2	CY	250	500	150	300			800
		Stairway	43	RISERS	750	32,250	750	32,250			64,500
		Handrails	40	LF	135	5,400	65	2,600			8,000
		Clarifier/Thickener Access Walkway	1	TON	3,500	4,550	5,500	7,150			11,700
		Guardrails	270	LF	85	22,950	40	10,800			33,750
		Clarifier/Thickener Equipment	2	EA	170,000	340,000	34,000	68,000			408,000
		Pipe, Valves and Accessories	1	LS	50,000	50,000	50,000	50,000			100,000
		DECANT AND SOLIDS PUMP STATION									
		RCT Solids Transfer Pumps	2	EA	10,000	20,000	5,000	10,000			30,000
		RCT Solids Pump Station Wet Well	1	LS	25,000	25,000	15,000	15,000			40,000
		RCT Solids Pump Equipment Pad	1	LS	2,500	2,500	2,500	2,500			5,000
		MECHANICAL DEWATERING EQUIPMENT AND STRUCTURE									
		Floc Tank-Belt Press Unit	2	EA	500,000	1,000,000	200,000	400,000			1,400,000
		Conveyor	1	EA	15,000	15,000	7,500	7,500			22,500
		Bins	1	LS	5,000	5,000	500	500			5,500
		Concrete Slab	90	CY	250	22,500	150	13,500			36,000
		Equipment Building	1,575	SF	150	236,250	100	157,500			393,750

OPINION OF PROBABLE CONSTRUCTION COST | **KENNEDY/JENKS CONSULTANTS**

Project: **Water Transfer Infrastructure Summary Report**

Building, Area: **Graham Hill WTP Solids Handling System Improvements for High Turbidity**

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ____________
Escalated to ENR ____________
Months to Midpoint of Construct ____________

Estimate Type:
- [X] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** __________ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Filtrate Pumps	2	EA	10,000	20,000	5,000	10,000			30,000
		Filtrate Piping, Valves and Accessories	1	LS	15,000	15,000	15,000	15,000			30,000
		Filtrate EQ Pump Station Wetwell	1	LS	10,000	10,000	10,000	10,000			20,000
		Polymer Processing and Feed System	1	LS	25,000	25,000	15,000	15,000			40,000
		SOLIDS EQ AND THICKENING TANK IMPROVEMENTS									
		New Concrete or Steel Tank (1 MG)	1	LS	667,000	667,000	333,000	333,000			1,000,000
		Tank Inlet/Outlet Reconfiguration	1	LS	30,000	30,000	90,000	90,000			120,000
		Solids Transfer Pumps	2	EA	10,000	20,000	5,000	10,000			30,000
		Solids Pump Station Wet Well	1	LS	25,000	25,000	15,000	15,000			40,000
		Solids Pump Equipment Pad	1	LS	2,500	2,500	2,500	2,500			5,000
		ELECTRICAL AND INSTRUMENTATION (15%)	1	LS	300,000	300,000	300,000	300,000			600,000
		Subtotals				3,232,950		1,868,450			5,101,400
		Division 1 Costs	@	10%		323,295		186,845			510,140
		Subtotals				3,556,245		2,055,295			5,611,540
		Taxes - Materials Costs	@	8.75%		311,171					311,171
		Subtotals				3,867,416		2,055,295			5,922,711
		Contractor OH&P	@	15%		580,112		308,294			888,407
		Subtotals				4,447,529		2,363,589			6,811,118
		Estimate Contingency	@	40%							2,724,447
		Construction Cost									**9,535,565**
		Legal/Permitting	@	10%							953,557
		Subtotals									10,489,122
		Engineering and CM	@	15%							1,573,368
		Subtotals									12,062,490
		SCWD Admin	@	5%							603,125
		Total Project Cost									**12,665,615**
		Total Project Estimate									**12,700,000**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Graham Hill WTP Solids Handling System Improvements for Normal Transfer

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ____
Escalated to ENR ____
Months to Midpoint of Construct ____

Estimate Type:
- [X] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
- [ ] Construction
- [ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		SITE WORK									
		Excavation	1,000	CY			20	20,000			20,000
		Fill and Compaction	1,000	CY	10	10,000	15	15,000			25,000
		Yard Piping	1	LS	50,000	50,000	50,000	50,000			100,000
		REACTOR CLARIFIER/THICKENER EQUIPMENT									
		Concrete Foundation	115	CY	250	28,750	150	17,250			46,000
		Structural Fill/CLSM	350	CY	12	4,200	8	2,800			7,000
		Sloped Bottom	80	CY	250	20,000	150	12,000			32,000
		Swept In Grout	150	SF	3	450	5	750			1,200
		Concrete Walls	150	CY	600	90,000	400	60,000			150,000
		Launders	5	CY	1,100	5,500	700	3,500			9,000
		Stair Landing	2	CY	250	500	150	300			800
		Stairway	24	RISERS	750	18,000	750	18,000			36,000
		Handrails	20	LF	135	2,700	65	1,300			4,000
		Clarifier/Thickener Access Walkway	1	TON	3,500	4,550	5,500	7,150			11,700
		Guardrails	150	LF	85	12,750	40	6,000			18,750
		Clarifier/Thickener Equipment	1	EA	170,000	170,000	34,000	34,000			204,000
		Pipe, Valves and Accessories	1	LS	50,000	50,000	50,000	50,000			100,000
		DECANT AND SOLIDS PUMP STATION									
		RCT Solids Transfer Pumps	2	EA	10,000	20,000	5,000	10,000			30,000
		RCT Solids Pump Station Wet Well	1	LS	25,000	25,000	15,000	15,000			40,000
		RCT Solids Pump Equipment Pad	1	LS	2,500	2,500	2,500	2,500			5,000
		SOLIDS EQ AND THICKENING TANK IMPROVEMENTS									
		New Concrete or Steel Tank (1 MG)	1	LS	667,000	667,000	333,000	333,000			1,000,000
		Tank Inlet/Outlet Reconfiguration	1	LS	30,000	30,000	90,000	90,000			120,000
		Solids Transfer Pumps	2	EA	10,000	20,000	5,000	10,000			30,000
		Solids Pump Station Wet Well	1	LS	25,000	25,000	15,000	15,000			40,000
		Solids Pump Equipment Pad	1	LS	2,500	2,500	2,500	2,500			5,000
		ELECTRICAL AND INSTRUMENTATION (15%)	1	LS	100,000	100,000	100,000	100,000			200,000
		Subtotals				1,359,400		876,050			2,235,450

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: **Water Transfer Infrastructure Summary Report**

Building, Area: **Graham Hill WTP Solids Handling System Improvements for Normal Transfer**

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ____
Escalated to ENR ____
Months to Midpoint of Construct ____

Estimate Type: [X] **Conceptual** [ ] **Construction**
[ ] **Preliminary (w/o plans)** [ ] **Change Order**
[ ] **Design Development @** ____ **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Division 1 Costs	@	10%		135,940		87,605			223,545
		Subtotals				1,495,340		963,655			2,458,995
		Taxes - Materials Costs	@	8.75%		130,842					130,842
		Subtotals				1,626,182		963,655			2,589,837
		Contractor OH&P	@	15%		243,927		144,548			388,476
		Subtotals				1,870,110		1,108,203			2,978,313
		Estimate Contingency	@	40%							1,191,325
		Construction Cost									**4,169,638**
		Legal/Permitting	@	10%							416,964
		Subtotals									4,586,602
		Engineering and CM	@	15%							687,990
		Subtotals									5,274,592
		SCWD Admin	@	5%							263,730
		Total Project Cost									**5,538,322**
		Total Project Estimate									**5,538,400**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Scotts Valley Intertie

Prepared By: ANK
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:
- [X] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ______ % Complete
- [ ] Construction
- [ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		12-inch Diameter Pipe	8,200	LF	88	720,000	88	720,000			1,440,000
		Pump Station at La Medrona Drive (3 MGD)	1	LS	673,200	673,200	215,000	215,000			888,200
		Subtotals				1,393,200		935,000			2,328,200
		Division 1 Costs	@	10%		139,320		93,500			232,820
		Subtotals				1,532,520		1,028,500			2,561,020
		Taxes - Materials Costs	@	8.75%		134,096					134,096
		Subtotals				1,666,616		1,028,500			2,695,116
		Contractor OH&P	@	15%		249,992		154,275			404,267
		Subtotals				1,916,608		1,182,775			3,099,383
		Estimate Contingency	@	40%							1,239,753
		Construction Cost									**4,339,136**
		Legal/Permitting	@	10%							433,914
		Subtotals									4,773,050
		Engineering and CM	@	15%							715,957
		Subtotals									5,489,007
		SCWD Admin	@	5%							274,450
		Total Project Cost									**5,763,457**
		Total Project Estimate									**5,800,000**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Soquel Creek Intertie

Prepared By: ANK
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______
Months to Midpoint of Construct ______

Estimate Type:
[X] Conceptual
[ ] Preliminary (w/o plans)
[ ] Design Development @ ______ % Complete
[ ] Construction
[ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Santa Cruz WD Pipelines	1	LS	2,929,700	2,929,700	2,929,700	2,929,700			5,859,400
		Soquel WD Pipelines	1	LS	437,600	437,600	437,600	437,600			875,200
		Morrisey Pump Station Improvements	1	LS	500,000	500,000	250,000	250,000			750,000
		Subtotals				3,867,300		3,617,300			7,484,600
		Division 1 Costs	@	10%		386,730		361,730			748,460
		Subtotals				4,254,030		3,979,030			8,233,060
		Taxes - Materials Costs	@	8.75%		372,228					372,228
		Subtotals				4,626,258		3,979,030			8,605,288
		Contractor OH&P	@	15%		693,939		596,855			1,290,793
		Subtotals				5,320,196		4,575,885			9,896,081
		Estimate Contingency	@	40%							3,958,432
		Construction Cost									**13,854,513**
		Legal/Permitting	@	10%							1,385,451
		Subtotals									15,239,964
		Engineering and CM	@	15%							2,285,995
		Subtotals									17,525,959
		SCWD Admin	@	5%							876,298
		Total Project Cost									**18,402,257**
		Total Project Estimate									**18,500,000**

ENGINEER'S ESTIMATE OF PROBABLE COST | **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Prepared By: --
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Building, Area: Tait Street Pump Station O&M - Normal Winter (7.5 MGD)

Current at ENR ______
Escalated to ENR ______

Estimate Type:
[X] **Conceptual** [ ] **Construction**
[ ] **Preliminary (w/o plans)** [ ] **Change Order**
[ ] **Design Development @** ______ **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Power (for 300 feet static lift and headloss across 1 mile of 24-inch diameter pipe)	1,836,202	kWh	0.16	293,792					293,792
		Sand and Debris Removal and Hauling	830	CY			40.00	33,187			33,187
		Sand and Debris Tipping Fee for Disposal	159	TON			130.00	20,650			20,650
		Maintenance Materials	1	LS	24,020.00	24,020					24,020
		Additional Labor and Maintenance	0.5	person					100,000	50,000	50,000
		Total Estimate									421,700
		$/AF									101

ENGINEER'S ESTIMATE OF PROBABLE COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: Tait Street Pump Station O&M - Transfer Winter (14 MGD)

Prepared By: --
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______

Estimate Type:
[X] Conceptual
[ ] Preliminary (w/o plans)
[ ] Design Development @ ______ % Complete
[ ] Construction
[ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Power (for 300 feet static lift and headloss across 1 mile of 24-inch diameter pipe)	3,659,767	kWh	0.16	585,563					585,563
		Sand and Debris Removal and Hauling	3,289	CY			40.00	131,572			131,572
		Sand and Debris Tipping Fee for Disposal	630	TON			130.00	81,868			81,868
		Maintenance Materials	1	LS	51,370.00	51,370					51,370
		Additional Labor and Maintenance	1.0	person					100,000	100,000	100,000
		Total Estimate									950,400
		$/AF									122

ENGINEER'S ESTIMATE OF PROBABLE COST — **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Building, Area: GHWTP O&M - Normal Winter (10 MGD)

Current at ENR ____
Escalated to ENR ____

Estimate Type:
- [X] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
- [ ] Construction
- [ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Power	905,000	kWh	0.16	144,800					144,800
		Chemicals									
		Alum	604,000	LBS	0.25	151,000	0.001	600			151,600
		Polymer (Pretreatment)	31,000	LBS	1.01	31,310	0.019	600			31,910
		Oxygen for Ozone production	23,000	LBS	0.75	17,250	0.011	256			17,506
		Polymer (Dewatering)		LBS	1.01						
		Chlorine	31,000	LBS	0.25	7,750	0.019	600			8,350
		Sand for Ballasted Floc	11	TON	200	2,172					2,172
		Solids Hauling to Kern County	1,246	CY			40	49,831			49,831
		Solids Disposal Tipping Cost	239	TON			130	31,006			31,006
		Maintenance Materials	1	LS	228,000	228,000					228,000
		Labor (Half Year)	5	STAFF			50,000	250,000			250,000
		Total Estimate									915,200
		$/AF									165

ENGINEER'S ESTIMATE OF PROBABLE COST **KENNEDY/JENKS CONSULTANTS**

Project: Water Transfer Infrastructure Summary Report

Building, Area: GHWTP O&M - Transfer Winter (12 MGD)

Prepared By: ANK/TKR
Date Prepared: 24-Oct-13
K/J Proj. No. 1368009*00

Current at ENR ______
Escalated to ENR ______

Estimate Type: [X] Conceptual [ ] Construction
[ ] Preliminary (w/o plans) [ ] Change Order
[ ] Design Development @ ______ % Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		Power	1,351,000	kWh	0.16	216,160					216,160
		Chemicals									
		Alum	906,000	LBS	0.25	226,500	0.001	600			227,100
		Polymer (Pretreatment)	55,000	LBS	1.01	55,550	0.011	599			56,149
		Oxygen for Ozone production	46,000	LBS	0.75	34,500	0.008	358			34,858
		Polymer (Dewatering)	65	LBS	4.63	300	0.019	1			301
		Chlorine	31,000	LBS	0.25	7,750	0.019	600			8,350
		Sand for Ballasted Floc	18	TON	200	3,600	5.00	90			3,690
		Solids Hauling to Kern County	4,939	CY			40	197,556			197,556
		Solids Disposal Tipping Cost	946	TON			130	122,925			122,925
		Maintenance Materials	1	LS	418,000	418,000					418,000
		Labor (Half Year)	7	STAFF			50,000	350,000			350,000
		Total Estimate									1,635,100
		$/AF									245