IEUA Wastewater Facilities Master Plan
TM 8 CCWRF Future Plans

PREPARED FOR: Inland Empire Utilities Agency

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REVIEWED BY: CH2M HILL

DATE: October 28, 2014

Executive Summary

Carbon Canyon Water Recycling Facility (CCWRF) began operation in 1992 and treats wastewater from the Cities of Chino, Chino Hills, Ontario, Montclair, and Upland. CCWRF consists of liquid treatment facilities and sends primary and secondary solids to RP-2 for treatment.

The current and future flows and loads for CCWRF were estimated in *TM 4 Wastewater Flow and Loading Forecast*. An analysis of the influent wastewater characteristics at CCWRF was conducted to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and the 2060 ultimate buildout year. The influent flow and loading projections and the effluent requirements detailed in the Santa Ana Regional Water Quality Control Board (RWQCB) Order No. R8-2009-0021 were used to evaluate the existing capacities of the CCWRF liquid treatment facilities. The estimated capacities were then compared to the projected flow and loads to determine the CCWRF processes that require expansion within the 20-year planning period and when those facilities would need to be online.

This evaluation indicated that the existing capacity of CCWRF was sufficient to treat predicted flows and loads through planning years 2035 and 2060. No expansion projects are planned during the 20-year planning period.

1.0 Background and Objectives

The Inland Empire Utilities Agency (IEUA) contracted with CH2M HILL and Carollo Engineers (Consultant Team) to develop a Wastewater Facilities Master Plan (WFMP). The objective of the WFMP is to plan IEUA's wastewater treatment and conveyance improvements and develop a capital improvement program (CIP). The capital program will guide IEUA in the development of major improvements to their treatment and conveyance facilities. There are five specific goals for this technical memorandum (TM):

- Summarize information from TMs 1 through 4 as it pertains to CCWRF.
- Evaluate the current capacities and limitations of the existing facilities.
- Determine treatment facilities required to treat predicted flows and loads through planning year 2035.
- Estimate timing and preliminary capital costs for plant expansion projects required during the 20-year planning period.

2.0 CCWRF Overview

Liquid facilities include influent pumping, and preliminary, primary, secondary, and tertiary treatment. The facilities are designed to treat an annual average flow of 11.4 million gallons per day (mgd). A schematic of the CCWRF is shown in Figure 8-1.

Preliminary treatment at CCWRF includes influent diversion, flow measurement, screening, and grit removal. Raw wastewater enters the plant through the influent diversion structure and then is directed to the headworks where it is split between two mechanical bar screens. Following screening, flow enters a vortex grit chamber and is then metered by a Parshall flume. Foul air from the preliminary and primary treatment facilities is sent to a chemical scrubber for treatment and discharge. Primary treatment at CCWRF consists of two 95-foot-diameter, circular primary clarifiers. Ferric chloride is added upstream of the headworks to enhance settling performance. The two clarifiers have a common sludge and scum pump station, which pumps solids to RP-2 for processing.

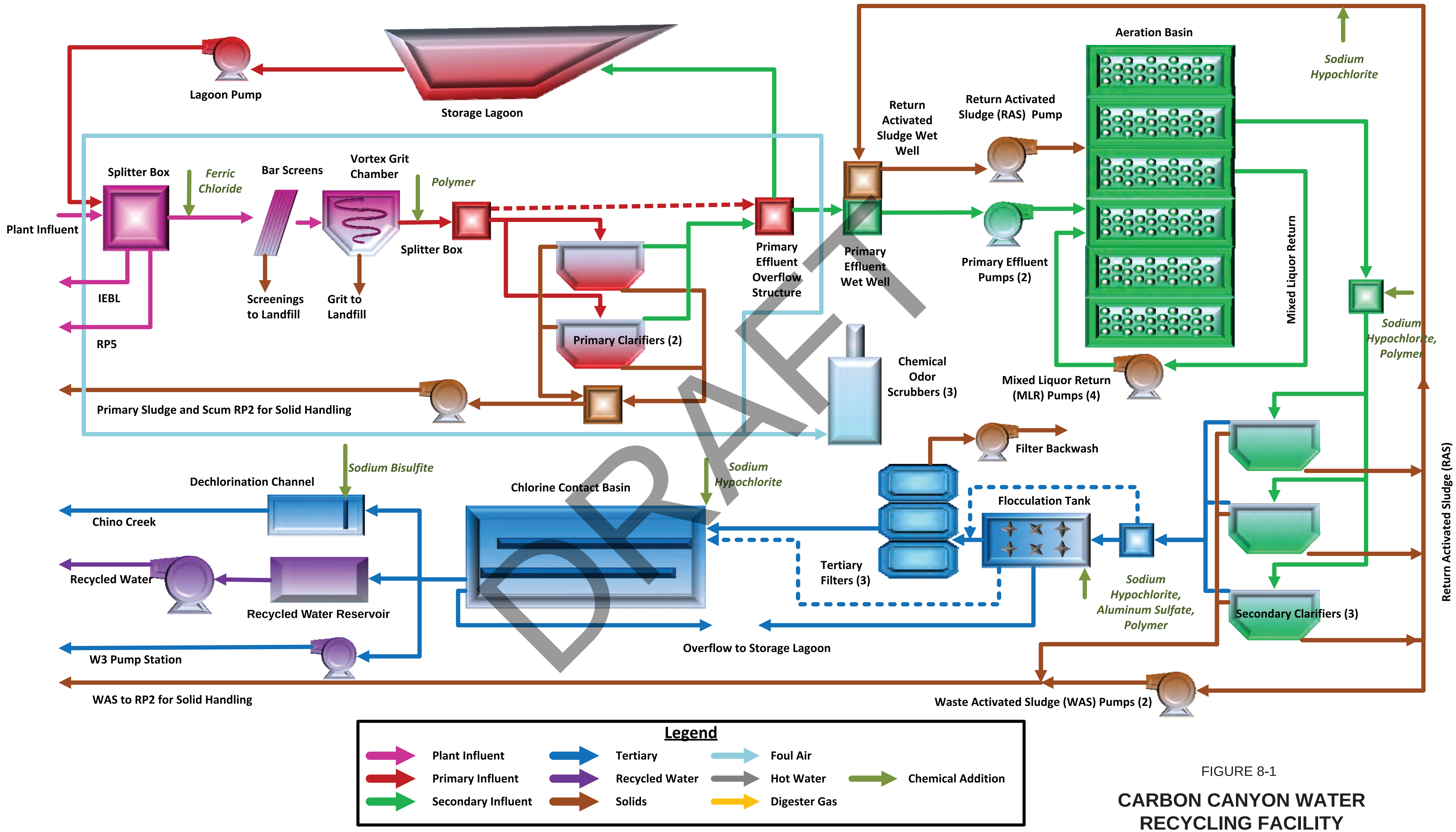

FIGURE 8-1

CARBON CANYON WATER RECYCLING FACILITY PROCESS FLOW SCHEMATIC

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Secondary treatment at CCWRF includes six parallel, two-stage biological nutrient removal activated sludge treatment trains and three circular secondary clarifiers. The aerobic zones are equipped with fine bubble tube diffusers supplied by three centrifugal blowers. Tertiary treatment at CCWRF consists of coagulation/flocculation (not typically used), filtration, and disinfection. Secondary effluent is fed to a rapid mix basin upstream of a baffled, serpentine flocculation basin. After the flocculation basin, secondary effluent is fed to one of three continuous backwash, shallow bed, traveling bridge filters. Following the filter, filter effluent is directed to a chlorine contact basin and finally conveyed to the Recycled Water Pump Station. Disinfection is achieved using sodium hypochlorite, which is added to either the filter influent or effluent and fed to the contact tank. Recycled water is sent to a water storage reservoir prior to being pumped to the distribution system for reuse; excess recycled water is dechlorinated using sodium bisulfite and discharged to Chino Creek. Further details of the facilities are summarized in *TM 1 Existing Facilities*.

3.0 Current and Future Flows and Loads

As presented in *TM 4 Wastewater Flow and Loading Forecast*, an analysis of the influent wastewater characteristics at CCWRF was conducted as part of this WFMP effort in order to establish current average and peak influent flows, concentrations, and loads at the plant and to develop flow and load projections for the 2035 planning year and 2060 ultimate buildout year. The data analysis is based on two consecutive years of recent data provided by IEUA for influent flow and key wastewater quality constituents including biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), ammonia as nitrogen (NH3-N), and total Kjeldahl nitrogen (TKN).

Flow projections were developed by the Integrated Resources Plan (IRP) Consultant and are based on the average influent wastewater flows measured during the flow monitoring period in November 2013 and projected through the year 2060 using population, employment, and land use information. As discussed in *TM 3 Regional Trunk Sewer Alternatives Analysis*, the WFMP planning effort is based on IEUA's preferred Flow Diversion Alternative 2, which includes diverting flows from Whispering Lakes and Haven Pump Stations to RP-1. The corresponding influent wastewater flow and loading projections under this alternative for the planning year 2035 form the basis of the master planning effort and treatment plant capacity evaluation presented herein. Projections are also presented for the 2060 ultimate buildout year and are used for site planning considerations. Influent wastewater flows are projected to increase slightly at CCWRF between 2020 and 2060 as a result of population growth in areas served by CCWRF.

A summary of the current and projected average influent wastewater flows and loads for CCWRF are presented in Tables 8-1 and 8-2.

TABLE 8-1
CCWRF Current and Projected Average Influent Wastewater Flows

	Current	2035[a]	2060[a,b]
Average Influent Flow (mgd)	7.2	7.3	7.9

[a] Projections developed by IRP Consultant and IEUA based on November 2013 flow monitoring period. Reflects projected flows for IEUA preferred Flow Diversion Alternative 2.
[b] Site planning considerations are based on the projections established for the 2060 ultimate buildout planning year.

TABLE 8-2
CCWRF Current and Projected Average Influent Wastewater Characteristics

	Current Concentration (mg/L)	Current Load (lb/day)	2035 Load[a] (lb/day)	2060 Load[a] (lb/day)
BOD	455	26,839	27,708	29,985
TSS	367	21,683	22,353	24,190
NH3-N	34	1,993	2,048	2,217
TKN	53	3,105	3,257	3,524

[a] Load projections based on projected flows, concentrations, and load peaking factors presented in TM 4.
mg/L – milligrams per liter
lb/day – pounds per day

4.0 Treatment Requirements

IEUA operates under an umbrella permit and must meet water quality requirements for discharge and recycled water.

4.1 Discharge Requirements

The tertiary effluent from CCWRF is discharged at Reach 2 of Chino Creek (Discharge Point [DP] 004), regulated by RWQCB Order No. R8-2009-0021, which replaced Order No. 01-1 and Order No. 95-43, National Pollutant Discharge Elimination System (NPDES) No. CA 0105279. This permit is an umbrella permit, governing over all of IEUA's water recycling plants (RP-1, RP-4, RP-5, and CCWRF). It includes a stormwater discharge permit and the enforcement of an industrial pretreatment program. Effluent quality standards require tertiary treatment with filters and disinfection equivalent to Title 22 requirements for recycled water, due to the use of receiving waters for water-contact recreation. A summary of the main effluent quality limits is provided in Table 8-3.

TABLE 8-3
Summary of Effluent Quality Limits for RP-5[a]

Parameter	Weekly Average	Monthly Average	Annual Average	Daily Maximum	Notes
BOD	30 mg/L[b]	20 mg/L[b]	-	-	45 mg/L weekly average and 30 mg/L monthly average with 20:1 dilution.
TSS	30 mg/L[b]	20 mg/L[b]	-	-	
NH_4-N	-	4.5 mg/L	-	-	
Chlorine Residual	-	-	-	0.1	Instantaneous maximum ceiling 2 mg/L
TIN	-	-	8 mg/L	-	
TDS	-	-	550 mg/L	-	Shall not exceed 12-month running average TDS concentration in water supply by more than 250 mg/L
Turbidity	-	-	-	-	1. Daily average – 2 NTU 2. 5% maximum in 24 hour – 5 NTU 3. Instantaneous maximum – 10 NTU
Coliform	< 2.2 MPN	-	-	-	Maximum 23 MPN, once per month
pH	-	-	-	6.5 – 8.5	99% compliance

TABLE 8-3
Summary of Effluent Quality Limits for RP-5[a]

Parameter	Weekly Average	Monthly Average	Annual Average	Daily Maximum	Notes
Free Cyanide	-	4.3 µg/L	-	8.5 µg/L	
Bis(2-ethylhexyl) Phthalate	-	5.9 µg/L	-	11.9 µg/L	

[a] RWQCB Order No. R8-2009-0021
[b] Without 20:1 Dilution and for recycled water
TIN – total inorganic nitrogen
NTU – nephelometric turbidity unit(s)
MPN – most probable number
µg/L – micrograms per liter

4.2 Recycled Water Requirements

Recycled water from CCWRF is used for irrigation in the area overlying Chino North "Max Benefit" Groundwater Management Zone (DP 008). Recycled water quality requirements are governed under RWQCB Order No. R8-2009-0021 and must meet the discharge requirements set forth in Table 8-3.

5.0 Existing Plant Capacity and Limitations

Existing facilities and current plant performance were used as the basis for CCWRF process model development. A whole plant model was developed using PRO2D and calibrated based on plant influent data and plant operations data for the period between October 15, 2011, and October 15, 2013. This period was selected as the basis after a review of influent and plant data to reflect a 2-year-long complete data set. Existing plant operation and the findings of the capacity evaluation through the use of process modeling is presented below for the liquid treatment facilities at CCWRF.

5.1 Existing Plant Operation

A summary of CCWRF plant operations is provided in Table 8-4 for the liquid treatment and solids handling facilities. Unit process performance values were averaged over the evaluation period, with operating ranges noted. These values were used in development and calibration of the process models. Detailed data summaries for the evaluation period are provided in Appendix 8-A.

A performance summary for the major treatment processes is presented in Table 8-5. These values, which represent the average over the evaluation period, were used in the subsequent plant process modeling and the capacity evaluations for major treatment units. Detailed data summaries for the evaluation period are provided in Appendix 8-A.

TABLE 8-4
CCWRF Average Plant Operations Summary

Parameter	Value
Primary Treatment	
TSS Removal Rate (%)	73
TOC Removal Rate (%)	38
Primary Sludge (gpd)	80,500
Secondary Treatment	
MLSS (mg/L)	3,500

TABLE 8-4
CCWRF Average Plant Operations Summary

Parameter	Value
MLVSS (%)	84
RAS SS (mg/L)	7,300
Solids Inventory (Basins Only) (lb)	260,000
Solids Inventory (Basins, Clarifiers, RAS) (lb)	281,000
Secondary Clarifier Loading (gpd/ft^2)	550
Secondary Clarifier Loading (lb/d/ ft^2)	16
Basins DO (mg/L)	1.75
Waste Activated Sludge (WAS) (mgd)	0.116
SVI (mL/g)	189
SRT (Basins Only) (day)	36
Residual Alkalinity (mg as $CaCO_3$/L)	142

Notes:
gpd – gallons per day
lb – pound(s)
RAS – return activated sludge
gpd/ ft^2 – gallons per day per square foot
lb/d/ ft^2 – pounds per day per square foot
SVI – sludge volume index
SRT – solids retention time
$CaCO_3$/L – calcium carbonate per liter

TABLE 8-5
CCWRF Average Plant Performance Summary

Parameter	Primary Effluent	Secondary Effluent	Final Effluent
TOC (mg/L)	138	5	4.8
BOD (mg/L)	249	1.5	1.2
TSS (mg/L)	83	5	2
NH3-N (mg/L)	30	0.15	0.10
NO3-N (mg/L)	N/A	4.60	4.71
NO2-N (mg/L)	N/A	0.07	0.06
TIN (mg/L)	N/A	5.0	4.87
Alkalinity (mg as $CaCO_3$/L)	N/A	142	138

The values above are for the current operation, which includes secondary treatment operation with internal mixed liquor recycling, representing a Modified Ludzack-Ettinger biological nutrient removal (BNR) configuration.

5.2 Existing Plant Capacity

5.2.1 Process Modeling

The capacity of the existing system was evaluated through process modeling using CH2M HILL's whole plant simulator, PRO2D. PRO2D is a process simulation model that takes into account the mass balances through an entire facility for particulate and soluble components. Similar to other commercially available process models, PRO2D is based on the International Water Association (IWA) ASM2D biological process kinetics. The base model was constructed to reflect the actual facility setup, including flow splits and backwash. The process model facility setup flow diagram is presented in Figure 8-2. The model was constructed with operations and performance criteria reflective of the evaluation period; it was then calibrated to reflect the actual performance, solids yields and water quality data.

As shown in Figure 8-2, the model was constructed to represent the actual plant operation for all the major process units. The model also allows establishing sizing and design considerations for each major unit process tankage and equipment. Similar to the actual operations, the plant model was built with the filter backwash and solids thickening recycles being returned to the main plant for further treatment, with the dewatering recycles being diverted offsite. The liquid and solids mass balances calculated for the current conditions allow calibration of the model against the actual field data. The calibrated model is then used to evaluate current capacity as well as establish expansion needs and process bottlenecks.

The process model was constructed and calibrated using the current influent and operating data available for the facility. The purpose of the model calibration step is to establish a baseline condition that closely resembles current operations and provides a means to reliably predict operations and system limitations under different scenarios or alternatives. Key model calibration results are presented in Table 8-6. As the listed values show, the model was calibrated such that the simulation results and actual plant data are within a value range that is 5 percent or smaller relative to the actual data. This level of accuracy will allow reliable capacity estimations to be made for the various capacity scenarios and future operation needs.

TABLE 8-6
CCWRF Average Plant Performance Summary

Parameter	Actual Data Average Values	Model Results
Effluent BOD (mg/L)	1.5	1.5
Effluent TSS (mg/L)	<5	<5
Effluent TIN (mg/L)	4.71	4.86
Effluent Alkalinity (mg as $CaCO_3$/L)	138	141
Train 2-6 MLSS Inventory (lb)	215,600	217,320
Train 1 MLSS Inventory (lb)	44,200	43,960
Sludge VS Content	84	84
Total Waste Solids (Dry Solids lb/d)	7,000	6,720
Total Primary Sludge (gpd)	80,500	80,720
Filter Backwash (gpd)	90,200	91,200

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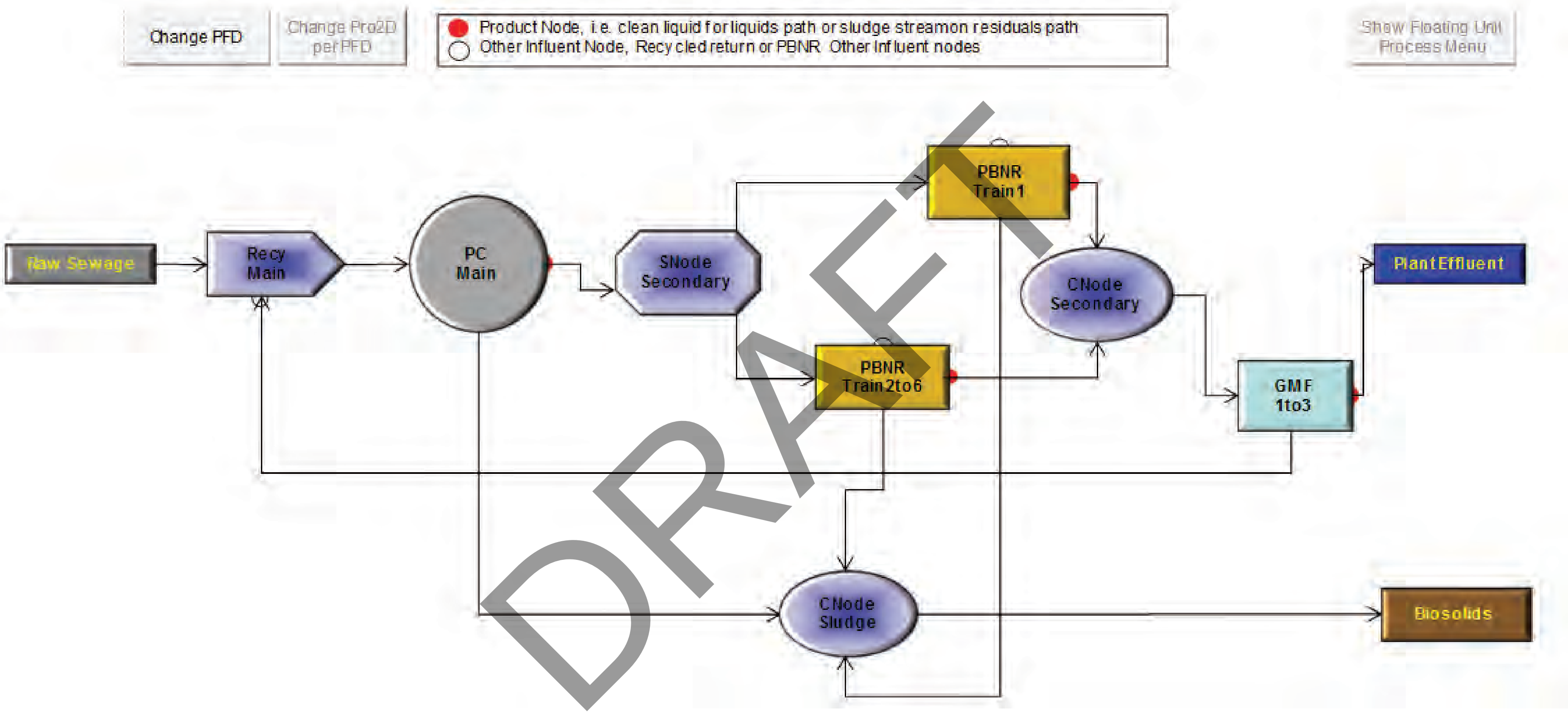

FIGURE 8-2

CCWRF PROCESS MODEL FACILITY SETUP

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Subsequent process modeling using the calibrated model as the base model was conducted to evaluate the following scenarios:

- Current Plant Capacity
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under flow and load conditions
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under maximum month flow and load conditions
  - Solids generation rates under average and maximum month flow and load conditions
- Future capacity implications for the planning year 2035
- Future facility footprint implications for the planning years 2035 and 2060

Findings of the current plant capacity evaluation are presented next in this section. Future capacity needs are presented in Section 6.0.

5.2.2 Liquid Treatment Capacity

An evaluation of the liquid treatment capacity was conducted using the whole plant process model under both the average and maximum month conditions. The capacity evaluation was conducted based on achieving a plant effluent TIN concentration of 8 mg/L. As established at the onset of the project, the facility reliability and redundancy considerations are based on the IEUA's overall wastewater treatment system, with RP-5 being the end of the line facility receiving all flow diversions if needed from other Regional Water Recycling Plants. Since redundancy is provided by taking the largest unit out of service for each process at RP-5, the CCWRF plant capacity is based on all CCWRF units in service.

The facility has two primary clarifiers in service. The average hydraulic loading rates with two units in service are around 1,100 gpd/ ft^2. Under peak day, and especially if one unit needs to be taken out of service, the primary clarifiers will be hydraulically overloaded. Considering that flow diversion to RP-5 is available for times if a primary clarifier needs to be taken out of service, the facility will need to operate at a lower treatment capacity under these temporary conditions. Alternatively, chemically enhanced primary treatment (CEPT) could be implemented under these conditions to avoid overloading the downstream secondary treatment system.

Waste solids (primary sludge and WAS) generated at CCWRF are diverted to RP-2 currently. CCWRF waste solids will continue to be diverted offsite, either to RP-2 or to the new solids handling facility that will be located at the RP-5 site. Therefore, there are no solids handling recycles processed at this facility.

Process modeling showed that the liquid treatment capacity is also limited by the secondary treatment system. One of the limitations was found to be the aeration and the ability to control dissolved oxygen (DO) in the anoxic and oxic zones in the aeration basins. The implications of DO are TIN fluctuations in the effluent and SVI values that are greater than 180 milliliters per gram (mL/g), which indicates sludge settleability could be impaired at times. Another limitation of the secondary treatment system was found to be the secondary clarification solids loading resulting from the current operations and the influent wastewater solids loading rates. Maintaining the SVI values at or below 150 mL/g is important for this reason also. Primary and secondary treatment capacity is presented in Table 8-7.

TABLE 8-7
CCWRF Existing Primary/Secondary Treatment Capacity

	All Units in Service	**One Unit Out of Service**[a]
Capacity with Effluent TIN $\leq$ 8 mg/L	14 mgd	12 mgd

[a] One secondary clarifier out of service.

The CCWRF tertiary filters were designed based on a California Department of Public Health (CDPH) maximum filter loading rate of 4.0 gpm/ft^2 for shallow bed sand filters (RWQCB, 2010). As indicated in the Title 22 Engineering Report (DDB Engineering, Inc. [DDB], 2014) and confirmed by IEUA, the filters are rated based on all three filters in service, with average capacity equal to maximum capacity, on the premise that reliability and redundancy are provided by the ability to discharge peak flows to RP-5, the availability of short-term onsite storage, the availability of standby equipment, and the use of automatic flow controls. In order not to exceed the maximum approved filter loading rate, the maximum flow that the filtration system can handle is 27.6 mgd. Given the flexibilities discussed above, the Title 22 Engineering Report equates the average flow for the plant to the peak flow. As such, the CCWRF average filtration capacity is reported as 27.6 mgd in the current Title 22 report.

The disinfection system was designed based on the Title 22 concentration-time (CT) and modal contact requirements of 450 milligrams per minute per liter (mg-min/L) and 90 minutes during the peak hourly dry weather flow, respectively. Tracer testing conducted at CCWRF in 2004 showed that the disinfection system can handle a peak flow of 15.4 mgd while maintaining a modal contact time of 90 minutes (DDB, 2014). The resulting average disinfection capacity is therefore also 15.4 mgd for the reasons discussed above. The results of the tertiary capacity evaluation are summarized in Table 8-8.

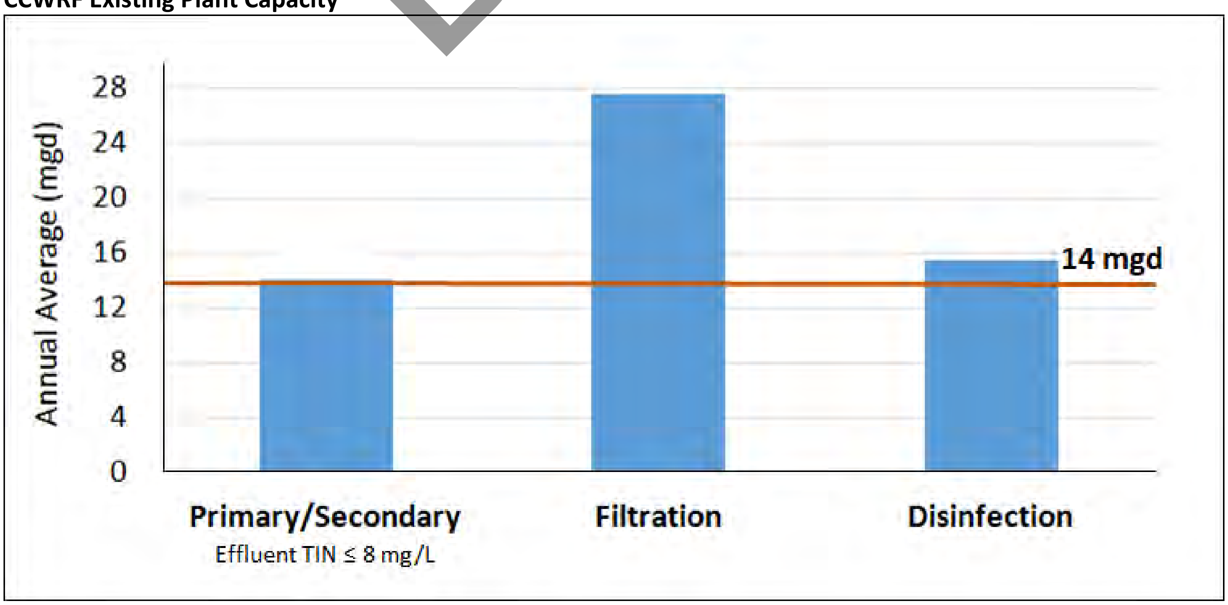
TABLE 8-8
CCWRF Existing Tertiary Treatment Capacity

	All Units in Service	One Filter Out of Service
Average Filtration Capacity[a]	27.6 mgd	18.4 mgd
Average Disinfection Capacity[a]	15.4 mgd	N/A

[a] Per Title 22 Engineering Report, the reliable annual average capacity is equal to peak capacity due to the ability to discharge to RP-5, availability of short-term onsite storage, standby equipment, and use of automatic flow controls to provide reliability and redundancy.

The overall plant capacity is determined by its most limiting process capacity. As shown in Figure 8-3, the limiting treatment process is the secondary treatment system. Therefore, the average CCWRF plant capacity is 14 mgd under the current wastewater flow and loads, as well as the reliability and redundancy considerations outlined previously.

FIGURE 8-3
CCWRF Existing Plant Capacity



6.0 Plant Expansion Needs

CCWRF has sufficient capacity to treat estimated flows and loads presented in Section 3.0 for planning years 2035 and 2060. There are no expansion projects planned for CCWRF during the 20-year planning period.

6.1 Facility Expansion Requirements

There are no projects planned for CCWRF in planning years 2035 or 2060.

6.2 Ultimate Facilities Site Plan

As there are no projects planned for the expansion of CCWRF, the plant will remain as currently operated. Figure 8-4 presents the current site layout, which is estimated to be the ultimate facilities site plan.

7.0 20-Year CIP Plant Expansion Projects and Capital Cost

CCWRF has sufficient capacity to treat estimated flows and loads projected for planning years 2035 and 2060. No expansion projects are planned during the 20-year planning period.

8.0 Conclusion

The following conclusions can be made from the evaluation of CCWRF:

- CCWRF has sufficient capacity to treat predicted liquid flows through the 20-year planning period.

9.0 References

DDB Engineering, Inc. (DDB). 2014. *Inland Empire Utilities Agency Carbon Canyon Water Recycling Facility Title 22 Engineering Report.* March.

Regional Water Quality Control Board (RWQCB). 2010. *Effluent Monitoring Point and Filter Loading Rate Approval – Waste Discharge and Producer/User Reclamation Requirements Order No. R8-2009-0021 for the Inland Empire Utilities Agency.* July 30.

FIGURE 8-4

CCWRF ULTIMATE FACILITIES SITE PLAN

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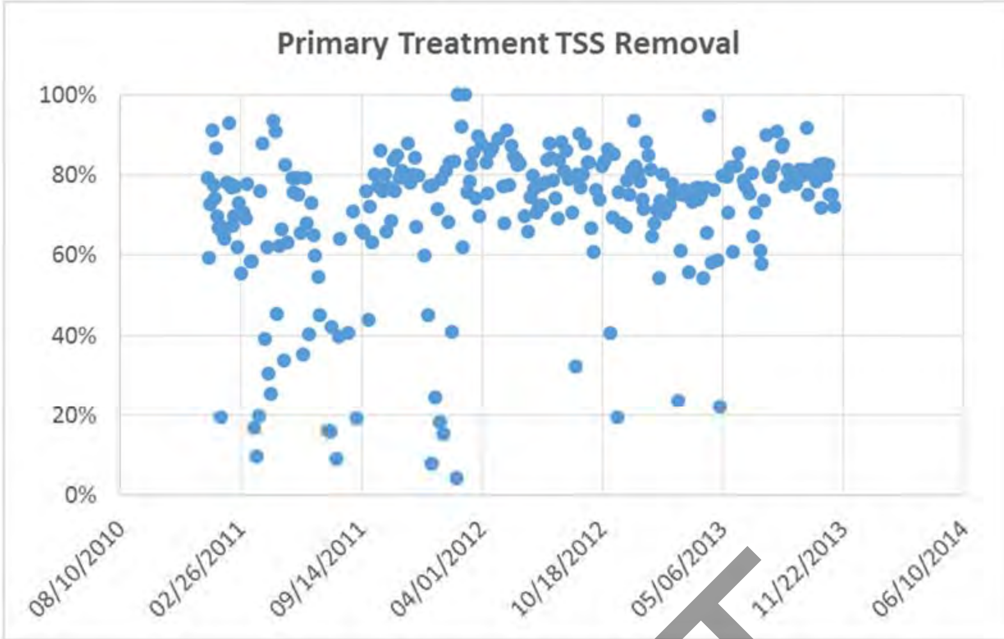
Appendix 8-A
CCWRF Plant Operations Summary (2011-2013)


Primary Treatment TSS Removal
100%
80%
60%
40%
20%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
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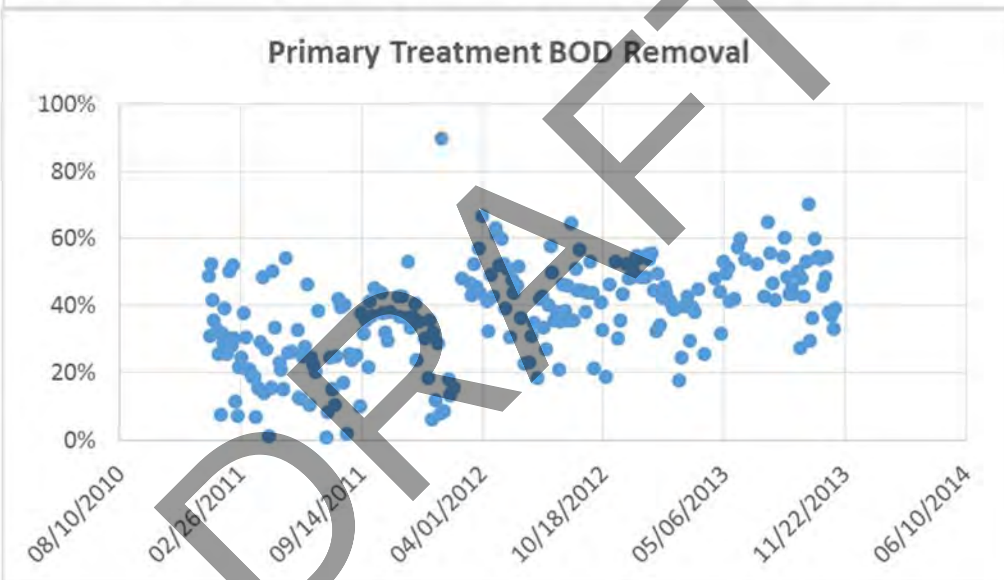
05/06/2013
11/22/2013
06/10/2014


Primary Treatment BOD Removal
100%
80%
60%
40%
20%
0%
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02/26/2011
09/14/2011
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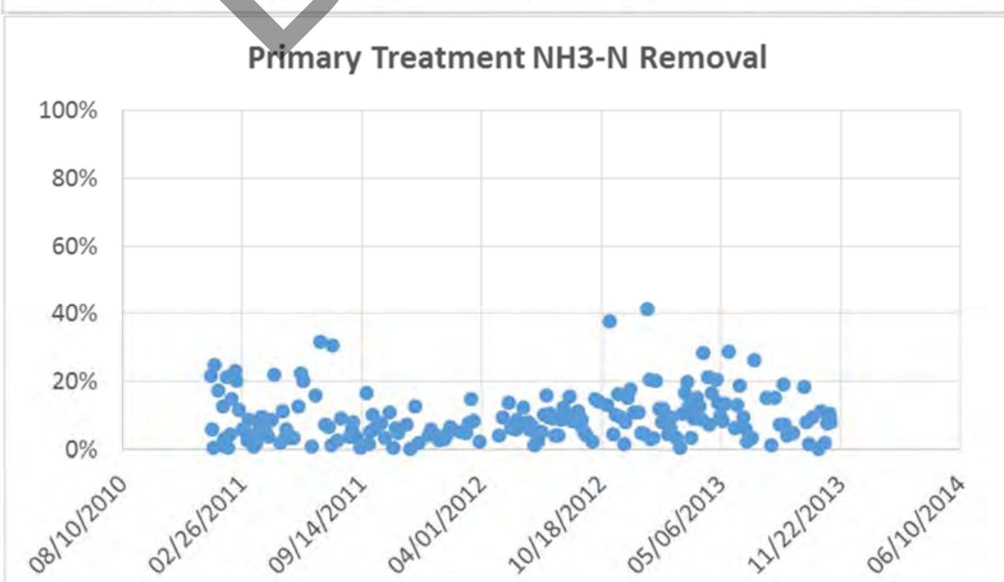
06/10/2014


Primary Treatment NH3-N Removal
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80%
60%
40%
20%
0%
08/10/2010
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09/14/2011
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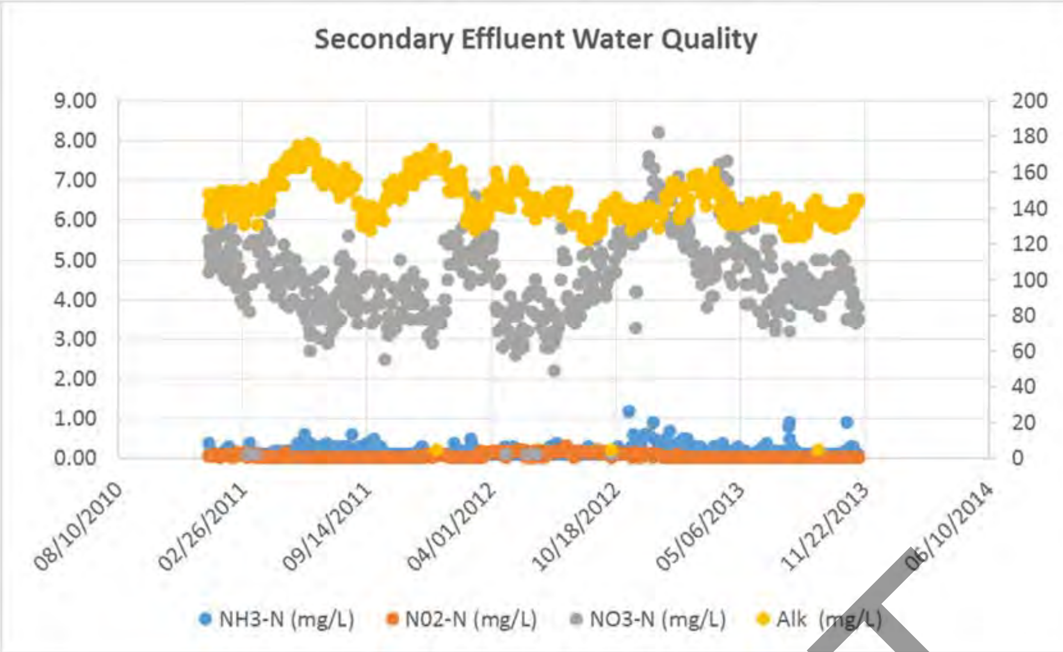
06/10/2014


Secondary Effluent Water Quality
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8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
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160
140
120
100
80
60
40
20
0
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014
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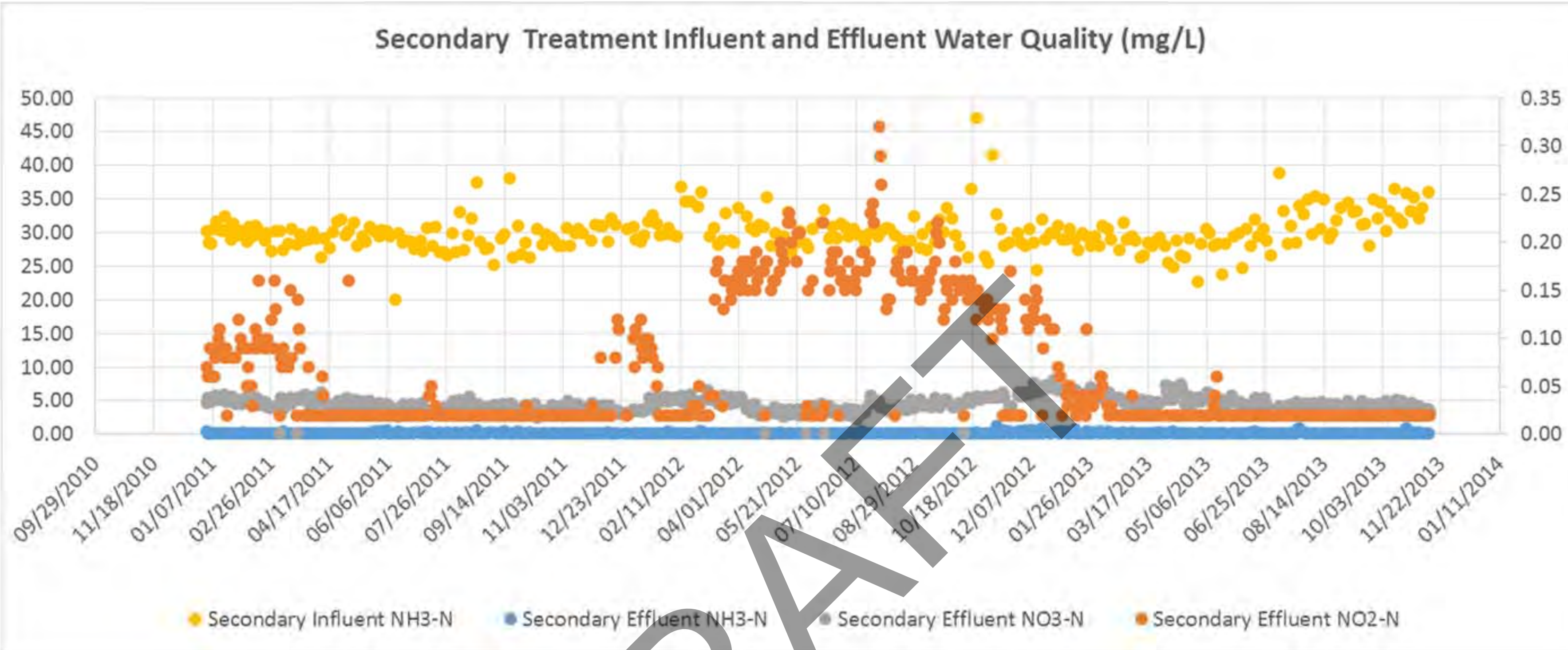
N02-N (mg/L)
NO3-N (mg/L)
Alk (mg/L)


Secondary Treatment Influent and Effluent Water Quality (mg/L)
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45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
09/29/2010
11/18/2010
01/07/2011
02/26/2011
04/17/2011
06/06/2011
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02/11/2012
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07/10/2012
08/29/2012
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12/07/2012
01/26/2013
03/17/2013
05/06/2013
06/25/2013
08/14/2013
10/03/2013
11/22/2013
01/11/2014
Secondary Influent NH3-N
Secondary Effluent NH3-N
Secondary Effluent NO3-N
Secondary Effluent NO2-N