Engineering Report on Production and Use of Reclaimed Water

Crescent City Water Pollution Control Facility
March 2011

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1.0 OVERVIEW

The Crescent City Water Pollution Control Facility (CCWPCF) is located on the oceanfront in downtown Crescent City and serves the metropolitan area. The CCWPCF is currently being upgraded to improve treatment of 1.89 million gallons per day (mgd). The November 2003 Facilities Plan and April 2004 Value Engineering laid out a staged approach to the upgrades but was later converted to a single phase approach. The plant is currently being constructed with a planned finish date of January 2011. It will serve an average dry weather flow of 1.6 mgd and will have a peak hour hydraulic flow capacity of 11.5 mgd. A map showing the location of the CCWPCF is presented in Figure 1-1.

As part of construction the City proposes to reclaim a portion of the effluent it now discharges to the ocean and reuse it for agronomic purposes. The reuse will be "optional" in the sense that it is not required for disposal of the effluent. The Crescent City Water Reclamation Plant (CCWRP) will produce the reclaimed water and the City will be the holder of the permit and water reuse requirements. The City will be the only agency involved in the treatment, distribution, and operation and maintenance of recycle facilities. Brown and Caldwell and Stover Engineer have been contracted for the design and engineering report required by Title 22, Division 4, Chapter 3, Article 7, section 60323. Wahlund Construction has been contracted by the City for the installation of the reuse equipment detailed herein.

The water reclamation plant (WRP) will be constructed within the CCWPCF to produce Class 1 (disinfected tertiary) reclaimed water which is the highest quality reclaimed water required by the California Department of Public Health (CDPH). Class 1 water is suitable for all the intended uses identified for the project. To produce Class 1 water, the reclamation plant will process secondary effluent from the CCWPCF through microfiltration membranes with an effective pore diameter of 0.1 microns. The filtrate will then be pumped through a pipe containing inline ultraviolet disinfection units. A transmission main will deliver the reclaimed water to the use areas for agronomic purposes.

This engineering report on the production, transmission, and reuse of reclaimed water has been prepared as supporting documentation for the City's application for water reclamation requirements. The report contains a summary of the water quality requirements, a description of the facilities, and proposed reliability features as well as other items as requested by CDPH in a letters dated 31 January 2005 and 1 September 2010 responding to the November 2004 and October 2009 draft engineering report on production and use of reclaimed water respectively. Additional memos have been produced to respond to various requests from the State Water Resources Control Board.

Figure 1-1 Location Map

2.0 RECLAIMED WATER QUALITY STANDARDS AND TREATMENT REQUIREMENTS

Water quality standards for water reclamation vary depending upon the specific end-use desired. Standards for the quality of reclaimed water and design criteria for treatment processes are described in regulations developed by CDPH. Water quality standards and conformance of the WRP with CDPH treatment process regulations are discussed in the following sections.

2-1. Water Quality Standards

In California the production, conveyance, and use of reclaimed water is regulated by the State Water Resources Control Board (SWRCB) through its Regional Water Quality Control Boards (RWQCB); alternatively applicants may apply for coverage under the States General Permit for Recycled Water Order No. 2009-0006-DWQ. Water reclamation requirements are established by the Regional Boards for specific reuse projects based on input from the CDPH and local health agencies. The overriding regulatory criteria governing wastewater reuse are found in the California Code of Regulations, Title 22, Division 4, Section 60301, et seq., commonly referred to as Title 22. Treatment requirements, process redundancy, facility reliability, monitoring frequency, and effluent quality are specified under Title 22 for various reuse categories. The fundamental theme of the Title 22 criteria is the protection of public health with end use alternatives that generate the highest potential for public exposure requiring the greatest level of treatment and reliability.

The potential for disease transmission through pathogenic organisms (bacteria, protozoa, helminthes, and viruses) is the critical concern addressed in the Title 22 regulations. The relationship between reclaimed water's bacteriological quality, treatment requirements, and the opportunities for public exposure is summarized in Table 2-1.

Under the proposed project, it is the intent of the CCWRP to produce only reclaimed water which has been treated to the highest level and can be most liberally used for irrigation in accordance with Title 22. Based on the proposed uses and the water quality requirements summarized in Table 2-1, the water quality standards presented in Table 2-2 are anticipated.

Table 2-1. General Treatment and Water Quality Requirements for Various Reclamation Alternatives as Established Under Title 22

Reclamation Alternative	Treatment and Effluent Quality Requirement[a] MPN/100 mL	Reclaimed Water Class	Reclaimed Water Class
Agricultural food crops	Secondary treatment, filtration and disinfection, total effluent coliform <2.2/100 mL	I	Disinfected tertiary
Parks, playgrounds and schoolyard irrigation	Secondary treatment, filtration and disinfection, total effluent coliform <2.2/100 mL	I	Disinfected tertiary
Golf course (restricted access), cemetery, freeway median, and greenbelt irrigation	Secondary treatment, total effluent coliform <23/100 mL	III	Disinfected secondary – 23
Pasture for milking animals	Secondary treatment, total effluent coliform <23/100 mL	III	Disinfected secondary – 23
Fodder, fiber, and seed crops, orchards and vineyards	Primary treatment	--	undisinfected secondary – (oxidized wastewater)

NOTES: [a] Required by current Title 22. Total effluent coliform requirements refer to 7-day median value.

Table 2-2. Anticipated Water Quality Standards for Reclaimed Water

Constituent	Amount[a]
BOD_5, mg/L	5 (30 day average) 15 (daily maximum)
TSS, mg/L	5 (30 day average) 15 (daily maximum)
Turbidity, NTU	≤0.2 (95% of time within a 24hour period) ≤0.5 (maximum any time)
Total Coliform, MPN/100 mL	≤2.2 (7 day median) ≤23 (in no more than one sample/30 days) ≤240 (maximum)

NOTES: [a] Proposed uses: future irrigation.

2-2. Treatment Requirements

The treatment steps required to achieve the reclaimed water quality standards presented in Table 2-2 are specified in Title 22. When the specified treatment steps are employed and the corresponding water quality standards are met, the reclaimed water is suitable for the approved uses.

For reclaimed water used for unrestricted irrigation and in-plant process use, Title 22 requires that the wastewater receive the highest degree of treatment, which is termed "disinfected tertiary reclaimed water." To qualify as disinfected tertiary reclaimed water, the wastewater must be "filtered" and disinfected.

"Filtered wastewater" is defined in the criteria to include membrane microfiltration producing an effluent with turbidity which "does not exceed any of the following: 0.2 nephelometric turbidity unity (NTU) more than 5 percent of the time within a 24-hour period and 0.5 NTU at any time."[1] Additional information on the features of the WRP is presented in Section 4.

Disinfection of the reclaimed water must occur by one of two specified means: 1) a chlorine disinfection process that provides a CT of 450 milligram-minutes per liter with a modal contact time of not less than 90 minutes based on peak dry weather flow, or 2) a disinfection

[1] November 2003. Treatment Technology Report for Recycled Water, State of California Division of Drinking Water and Environmental Management.

process that, when combined with filtration, has been demonstrated to achieve 5-log inactivation of virus; 99.999 percent of plaque-forming units of F-specific bacteriophage MS2, or polio virus must be inactivated or removed. The proposed WRP will comply with these criteria as follows:

1. The WRP will be designed to pass effluent through a microfiltration membrane following which the turbidity does not exceed 0.2 NTU more than 5 percent of the time within a 24-hour period and 0.5 NTU at any time, AND

2. The disinfection process will consist of inline ultraviolet disinfection equipment manufactured by Aquionics and approved by the National Water Research Institute (NWRI) under their 2003 guidelines.[2]

[2] May 2003. Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, 2nd Edition, National Water Research Institute.

3.0 RESPONSIBLE PARTIES

Crescent City Public Works Department will oversee the treatment, distribution, and use of the reclaimed water described in this report. Crescent City WPCF staff will be responsible for the operation, maintenance, and monitoring of all aspects of the treatment of wastewater and delivery of reclaimed water to the reuse transmission pipe. City staff will be responsible for the operation, maintenance, and monitoring of all aspects of the irrigation of City landscaping. A table delineating these responsibilities is provided as Table 3-1.

Table 3-1. Responsible Parties

Crescent City Public Works Department And Staff	
Operation and maintenance of reclaimed water distribution piping up to and including City landscaping irrigation	Operation and maintenance of all WRP equipment
Operation and maintenance of reclaimed water distribution piping up to but not including future users.	Compliance with all Title 22 requirements for creation of reclaimed water
Compliance with all Title 22 requirements for application of reclaimed water on public landscaping	

The City is responsible for ensuring that any end use will comply with all Title 22 requirements in the application of reclaimed water. The City is committed to ensuring that any future use of the recycled water to irrigate City landscaping will also be designed and implemented to fully comply with all federal, state, and local requirements. Draft Rules and Regulation (Appendix A), Municipal Code for Cross-Connections (Appendix B), Recycled Water Guidelines and Best Management Practices (Appendix C), and Recycled Water Inspection and Monitoring Program (Appendix D) are attached. The purpose of these documents is to demonstrate the level of preparedness of the City to introduce, utilize, and inspect and monitor its recycled water system.

4.0 WASTEWATER CHARACTERISTICS

This section presents discussions of the quality of the raw wastewater, effluent projected from the upgraded CCWPCF, and a discussion of the projected recycled water quality from the new reclamation plant.

4-1. CCWPCF Raw Wastewater Characteristics

The wastewater received by the CCWPCF is largely of domestic nature. The City also has a pretreatment ordinance which regulates industrial discharges to the WPCF. Table 4-1 shows the 2008 values for both TSS and BOD.

Table 4-1. Raw Wastewater

2008 Raw Wastewater Characteristics				
	95th Percentile		Median	
DATE	TSS	BOD	TSS	BOD
Jan-08	213	152	109	101
Feb-08	221	183	161	130
Mar-08	250	193	181	145
Apr-08	429	406	303	250
May-08	460	434	333	295
Jun-08	426	433	316	285
Jul-08	467	429	400	312
Aug-08	495	348	455	328
Sep-08	497	382	343	276
Oct-08	537	582	437	348
Nov-08	524	369	419	286
Dec-08	513	394	219	226

4-2. Projected CCWPCF Effluent Quality

The wastewater received by the CCWPCF is largely of domestic nature. The upgraded treatment plant will have an average dry weather design flow of 1.6 mgd and a peak hour wet weather design hydraulic capacity of 11.5 mgd. Dry weather wastewater treatment will be provided through a process train consisting of raw wastewater screening, grit removal, primary sedimentation, fine screening, aerated biological treatment, and microfiltration, followed by ultraviolet disinfection for recycled water or chlorination for disinfection and dechlorination prior to ocean discharge of treated wastewater. Wet weather flow will be treated through a process train consisting of raw wastewater screening, grit removal, primary sedimentation, rotating biological contactor biological treatment, secondary sedimentation, and sodium hypochlorite disinfection and dechlorination prior to ocean discharge of treated wastewater. Table 4-2 shows the predicted final effluent quality discharged to the ocean under various conditions.

Table 4-2. Projected CCWPCF Secondary Effluent Water Quality (Discharge to Ocean), mg/L

	BOD_5	TSS	NH_4-N
Annual Average	12	5	3
Maximum Month	19	7	3
Maximum Week	21	9	3
Maximum Day	28	10	3

4-3. Projected Recycled Water Quality

The plan for the CCWPCF water reclamation project is to construct a reclamation plant with a capacity of 1.2 mgd to serve City use areas with irrigation. This capacity is equal to a portion of the dry weather flow through the CCWPCF and therefore there will be ample secondary effluent available to meet the projected recycled water need.

The two key criteria for reclaimed water quality set forth in Title 22 are turbidity and total coliform. As shown in Table 4-2, the membrane microfiltration and ultraviolet disinfection system are predicted to meet Title 22 requirements.

Table 4-3. Projected Reclaimed Water Quality

	Units	7-day Median	30-day Average	Daily Average	Daily Maximum
Total Suspended Solids	mg/L	1	1	--	1
BOD_5	mg/L	1	1	--	
Turbidity	NTU	--	--	≤ 0.2[1]	≤ 0.5[2]
Coliform Organisms	MPN/100 mL	< 2.2		--	23

1. 95% of time within a 24-hour period
2. any time

The above prediction for the membrane filtration system is based on the CDPH's 2009 report, Treatment Technology Report for Recycled Water, and CDPH's conditional acceptance letter for the MemJet® B30R filtration technology dated 11/18/05. The prediction for the disinfection equipment is based on an April 2008 report filed with CDPH titled INLINE+ UV Disinfection Systems Validation Report. CDPH has subsequently issued letters of conditional acceptance. It is anticipated that the WRP will achieve the mandated water quality requirements for reclaimed water.

The system will be fully tested for compliance with all applicable laws and as required by CDPH and the RWQCB prior to discharge of any reclaimed water. Appendix E and F are the manufacturer's proposed plans for testing the UV and membrane systems respectively. Both the filter and UV manufacturers are contractually obligated to perform this work.

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5.0 WATER RECLAMATION PLANT DESCRIPTION

This section presents a description of the facilities to be provided at the water reclamation plant. The design criteria, process operation and control, as well as the reliability of the facilities are also discussed.

5-1. Design Criteria

The reclamation plant will be provided with a treatment process train designed to meet the requirements of Title 22, the CDPH, and the RWQCB. The most significant design criteria are as follows:

1. The plant will be provided with a nominal capacity of 1.2 mgd. The anticipated instantaneous maximum membrane filtration capacity will allow for a peaking factor of 1.58. A maximum flow of 1.2 mgd disinfection and pumping capacity will be provided to deliver reclaimed water for irrigation use. The remaining filtrate, .38 mgd, will flow through the plants chlorine disinfection basin and be discharged to the ocean outfall.

2. The plant facilities will provide the wastewater with biological oxidation, microfiltration, and ultraviolet disinfection.

3. The microfiltration membranes will have an effective pore size of 0.1 microns. These extremely small pores provide a physical barrier to particles above this size. The reclaimed water will have a turbidity of less than 0.2 NTU.

4. Disinfection of the filtered water will be accomplished by an inline ultraviolet system, designed to reduce the total coliform most probable number to levels not higher than 2.2 per 100 milliliters (mL).

5. Sufficient number of membrane modules will be provided such that when the plant is operating at its design capacity, the filtration rate will not exceed 0.5 gallons per minute per square meter (gpm/m^2) of membrane surface with one of the racks being backwashed or out of service.

The plant design data based on these design criteria are presented in Table 5-1.

Table 5-1. Crescent City Reclaimed Water Plant Design Data Table

Description	Value
Design Flow	
Average dry weather (ADWF), mgd	1.6[1]
Maximum day dry Weather (MDDWF), mgd	2.5
Average Wet Weather (AWWF), mgd	1.8
Maximum month wet weather (MMWWF), mgd	2.7
Maximum week wet weather (MWWWF), mgd	3.2
Maximum day wet weather (MDWWF), mgd	5.0
Maximum hour wet weather (MHWWF), mgd	7.8
Design BOD Load	
Annual average, ppd	1,440
Maximum month, ppd	2,400
Maximum week, ppd	2,650
Maximum day, ppd	3,570
Design TSS Load	
Annual average, ppd	2,420
Maximum month, ppd	3,500
Maximum week, ppd	4,490
Maximum day, ppd	4,730
Effluent Permit Limits	
Ocean Discharge	
Monthly average BOD/TSS, mg/L	30/30
Weekly average BOD/TSS, mg/L	45/45
Daily maximum BOD/TSS, mg/L	-/-
Effluent Reuse	
Maximum Daily Flow, mgd	1.2
Disinfection requirements	2.2 mpn/100 mL
Fine Screening (prior to MBR treatment)	
Type: Fine, 1 to 2 mm, opening	

Description	Value
Number	1
Capacity, mgd, each	2.4
Membrane Bioreactors	
Continuous rated flow capacity, mgd	1.2
Maximum day flow capacity, mgd	1.5
Maximum hour flow capacity, mgd	1.9
Disinfection	
Type of Effluent Disinfection:	
Ocean discharge	Chlorine
Reuse applications	UV-LPHO
Effluent Reuse Pumping Station	
Number of pumps at capacity, each, mgd	2 at 0.8

Notes: 1. From the total of 1.6 mgd, only 1.2 mgd maximum could be processed via the disinfection and pumping equipment and the remainder, 0.4 mgd, will flow by gravity to the chlorine contact basin for disinfection and ultimately to the ocean outfall.

5-2. Facility Description

While Table 5-1 presents the design criteria, it also presents a listing of the main processes and the auxiliary facilities to be provided at the reclamation plant. A flow diagram of the plant's process train is shown in Figure 5-1 and a layout of the plant facilities is provided in Figure 5-2.

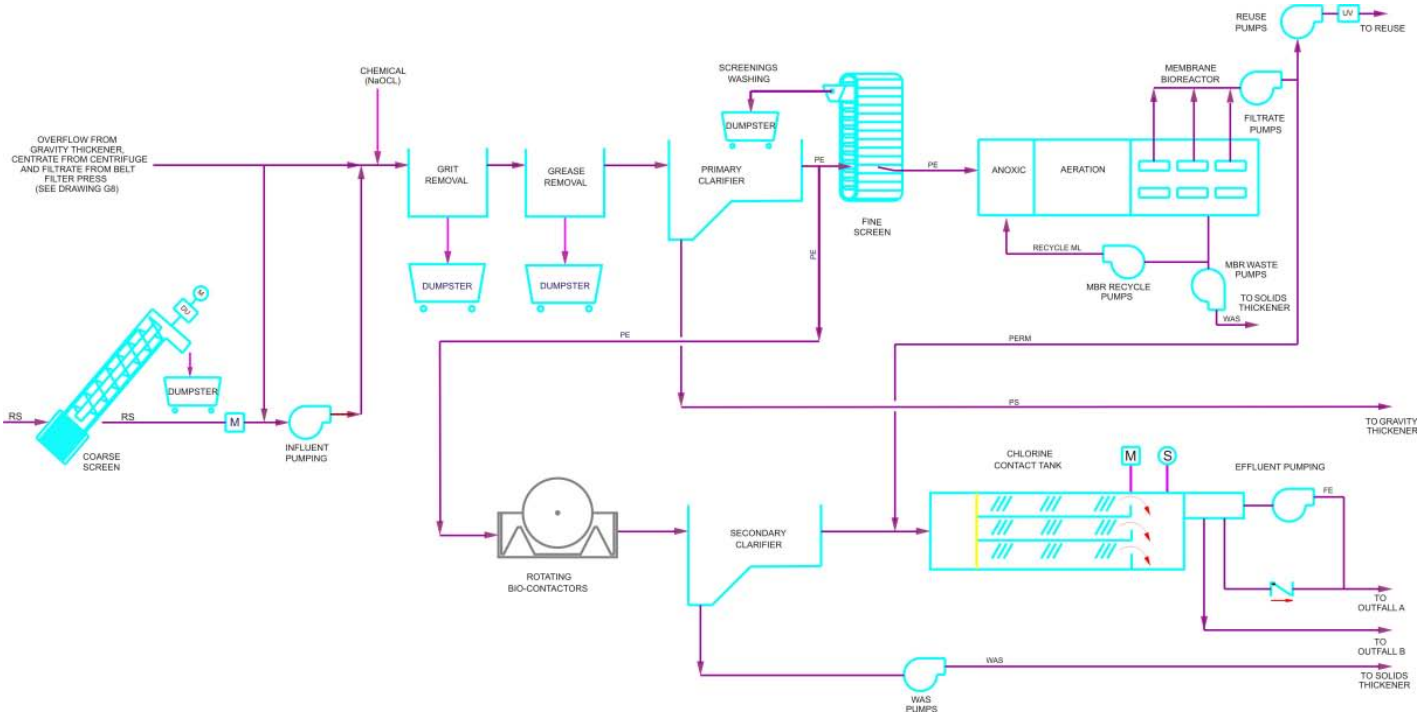

Figure 5-1 Flow Diagram

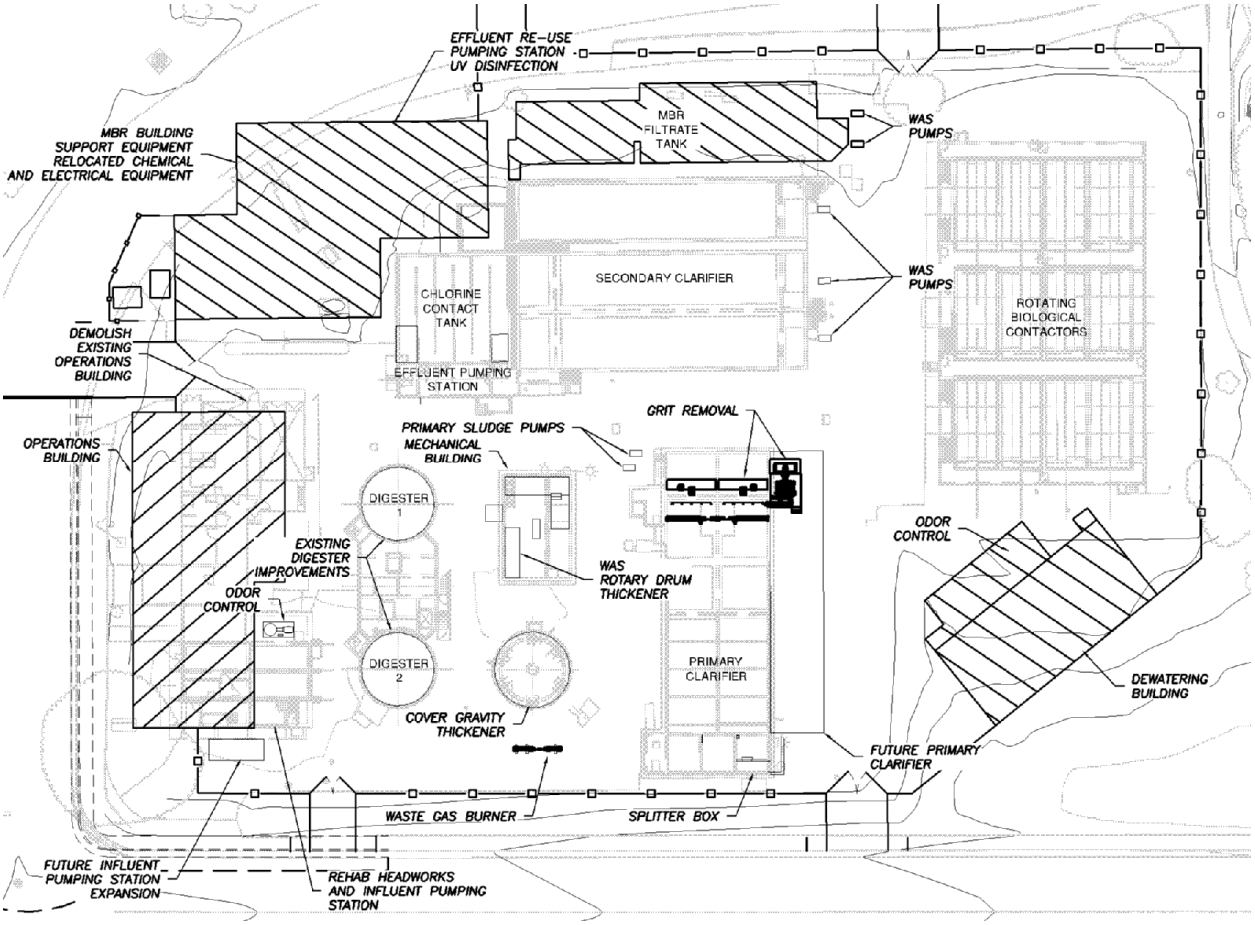

Figure 5-2. Plant Facilities Layout

Generally, the mixed liquor will be pumped from the aerobic reactor to one of three membrane tanks. Filtrate pumps will pull the filtrate through the pores in the membrane fibers (leaving the solids behind in the membrane tanks) and pump it to the filtrate tank. Reuse pumps will draw up to 1.2 mgd from the filtrate tank and pump it through the in-line ultraviolet disinfection system. The disinfected filtrate will then flow through the 12-inch reuse pipeline to the City's irrigation facilities.

Other facilities to be provided at the reclamation plant will include the membrane chemical storage and handling system and a building to house the electrical and control equipment as well as the miscellaneous auxiliary equipment. In addition to the facilities for water reclamation, the plant will have certain facilities to disinfect secondary filtrate with chlorine and discharge it through the plant's ocean outfall. A description of each facility is presented in the following paragraphs:

A. Membrane Bioreactor (MBR) System: The MBR system comprises a fine screen, followed by biological oxidation of the wastewater and membrane microfiltration of the effluent.

1. Fine Screens: The MBR process requires fine screening of the liquid to remove material that can blind and foul the membranes. A fine screen will be installed in the flow stream between the primary clarifiers and the MBRs. This screen will be located at the inlet to the new MBR anoxic basin and remove all particulate material larger than two 2 millimeters (mm) in diameter. The unit will be sized to treat up to an hourly peak of 2.4 mgd of wastewater. Screenings will be macerated and washed to remove organics and dewatered for storage in a dumpster where it will be removed periodically for disposal. Screenings wash water will be piped to the plant drain system.

2. Membrane Bioreactors: As illustrated in Figure 5-3, fine-screened primary effluent will enter an anoxic basin, where it will be combined with recycled microorganisms from the membrane tank. Mixers will keep the solids in suspension; the microorganisms will utilize the incoming biochemical oxygen demand (BOD) to denitrify nitrate (NO_3^2) to nitrogen gas (N_2). From the anoxic zone, the mixed liquor will flow to an aeration basin where diffused air will be provided for the biochemical breakdown of BOD.

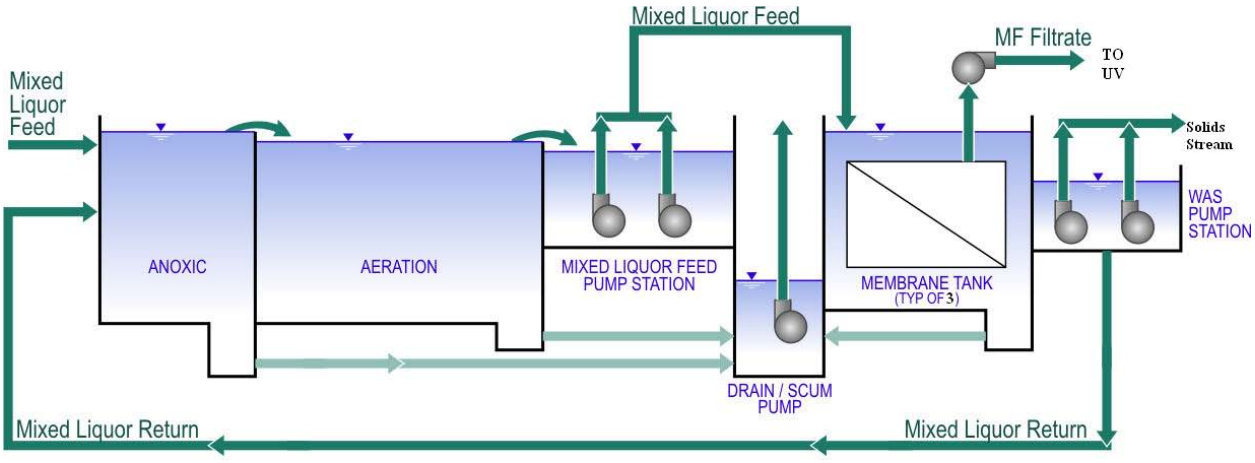

Figure 5-3. MBR Process Flow Diagram

Mixed liquor will be pumped into the membrane tank for filtration of the microorganisms from the finished effluent. Membranes designed to remove small particles will be used to separate the treated effluent from the microorganisms. Filtrate pumps pull water across the membranes, leaving the microorganisms behind to be either pumped back to the anoxic tank (recycled) or removed from the system (wasted). Wasting is carefully controlled to maintain the proper amount of microorganisms in the system to treat the incoming load. The filtrate will be pumped to a filtrate tank which will be used to deliver treated water to ultraviolet (UV) disinfection during the effluent reuse season or the chlorine contact channel in the wet weather months.

Many configurations of membranes are available, from various commercially available manufacturers. US Filter MemJet®, now owned by Siemens, 0.1 micron polyvinylidene fluoride hollow fiber membranes have been pre-selected in a competitive process. MemJet® membranes are provided in modules containing thousands of long, thin membrane tubes. The tubes are immersed in the mixed liquor and the pumps pull water into the hollow center of the tubes, leaving the microorganisms concentrated outside the tubes. Scour air is supplied by blowers to clean the membrane surfaces so the microorganisms do not mat up and block the membrane pores.

The MBR system will be sized to treat an average dry weather flow of 1.2 mgd and up to an hourly peak of 1.9 mgd. Flux rate will not exceed 0.5 gpm/m^2, and transmembrane pressure will not exceed 18 pounds per square inch (psi). The MemJet® membranes are approved for California's Title 22 requirements. The manufacturer will provide all membrane equipment including mixers, pumps, membranes, blowers with necessary piping, valves, instrumentation and controls, to ensure the seamless operation of the process as a whole. Appendix A contains the complete drawing package submitted to the City for the Siemens supplied equipment.

B. Filtrate Tank: The membrane filtrate will be pumped to a 9,000-gallon filtrate tank located adjacent to the membrane tanks. The filtrate tank will passively overflow to the chlorine contact channel for chlorine disinfection and ocean discharge of all treated effluent not reclaimed for reuse. Reuse pumps will draw from the filtrate tank. Filter backwash pumps will also draw from this tank, to regularly backwash the membrane filters to prevent solids build-up from fouling the membrane surfaces.

C. **Reuse Pumps:** The reuse pumps will pump disinfected reuse water for use as irrigation water. Water used for reuse will be filtrate from the treatment plant's membrane bioreactor (MBR). The following criteria will guide the reuse pumps design:

- Pump capacity will equal peak reuse demand of 1.2 mgd. Average planed demand will be significantly less.
- Initial pressures will be regulated by a pressure regulating valve.

Other design considerations include providing safe guards against water hammer, maintaining minimum needed flows through the UV disinfection system, providing adequate clearance around the equipment, and means for pump removal.

The reuse pumps will include two, 20 to 25 hp, variable-speed pumps that will discharge at a pressure of about 65 psi. Total capacity will be equal to the maximum reuse demand of 1.2 mgd. One pump will operate at lower flow conditions with both pumps running during high demand conditions. Should one of the two pumps fail, the maximum demand of 1.2 mgd will not be met. However, operation of the one remaining pump would provide flows in excess of the average demand. The use of variable speed drives will allow the pumping station to match demand for reuse water. It will also eliminate problems associated with the downstream UV disinfection system and sudden flow changes that would be associated with a constant speed pumping station.

D. **UV Disinfection:** UV light will be used to disinfect reuse water being pumped to the point of use. Disinfection using UV light is a physical process in which light energy penetrates the cell walls of bacteria, viruses, and protozoa, and damages these organisms ability to reproduce. Light with wavelengths ranging between 210 nanometers (nm) and 300 nm has germicidal properties with maximum disinfection occurring at a wavelength near 260 nm.

The following criteria will guide the design of the UV disinfection system:

- Design shall meet the requirements of the Water Recycling Criteria contained in the California Code of Regulations, Title 22 and the 2003 Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse published by the NWRI.

- Peak design flow to be disinfected is 1.2 mgd, resulting in a flow velocity of 1.7 ft/s. Average flow is significantly lower.

- Water shall be treated to meet Title 22 standards for disinfected tertiary recycled water.
- Membrane filtration will provide water with a UV transmissivity of 65 percent or greater.
- Design UV dose shall be at least 80 millijoule per square centimeter (mJ/cm^2) during peak flow.
- Two reactors will be provided and operated in the reactor train.
- Standby reactors will not be provided. Should the UV system fail, MBR filtrate will be mixed with secondary effluent from the plant's existing biological treatment process and directed to the existing chlorination system, contact tank, and ocean outfall.

Other design considerations include provisions for lamp cleaning, and providing adequate clearance around the equipment.

Equipment:
Medium pressure, high intensity lamps are mercury vapor lamps that operate at temperatures between 600 and 800 degrees C and are enclosed within quartz sleeves.[1] Medium pressure, high intensity lamps produce light at wavelengths across the entire germicidal spectrum. Localized peak output at wavelengths near 254 nm and 265 nm provide for effective destruction of microbes. The lamps have a life of approximately 3,000 to 7,000 hours.

Aquionics, Inc. manufactures the in-vessel UV disinfection system that is proposed for the Crescent City WRP. The stainless steel vessels containing the medium pressure, high intensity lamps will be installed in the discharge piping of the reuse pumping station, located in the lower level of the MBR Building. Figure 5-5 shows an Aquionics, Inc. installation. Aquionics, Inc. in-vessel system has completed final testing for its Inline+ series. The report regarding these tests has generated three acceptance letters from the CDPH.

Notes: 1. Operating temps According to Aquionics approved report submitted to CDPH.

Figure 5-5. Aquionics, Inc. InLine+ UV System

To comply with NWRI redundancy guidelines for the disinfection of recycled water, Crescent City's system consists of two units in series. Flow rate, UV intensity, UV transmittance, and turbidity will be continuously monitored and used to adjust the operational UV dose provided by the in-vessel system. A complete monitoring and alarm system will be provided to alert treatment plant staff to problems with the UV system, and if warranted, stop pumping of recycled water to the use areas. An automatic sleeve wiping system is provided to clean lamp sleeves. Table 5-2 summarizes the Aquionics equipment features.

Table 5-2. Aquionics UV Equipment Description

Number of lamps	Two units, with twelve lamps per unit
Lamp type	Medium pressure, 3.5 kW
Arc lengths	35 cm
Ballasts	Electromagnetic, with constant wattage transformers and capacitors
Electrical facilities	NEMA 12 cabinets, powered by a single, 480V, 3 phase power supply per cabinet
Sleeves	
Sleeve material	Quartz
Sleeve diameter	34 mm
Sleeve thickness	1.5 mm

E. **Recycled Pipeline:** A 12-inch pipeline will carry reuse water to smaller branch lines which will terminate at the use areas.

F. **Filtrate Channel:** A channel will convey membrane filtrate from the filtrate tank via an overflow by gravity to the chlorine contact channel.

G. **Chemical Handling System:** Chemicals stored in the MBR Building for use in cleaning the membranes include sodium hypochlorite and citric acid. Sodium bisulfite is also stored and used to de-chlorinate effluent after it has been disinfected in the chlorine contact basin. Sodium bisulfite is not used as part of the MBR or reuse processes.

5.3 Process Operation and Control

To optimize the operational efficiency and the cost-effectiveness of the reclamation plant, the operation of the plant facilities will be automated to the extent practical. The operating parameters and mode of operation for the reclamation plant as well as the individual unit processes are discussed in the following paragraphs:

A. **Operating Cycle and Operating Flow:** Unlike the CCWPCF, which must be operated continuously to accommodate the wastewater flow to the treatment plant, the reclamation plant can be operated either continuously or intermittently as desired. The MBR system will be operated continuously

during the dry weather season, processing all plant flows up to 1.2 mgd. Peak flows up to 1.5 mgd can be accommodated through the membranes for up to a 24-hour period; as flows peak, operators will decide when or whether to divert flow to the rotating biological contactor system (RBC). During dry periods sufficient flow will be directed to the RBC to ensure that the biology of the system remains efficacious and ready for use during wet weather flows.

The daily reclaimed water demand may vary up to 1.2 mgd. The reuse pumps will be provided with variable frequency drives so they can provide reclaimed water as needed in the use areas. When plant flows exceed agronomic demand, or at any time when the reclaimed water disinfection and delivery system is out of service, the filtrate tank will fill up and flow by gravity to the chlorine contact channel; these flows will be disinfected with chlorine, de-chlorinated with sodium bisulfite, and discharged through the ocean outfall.

B. Operation Limiting Conditions: For protection of the plant facilities, avoidance of spillage and for maintenance of the reclaimed water quality, several conditions will be established to prohibit or interrupt the operation of the reuse pumps. These conditions include the following:

- Excessively high turbidity or excessively low UV transmittance in the filtrate.
- Excessively low operational UV dose.
- Failure of either UV disinfection unit.

These limiting conditions will be discussed in further detail in the description of the unit process operation presented in the following paragraphs.

C. Membrane Cleaning: During operation, the micro-filter membranes leave behind the solids in the mixed liquor, some of it forming a compressible filter cake on the membrane surface. The size of this filter cake must not be allowed to create an unreasonable pressure drop across the membrane wall during filtration. The common method for removing this layer involves three processes – relaxation, clean-in-place, and maintenance clean.

1. Relaxation

The cross-flow created by the MemJet® is effective at preventing solids build-up on the surface of the membrane during filtration. However, the jet scrubbing action effectiveness is enhanced when the unit is not filtering, i.e. in relaxation. The membrane operating system (MOS) unit stops after a set time of filtration to perform a relaxation step. This allows for the filter cake to relax and decompress, which improves the efficiency of the jet scrubbing action as the solids are swept from the fiber and the system.

2. Clean in Place (CIP)
Clean-in-place (CIP) is necessary to remove the build-up of contaminants that cannot be completely removed by physical processes alone. As the transmembrane pressure approaches the maximum allowable pressure, a chemical CIP will be required to restore the initial transmembrane pressure. A CIP uses a chemical solution, either 1,500 ppm sodium hypochlorite or 2% w/w citric acid to oxidize the fouling layer.
Siemens water technologies recommends the following CIP parameters:

Sodium hypochlorite CIP
Cleaning Frequency: Every 90 days
Bulk Chemical Composition:12.5% sodium hypochlorite
Cleaning Concentration: 1,500 ppm sodium hypochlorite

Citric Acid CIP
Cleaning Frequency: Every 180 days
Bulk Chemical Composition: 50% citric acid
Cleaning Concentration:2% w/w citric acid

3. Maintenance Clean (MC)
Maintenance Clean (MC) provides interim disinfection of the membrane modules and filtrate pipe work. This is an important preventive step to control biological growth and membrane fouling. A MC essentially is a "backwash and aerate" process with sodium hypochlorite added to the filtrate flow entering the lumen side of the membranes.
Siemens Water Technologies recommends the following MC parameters:

Sodium Hypochlorite MC
Cleaning Frequency: Every 7 days
Bulk Chemical Composition: 12.5% sodium hypochlorite
Cleaning Concentration: 300 ppm sodium hypochlorite
Backwash flow: 2.5 gpm per module

D. Reuse Pumping: The reuse pumps will be automatically shut down under the following conditions:

1. High-high turbidity (greater than 0.5 NTU) or low UV transmittance (less than 65 percent) would interfere with the ability of ultraviolet light to penetrate the water and effectively inactivate pathogenic organisms.

2. Low UV dose (less than 80 mJ/cm^2) would signify that the reclaimed water is inadequately disinfected.

3. Failure of either UV disinfection unit would signify that the reclaimed water is inadequately disinfected.

4. Low water level in the filtrate tank signifies a lack of reclaimed water available for pumping to the use areas. This automatic shutdown is primarily intended to protect the reuse pumps from "pumping dry."

5. High pump discharge pressure or high pump temperature signifies that a maintenance check is required to protect the pumps from harm.

These protections will ensure that all reclaimed water used in the designated reuse areas complies with Title 22 requirements.

E. Disinfection: The UV disinfection system will be in continuous operation whenever reclaimed water is being pumped from the filtrate tank to the reuse areas. Two monitors will ensure the quality of the product and integrity of the equipment:

1. UV intensity monitor detects changes in water quality, lamp degradation, or sleeve fouling. The monitor is relative and is set to 100 percent at startup and after 100 hours.

2. Temperature sensor shuts down the UV equipment if temperature increases because of no or low flow conditions.

5.4 Reliability

Title 22 has set forth reliability and redundancy requirements for water recycle plants. However, these requirements are based on a plant that combines wastewater treatment and recycling in a single process stream with no alternative method of wastewater disposal. For this project, wastewater treatment will be provided by the CCWPCF that has the option of ocean discharge and will not depend on the recycling plant for effluent disposal. The location of the WRP in the newly constructed MBR building allows for efficiency and convenience in operation and maintenance, as well as providing flexibility of operation, and also leaves space for future expansion. Furthermore, the recycled water to be produced by the recycling plant is an interruptible water supply. To avoid prolonged interruption of the recycled water supply and to render the plant as a reliable source of recycled water supply, the critical plant facilities will have the reliability features required by Title 22, Division 4, Chapter 3, Article 10:

1. Emergency storage and disposal of recycled water is not an issue for the CCWPCF and WRP. If at any time any of the elements fail to fully treat

recycled water, the plant will be able to treat and discharge waste water to the ocean outfall while meeting the requirements of the NPDES permit.

2. The primary treatment process is provided with multiple primary treatment units capable of producing primary effluent with one unit not in operation.

3. The secondary oxidation biological treatment unit process is provided with an alarm system and the ability to store and alternately dispose of effluent through the ocean outfall until repairs can be made.

4. The recycled water plant does not have a secondary sedimentation unit process and should be exempted from section 60347.

5. The recycled water plant does not have a coagulation unit process and should be exempted from section 60349.

6. The Filtration unit process provides for automatically actuated disposal provisions. There will be sufficient number of membrane racks such that if one unit is being backwashed, the filtration rate at the other operating membranes will not exceed 0.5 gpm/m^2.

7. The WRP provides for injection of sodium hypochlorite downstream of the UV system. This system is not intended as the primary source for disinfection of the recycled water, but to introduce a small residual of chlorine when the system will be out of service for a period of time; the residual is to prevent undesired growth in the pipeline.

8. Monitoring of the filtrate turbidity and UV transmittance will ensure that the recycled water quality will comply with Title 22 requirements.

9. The plant will be provided with a monitoring and alarm system that will alert the plant operator of the various limiting conditions for plant operation described in the preceding paragraphs. In addition, alarms for power supply failure, individual equipment failure or malfunction and high and low water levels at the critical areas will also be provided. Alarms will be both visual and audible. All alarms will be connected to a system control and data acquisition (SCADA) system which has an uninterruptable power supply rendering it unaffected by loss of power. An automatic telephone dialer is also connected to the system so that during periods when the plant is not staffed, the plant manager and other supervisorial personal will be notified of any irregularities and alarms.

10. Recycle pumps will automatically shut down in response to conditions that would compromise the quality of the recycled water. All filtrate water beyond the capacity of the filtrate tank will flow to the chlorine contact channel and discharge to the ocean outfall.

11. In spite of the reliability features to be provided, occasional shutdown of the recycling plant will be unavoidable. Shutdown of the recycling plant can be due to maintenance activities, upset of the treatment processes at the CCWPCF, or occasional high turbidity or low UV transmittance. Due to the naturally mild climate, the loss of irrigation for a period of time will not have long-term deleterious effects on the irrigated use area.

12. Laboratory results, from the onsite laboratory, for total coliform will be reported as soon as available to the plant Manager or his designee. This information will be used to ensure that the maximum level of safety to public health is guaranteed. If levels exceed those allowed, the plant will be shut down and action taken to remedy the problem; the qualified plant manager will direct the remedial actions and generate a report of how the problem was handled.

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6.0 WATER RECLAMATION PLANT MONITORING PROGRAM

The City currently has a program in place to monitor the quality of all water discharged from its facilities. With the new SCADA system, generation of hourly, daily, weekly, monthly, and yearly reports will by greatly expedited. The reclaimed water to be produced by the reclamation plant as well as the performance of the various plant facilities will be included in the reports required under the RWQCB permit. This section presents a discussion of the elements that will be incorporated into the monitoring system.

6.1 Monitoring Stations

To monitor the quality of the reclaimed water to be produced by the reclamation plant, only the monitoring of the plant effluent would be necessary. However, in order to monitor the performance of the reclamation plant facilities, additional monitoring stations should be established at various strategic locations. A listing of the monitoring stations that should be established is presented in Table 6-1.

Table 6-1. Monitoring Stations

Station No.	Location
1	Filtrate line
2	Reuse pump discharge
3	UV disinfection system discharge

6.2 Required Monitoring

The monitoring program must meet the requirements of the regulatory agencies. Article 6 of Title 22 has set forth certain sampling and analysis requirements for monitoring of reclaimed water quality. In addition to these, the RWQCB and the CDPH may impose other monitoring requirements. While the monitoring program presented in this section includes elements that can be reasonably expected to be a part of the required monitoring, it may be necessary to expand this program when the exact requirements of the RWQCB and CDPH are determined. Any time that untreated water is discharge, contact will be made with the regulatory agencies in accordance with the regulations.

6.3 Process Control Monitoring

Process control monitoring will essentially be collecting plant performance data and maintenance of records. Such monitoring will enable the plant operating staff to assess the

performance of the various plant facilities and to make decisions for adjustment to the plant operation to obtain the optimum operating efficiency.

6.4 Parameters to be Monitored

Title 22 requires the monitoring of settleable solids, turbidity, and coliform bacteria. Since sedimentation will not be used for solids separation at the WRP, monitoring of settleable solids at the reclamation plant should not be an applicable requirement. Instead, turbidity, and coliform bacteria will be monitored. Since the reclaimed water will be used for irrigation, monitoring of quality parameters that reflect the suitability of the reclaimed water for irrigation use, such as total dissolved solids (TDS) and alkalinity, will be included in the program. Table 6-2 presents a summary of the parameters to be monitored, frequency, and location of sampling, and the type of samples to be collected.

Table 6-2. Monitoring Program

Monitoring Parameter	Monitoring Location[a]	Sampling or Reading Frequency	Type of Sample or Reading
1. Flow	2	Continuous	Instantaneous and totalized
2. Turbidity	1	Continuous	
3. Total coliform	3	Daily	Grab
4. Total dissolved solids	3	Quarterly	Composite
5. Alkalinity	3	Quarterly	Composite

NOTES:

[a] See Table 6-1 for location of monitoring stations.

6.5 Sampling and Analysis

Sampling and analysis will be in accordance with the procedures published in Standard Methods for the Examination of Water and Wastewater. Where composite samples are required, the composite samples will be flow-proportioned for 24 hours or the duration of the plant operating cycle, whichever is shorter. Flow, pH, and turbidity will be automatically and continuously monitored by the instrumentation to be provided at the reclamation plant. The monitoring instruments will be calibrated according to professional industry standards. See section 8.4 below for more detailed calibration information.

6.6 Records Management

Operating and maintenance records are retained at the CCWRP for at least three years. The hard copy records include:

- Monthly reports
- Daily diaries (by year)
- Monthly lubrication/oil record sheets
- Annual reports
- Intermittent and special reports

In addition to the hard copy records, electronic files of this information are kept at the CCWRP for at least one year.

Hard copies of monthly and annual monitoring reports are retained in the City's central records system for a period of at least five years.

Monthly and annual reports are filed in compliance with appropriate regulatory agencies. These include, but are not limited to the County and State Departments of Health Services, Regional Water Quality Control Board, State Water Resources Control Board, and US Environmental Protection Agency.

7.0 RECLAIMED WATER TRANSMISSION SYSTEM

The reclaimed water transmission system will consist of a 12-inch pipeline beginning at the CCWPCF and terminating at the Front Street Park area as shown in Figure 7-1. The pipeline will also connect to the distribution systems as shown in the use area figures in section 7.2 of this report. The City intends to supply final design to CDPH prior to the delivery of recycled water.

7.1 Transmission Layout

The Reclaimed water exits the WRP building below ground as shown in figure 7-1 and continues in a southerly direction to where it would be connected to the use area piping, a pressure regulating valve, and a distribution pipeline for future use. From the current shown termination point of the 12-inch pipeline there is a 12-inch pipeline that returns recycled water back to the plants secondary clarifiers; See figure 7-2. While this line was originally installed for testing purposes, it will remain in place to provide an additional method of bringing recycled water back to the plant once it has been through the UV system.

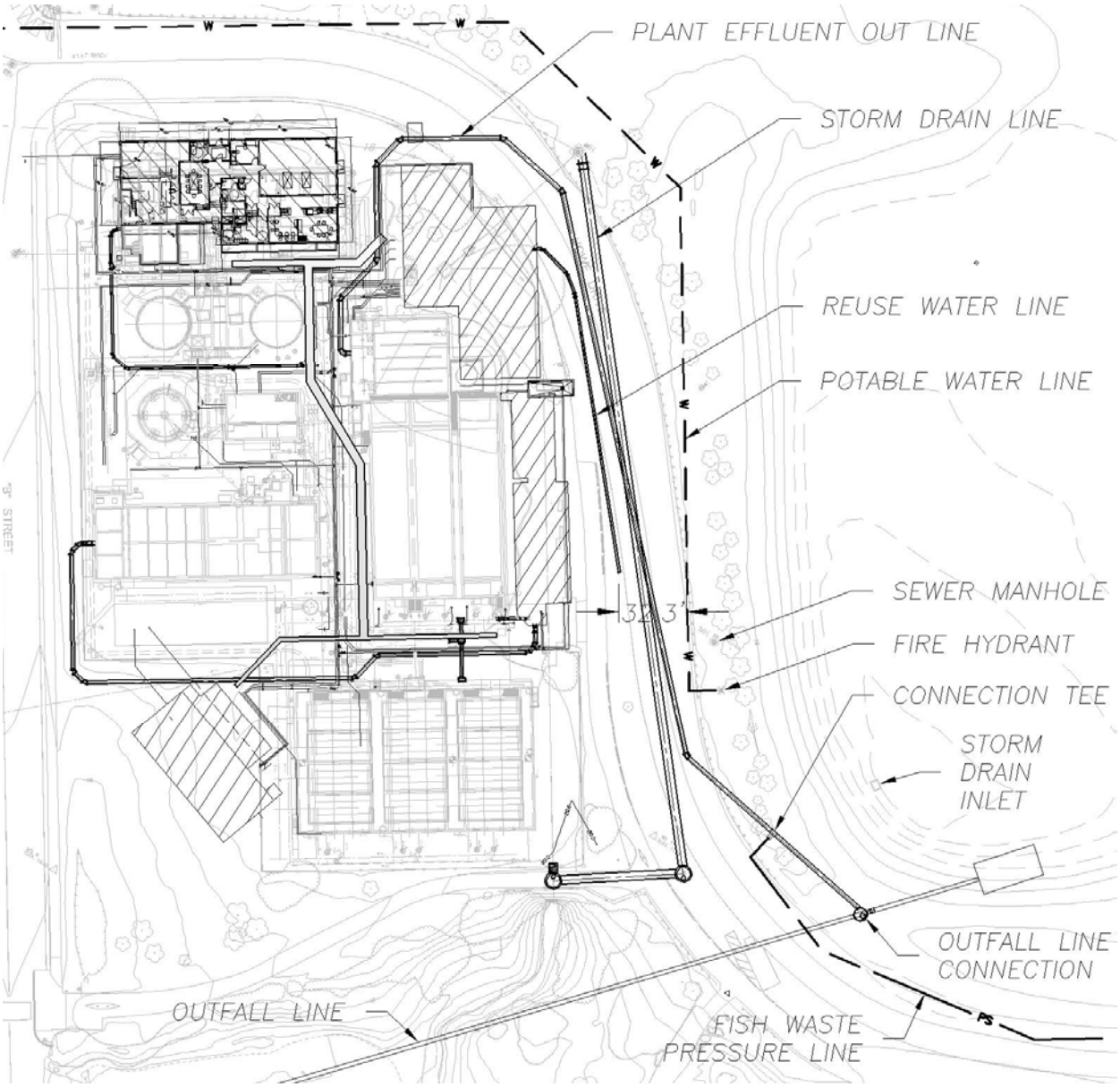

Figure 7-1 Transmission Layout

The figures below include the location of all potable water lines, Proposed recycled water lines and existing sewer lines within the recycled water service area and use area(s).

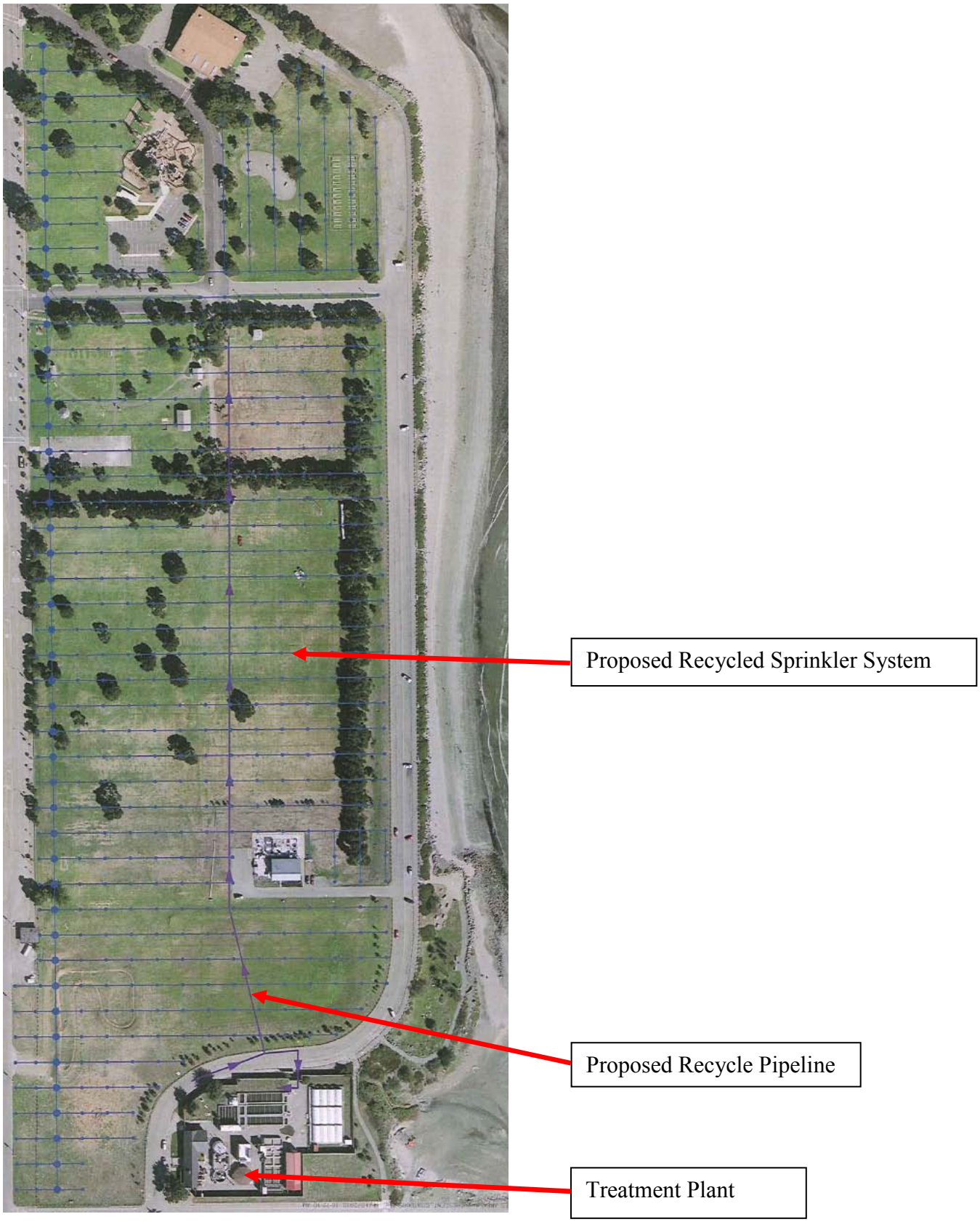

Figure 7-2 Proposed Use area

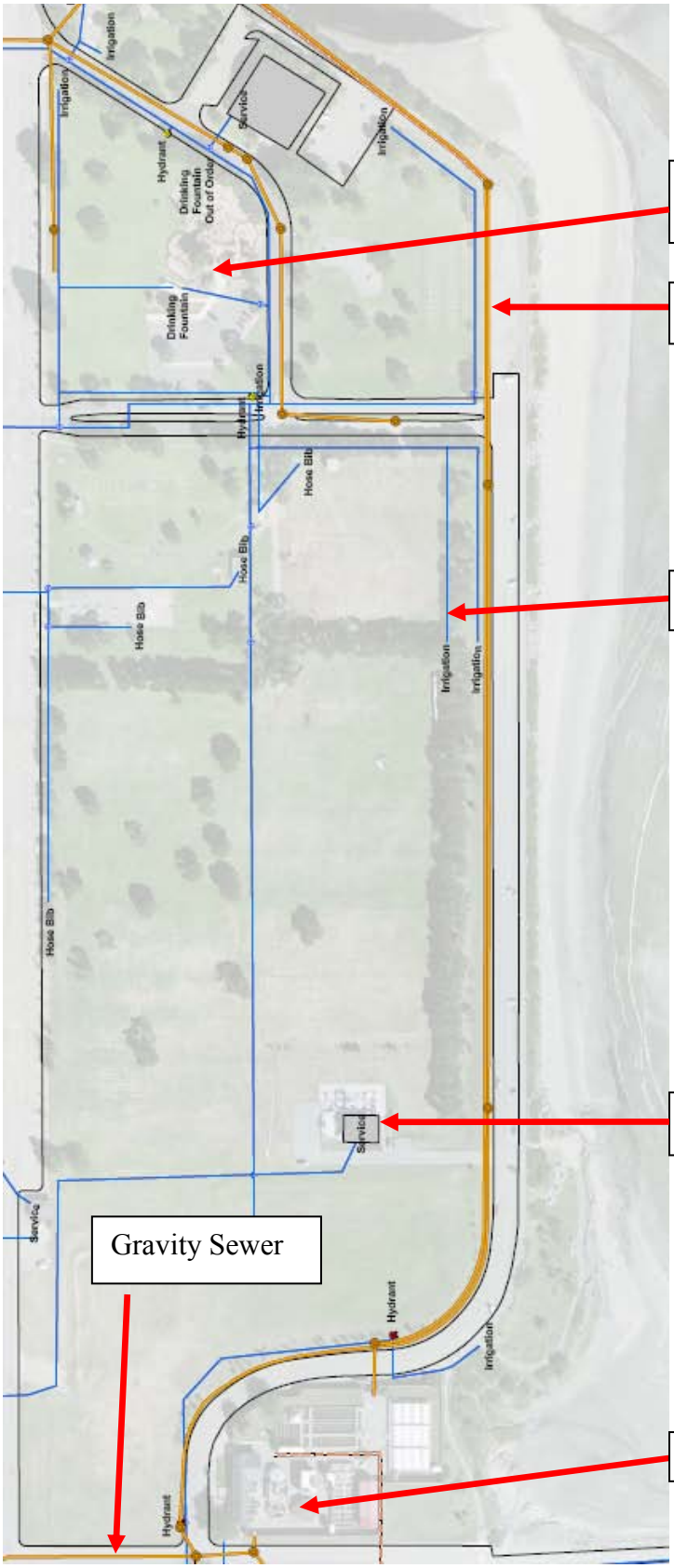

Figure 7-3 Existing Facilities in Proposed Use area

7.2 Use area

In accordance with section 4 of the GUIDELINES FOR THE PREPARATION OF AN ENGINEERING REPORT FOR THE PRODUCTION, DISTRIBUTION AND USE OF RECYCLED WATER provided by CDPH, the following information is being provided. In order to ensure full compliance with the guidelines, each pertinent part of section 4 of the guidelines has been copied to this report and *italicized*. Following each *italicized* item is the information being required by the guidelines.

The description of each use area should include:
The type of land uses

According to the Crescent City General Plan Land Use Diagram the majority of the proposed irrigation area is described as open space and a very limited portion described as visitor or local commercial. Figure 7.2-1 below shows all adjacent land use areas.

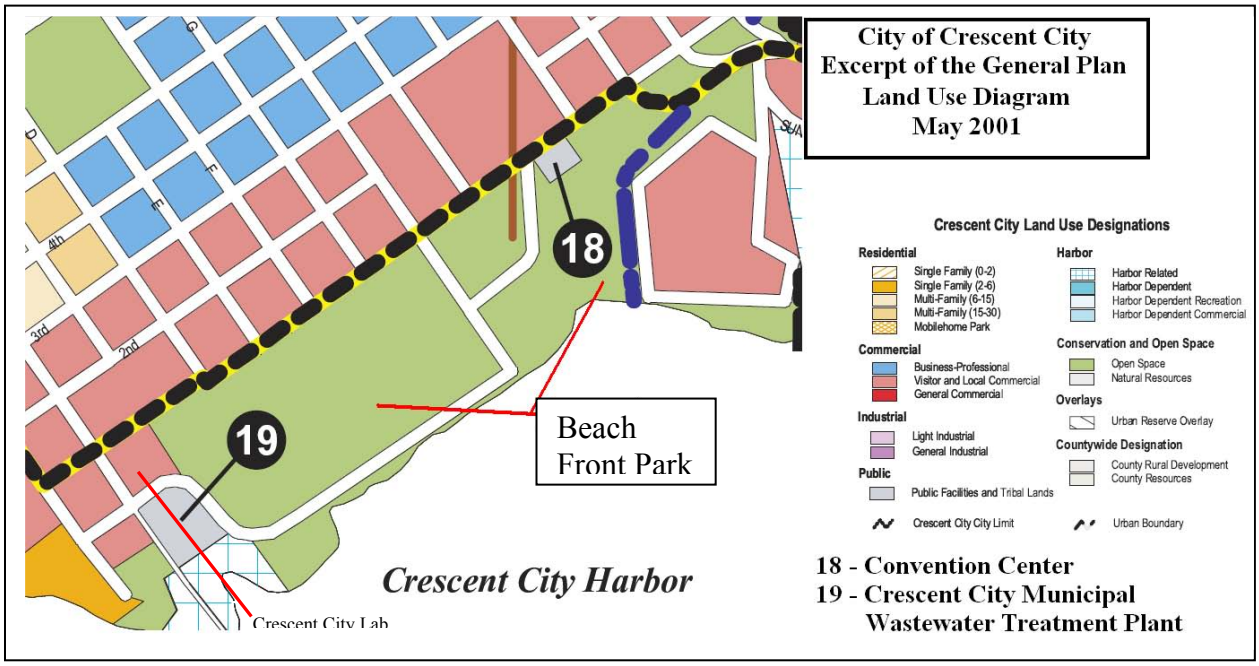

Figure 7.2-1 Land Use Designation Map (2001/current General Plan)

Beach Front Park is designated as open space and is currently used for soccer, disk golf, horse shoes, and other open space compatible activities. Beach Front Park is also home to a few historical monuments; namely a piece of the SS Emido (a World War II ship) and an old growth hollow redwood log showing the size of timber once harvested in the area.

The Crescent City Laboratory adjacent to Beach Front Park and fills the majority of the land use designated as visitor and local commercial; see Figure 7.2-1 above. The City owns the entire lot which is not likely to be further developed until laboratory or another Waste Water Treatment Plant Facility expansion is required. The unused space is comprised of landscaping and turf grass. The turf grass in the visitor and local commercial designated areas along with the open space designated locations are the areas that would be irrigated with recycled water.

The appraiser parcel numbers that would be irrigated are as follows: 118-02-030, 31, 118-03-012, 13, 14, 15, 16, 18, 19.

The specific type of reuse proposed

Spray irrigation for turf grass and trees is the only reuse being proposed in this engineering report for the production, distribution, and use of recycled water. Any proposed changes in use or future expansions of use would be brought to the attention of the regulating authority prior to any implementation.

The party(s) responsible for the distribution and use of the recycled water at the site

The City of Crescent City is the party that will be solely responsible for the distribution and use of the recycled water at the use area(s).

Identification of other governmental entities which may have regulatory jurisdiction over the re-use site.

The City of Crescent City is not aware of any governmental entities which may have regulatory jurisdiction over the recycled water use area other than the California Department of Public Health and the State Water Resources Control Board.

Use area containment measures

The proposed use area will not have any special containment measures in place. Improper planning, maintenance, and regular monitoring and adjustment of irrigation systems is the primary cause of overspray, ponding, and other undesired affects. Title 22 demands that irrigation with recycled water be performed at agronomic rates; irrigation at agronomic rates will not lead to ponding and other undesired effects. The City has also performed a complete nutrient and water balance report to define what the agronomic application rates are for many different scenarios (Appendix H). Ultimately the City must depend on its team of experienced and certified professionals in the City's Engineering and Parks Departments to make decisions based on daily dynamic climatic conditions; natural systems are perpetually changing and good judgment must be employed. Antidegradation and water/nutrient balance reports, requested by SWRCB, are attached to this report as Appendix G and H respectively.

A map showing:
Specific areas of use

See the proposed use area map.

Areas of public access

The proposed use areas have basically totally unrestricted access.

Surrounding land uses

The surrounding land use areas are all either Visitor and Local Commercial or public Facilities. See Figure 7.2-1 above.

The location and construction details of wells in or within 1000 feet of the use area

There are no known potable water wells within 1000 feet of the proposed use area.

Location and type of signage

Signage will be placed at regular intervals and near sprinkler systems and will be consistent with the Water Recycling Criteria Figure 60310-A as shown in Appendix C of this report.

The degree of potential access by employees or the public

The degree of potential access by employees or the public is unrestricted; the proposed use area is designated as open space and is therefore not a restricted access area.

For use areas where both potable and recycled water lines exist, a description of the cross-connection control procedures which will be used.

The City has already adopted a Cross-Connection Municipal Code. This code is available in its entirety in Appendix B of this report. The City's Public Works department has been diligent with performing necessary periodic checks. During the design of the new irrigation system, the most likely points of cross-connections will be identified.

In addition to the general information described above, the following should be provided for the following specific proposed uses:

4.1 Irrigation
Detailed plans showing all piping networks within the use area including recycled, potable, sewage and others as applicable.

See the general use area maps showing all piping networks within the use area. The City has plans to send out a request for proposal for the design and installation of the new recycled water irrigation system. The detailed irrigation plans will be sent to CDPH prior to the delivery

of recycled water. It is the intent of the City to obtain coverage under the General Permit for Landscape Irrigation Uses of Recycled Water through the State Water Board.

Description of what will be irrigated (e.g. landscape, specific food crop, etc.)

Turf grasses with various intermittent trees comprise the irrigation area(s).

Method of irrigation (e.g. spray, flood, or drip)

Spray irrigation is the only method being proposed for use in the use area. During detailed design of the system other methods may be considered for protection of facilities.

The location of domestic water supply facilities in or adjacent to the use area

Please see the use area map; there are no domestic water supply wells in or adjacent to the use area. All potable water lines are shown on the use area map. Final plans for the irrigation system will address separation distances.

Site containment measures

Figure 7.2-2 below shows site topography with drainage directions and drainage improvements indicated. In the event that water is applied over agronomic rates due to equipment malfunction, broken line, or other emergency situations, water not percolating may pond or flow to storm drains as shown. Water flowing in the gutter pan, off of sidewalks or on the street are all indications that water is being improperly applied. Based on the quality of the water being used for irrigation and the rare circumstances that could cause runoff or ponding, negative health impacts are not anticipated.

The City plans daily monitoring for coliform based on the requirements of Title 22. This monitoring along with the monitoring of UV dose will be a regular assurance that even if water were to pond that it is highly unlikely to have negative health impacts. In the June 25 2010 Final Report *Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water* the Science Advisory Panel concluded that the very low risk associated with recycled water "does not warrant a (CEC) monitoring program…to protect public health."

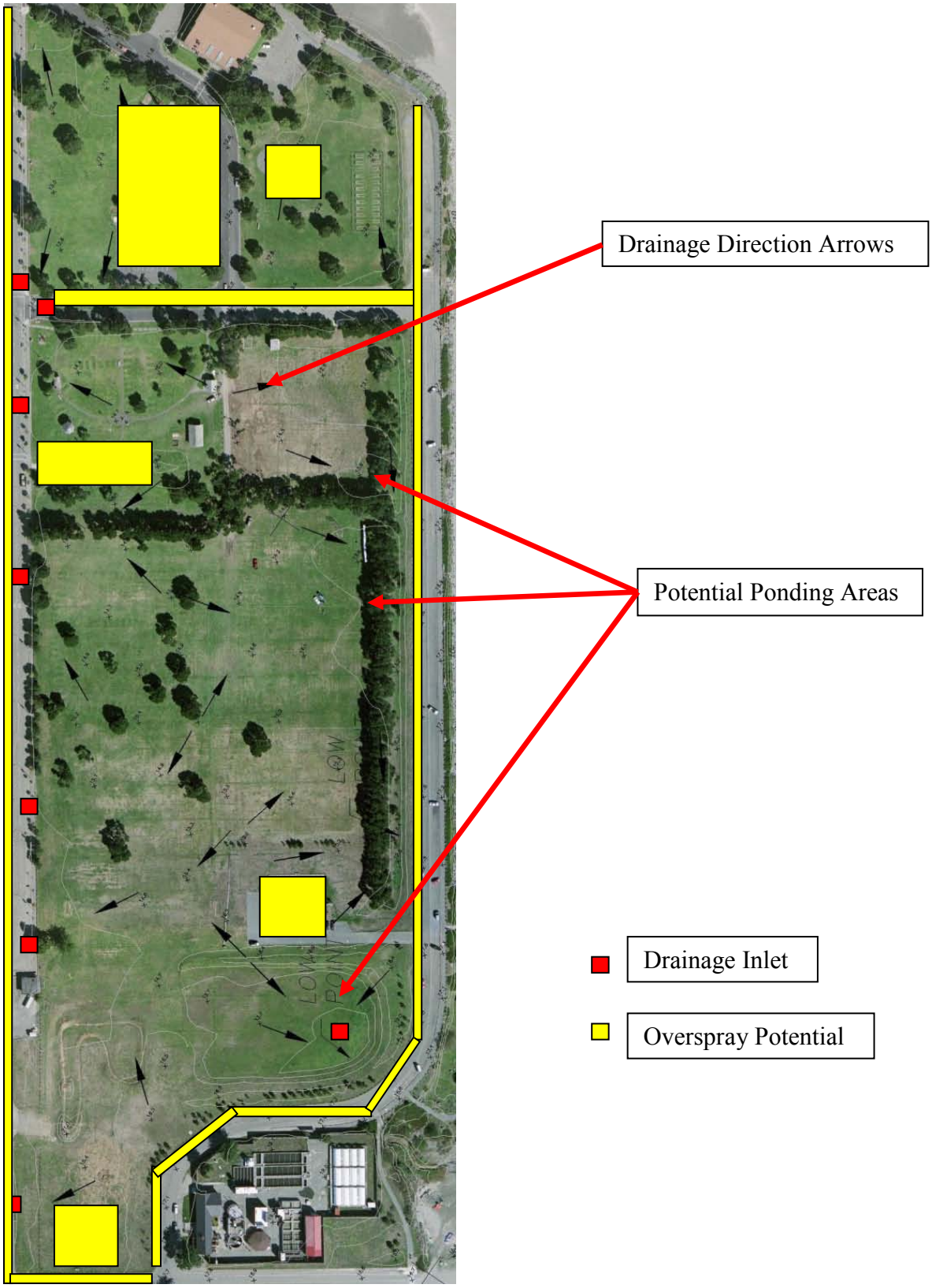

Figure 7.2-2 Site Topography and Drainage

Measures to be taken to minimize ponding

Application of irrigation water at agronomic rates and a good monitoring program are common best management practices that will be implemented to ensure that ponding will be minimized or avoided altogether.

The direction of drainage and a description of the area to which the drainage will flow

Application of irrigation water at agronomic rates, limiting overspray, and a good monitoring program are the common best management practices that will be implemented to ensure that irrigation water is not flowing off the site.

A map and/or description of how the setback distances of Section 60310 will be maintained

The City has proposed irrigating with disinfected tertiary recycled water. As described earlier, there are no domestic water supply wells within 1,000 feet of the use area. There is also no plan to have any impoundment in the use area. Based on agronomic application rates no irrigation runoff is anticipated.

While spray irrigation is proposed, best management practices will be implemented to insure that "spray, mist, or runoff shall not enter dwellings, designated outdoor eating areas, or food handling facilities." Irrigating at agronomic rates, maintaining properly adjusted irrigation equipment, and irrigating at times when the wind is at a minimum are the best ways to prevent the forgoing. Picnic tables and temporary food handling facilities are mobile in nature and their locations change over time. Based on the forgoing it is important to monitor spray irrigation and modify times and patterns of irrigation to properly accommodate the dynamic times and locations of mobile facilities such as picnic tables and food preparation facilities based on actual activities in the use areas. The City will train their operators to be aware of the locations of picnic tables and temporary food handling facilities and the available operational methods to prevent spray, mist, or runoff from entering these areas/facilities.

Protection measures of drinking water fountains and designated outdoor eating areas, if applicable

Maintaining properly adjusted irrigation equipment that is directed away from fountains and outdoor eating areas, and irrigating at times when the wind is at a minimum, are the best ways to protect the public from possible contact with recycled water. Additionally larger setbacks can be used near drinking fountains or the use of lower flow sprinkler heads; drip irrigation may also be employed around drinking fountains to further reduce the possibility of recycled water contacting drinking fountains. All hose bibs will be protected similarly to drinking fountains. The City will train its operators to practice the best available operational methods to protect the drinking fountains from contact with recycled water spray, mist, or runoff.

Location and wording of public warning signs

Signage will be placed at regular intervals and will be consistent with the Water Recycling Criteria Figure 60310-A as shown in Appendix C of this report.

The proposed irrigation schedule (if public access is included), and measures to be taken to exclude or minimize public contact

The City proposes to irrigate at times when the public is generally not occupying the use area. Beach Front Park is not used extensively during the night. The City proposes to irrigate from 9pm till the evapotranspirative demands of the turf grass has been met; this time will vary depending on time of year and precipitation.

4.2 Impoundments

The City does not plan on having any impoundment areas. Any future proposals to use impoundment areas would not be implemented till the CDPH and the State Water Board have approved them as required.

4.3 Cooling

The City does not plan on using recycled water for any type of cooling processes.

4.4 Groundwater Recharge

While the City has not proposed any groundwater recharge facilities, the antidegradation analysis performed on behalf of the City shows that any groundwater recharging by surface spreading would not likely have a negative effect on groundwater nor involve a potential risk to public health. If CDPH has a different opinion, while having no effect on this report, please provide what items would be required for a ground water recharge via surface spreading. See the November 2010 Crescent City Recycled Water System- Antidegradation Revised Report.

4.5 Dual Plumbed Facilities In accordance with Sections 60313-60316 Water Recycling Criteria.

The City of Crescent City has no intention of creating dual plumbed facilities, as defined in Sections 60301.250, in the use area. “Dual plumbed system” or “dual plumbed” means a system that utilizes separate piping systems for recycled water and potable water within a facility… The City is not planning to dual plumb a facility. The City will not be using recycled water to serve plumbing outlets within any building nor for outdoor landscape irrigation at any individual residences. If CDPH were to define the open space as a dual plumed facility, it would have virtually no impact on the actual operation or maintenance of the use area; the City already employs its own cross-connection program which is strictly followed. Furthermore the proposed operating pressure will be approximately 50 psi; the City’s potable water system at Beach Front Park operates at approximately 70 psi. This pressure differential helps to ensure that recycled water is not pushed into the higher pressure municipal water supply.

4.6 Other Industrial Uses

No uses other than irrigation for turf grasses and trees are being proposed.

4.7 Use Area Design

The report should discuss how domestic water distribution system shall be protected from the recycled water in accordance with the Regulations Relating to Cross-Connections and the California Waterworks Standards, and how the facilities will be designed to minimize the chance of recycled water leaving the designated use area. Any proposed deviation from the Water Recycling Criteria and necessity therefore, should be discussed in the report.

The City of Crescent City has implemented a Cross-Connection Control and Backflow Prevention Program pursuant to California Administrative Code, Title 17, to protect our public water systems from potential contamination. The Municipal Code is found in Appendix B. Water distribution system personnel have been certified through State approved programs which meet the California Waterworks Standards.

The design of the new sprinkler system will require that a distinct color of pipe be used for the sprinkler distribution system. Having a different color will help aid the Contractor, inspector, and others avoid connecting recycled water to potable water lines. Furthermore it is likely that the City will have all of the old sprinkler system removed from the park area prior to installing a new recycled sprinkler system. This will assist in reducing the number of possible connection points.

As part of the new sprinkler system design the City will request that the designer minimize the number of connection points to the City's potable water system and install reduced pressure principle backflow prevention devices to protect the remaining domestic water connections. These plans will all be submitted to CDPH prior to delivery of the recycled water.

The facilities are designed and will be operated so that recycled water will be applied at agronomic rates. Based on agronomic application rates no irrigation runoff is anticipated. See the drainage map presented above for unanticipated runoff.

The City does not plan to deviate from the Water Recycling Criteria.

The final design of the use area system will detail the separation distances required by the Water Works Standards for both the horizontal and vertical distances between potable and recycled water lines. If alternatives are required due to site constraints, then they will be proposed to CDPH.

The final location and type of all spray heads will depend on the final design of the irrigation in the use area. Due to concerns of overspray and runoff, heads covering smaller areas or drip irrigation may be employed at the perimeter of the use area. These plans will all be submitted to CDPH prior to delivery of the recycled water.

4.8 Use Area Inspections and Monitoring

The report should describe the use area inspection program.

The use area inspection and maintenance program is attached to this report (Appendix D).

It should identify the locations at the use area where problems are most likely to occur (e.g. ponding, runoff, overspray, cross-connections, etc.) and the personnel in charge of the monitoring and reporting of use area problems.

Examination of the nutrient water balance provided to the State Water Board is instructive, and serves to remind all parties involved in the production, use, and regulation of recycled water "that the soil plant water system is natural, biological, and variable in time and space. The responsible party must therefore monitor and evaluate its development and performance." The City will monitor all use areas in order to ensure that water is being put to beneficial use. It is the City's duty to protect valuable resources and not to waste them.

The most common area for ponding to occur will be at the low spots in the use area as identified in the above drainage figure. These would be regularly inspected to verify that no ponding is occurring. Runoff from the site will be apparent on Front Street if the gutter has water flowing in it and there has not been recent precipitation. Inspections should identify any water flowing in storm drains surrounding the site and into the ones in Beach Front Park identified on the above drainage map.

Overspray will be most apparent at the perimeter of the site or in areas that are not vegetated. Inspectors will be trained to look for vegetation free areas that are damp from overspray and also how to adjust sprinkler heads so as to minimize these problems.

4.9 Employee Training

The report should describe the training which use area employees will receive to ensure compliance with the Recycled Water Criteria, and identify the entity that will provide the training and its' frequency.

All City employees that will work in, on, or around recycled water will be instructed in accordance with Title 22, Crescent City Rules and Regulations Governing the Use of Recycled Water, and California-Nevada Section of the American Water Works Association's *Guidelines for Distribution of Nonpotable Water.* The recycled water plant will have a qualified treatment plant supervisor, and all use areas will have a qualified water distribution supervisor.

The report should also identify any written manuals of practice to be made available to employees.

City employees will have access to Appendix C, Recycled Water Guidelines and Best Management Practices, as well as City Ordinances and other materials that provides direction of the proper use of recycled water. If the State Water Control Board, or CDPH has other specific manuals that would be useful in providing guidance to employees or the public, the City would be very receptive to those suggestions.

8.0 CONTINGENCY PLAN

The contingency plan is designed to prevent inadequately treated wastewater from being delivered to the reuse areas. Any time inadequate treatment parameters are detected, the pumps are shut down; this prevents further discharge. The monitoring and reporting program, previously discussed, describes events which will trigger reports to be filed.

8.1 Security

Security for the reclamation facility will be provided through the existing City security facilities of the CCWPCF. The CCWPCF site perimeter is secured with a combination of building walls and fencing. There will be a main gate and four perimeter gates. All gates are manual and locally controlled. The perimeter gates are locked when the plant is not manned. No additional perimeter or interior security devices are required at the WRP.

8.2 Supply, Storage, and Delivery of Chemicals

Chemical supply is secured through annual bids. Primary and secondary vendors are secured to assure adequate supply of critical chemicals and spare parts. Bulk chemicals for the reclamation facility will be secured through existing purchasing procedures. This will include sodium hypochlorite and citric acid.

Chemicals are stored in the MBR Building in high density polyethylene tanks designed to resist the stored chemicals. The chemicals pumped from the storage tanks to their respective receiving locations via chemical metering pumps. The chemical solutions are injected to the plant carrier water system and deposited into the MBR tanks for cleaning purposes. The relative chemical concentrations, dose rates, are described in section 5.3 above. Waste chemicals will be metered to the influent channel for proper disposal.

8.3 Spare Parts

Spare parts will be managed through the CCWTP's existing inventory and warehousing control system. Critical spare parts will be inventoried on-site. Routine non-critical parts may be retained on-site or with vendors.

8.4 Predictive Maintenance

All equipment and structures will be incorporated into the City's existing, comprehensive maintenance management program. Maintenance will be scheduled upon the combined basis of manufacturer's recommendations and the City's site-specific experience. Professional and industry standards will be observed with regard to monitoring equipment condition, performance, and calibration.

Membrane filtrate turbidity will be measured and recorded continuously. An alarm will enunciate if the turbidity exceeds 0.2 NTU. The reuse pumps will automatically shut off if turbidity is greater than 0.5 NTU.

Operation and maintenance manuals for each piece of proposed equipment have been obtained. A consultant has been retained by the City to digitize all paper manuals and incorporate them into a plant-wide operation and maintenance manual.

Critical Instrument calibration related to conformance with Title 22 are as follows:
Flow Meters: Siemens MAGFLO meters come bench calibrated and have no recalibration frequency.
Turbidimeters: Hach turbidimeters must be cleaned daily and calibrated monthly using StablCal® Stabilized Formazin. The full procedure is available in Volume 3 of a 4 volume Siemens supplied Installation, Operations, and Maintenance Manual under tab 15.

8.5 Emergency Response and Notification Procedures

Emergency response and notification procedures will be initiated under conditions of plant performance failure. These conditions are expected to include the following:

A. Non-compliance with:

1. Average turbidity limit
2. Instantaneous turbidity limit
3. Coliform limit*
4. Other pollutants of concern

* Coliform tests are performed at the Crescent City Laboratory located approximately 150 feet from the WWTP Operations building. If laboratory results show that the Coliform limit exceeds, in MPN/100ml, of 2.2 for a 7-day median or 23 daily maximum, then the lab technician will immediately contact the plant manager and inform him of the failure to meet the requirements. The plant manager will then immediately shutdown the system until such time as the system can meet the limits.

B. Failure of disinfection system resulting in inadequately disinfected water being pumped to the reuse sites.

Notification procedures will include the following steps:

A. Operator/laboratory notification of senior operator, plant superintendent and plant engineer.

B. Plant superintendent notification of RWQCB and State CDPH.

C. Notification by telephone within 24 hours.

D. Written notification within 5 days to include:

1. Statement of condition
2. Cause of condition (if known)
3. Corrective action taken
4. Further corrective action planned
5. Follow-up schedule

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9.0 REFERENCES

1. State of California Department of Health Services, Sanitary Engineering Section, California Administrative Code, Title 22, Division 4, Environmental Health, *Wastewater Reclamation Criteria*, 1978.

2. State of California Department of Health Services, Division of Drinking Water and Environmental Management, Technical Operations Section, Recycled Water Unit, *Treatment Technology Report for Recycled Water*, November 2003.

3. California-Nevada Section, American Water Works Association, *Guidelines for Distribution of Nonpotable Water*, 1992.

4. National Water Research Institute and American Water Works Association Research Foundation, *Ultraviolet Disinfection Guidelines for Drinking Water And Water Reuse*, Second Edition, May 2003.

5. American Public Health Association, et al., Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

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