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

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Prepared by:

Santa Cruz County Environmental Health Services

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Regional Water Management Foundation

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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.

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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

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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.

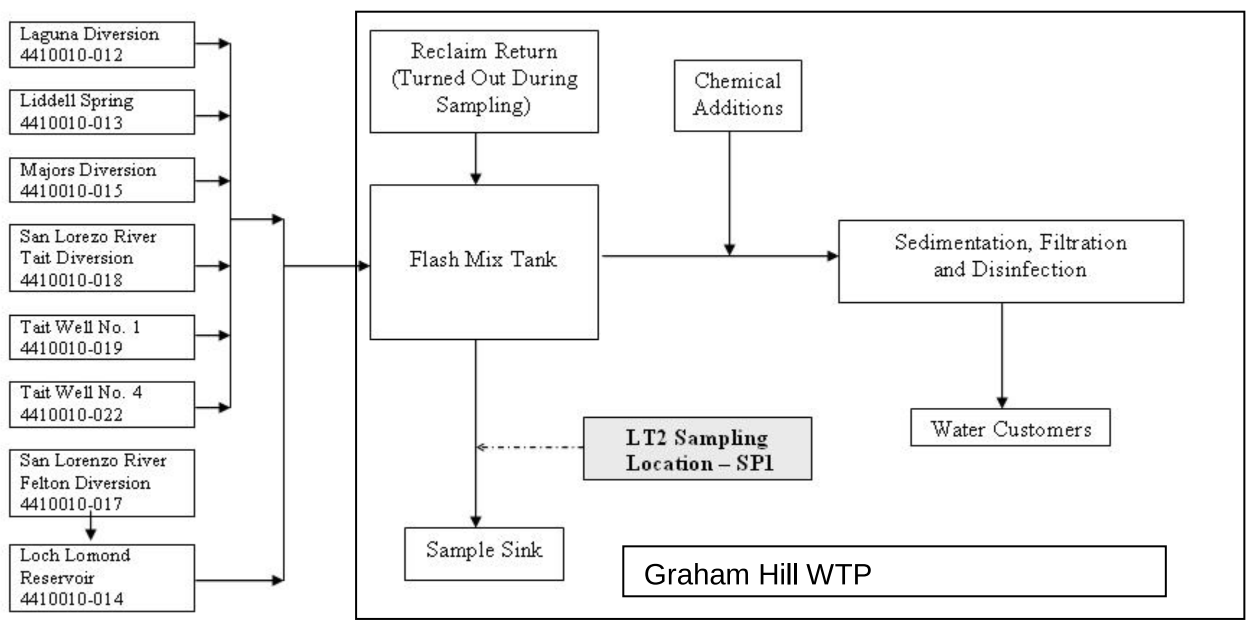
Section 2: Existing Surface Water System

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^oC - 7.5 pH	8^oC - 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.

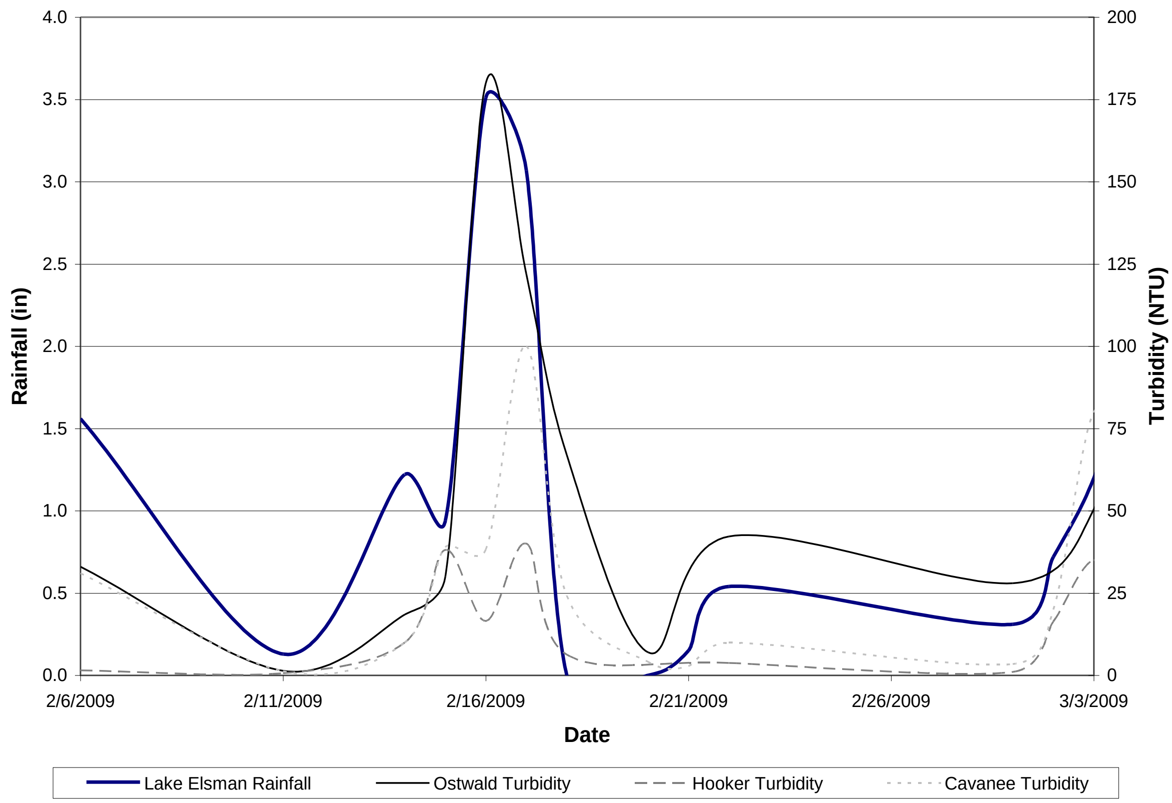
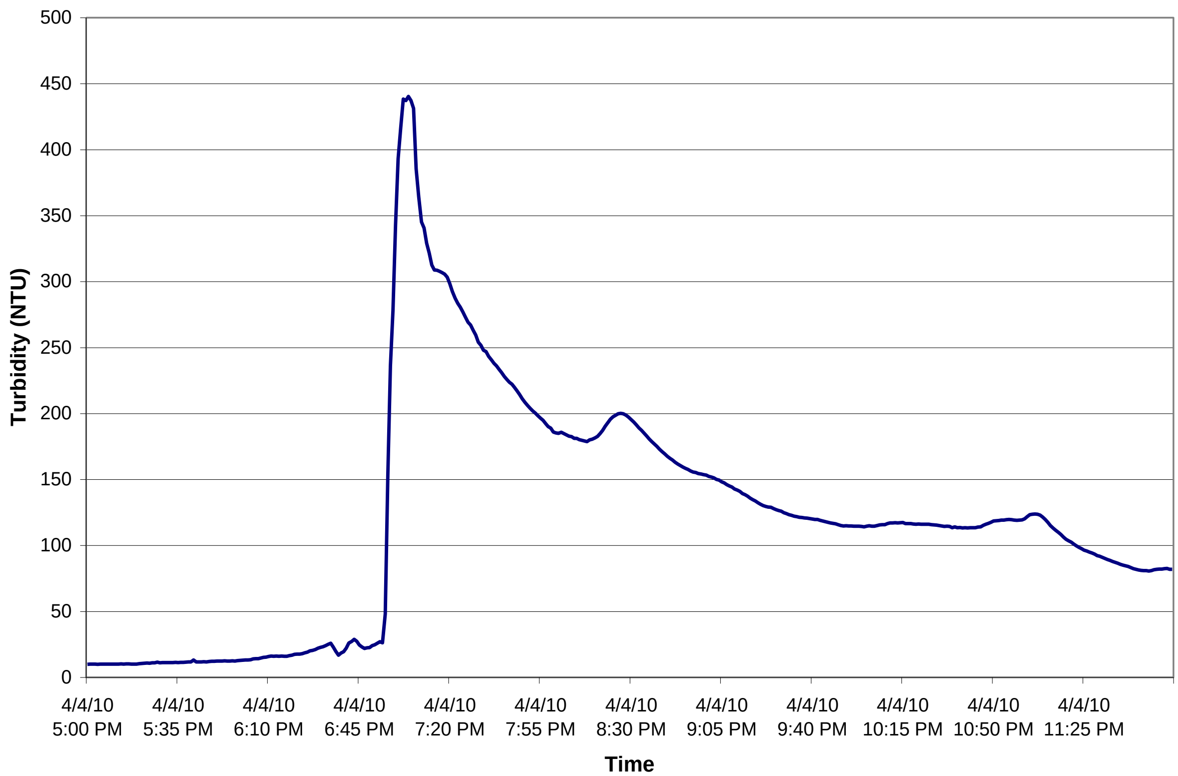


Figure 6: Turbidity Profile of a Santa Cruz Mountain Watershed Stream during and after a Storm Event



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.

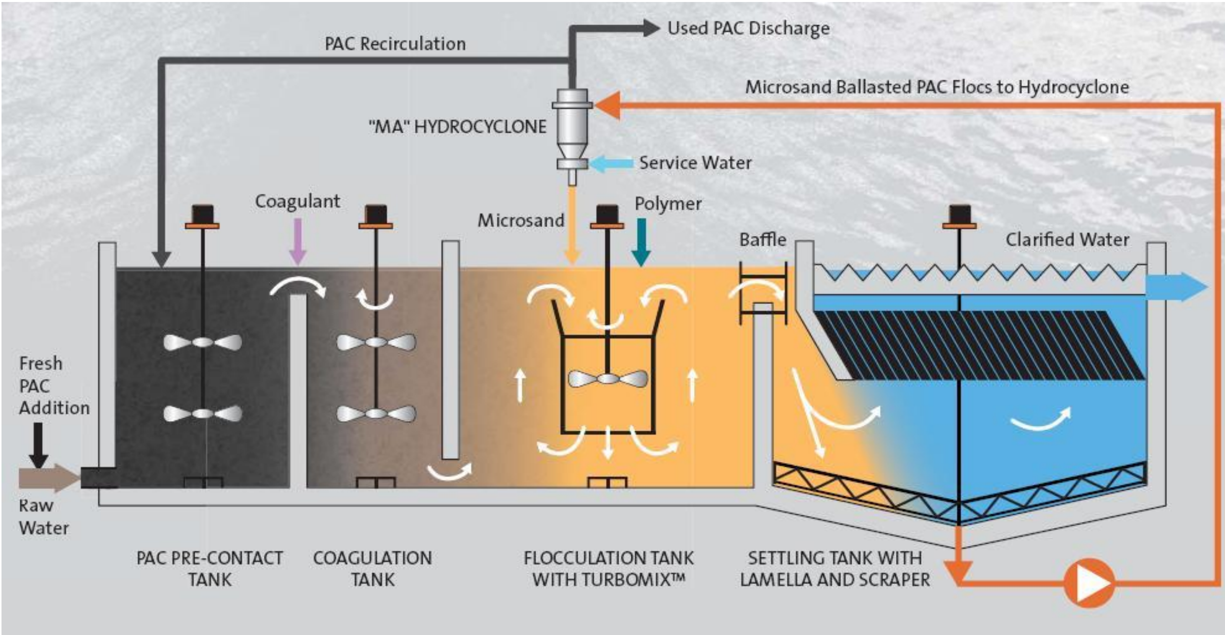
4.2.2 Pre-Treatment System Improvements

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.

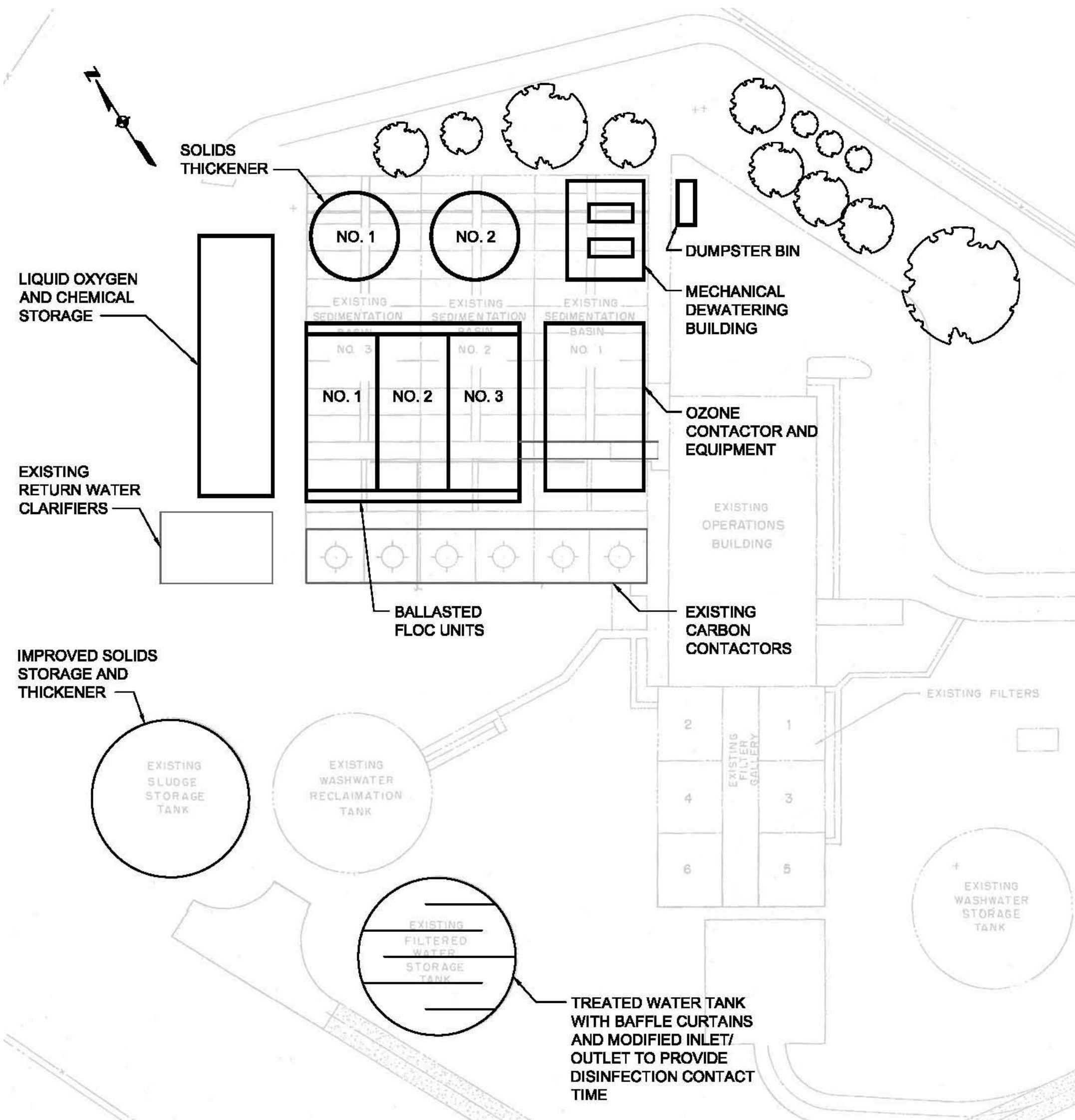
- Two belt press or centrifuge type mechanical dewatering systems with associated polymer feed systems.

- 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

Akel Engineering Group, 2013. Desalination Plant Hydraulic Modeling and Analysis; February 2013.

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.

Gary Fiske and Associates, 2013. Phase 2 Water Transfer Project Draft Task 3 TM: Potential Transfers with Unlimited Tait Street Capacity; June 20, 2013.

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

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

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

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
		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		Installation		Sub-contractor		Total
					$/Unit	Total	$/Unit	Total	$/Unit	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**

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

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

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

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** [ ] **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**
- [ ] **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 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**
K/J Proj. No. **1368009*00**

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

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									
		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

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 [ ] 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
		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**
- [ ] **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
		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**
[ ] **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)	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**

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

Building, Area: **Tait Street Pump Station O&M - Transfer Winter (14 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 (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**
- [ ] **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	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