APPENDIX 2A

MAGNA WATER DISTRICT WASTEWATER FACILITY PLAN

Magna Water District

WASTEWATER FACILITY PLAN

FINAL March 2017

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN

FINAL
March 2017

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MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN

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BASIS OF DESIGN

1.1 INTRODUCTION

The Magna Water District (MWD or District) provides drinking water and wastewater collection and treatment services to Magna Township and a small area of West Valley City. For wastewater treatment, MWD treats an average flow of 2.3 million gallons per day (mgd) with an activated sludge system consisting of a headworks, two oxidation ditches, two secondary clarifiers, a chlorine contact facility, and mechanical dewatering. The majority of the existing facility was constructed in 1985 for a design flow of 3.3 mgd. Two main trunk lines convey wastewater from east and west sides of the service area to the facility by gravity. Treated wastewater currently flows into the Great Salt Lake via a series of manmade and natural waterways.

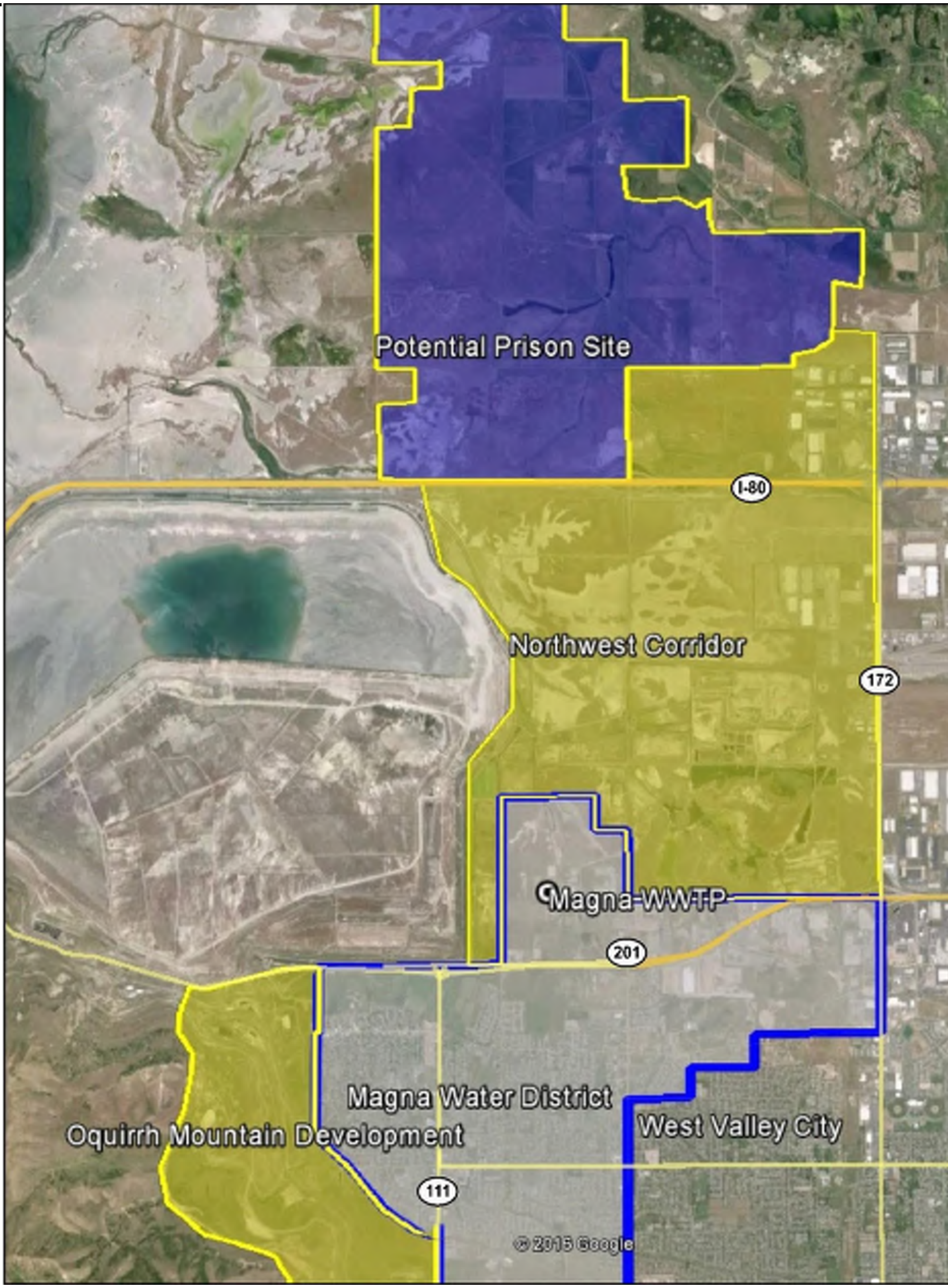
MWD hired Carollo Engineers, Inc. (Carollo) to conduct a wastewater treatment facility master plan as a result of new nutrient removal regulations adopted by the Utah Division of Water Quality (DWQ) for ammonia and phosphorus, aging infrastructure, particularly the aeration equipment, and the steady growth expected in the MWD service area. The specific objectives of this wastewater treatment facility master plan are as follows:

- Project future flows and nutrient loads over a 20-year planning period based on current wastewater characteristics and population growth rates.
- Identify hydraulic and treatment capacity limitations within the current facility and evaluate current operations, including efforts to optimize process for ammonia removal.
- Forecast future regulations and evaluate feasibility of cost and treatment technology alternatives.
- Recommend a preferred treatment alternative and implementation schedule.
- Evaluate compatibility of the preferred treatment alternative with current and future MWD projects including reuse pump station, brine line for electrodialysis reversal (EDR) concentrate, and perchlorate treatment at the BIOBROx facility.

1.2 BACKGROUND

The Magna Township is a small community located at the base of the Oquirrh Mountains west of Salt Lake City, Utah. Magna was established in 1851 as an agricultural community, but with the growth of Salt Lake City 14 miles to the east, and the town's proximity to State Route 201, it has grown substantially. Although largely a bedroom community, there are industrial areas, with the two largest facilities being Orbital ATK and Rio Tinto, formerly Kennecott Copper Corporation.

In addition to the expected population growth within the existing MWD service area, there are two possible future developments, as shown in Figure 1.1, which may increase demand for water and wastewater services from MWD. The first is the relocation of the State Prison to Salt Lake City, north of Interstate 80.



Legend

- Potential Development Areas
- Potential Prison Site
- Current Service Area

MAGNA WATER DISTRICT SERVICE AREA AND POTENTIAL GROWTH AREAS

FIGURE 1.1

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

pw://Carollo/Documents/Client/UT/Magna/9910B00/Deliverables/Figure 1.1

MWD and Salt Lake City Public Utilities Department have both submitted proposals to the State of Utah to provide water and wastewater services to the new prison complex. Should MWD's proposal be selected, the Magna Township will likely annex the land north of the current boundaries all the way to the prison site. This area is referred to as the Northwest Corridor for this study.

The second is the development of the Oquirrh Mountain foothills. This land is currently owned by Rio Tinto and is used in their mining operations. There have been discussions about turning the area stretching from Barney's Canyon (approximately 8600 South) to the Kennecott tailings ponds (North of State Route 201) into a large housing development. The timeline for this development is unknown and is subject to Rio Tinto's business plans. Therefore, as a timeline cannot be established for this growth scenario, it will not be considered further in this report.

1.3 POPULATION PROJECTION

The MWD service area includes Magna Township and extends beyond to include portions of West Valley City and unincorporated areas of Salt Lake County. Most recent population estimates are from the 2010 U.S. Census Bureau of 26,505 (Magna Township only).The current population within the service area was last estimated at 31,111 for the year 2015 in the 2013 Impact Fee Facility Plan (2013 Plan). MWD reports 9,056 residential equivalent connections to their sewer system. Using the population per residential equivalent (RE) factor of 3.11 derived from the 2013 Plan, population estimates for 2015 are approximately 28,160. Based on these recent estimates, MWD has modified the projected growth rate from 1.4 percent in the 2013 Plan to 1.2 percent for this plan.

Table 1.1 shows the estimated population within MWD's service area based on 1.2 percent growth through the year 2050.

Table 1.1 MWD Service Area Population Projections
Wastewater Facility Plan
Magna Water District

	2015[1]	2020	2025	2030	2035	2050
Total	31,111	33,035	35,078	37,247	39,550	47,350

Notes:
(1) Population value corresponds to MWD Water and Sewer Master Plan.

1.4 WASTEWATER FLOW CHARACTERISTICS

MWD provided daily influent flow data for 2006 to 2015. From 2009 to current day, concentrate from MWD's EDR drinking water treatment plant is wasted into the sewer system at an average rate of 0.5 mgd. A project is currently underway to divert this concentrate from the sanitary sewer, therefore, this flow was subtracted from the data in order to determine the municipal waste flow. The average wastewater flow without EDR is 2.3 mgd as shown in Table 1.2. Peaking factors were derived from this historical data for annual average day flow (AADF) to maximum month daily flow (MMDF). The highest flow year, 2009, was selected for flow projections, resulting in an AADF:MMDF peaking factor of 1.25.

Table 1.2 Historical Wastewater Influent Flow
Wastewater Facility Plan
Magna Water District

Month	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Max
Jan	2.2	2.2	2.2	2.4	2.5	2.5	2.4	2.3	2.3	2.2	2.5
Feb	2.2	2.3	2.2	2.4	2.3	2.5	2.4	2.2	2.3	2.1	2.5
Mar	2.3	2.3	2.3	1.9	2.4	2.5	2.3	2.3	2.2	2.1	2.5
Apr	2.4	2.2	2.3	2.1	2.1	2.7	2.3	2.5	2.2	2.1	2.7
May	2.3	2.2	2.3	2.1	2.0	2.6	2.1	2.7	2.3	2.2	2.7
Jun	2.4	2.3	2.4	2.0	2.1	2.5	2.0	2.5	2.2	2.2	2.5
Jul	2.4	2.4	2.4	2.8	2.4	2.5	2.2	2.3	2.2	2.4	2.8
Aug	2.5	2.4	2.3	2.8	2.7	2.7	2.4	2.2	2.4	2.5	2.8
Sep	-	2.3	2.4	2.5	2.7	2.4	2.3	1.9	2.4	2.5	2.7
Oct	-	2.2	2.2	2.4	2.7	2.4	2.4	2.3	2.3	2.6	2.7
Nov	-	2.1	2.4	2.3	2.4	2.3	2.3	2.2	2.2	2.5	2.4
Dec	-	2.2	2.5	2.2	2.6	2.4	2.6	2.2	2.2	2.6	2.6
Average Day	2.3	2.3	2.3	2.3	2.4	2.5	2.3	2.3	2.3	2.3	2.5
Max. Month	2.5	2.4	2.5	2.8	2.7	2.7	2.6	2.7	2.4	2.6	2.8

Table 1.3 shows a summary of the flow and loading data for the year of 2014. Similar to the data in Table 1.2, monthly flow records from the EDR plant were subtracted from monthly influent wastewater flow to determine the average flow without EDR flow. The complete flow and loading data is included in Appendix A.

Table 1.3	Historical Influent Wastewater Characteristics Wastewater Facility Plan Magna Water District				
	Average Flow (without EDR Flow)	**BOD (mg/L)**	**TSS (mg/L)**	**NH3 (mg/L)**	**TP (mg/L)**
2014 Annual Average	2.26	113.1	111.3	21.8	4.1
2014 Max Month	2.40	139.3	161.5	25.5	6.4
2014 Max Day	2.84	216.0	516.0	33.7	17.0
2014 Max Month Occurrence	August	February	August	January	March
2014 Min Month	2.18	80.6	80.2	16.3	3.0
2014 Min Month Occurrence	March	July	January	July	June

Using the average flows from 2014 of 2.3 mgd and the peaking factor of 1.25, the average and maximum month flow per capita was determined to be 74 and 92 gallons per person per day (gpcd), respectively.

1.5 PROJECT FLOWS AND LOADS

Two flow and load scenarios will be used to represent the possible growth scenarios for the wastewater facility. The first scenario represents the flows and loads for the MWD service area alone with population growth of 1.2 percent per year. The second scenario represents the flows and loads from the MWD and includes additional flow of 0.5 mgd for the prison and subsequent growth of 1 mgd for the Northwest Corridor. These two flow scenarios will be used to evaluate the existing facility (Chapter 2) and improvement alternatives will be developed in Chapter 3. The following sections present additional details of these two flow scenarios.

1.5.1. Scenario 1: MWD Service Area

Scenario 1 assumes that population growth rates hold constant at 1.2 percent over the next 20 years and growth is limited to within the existing service area. The 20-year flow was calculated with the AADF flow per capita value of 74 gpcd multiplied by the 2035 population projections (Table 1.1) resulting in the 20-year annual average day flow of 2.95 mgd.

1.5.2. Scenario 2: MWD with Prison and NW Corridor

If MWD were selected to provide water and wastewater services to the new Utah State Prison, an additional 0.5 mgd of high strength (300 mg/L BOD based on personal communication with South Valley Sewer District) wastewater would be sent to MWD for treatment.

For planning purposes, it was assumed that the prison construction will be complete by the year 2020. Once the prison is built, additional development along the Northwest (NW) Corridor is anticipated, mainly along I-80 and 5600 West. To account for this additional development, in 20 years it is anticipated that land within a half mile west of South 5600 West and a half mile north and south of I-80 will develop as light industrial at 200 gallons per day per acre for a total flow of 1 mgd. Table 1.4 shows the projected flows for the existing MWD service area alone, and for the MWD service area with the addition of the prison and NW Corridor in 2020.

Table 1.4 Projected Flows for 1) Magna WD Alone; 2) w/ Prison + NW Corridor
Wastewater Facility Plan
Magna Water District

Annual Average Daily Flow (mgd)	2015	2020	2025	2030	2035	2050
Magna	2.3	2.47	2.62	2.78	2.95	3.50
Prison	--	0.50	0.50	0.50	0.50	0.50
NW Corridor	--	0.11	0.22	0.47	1.00	1.00
Magna WD Only	2.3	2.47	2.62	2.78	2.95	3.50
Magna WD + Prison + NW Corridor	2.3	3.07	3.34	3.75	4.45	5.00

1.5.3. Wastewater Design Characteristics

Table 1.5 shows the wastewater design strength for both flow scenarios.They were developed based on the historical water quality in Table 1.3 for MWD, known values for the prison, and estimated values[1] for the NW Corridor. These design conditions will be used in Chapter 3 to size alternatives that will be evaluated for both Scenario 1 and 2.

Table 1.5 Wastewater Design Characteristics
Wastewater Facility Plan
Magna Water District

Wastewater Characteristics	Scenario 1: Magna Water District (MWD) only	Scenario 2: MWD + Prison + NW Corridor
BOD5	**Mg/L**	**Mg/L**
Average	113	140
Max Month	140	160
Max Day	216	210
TSS		
Average	111	150
Max Month	160	180
Ammonia-N		
Average	22	22
Max Month	26	25
Max Day	31	28

[1] Metcalf and Eddy (2014), Wastewater Engineering, Table 3-18.

Table 1.5	Wastewater Design Characteristics Wastewater Facility Plan Magna Water District	
Wastewater Characteristics	**Scenario 1: Magna Water District (MWD) only**	**Scenario 2: MWD + Prison + NW Corridor**
Total Phosphorus		
Average	4	5
Max Month	7	7

1.5.4. Summary of Projected Flows and Loads

The projected flows and loads for both flow scenarios were developed by combining the flow data from Table 1.4 and the strength data from Table 1.5. From this information, the projected loads for BOD_5, TSS, Ammonia, and Total Phosphorus were calculated, as shown in Table 1.6 for MWD only, and Table 1.7 for MWD with the Prison and NW Corridor.

Table 1.6	Projected Flows and Loadings - Scenario 1: Magna Water District (MWD) Only Wastewater Facility Plan Magna Water District									
Parameter	**2015**		**2020**		**2025**		**2030**		**2035**	
Flow	**MGD**		**MGD**		**MGD**		**MGD**		**MGD**	
Average	2.30		2.45		2.61		2.77		2.94	
Max Month	2.88		3.07		3.26		3.46		3.67	
	mg/L	**lb/day**	**mg/L**	**lb/day**	**mg/L**	**lb/day**	**mg/L**	**lb/day**	**mg/L**	**lb/day**
BODs										
Average	113	2,168	113	2,309	113	2,460	113	2,610	113	2,771
Max Month	140	3,363	140	3,585	140	3,806	140	4,040	140	4,285
TSS										
Average	111	2,129	111	2,268	111	2,416	111	2,564	111	2,722
Max Month	160	3,843	160	4,097	160	4,350	160	4,617	160	4,897
Ammonia-N										
Average	22	422	22	449	22	476	22	506	22	537
Max Month	26	623	26	663	26	704	26	747	26	793
Total Phosphorus										
Average	4	77	4	82	4	87	4	92	4	98
Max Month	7	168	7	179	7	190	7	202	7	214

Table 1.7	Projected Flows and Loadings - Scenario 2: MWD + Prison + NW Corridor Wastewater Facility Plan Magna Water District									
Parameter	**2015**		**2020**		**2025**		**2030**		**2035**	
Flow	**MGD**		**MGD**		**MGD**		**MGD**		**MGD**	
Average	2.30		3.06		3.33		3.74		4.44	
Max Month	2.88		3.83		4.16		4.68		5.55	
	mg/L	**lb/day**	**mg/L**	**lb/day**	**mg/L**	**lb/day**	**mg/L**	**lb/day**	**mg/L**	**lb/day**
BODs										
Average	140	2,685	140	3,562	140	3,876	140	4,354	140	5,169
Max Month	160	3,836	160	5,088	160	5,537	160	6,220	160	7,384
TSS										
Average	150	2,877	150	3,816	150	4,153	150	4,665	150	5,538
Max Month	180	4,316	180	5,724	180	6,229	180	6,998	180	8,307
Ammonia-N										
Average	22	422	22	560	22	609	22	684	22	812
Max Month	25	599	25	795	25	865	25	972	25	1,154
Total Phosphorus										
Average	5	96	5	127	5	138	5	156	5	185
Max Month	7	168	7	223	7	242	7	272	7	323

Chapter 2
EXISTING FACILITY REVIEW

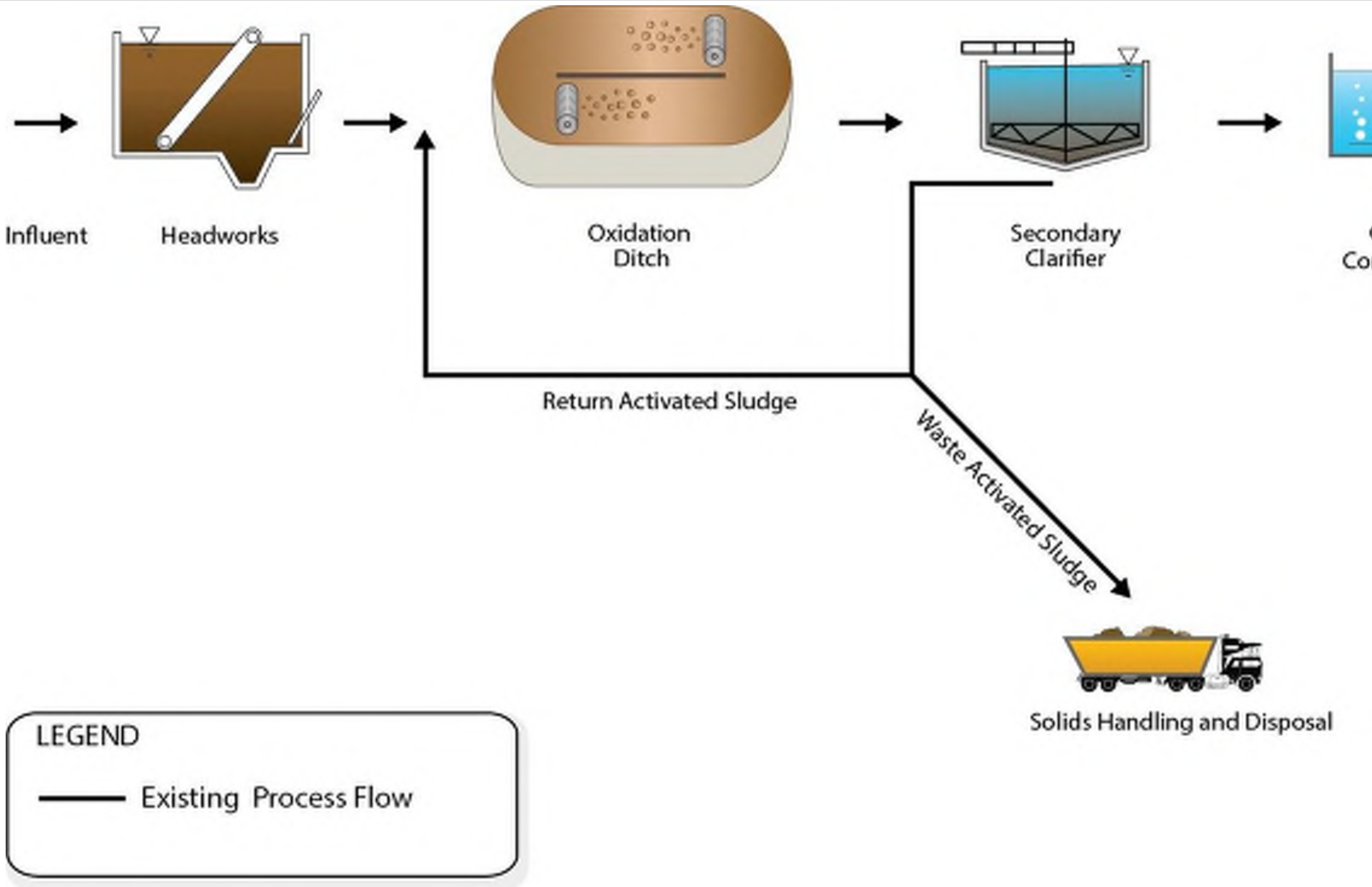
2.1 INTRODUCTION

Magna Water District (MWD) owns and operates wastewater collection and treatment facilities designed to protect the health of their customers and the environment. The treatment facility makes use of an activated sludge process where a mass of microbes is cultivated to biologically degrade waste within a controlled environment. Microbes are later removed by settling and mechanical dewatering, and the clear water remaining is disinfected prior to release back to the environment. The treatment system includes the following process units: influent pump station, course screening, grit removal, fine screening, intermediate pump station, oxidation ditches, secondary clarifiers, chlorine disinfection, and solids handling. These processes are also illustrated in a process flow diagram shown in Figure 2.1.

The existing treatment processes have been tailored to meet the effluent conditions specified under the existing permit. As an example, Figure 2.2 shows the historical effluent quality of BOD and TSS. Daily concentration values are shown and despite a few upsets the facility has always met the 30 day average effluent limits for BOD And TSS. Also shown is the historical effluent quality for total phosphorus and ammonia. While the facility is not currently regulated on these constituents, this record illustrates the need for improvements in order to meet proposed or future effluent limits. Chapter 3 will cover the new effluent limits in more detail. Within this chapter, the hydraulic and treatment capacities of the process units will be evaluated at three flow conditions: existing flows, Scenario 1: MWD alone; Scenario 2: the combined flows of MWD, proposed prison; and the northwest (NW) corridor.

2.2 BACKGROUND

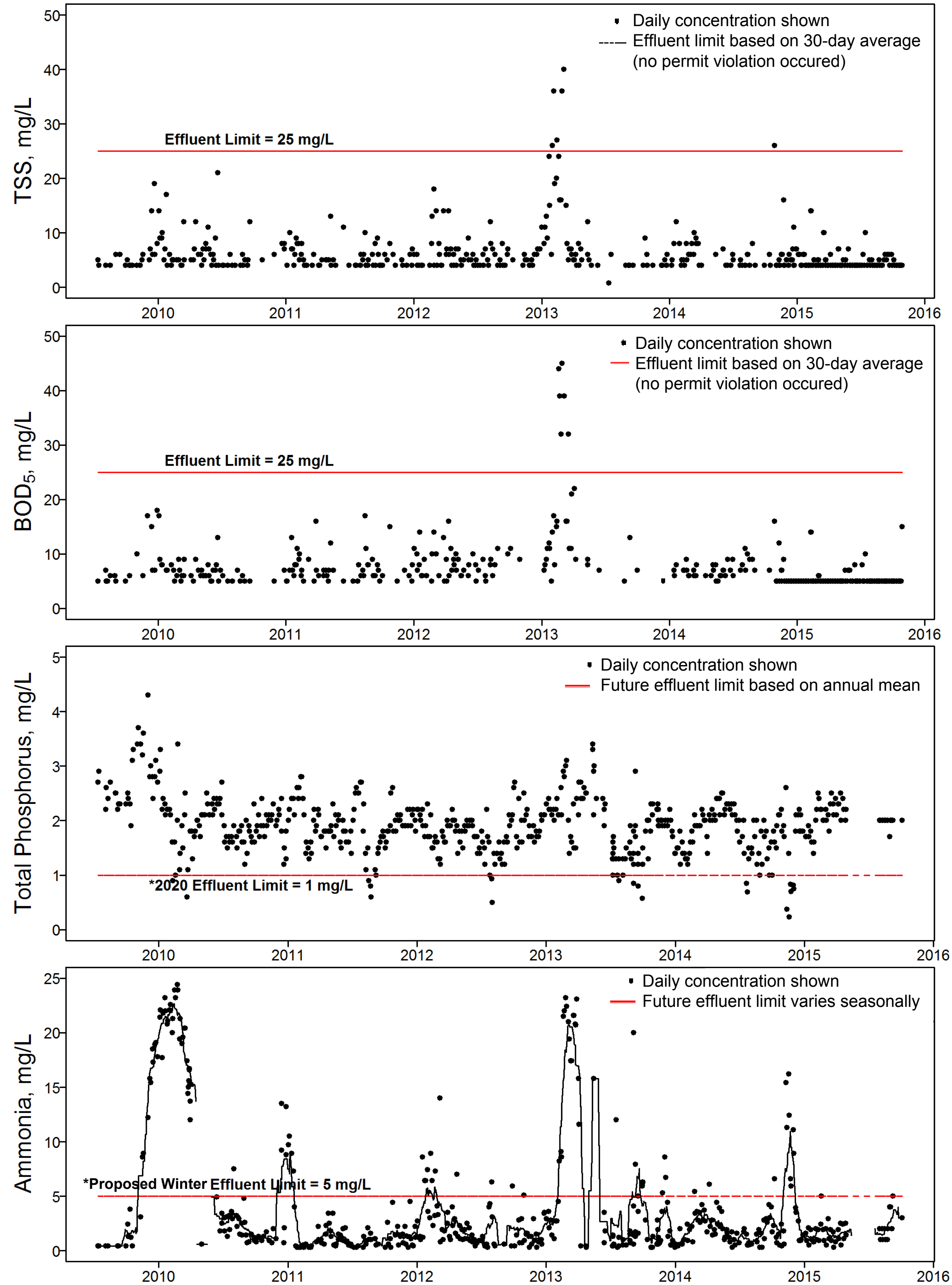
MWD's activated sludge treatment facility was constructed in 1985 with a design capacity of 3.3 million gallons per day (mgd). Although the core process of oxidation ditches and secondary clarifiers has remained unchanged, there have been improvements and modifications made, including a new mechanical dewatering building that replaced drying bed dewatering and a new East Headworks facility that replaced the West Headworks and Influent Pump Station. Flows increased in 2009 as a result of the addition of disposal concentrate from MWD's electrodialysis reversal (EDR) drinking water treatment facility to the sanitary sewer system. As a result, MWD applied for and received a permitted capacity increase from 3.3 mgd to 4.0 mgd. As stated in Chapter 1, the current average flow to the treatment facility is 2.3 mgd without concentrate from the EDR facility.



CURRENT SYSTEM PROCESS FLOW DIAGRAM

FIGURE 2.1

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017



HISTORICAL EFFLUENT QUALITY

FIGURE 2.2

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2017

pw://Carollo/Documents/Client/UT/Magna/9910B00/Deliverables/Fig. 2.2

For purposes of this evaluation, the capacities of redundant facilities such as the West Headworks and Influent Pump Station and the drying beds were not evaluated.

MWD currently has a project underway to construct a dedicated brine line for concentrate flows from the EDR facility. The brine line will convey concentrate directly to the outfall of the wastewater treatment facility, preserving hydraulic capacity in both the collection system and treatment facilities. As a result, Scenario 1 and 2 future flow projections established in Chapter 1 do not include concentrate flows.

The main treatment processes were evaluated based on the hydraulic and treatment criteria shown in Table 2.1. The following sections describe the results of this evaluation which are summarized for both existing and future flow conditions in Table 2.3. See Appendix B for additional details.

Table 2.1 Hydraulic and Treatment Criteria Wastewater Facility Plan Magna Water District

Process	Hydraulic Criteria	Treatment Criteria
Influent Pumps	PHF with largest pump offline	
Headworks Grit System Coarse Screens	PHF with 1 channel offline	
Oxidation Ditches 2 @ 1.7 MG ea.	Hydraulic Retention Time: 24 hours	Aeration Capacity: 1.2 lbs O_2 per lbs BOD_5 4.6 lbs of O_2 per lb NH_3
Clarifiers	Surface Overflow Rate: 400 gal/ft^2-day at AADF 800 gal/ft^2-day at PHF	Solids Loading Rate: 24 lb/ft^2-day at AADF 41.5 lb/ft^2-day at MMDF
Chlorination 2 @ 70,000 Gal. ea.	30 min. @ MMDF 60 min. @ AADF	25 mg/L dose at MMDF
RAS Pump	1.0 X AADF largest pump offline	
WAS Pump	0.1 X AADF	
Solids Dewatering	45 gpm @ 0.75% solids at AADF	600 lbs/hour at AADF

Notes:
(1) PHF – Peak Hour Flow.
(2) MMDF – Max Month Average Day Flow.
(3) AADF – Average Annual Day Flow.
(4) BOD_5 – Biological Oxygen Demand as measured by 5 day test.
(5) NH_3 – Ammonia.
(6) WAS – Waste Activated Sludge.

2.3 HYDRAULIC CAPACITY

A hydraulic model using Hydraulix®, Carollo's in-house hydraulic modeling software, was created based on information available from the 1985 Wastewater Treatment Plant Upgrade and Expansion and 2010 Magna WRF Fine Screen Facility record drawings. The model was calibrated using measurements taken at the facility during average flow conditions of 2.3 mgd. After calibration, the model was used to analyze hydraulic capacity of the plant at existing and projected Scenario 1 and 2 future flow conditions identified in Chapter 1. Pump stations were analyzed at firm capacity, defined as the largest pump out of service. These components were evaluated in the following sections at three flow scenarios: Existing Conditions, Scenario 1: MWD only, and Scenario 2: MWD, prison flow and NW Corridor. See Table 2.2 for the flow summary per scenario and refer to Chapter 1, Section 1.5 for the discussion of flows and loads for each scenario.

Table 2.2 Planning Scenario Flow Summary
Wastewater Facility Plan
Magna Water District

Scenario	AADF	MMDF	PHF
Existing	2.3	2.9	4.6
Scenario 1: MWD alone	2.95	3.7	5.9
Scenario 2: MWD with Prison and NW Corridor	4.45	5.6	8.9

2.3.1 Existing Facility Hydraulic Capacity Evaluation

The hydraulic model analyzed the facility based on existing flows. These flows included both domestic wastewater and the brine flow from the EDR process. Two primary criteria were verified: velocities within pipes were less than five feet per second and no control weirs were submerged. In addition, the chlorine contact basin volume was verified for Annual Average Daily Flow (AADF) and Maximum Monthly Daily Flow (MMDF) conditions.

2.3.2 Scenario 1 Hydraulic Capacity Evaluation

Scenario 1 includes flow increases over 20 years to represent growth of MWD only and evaluated with the criteria shown in Table 2.1. Based on the results of the hydraulic model, the limitations identified include the east influent lift station.

The east influent lift station and headworks does not have capacity alone for this flow. For the higher flows of this scenario, the West Headworks would need to operate. Operators should ensure that during peak flow conditions, wastewater can passively travel to the West Headworks.

2.3.3 Scenario 2 Hydraulic Capacity Evaluation

Scenario 2 includes flow increases over the 20-year period to represent growth of MWD with additional flow from the prison and northwest corridor and evaluated with the criteria shown in Table 2.1. Based on the results of the hydraulic model, the limitations identified include the east influent lift station

2.4 TREATMENT CAPACITY

Separate from hydraulic capacity, plant mechanical and process equipment were analyzed to determine the treatment capacity of the facility. Treatment capacities were evaluated for the following components:

- Oxidation ditch: aeration capacity.
- Clarifiers: overflow rate and solids loading rate.
- Chlorine contact basins: chlorine gas system.
- Screw press: solids loading rate.

These components were evaluated in the following sections at three flow scenarios: Existing Conditions, Scenario 1: MWD only, and Scenario 2: MWD, prison flow and NW Corridor. See Table 2.2 for the flow summary per scenario and refer to Chapter 1, Section 1.5 for the discussion of flows and loads for each scenario.

2.4.1 Existing Facility Treatment Evaluation

During existing conditions, the majority of the treatment process operates with sufficient capacity. Although the oxidation ditch has sufficient aeration capacity to meet the existing treatment requirements, the brush rotors have reached the end of their service life and lack the automation needed to consistently achieve low ammonia concentrations.

The secondary clarifiers have sufficient capacity to meet the solids loading rates during the existing flows. However, valves on the influent side of the east clarifier do not operate, which does not allow the clarifier to be completely isolated from service for maintenance or repair.

The gaseous chlorination system has sufficient capacity to meet the dosing requirement of 25 mg/L at MMDF.

The screw presses have sufficient capacity to meet the solids loading rate during the existing scenario.

2.4.2 Scenario 1 Treatment Capacity Evaluation

This scenario tests the treatment capacity of the system during 20-year flows of MWD alone. In addition to the aeration upgrade needed, the East Headworks will approach capacity with both channels in operation. As flows increase in the future during this scenario, the West Headworks will be used more frequently for peak flows. Although components in the West Headworks are aging and screening and grit removal is not as robust, MWD feels they can continue to operate the West Headworks in conjunction with the East Headworks through the 20-year planning period.

The screw presses have sufficient solids loading rate capacity for this scenario, however they may be limited hydraulically as flows approach the 20-year horizon. As flows increase and screw press run time approaches 12 hours per day, the district should plan for a third screw press, likely within the next ten to fifteen years.

2.4.3 Scenario 2 Treatment Capacity Evaluation

This scenario tests the treatment capacity of the system during the combined 20-year flows of the Magna Water District, the prison, and the NW corridor. These flows exceed the original 1985 design conditions of the plant. As such, capacity is exceeded for the oxidation ditch hydraulic retention time and the secondary clarifier overflow and solids loading rates.

In addition, the chlorination basin does not have sufficient volume to meet 60 minutes of contact time at AADF. The gaseous chlorination system does not have sufficient capacity to meet the dosing requirement of 25 mg/L at MMDF. These upgrades should occur as AADF approaches 4.5 MGD.

Table 2.3 WWTP Hydraulic and Treatment Capacity Evaluation Summary
Wastewater Facility Plan
Magna Water District

Process	Hydraulic or Treatment Criteria	Capacity Review		
		2015 Current Design 2.3 mgd AADF 2.9 mgd MMDF 4.6 mgd PHF	**2035 Design MWD only** 2.95 mgd AADF 3.7 mgd MMDF 5.9 mgd PHF	**2035 Design MWD + Prison +NW Corridor** 4.45 mgd AADF 5.6 mgd MMDF 8.9 mgd PHF
Influent Pump Station				
East Lift Station	Firm Cap. (2+1) of 3.7 mgd at PHF	✗	✗	✗
West Lift Station	Firm Cap. (2+1) of 6.6 mgd at PHF	✓	✓	✗
East + West Lift Station	Firm Cap. (5+1) of 12 mgd at PHF	✓	✓	✓
East + West Headworks[1]				
Coarse Screen	Firm Cap (3+1) of 16 mgd at PHF	✓	✓	✓
Grit Chamber	Firm Cap (3+1) of 16 mgd at PHF	✓	✓	✓
Fine Screen Facility	Firm Cap (1+1) of 6 mgd at PHF	✓	✓	✗
Oxidation Ditch	Aeration for BOD + NH4 @ MMDF	✓	✓	✗
	HRT > 24 hours @ AADF	✓	✓	✗
Clarifiers	Overflow Rate < 400 gal/ft²-d at AADF	✓	✓	✗
	Solids Loading Rate < 24 lb/ft²/day at AADF	✓	✓	✗

Table 2.3 WWTP Hydraulic and Treatment Capacity Evaluation Summary
Wastewater Facility Plan
Magna Water District

		Capacity Review		
Process	**Hydraulic or Treatment Criteria**	**2015 Current Design** 2.3 mgd AADF 2.9 mgd MMDF 4.6 mgd PHF	**2035 Design MWD only** 2.95 mgd AADF 3.7 mgd MMDF 5.9 mgd PHF	**2035 Design MWD + Prison +NW Corridor** 4.45 mgd AADF 5.6 mgd MMDF 8.9 mgd PHF
Chlorination	60 min. at AADF 30 min. at MMDF Dosing System 1,000 lbs/day @ 25 mg/L	✓ ✓ ✓	✓ ✓ ✓	✗ ✓ ✗
RAS Pumps	Firm Cap (2+1) of 5 mgd at 1 X AADF	✓	✓	✓
WAS Pumps	Firm Cap (1+1) of 0.5 mgd at 0.03 X AADF	✓	✓	✓
Screw Press	Loading Rate < 600 lb/hour at AADF	✓	✓	✓

Notes:
(1) Requires rehab of west headworks screen and grit system.

2.5 SUMMARY OF NECESSARY IMPROVEMENTS

Based on the hydraulic and treatment evaluation of the existing facility conducted in this chapter there are recommended improvements that should be incorporated into any of the treatment alternatives that will be proposed in future chapters. These improvements are described below and summarized in Table 2.4. Recommendations include both immediate needs and optional items that can be added as budgets allow the coming years.

2.5.1 Existing Facility Necessary Improvements

During the system evaluation at existing flows, the following components need improvements:

- Aerator system replacement and upgrade for oxidation ditches.
- SCADA upgrades for process control of aerator system operation.
- Repair existing clarifier valve.
- Reroute pipes for BIOBROx bypass.
    - Currently influent flow from the East Headworks is pumped through the BIOBROx® facility before entering the oxidation ditch. A yard piping change is needed to convey east influent directly to the oxidation ditch and preserve the BIOBROx® facility for perchlorate treatment if needed in the future as described in Chapter 6.
- Based on the hydraulic or treatment capacity evaluation, the District is very close to needing a third clarifier. If budget allows the District should include a third clarifier in the C7 project improvements.

2.5.2 Scenario 1 Necessary Improvements

During the system evaluation at Scenario 1 flows, in addition to the preceding items, the following components need improvements:

- Third screw press installed (2030).

2.5.3 Scenario 2 Necessary Improvements

During the system evaluation at Scenario 2 flows, in addition to the preceding items, a new oxidation ditch, secondary clarifier, and chlorine contact basin is required.

Table 2.4 Cost Estimate for Improvements Wastewater Facility Plan Magna Water District	
Needed Improvements	**Total**
SCADA Improvements	$ 100,000
Secondary Clarifier valve repair	$ 20,000
East Influent Bypass to Oxidation Ditch	$ 170,000
3rd Secondary Clarifier	$ 1,520,000
	$ 1,810,000
Future Improvements	
3rd Screw Press	$ 410,000

TREATMENT PROCESS ALTERNATIVES

3.1 INTRODUCTION

Magna Water District (MWD) operates the wastewater treatment facility in accordance with a discharge permit issued by the Utah Division of Water Quality (DWQ). This permit is renewed every three to five years and may include new regulations that require facility modifications independent of hydraulic or treatment capacities required to keep up with population growth. This chapter will discuss future discharge regulations likely to occur within 20-year planning period and present treatment alternatives that will satisfy both growth related and regulation-driven deficiencies.

3.2 FUTURE DISCHARGE REQUIREMENTS

Effluent limit scenarios are presented in this section, which represent the various levels of treatment requirements that may be imposed by DWQ. They range in order from least to most disruptive of current plant operations and include:

- No change to current permit conditions.
- Technology Based Phosphorus Effluent Limit - 1.0 mg/L or less total phosphorus limit as annual mean for all non-lagoon treatment facilities to be achieved by January 1, 2020.
- 2017 Proposed Permit Limits – Low ammonia, 5mg/L or less in the winter, and total residual chlorine (TRC), 0.011 mg/L or less..
- State Nutrient Criteria - DWQ studies have looked at cost and benefits of nutrient removal including the following tiers of potential limits:
  - Tier 2 possible limits – Total Phosphorus 1mg/L, Total Nitrogen 20 mg/L
  - Tier 1 possible limits – Total Phosphorus 0.1 mg/L, Total Nitrogen 10 mg/L
- Health Based Criteria – Nitrogen limits could potentially be implemented for total inorganic nitrogen (TIN), rather than total nitrogen. Potential regulation would be a TIN of 10 mg/L or less. At least one plant in Utah has a TIN limit currently in order to protect groundwater quality from a health criteria based standard.

A summary of the permit conditions and potential future limits are presented in Table 3.1.

3.2.1 No Change to Current Permit Conditions

Under the current permit, Magna WWTP adheres to effluent limits for seven constituents: BOD_5, TSS, E. coli, TRC, oil and grease, pH, and ammonia (as whole effluent toxicity). The facility currently meets the criteria set for each constituent as reported to the State.

Table 3.1 Potential Future Discharge Requirements
Wastewater Facility Plan
Magna Water District

<table>
<tr><th>Constituent</th><th>Units</th><th>Existing Permit</th><th>2017 Permit</th><th>2020 TBEL P</th><th>Tier II</th><th>Tier I</th></tr>
<tr><td>BOD_5</td><td>mg/L</td><td>25</td><td>25</td><td></td><td colspan="2" rowspan="3">same or decreasing</td></tr>
<tr><td>TSS</td><td>mg/L</td><td>25</td><td>25</td><td></td></tr>
<tr><td>Total Residual Chlorine</td><td>mg/L</td><td>1</td><td>0.011</td><td></td></tr>
<tr><td>Ammonia</td><td>mg/L</td><td>monitor</td><td>2.5 – 5</td><td></td><td>2.5 – 5</td><td>< 1 to meet TN standard</td></tr>
<tr><td>Total Phosphorus</td><td>mg/L</td><td>-</td><td>monitor</td><td>1</td><td>1</td><td>0.1</td></tr>
<tr><td>Total Nitrogen</td><td>mg/L</td><td>-</td><td>monitor</td><td></td><td>20</td><td>10</td></tr>
<tr><td>Total Inorganic Nitrogen</td><td></td><td></td><td></td><td></td><td></td><td>10</td></tr>
</table>

3.2.2 2017 Proposed Permit Limits

Under 2017 proposed permit limits, two key changes were made from previous requirements: lower limits for ammonia, and lower TRC. The lower TRC with a new limit of 0.011 mg/L is based on EPA aquatic freshwater criteria. This is a significant change from the prior 1 mg/L TRC limit, which the facility consistently meets with a range of 0.4 to 0.8 mg/L for residual chlorine. Without the addition of chemical dechlorination equipment, the new permit value is too low to reliably meet while maintaining a sufficient chlorine dose for disinfection.

The proposed permit also addresses ammonia with a new limit based on chronic ammonia criteria promulgated by the U.S. Environmental Protection Agency (EPA) in 2013 and adopted by the DWQ. The proposed 2.5 mg/L in the summer to 5 mg/L in the winter limits are based on a DWQ wasteload analysis on Kersey Creek using the new EPA criteria. As flow is minimal upstream of the plant discharge in Kersey Creek, effluent quality drives the creek quality. Hence, more stringent effluent limits were proposed. Technology Based Effluent Limit for Phosphorus

Recognizing phosphorus as a key limiting nutrient, the Utah Water Quality Board has passed a technology-based effluent limit (TBEL) on total phosphorus. This rule primarily affects all non-lagoon treatment plants requiring treated wastewater to contain less than 1 mg/L total phosphorus as annual mean. The rule goes into effect on January 1, 2020.

Treatment facilities like MWD’s WWTF will likely need to implement either a biological phosphorus removal process change or add equipment for chemical addition to meet this new regulation.

While the rule applies statewide, several variances are allowed for facilities that can demonstrate special circumstances such as economic hardship, innovative approaches to nutrient management like effluent reuse, and/or proving that the proposed limitation on phosphorus is not necessary to protect the receiving water quality or its beneficial uses. For MWD, effluent reuse is part of the District's long-term planning and there is another treatment facility with a similar Great Salt Lake discharge currently trying to demonstrate to DWQ that compliance does not make sense from a water quality standpoint. MWD and this study should consider both of these points as alternatives are considered for meeting the TBEL for phosphorus.

3.2.3 State Nutrient Criteria: Tier 1 and 2

Utah DWQ has conducted studies looking at the cost and benefits resulting from adopting statewide nutrient criteria for municipal wastewater treatment. Two potential categories or tiers of regulation targets have been identified:

Tier 2: 1 mg/L total phosphorus and 20 mg/L total nitrogen

Tier 1: 0.1 mg/L total phosphorus and 10 mg/L total nitrogen

In early 2016 the DWQ adopted the TBEL rule for phosphorus that corresponds to Tier 2 for phosphorus only. It is unclear if or when DWQ will adopt a total nitrogen limit, although 2025 was identified as a possible timeframe. Should a future nitrogen limit be implemented it may be modified to a total inorganic nitrogen limit of 10 mg/L or less to provide health protection related to nitrate levels in groundwater.

3.3 TREATMENT ALTERNATIVES

The following treatment alternatives were developed to address the potential future discharge regulations. The alternatives range from no action to substantial modifications, which integrate with current processes.

- Alternative No. 1: Pipeline to C7 Ditch
- Alternative No. 2: Nitrification with UV Disinfection
- Alternative No. 3: Biological Nutrient Removal with UV Disinfection
- Alternative No. 4: No Action

A summary of each alternative is shown in Table 3.2 to illustrate the feasibility of meeting future flow requirements and future water quality regulations.

Table 3.2	Feasibility of Treatment Alternatives to Meet Future Regulations Wastewater Facility Plan Magna Water District			
Criteria	**Alternative 1** C7 Ditch Pipeline	**Alternative 2** Nitrification with UV Disinfection	**Alternative 3** Biological Nutrient Removal with UV Disinfection	**Alternative 4** No Action
Meets 2017 Permit	✓	✓	✓	✕
Meets Tier II	✓	✕	✓	✕
Meets Tier I	✕	✕	✕	✕

The following sections will detail each of these alternatives providing a description, site plan, and process flow diagram for each. Additionally, the process flow diagrams show provision for the brine line and BIOBROx® facility as described in Chapter 6. As part of a future project, brine from the District's groundwater treatment facility will be piped directly to the effluent discharge rather than discharged to the collection system for conveyance.

3.3.1 Alternative 1: Pipeline to C7 Ditch

As shown in Figure 3.1, flow into Kersey Creek combines with the C7 Ditch, continues into Lee Creek, and empties into the Great Salt Lake. As the facility discharges into Kersey Creek, the effluent water quality must not impair the beneficial uses within the Creek. With a beneficial use designation of 2B and 3D, water within Kersey Creek is intended for infrequent primary contact recreation and protected for water fowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C. See Utah Administrative Code R317-2-6 for more information on beneficial use designations. In the case of the C7 ditch, it is Class 4 water - protected for agricultural uses including irrigation of crops and stock watering. The concept of a pipeline to the C7 ditch is in response to the requirements for discharging effluent into Kersey Creek. Should MWD construct a pipeline to convey effluent directly to the C7 ditch, it may allow for the treatment facility to continue operating under existing or similar effluent permit conditions. The C7 pipeline may alleviate the need for major process upgrades to meet the lower ammonia and TRC limits proposed 2017 permit as well as potentially lessen the upgrades needed for Tier 1 and 2 nutrient criteria requirements should they be adopted in the future. With the TBEL phosphorus rule, MWD will need to implement at least chemical addition for phosphorus removal to ensure compliance. Later, once the effluent pipeline is established to C7 Ditch, a water quality study in C7 Ditch or effluent reuse may support a request to establish a site-specific phosphorus variance.

This C7 Alternative includes the following upgrades: a new aeration system for the oxidation ditch process, electrical and SCADA upgrades to automate the new aeration system, chemical addition facility for phosphorus removal, pipeline to C7 ditch (see C7 Pipeline Study by Epic Engineers in Appendix C), and miscellaneous plant upgrades as outlined in Chapter 2.

WATERBODIES DOWNSTREAM OF WWTP

FIGURE 3.1

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

carollo

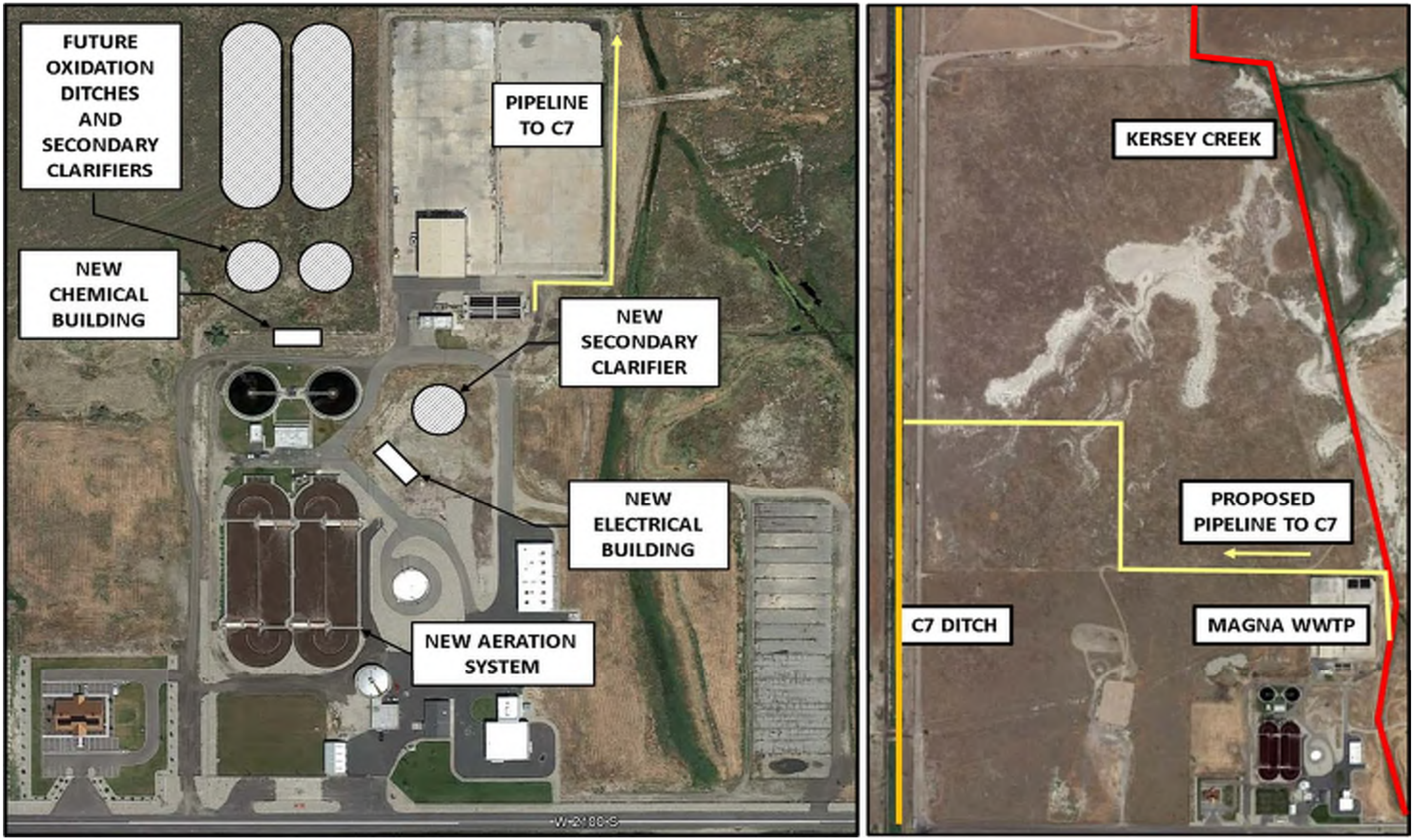
A site plan of the proposed pipeline is illustrated in Figure 3.2. A process flow diagram is shown in Figure 3.3.

3.3.2 Alternative 2: Nitrification Upgrade with UV Disinfection

This alternative focuses on attaining requirements set forth in the proposed 2017 permit conditions without constructing a pipeline to C7 ditch. The major upgrades required will be a new aeration system for the oxidation ditches with sufficient capacity for nitrification, a chemical phosphorus facility, and UV disinfection to meet the new TRC limit.

While these improvements will satisfy the proposed 2017 permit conditions, they do not meet Tier II or Tier I requirements. Optimization of aeration process for enhanced nitrogen removal may bring total nitrogen concentrations close Tier II requirements, however, they will not be sufficient to meet Tier I limits. Options for meeting Tier I will be presented in Alternative 3.

A site plan of the proposed nitrification alternative is illustrated in Figure 3.4. A process flow diagram is shown in Figure 3.5.

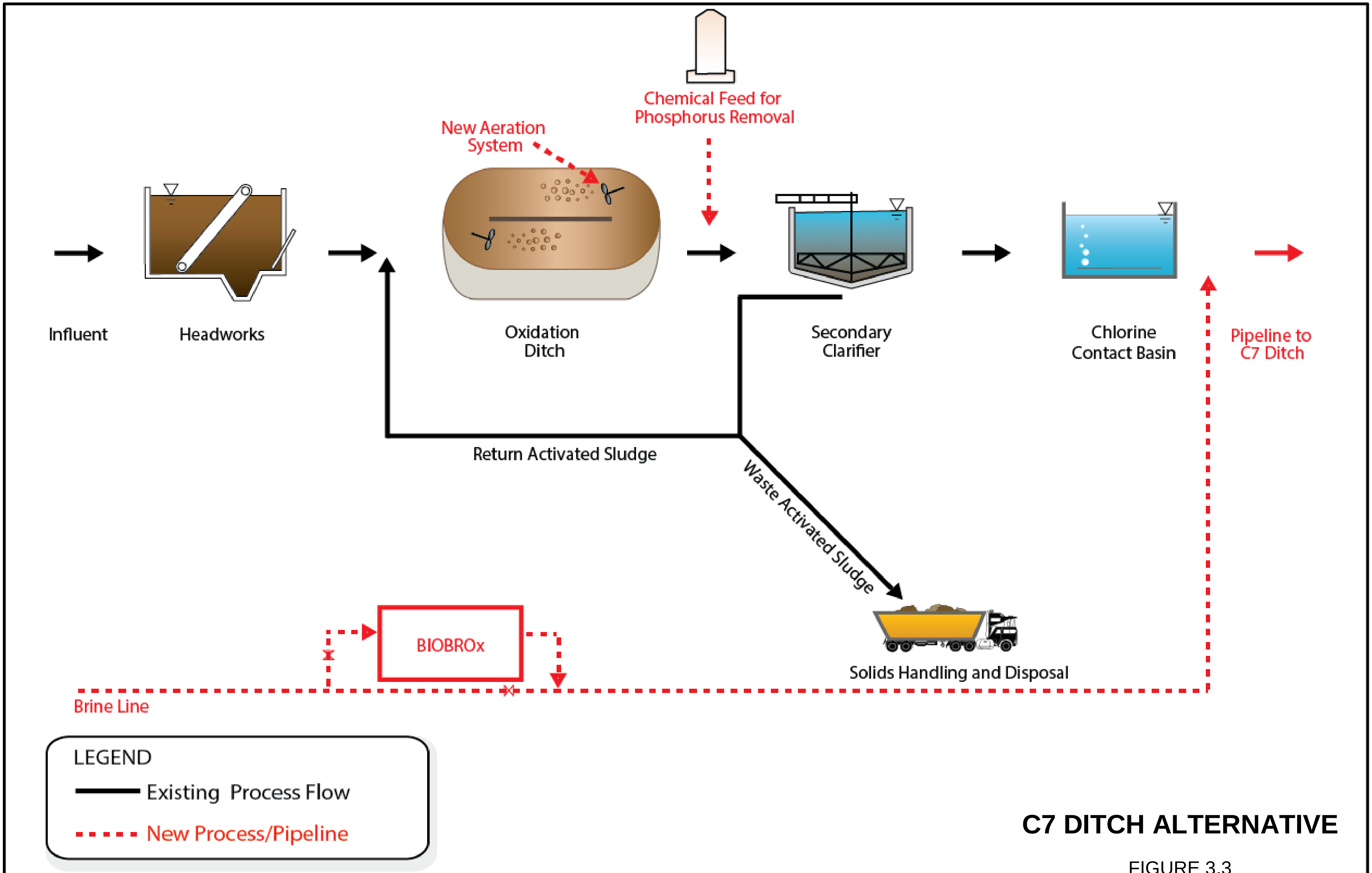


PLAN VIEW OF C7 DITCH ALTERNATIVE

FIGURE 3.2

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

carollo

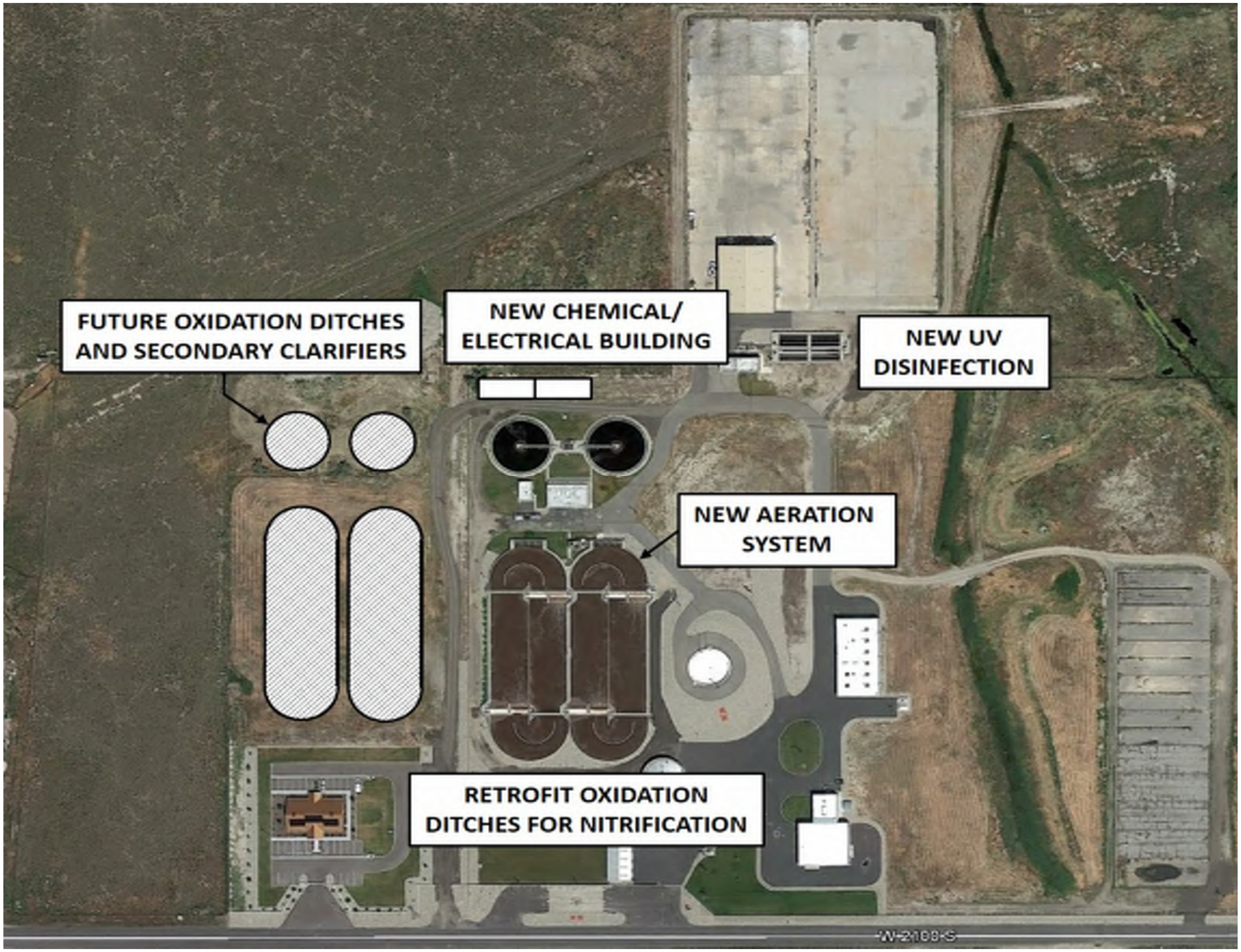


C7 DITCH ALTERNATIVE

FIGURE 3.3

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2017



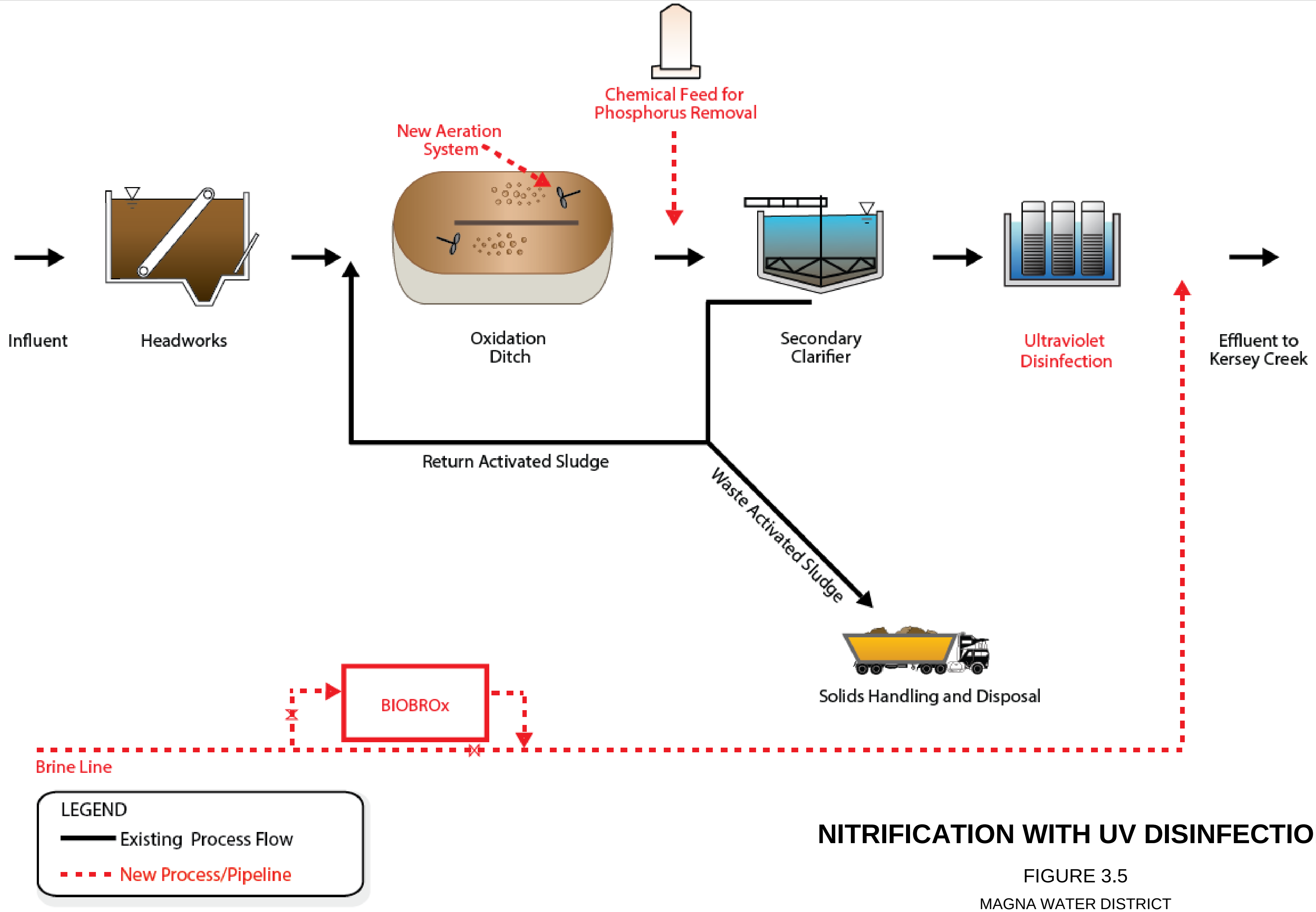
PLAN VIEW OF NITRIFICATION WITH UV DISINFECTION

FIGURE 3.4

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2017

carollo



NITRIFICATION WITH UV DISINFECTION

FIGURE 3.5

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2017

3.3.3 Alternative 3: Biological Nitrogen Removal with UV Disinfection

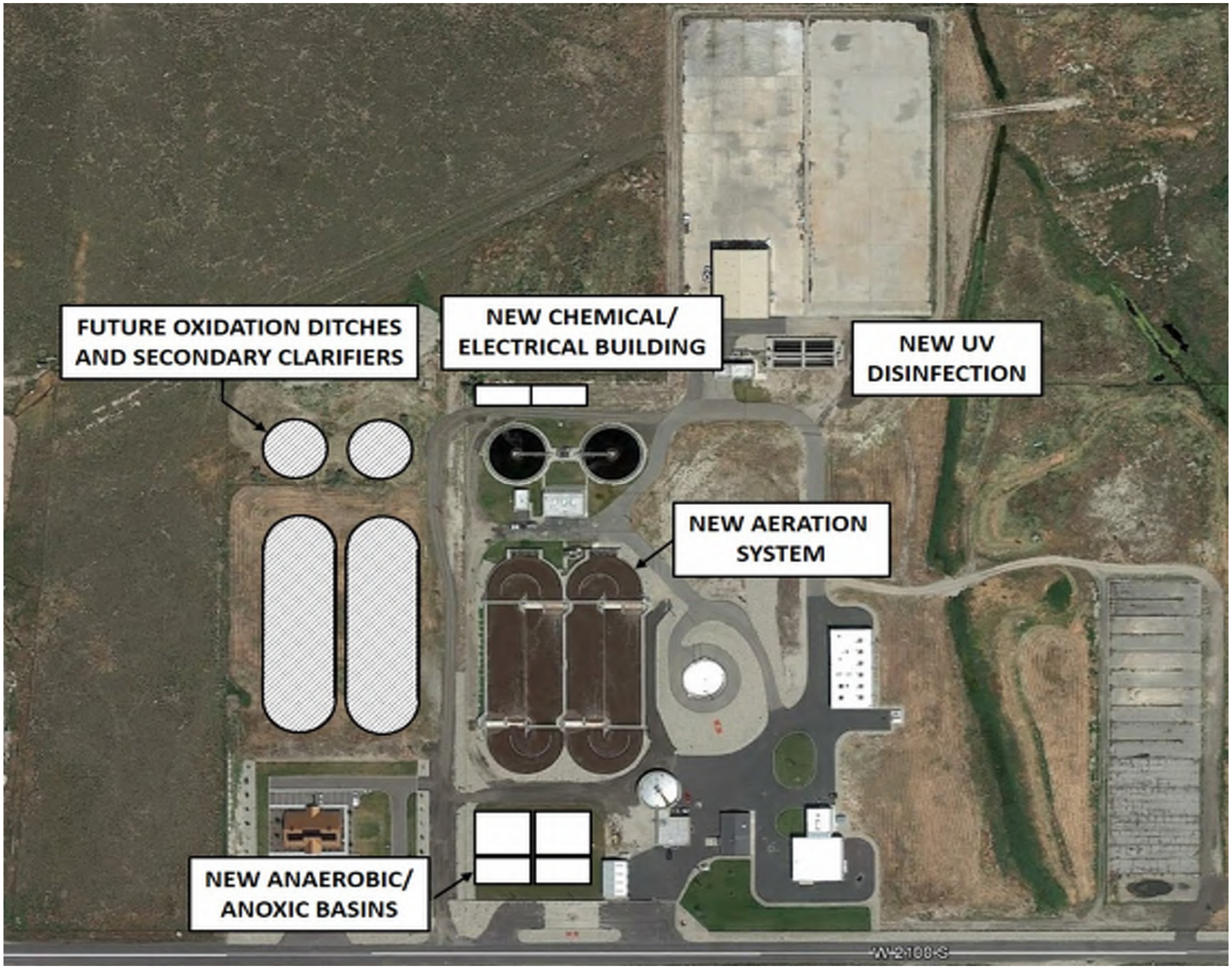
While this alternative builds on components presented in Alternative 2, the main difference is the addition of new basins to provide an anaerobic zone for biological phosphorus removal (via luxury uptake) and an anoxic zone for denitrification, the conversion of nitrate to nitrogen gas. The biological phosphorus removal process will be sufficient to meet an annual mean limit of 1 mg/L without chemical addition. Should MWD be required in the future to meet a lower limit such as 0.1 mg/L total phosphorus, the addition of metal salts ahead of tertiary filters will be required.

In addition to the new basins needed for biological nutrient removal, the existing oxidation ditches will be retrofitted with a new aeration system, and the chlorine contact basins will be retrofitted with UV disinfection to meet the TRC limits similar to Alternative 2 discussed previously. Space on the site plan and hydraulic profile needs to be considered for future chemical addition and tertiary filtration facilities should regulations require.

A site plan of the proposed biological nutrient removal alternative is illustrated in Figure 3.6. A process flow diagram is shown in Figure 3.7.

3.3.4 Alternative 4: No Action

The facility may have sufficient hydraulic capacity to meet the needs of the water district for the next 20 years at existing permit conditions. However, the facility cannot meet the proposed 2017 permit conditions without improvements. The facility will not meet the new ammonia limits due to insufficient aeration capacity and process control during wintertime operations. Proposed TRC limits cannot be met without some type of dechlorination process after disinfection or implementing UV disinfection. Finally, both Tier 1 and 2 nutrient limits will be too stringent for the facility to meet as configured. Failure to meet new effluent limits will result in permit violations with associated fines and penalties levied.

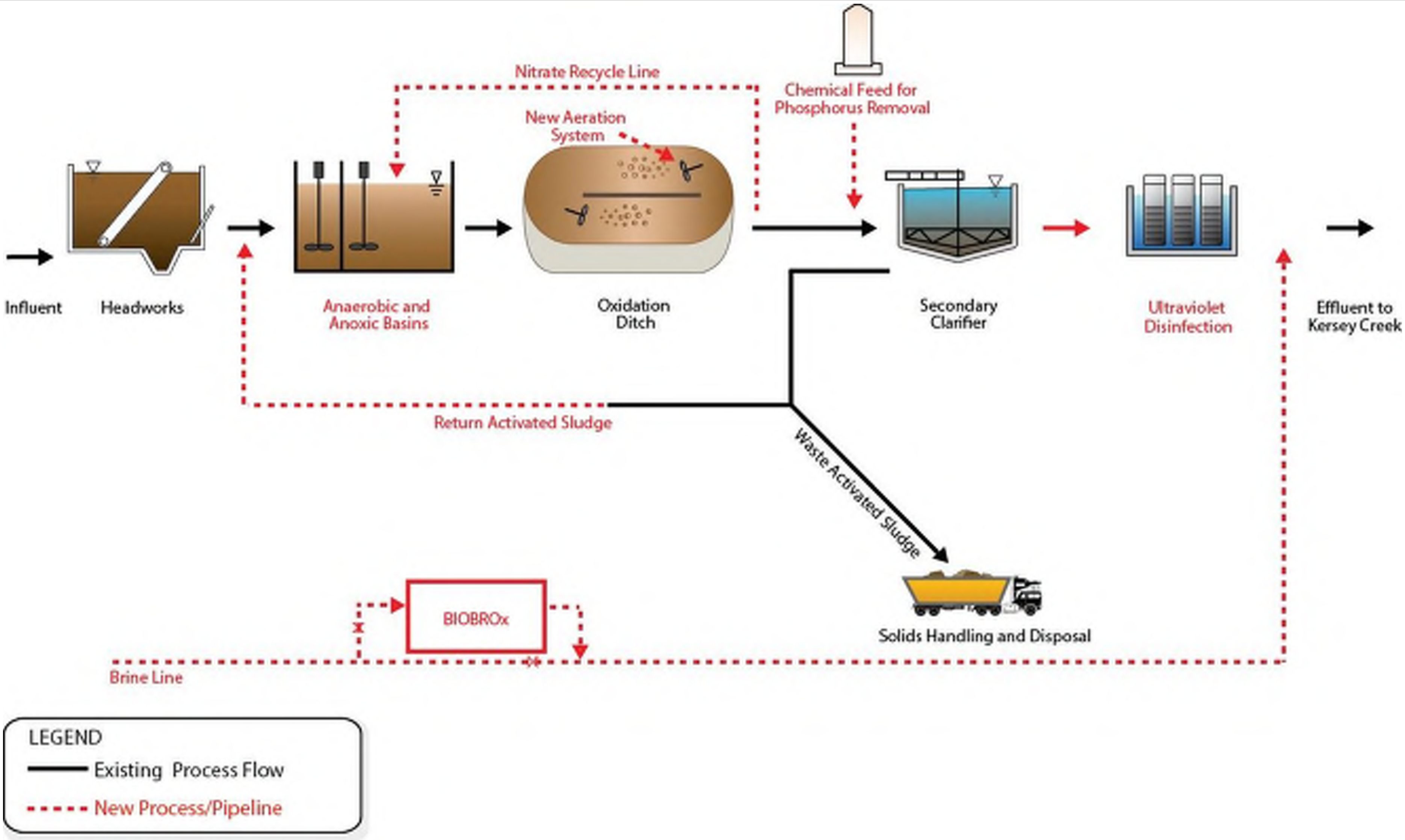


PLAN VIEW OF BIOLOGICAL NUTRIENT REMOVAL AND UV DISINFECTION

FIGURE 3.6

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2017



BIOLOGICAL NUTRIENT REMOVAL WITH UV DISINFECTION

FIGURE 3.7

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

Chapter 4
BACKGROUND

4.1. INTRODUCTION

In this chapter, the treatment alternatives presented in Chapter 3 are evaluated using both economic and non-economic criteria. Results from this evaluation will determine the recommended alternative.

4.1.1. Economic Evaluation

Detailed cost estimates for each alternative have been developed including capital and operation and maintenance (O&M) costs. Within each section, a table provides a summary of the annual O&M and annual lifecycle costs for each alternative. Annual lifecycle costs were calculated annualizing the project cost using a rate of three percent over 20 years. Operation and maintenance (O&M) costs were calculated based on personnel/labor, power, maintenance, and chemical.

Capital and O&M costs increase when flows change from 3.7 million gallons per day (mgd) (Magna Water District only) to 5.6 mgd (Magna Water District growth + Prison + NW Corridor). Since preparing the alternatives, the likelihood of MWD receiving the prison flows has diminished. The costs associated with the 5.6 mgd flow scenario are included in Appendix D for reference. Refer to Chapter 2 for a description of needed facility improvements that are included in the cost estimates for each of the alternatives.

Alternative 1 - C7 Effluent Pipeline and Aeration Upgrade

Major construction elements of this alternative include the following:

- Retrofit existing oxidation ditches with new aeration system.
- Electrical building and SCADA improvements to support new aeration system.
- 3,660 feet of 42-inch pipeline and tie-in structures (See Epic Engineering Study in Appendix C).
- Chemical storage and feed facility for phosphorus removal.
- Construction of tie-in structures at the treatment facility and C7 ditch.
- Site work and common facility improvements.

The cost estimate for this alternative is summarized in Table 4.1 for 3.7 mgd flows, Table 4.2 for operations and maintenance costs, and in Appendix D for 5.6 mgd flows.

Table 4.1	Cost Estimate for Alternative 1 - C7 Ditch at 3.7 mgd Flow Wastewater Facility Plan Magna Water District	
Item		**Total**
Eight 60 hp Triton Mixers w/ blowers	$	998,000
Chemical Feed Building, 25' x 35'	$	235,000
Electrical Building, 25' x 35'	$	185,000
Common Improvements(2)	$	1,810,000
Electric and I&C (25%)	$	807,000
Site Work	$	250,000
Contingency (30%)	$	1,286,000
Total Direct Cost	**$**	**5,571,000**
General Contractor OH&P (15%)	$	836,000
Engineering (16%)	$	891,000
Total Indirect Cost	**$**	**1,727,000**
42" Pipeline, Installed with inlet/outfall (1)	$	1,229,000
Total Project Cost	**$**	**8,527,000**

Notes:
(1) Preliminary cost estimate from Epic Engineering.
(2) See Chapter 2 for details on common elements to all alternatives.

Table 4.2	Additional Operations and Maintenance Estimate for Alternative 1 - C7 Ditch at 3.7 mgd Flow Wastewater Facility Plan Magna Water District	
Item		**Total**
Labor	$	-
Power	$	110,000
Materials	$	27,000
Chemical	$	50,000
Total Annual O&M	$	187,000
20-Year Present Worth O&M (@ 4%)	**$**	**2,541,000**

Alternative 2 - Aeration Upgrade and UV Disinfection

Major construction elements of this alternative include the following:

- Retrofit existing oxidation ditches with new aeration system sized for near complete nitrification.
- Electrical building and SCADA improvements to support new aeration system.
- Retrofit existing chlorine contact basins with UV disinfection.
- Site work and common facility improvements.

The aerators were sized based on oxygen requirements to meet the effluent requirement for BOD and ammonia (near complete nitrification). Surface aeration via floating aerators and aeration using diffusers were both considered. From an economic perspective, the surface aerators were the lower capital cost option, and the shallow depth (8 to 9 feet) of the existing ditches did not favor diffusers which are typically more efficient from a life cycle cost. In reviewing the operational and maintenance aspects of the two systems, the surface aerators were preferred as access to the diffused aerators at the bottom of the oxidation ditches would be severely limited. Therefore, we recommend the surface aerators to accomplish the enhanced aeration upgrade.

The cost estimate for this alternative is summarized in Table 4.3 for 3.7 mgd flows, Table 4.5 for operations and maintenance costs and in Appendix D for 5.6 mgd flows.

Table 4.3 Cost Estimate for Alternative 2 – Nitrification Upgrade with UV Disinfection at 3.7 mgd Flow
Wastewater Facility Plan
Magna Water District

Item		Total
Eight 60 hp Triton Mixers w/ blowers	$	998,000
UV system	$	850,000
Chemical Feed Building, 25' x 35'	$	235,000
Electrical Building, 25' x 35'	$	185,000
Common Improvements[(1)]	$	1,810,000
Electric and I&C (25%)	$	1,020,000
Site Work	$	318,000
Contingency (30%)	$	1,625,000
Total Direct Cost	**$**	**7,041,000**
General Contractor OH&P (15%)	$	1,056,000
Engineering (16%)	$	1,127,000
Total Indirect Cost	**$**	**2,183,000**
Total Project Cost	**$**	**9,224,000**

Notes:
(1) See Chapter 2 for details on common elements to all alternatives.

Table 4.4	Additional Operations and Maintenance Estimate for Alternative 2 - Nitrification Upgrade with UV Disinfection at 3.7 mgd Flow Wastewater Facility Plan Magna Water District	
Item		**Total**
Labor	$	60,000
Power	$	170,000
Materials	$	39,000
Chemical	$	50,000
Total Annual O&M	**$**	**319,000**
20-Year Present Worth O&M (@ 4%)	**$**	**4,335,000**

Alternative 3 - Aeration Upgrade, New Bioreactors, Secondary Clarifiers, and UV Disinfection

Major construction elements of this alternative include the following:

- Retrofit existing oxidation ditches with new aeration system sized for near complete nitrification.
- Electrical building and SCADA improvements to support new aeration system.
- New biological treatment basins (anaerobic and anoxic) and mixers.
- Upsize existing RAS pumps and pipeline.
- Retrofit existing chlorine contact basins with UV disinfection.
- Site work, yard piping, and common facility improvements.

The cost estimate for this alternative is summarized in Table 4.5 for 3.7 mgd flows, Table 4.6 for operations and maintenance costs, and in Appendix D for 5.6 mgd flows.

Table 4.5	Cost Estimate for Alternative 3 – Biological Nutrient Removal with UV Disinfection at 3.7 mgd Flow Wastewater Facility Plan Magna Water District	
Item		**Total**
Anaerobic Basin	$	440,000
Anoxic Basin	$	560,000
RAS Pipeline	$	80,000
Influent Pump Upsize	$	150,000
Nitrate Recycle Pipeline, Pumps and Building	$	400,000
Eight 60 hp Triton Mixers w/ blowers	$	998,000
UV system	$	850,000
Chemical Feed Building, 25' x 35'	$	235,000
Electrical Building, 25' x 35'	$	185,000
Common Improvements(1)	$	1,810,000
Electric and I&C (25%)	$	1,427,000
Site Work	$	449,000
Contingency (30%)	$	2,275,000
Direct Cost Subtotal	**$**	**9,859,000**
General Contractor OH&P (15%)	$	1,479,000
Engineering (16%)	$	1,578,000
Total Indirect Cost	**$**	**3,057,000**
Total Project Cost	**$**	**12,916,000**

Notes:
(1) See Chapter 2 for details on common elements to all alternatives.

Table 4.6	Additional Operations and Maintenance Estimate for Alternative 3 - Biological Nutrient Removal with UV Disinfection at 3.7 mgd Flow Wastewater Facility Plan Magna Water District	
Item		**Total**
Labor	$	90,000
Power	$	220,000
Materials	$	85,000
Chemical	$	50,000
Total Annual O&M	$	445,000
20-Year Present Worth O&M	**$**	**6,048,000**

Alternative 4 - No Action

The "no action" alternative continues to use the existing facilities without any improvements. This alternative would not meet the 2017 proposed permit limits, nor Tier I or Tier II effluent limits. Failure to comply with new permit limits could result in significant fines and potential legal action. Therefore, the "no action" alternative is not feasible.

Summary

Table 4.7 shows the summary of each alternative listing total capital cost, annual operation and maintenance cost, and the total present worth cost.

Table 4.7 Summary of Alternatives
Wastewater Facility Plan
Magna Water District

Alternative	Description	Total Capital Cost	O&M Present Worth	Total Life-Cycle Cost
1	C-7 Pipeline	$ 8,527,000	$ 2,541,000	$ 11,068,000
2	Nitrification Upgrade	$ 9,224,000	$ 4,335,000	$ 13,559,000
3	Biological Nutrient Removal	$12,916,000	$ 6,048,000	$ 18,964,000

4.1.2. Non-Economic Evaluation

Criteria used to evaluate the treatment alternatives on a non-economic basis and the associated weighting factors assigned to each are shown in Table 4.8. Weighting factors are assigned based on the relative importance of each criterion. The criteria were ranked for each treatment alternative with a score of 1 to 5. The score was multiplied by the respective weighting factor to determine the total points. The maximum possible score is 125 points. The criteria are described in the following sections, and the results of the evaluation are shown in Table 4.9.

Process Reliability

The potential for a treatment alternative to provide consistent and reliable effluent water quality is evaluated in this category. A treatment alternative that has the potential for frequent upsets, or that is difficult to operate in a stable manner receives a lower rating. This is particularly important with regard to treating the proposed ammonia and phosphorus limits.

Ease of Operations

This is a measure of the complexity of day-to-day operations for a treatment alternative. The total number of employees and training each requires to conduct daily operations and maintenance are judged. Alternatives that are of lesser complexity, or that are familiar to current plant operators, receive a higher score.

Permit Flexibility

The degree to which a treatment alternative can satisfy future unknown changes to permit conditions is measured in this category. As changes to regulations cause more stringent effluent limits, treatment processes must be modified. A treatment alternative that would require fewer modifications to achieve lower effluent targets receives a higher score.

Energy Use/O&M

The economic analysis evaluated the capital and O&M present worth of each alternative. As energy consumption is one of the largest operational costs of a treatment facility, it is measured here as a non-economic factor. Additionally, higher energy costs can impact the rate payer even after a bond for capital improvements has been paid off. Therefore, a treatment alternative that has relatively lower energy consumption or lower O&M costs receives a higher score.

Effluent Quality

This is a measure of the water quality expected from a treatment alternative. Any improvements to effluent quality will positively impact downstream waterbodies and their beneficial uses. A higher potential effluent quality receives a higher score.

Constructability

This category measures the relative ease an alternative can be implemented, including the overall ease of construction as well as the anticipated impact to existing facilities. A treatment alternative that includes the construction of relatively simple facilities that do not impact the operation of existing facilities and treatment processes receives a higher score.

Plant Compatibility

The ability for a treatment alternative to integrate with existing plant infrastructure and operations is measured with this category. Existing facilities have performed well and retain their value while in operation. A treatment alternative that better utilizes the existing system and works in harmony with current operations receives a higher score.

From the non-economic evaluation above the results indicate a near tie between Alternative No. 1 (C7 Ditch) and Alternative No. 3 (BNR). BNR edges out C7 on the basis that it provides the best long term process reliability and permit flexibility. However, BNR is best suited for full nutrient removal regulations which are a future condition, whereas building C7 now provides short term needs. MWD could easily add the components of the BNR alternative later.

Table 4.8	Non-Economic Evaluation Criteria Wastewater Facility Plan Magna Water District
Criteria	**Weight**
Process Reliability	5
Ease of Operation	4
Permit Flexibility	4
Energy Use/O&M	4
Effluent Quality	3
Constructability	3
Plant Compatibility	2
Total	**25**

Table 4.9 Non-Economic Evaluation
Wastewater Facility Plan
Magna Water District

Category	**Weight**	**Alternatives**							
		Alternative No.1 C7 Ditch		**Alternative No.2 Nitrification**		**Alternative No.3 Biological Nutrient Removal**		**Alternative No.4 No Action**	
Process Reliability	5	4	20	4	20	5	25	1	5
Ease of Operation	4	5	20	4	16	3	12	2	8
Permit Flexibility	4	2	8	3	12	4	16	1	4
Energy Use/O&M	4	5	20	4	16	3	12	3	12
Effluent Quality	3	3	9	4	12	5	15	1	3
Constructability	3	3	9	4	12	3	9	5	15
Plant Compatibility	2	5	10	4	8	4	8	5	10
Total	**25**		**96**		**96**		**97**		**57**

4.2. RECOMMENDATION

Based on the results of the economic and non-economic analysis, Alternative 1, the C7 Ditch, is the recommended treatment alternative provided that DWQ will calculate the waste load analysis at the mixing point of MWD's effluent with Lee's Creek instead of at Kersey Creek. This analysis from DWQ is pending but discussions with DWQ staff indicate that the C7 alternative likely results in less stringent requirements than currently proposed in the 2017 permit. This wastewater facility plan will be finalized once the revised waste load allocation has been received from the state.

Chapter 5

REUSE

5.1 INTRODUCTION

The purpose of this chapter is to discuss implementation of effluent reuse at the Wastewater Treatment Facility (WWTF) for augmentation of Magna Water District's (MWD) secondary water system. In 2008, a Water Reuse Master Plan was completed detailing onsite and secondary water reuse plans. Similarly, this chapter will discuss the following:

- Water quality and treatment required to meet Tier I reuse water.
- Integration with existing secondary system.

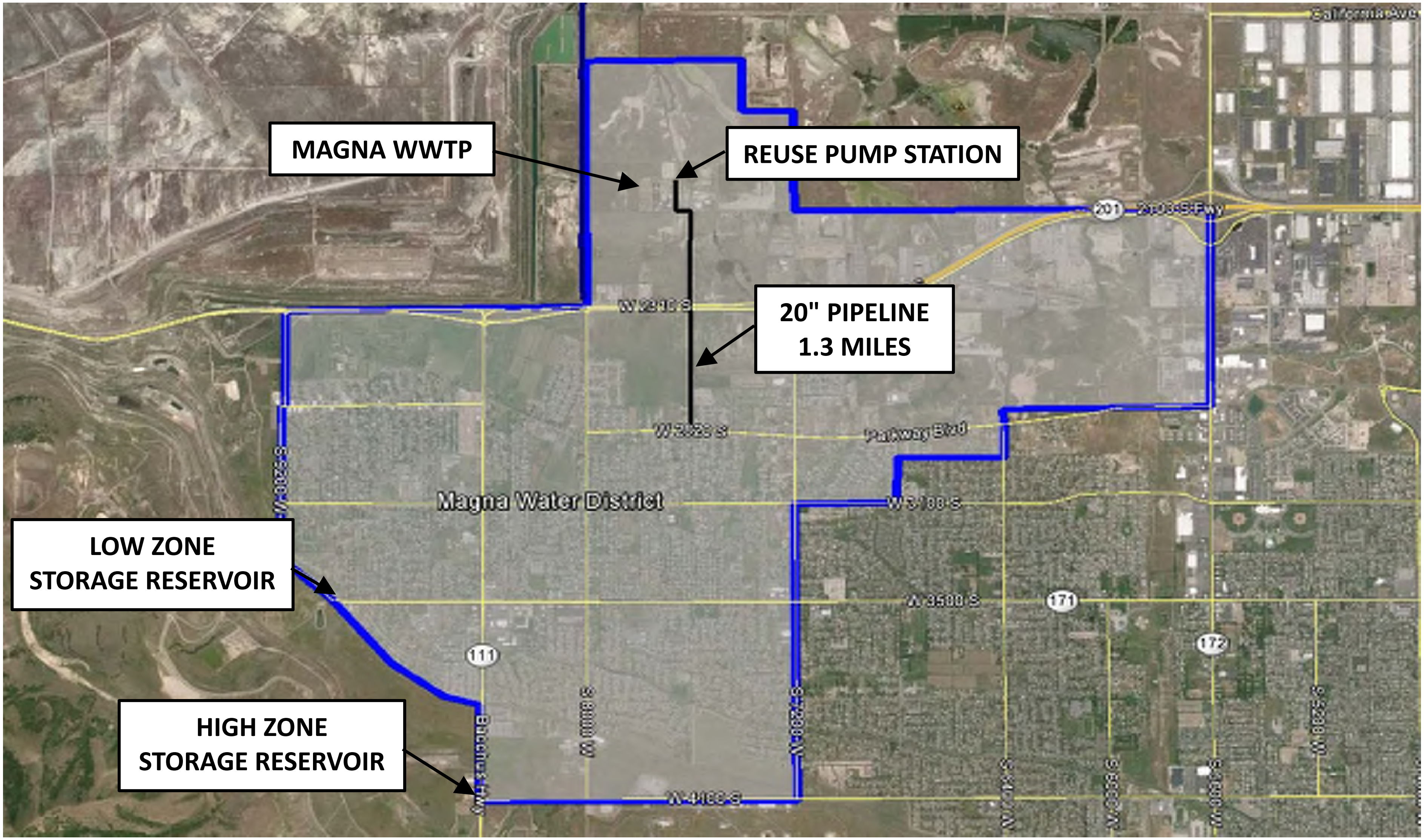
5.1.1 Existing Secondary Water System

MWD owns and operates a secondary water system that is separate from the culinary water system. The secondary water system provides irrigation water for residential, landscape and public areas such as parks, schools, government buildings, golf courses, and churches. The current sources for the secondary system include water from the Utah and Salt Lake Canal and several wells that are pumped directly into the system. The secondary system also includes a storage pond located on the southwest perimeter of the service area. A drawing of the secondary system can be found in Figure 5.1.

Treated wastewater could be added to the existing secondary system to increase water supply and improve reliability, especially during years of drought or algae concern, as long as the water is treated to a Type 1 reuse standard as defined by the Utah Division of Water Quality (DWQ). Treatment facilities will need to be added to MWD's existing WWTF in order to meet the reuse standard as well new infrastructure to convey the reuse water to the secondary water system including distribution system improvements, and a pump station.

5.1.2 Water Quality Requirements for Reuse

DWQ regulates the reuse of treated wastewater based on where or how the water will be used and the likelihood of human exposure. Type II reuse is the less strict standard that allows reuse for agricultural benefit on fenced-in ground, with the exception that the water is not to be applied to food crops or feed for milking animals. Type I reuse water can be applied in areas such as parks, lawns, or gardens where human exposure is likely. In addition to meeting normal wastewater permit requirements, Type I reuse requires filtration and higher disinfection.



SECONDARY WATER SYSTEM

FIGURE 5.1

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

5.2 TREATMENT TECHNOLOGIES

A tertiary filtration process must be added to the MWD WWTF in order to meet Type I reuse water requirements. Three types of filter technologies were investigated, resulting in an expected cost and treatment quality for each. These technologies include:

- Cloth media filter.
- Continuous back-wash sand filter.
- Intermittent backwash sand filter.

Each filter was designed at two flow and water quality scenarios:

- 3.7 mgd with 2 NTU mean turbidity, and shall not exceed 5 NTU at any time. Intent is to have less than 5 mg/L TSS in the effluent.
- 5.6 mgd with 2 NTU mean turbidity, and shall not exceed 5 NTU at any time.

Table 5.1 shows the capability of each filter type to meet flow and reuse requirements. As design for a reuse and tertiary filtration system proceeds further, we recommend a subset of these the technologies/manufacturers be selected for pilot testing at the facility to verify treatment efficiency of their equipment.

Table 5.1 Reuse Filter Design and Treatment Capacity
Wastewater Facility Plan
Magna Water District

Design Criteria	**Cloth Media Filter 5-Star Disc Filter**	**Continuous Backwash Sand Filter Blue Pro**	**Intermittent Backwash Sand Filter Dynasand**
Gravity Flow	✓	✓	✓
Treatment Criteria			
Meets Type 1 Reuse	✓	✓	✓
Capacity for 5.6 mgd	✓	✓	✓

5.2.1 Tertiary Treatment

Major construction elements of this option include the following:

- Tertiary filtration.
- New filter building.
- Electrical and site work.
- Pumps, distribution improvements.

Should MWD decide to implement reuse, the required filters could serve the dual purpose of filtration for reuse and phosphorus removal. Dosing a chemical coagulant like ferric or alum upstream of the filters forms particulate phosphorus that is removed by the filters.

5.3 CONNECTING TO SECONDARY WATER SYSTEM

Distribution system improvements are required to deliver the treated reuse water to the end users. These will occur in two phases. The primary improvements for phase one include a new pipeline to connect the wastewater facility reuse water to the secondary water system, and a booster station to bring the water pressure up to design service levels with enough reserve pressure to deliver excess water to the low level reservoir. Phase two improvements include an additional booster station to deliver water to the remaining users south of the low level zone with enough residual pressure to deliver water to the high zone reservoir.

5.3.1 Pipeline to Connect Reuse Water to Secondary Water System

Distribution improvements were outlined in the 2009 Reuse Master Plan consisting in part of new pipe from the WWTF on West 2100 South to West 2820 South where the tie-in to the existing secondary water system would occur. From there, pipe upsizes are required to deliver water efficiently from this new distribution point.

5.3.2 Low Level Booster Station

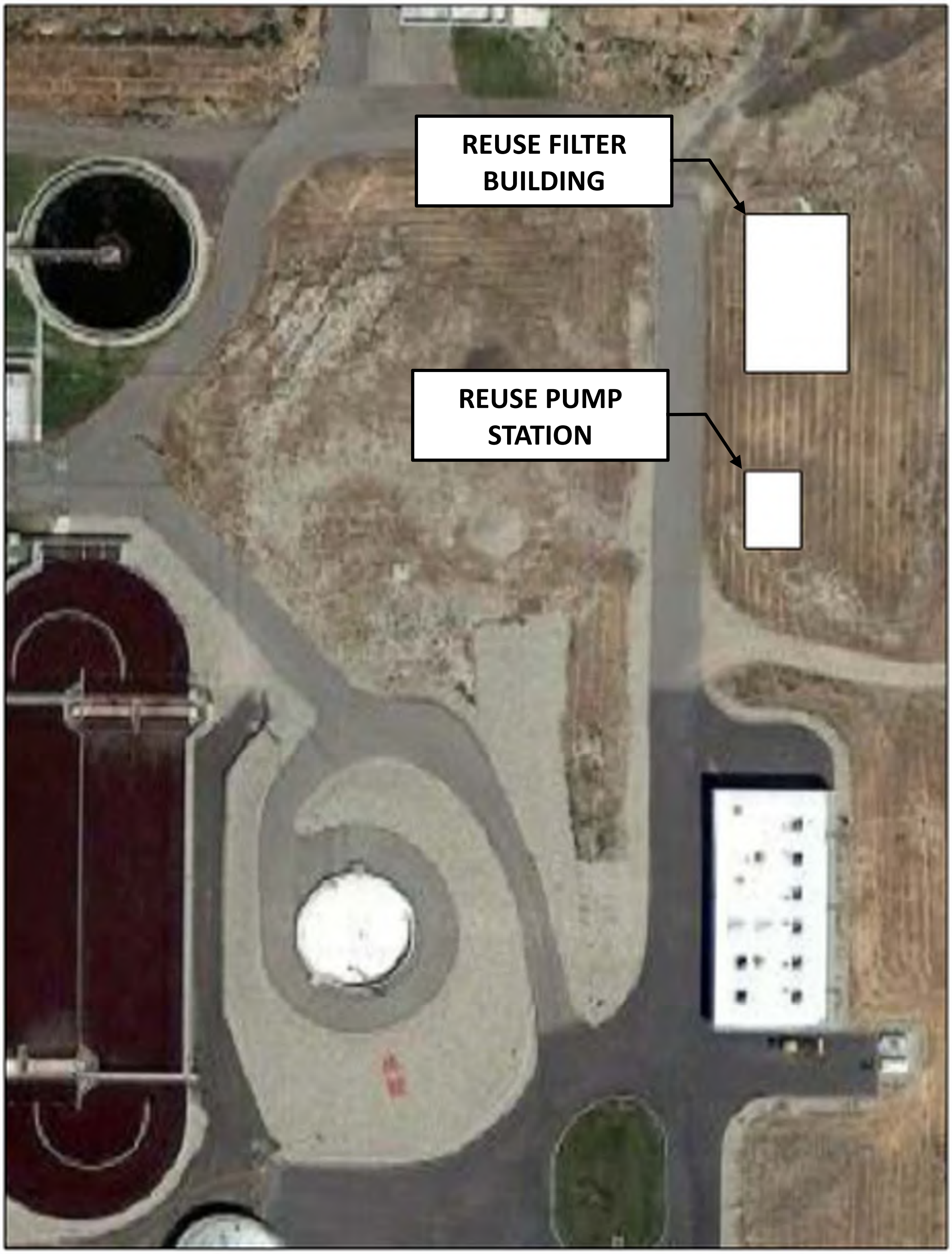
The reuse water delivered from the WWTF must meet required minimum service pressures within the secondary water system with sufficient residual pressure to allow any unused water to fill the low level reservoir. For necessary service pressure combined with the elevation gain, a new pump station is needed with three booster pumps (2+1), each sized at 150 horsepower (hp), capable of 1,300 gallons per minute (gpm) at a total head of 350 feet. Space in the pump station should be reserved for an additional pump and piping which will bring the firm capacity of the station to 3,900 gpm (5.6 mgd).

5.4 REUSE SYSTEM COST ESTIMATE

A single filter manufacturer was selected to illustrate typical capital and O&M costs. These estimates were combined with the secondary water distribution improvements and reuse pump station costs. The overall cost estimates resulting from the 3.7 mgd flow scenario is summarized in Table 5.2. Figure 5.2 shows the plan view of the reuse filter and pump station at the existing wastewater facility. Table 5.3 shows estimated annual O&M costs for treating and pumping reuse water to the secondary system. It is assumed that reuse treatment and pumping only occurs 6 months of the year.

Table 5.2	Cost Estimate for Reuse Filters Wastewater Facility Plan Magna Water District	
Item		**Total**
Filter Building, 75'X48' with sand filters	$	2,440,000
Reuse Pump Building, 28'X38'	$	375,000
1,300 gpm, 350' TDH, 150 hp pump + VFD	$	336,000
Electric and I&C (25%)	$	788,000
Site Work	$	207,000
Contingency (30%)	$	1,244,000
Direct Cost Subtotal	**$**	**5,390,000**
General Contractor OH&P (15%)	$	809,000
Engineering (16%)	$	862,000
Total Indirect Cost	**$**	**1,671,000**
Total Project Cost	**$**	**7,061,000**

Table 5.3	Additional Operations and Maintenance Estimate for Reuse Filters Wastewater Facility Plan Magna Water District	
Item		**Total**
Labor	$	15,000
Power	$	103,500
Materials	$	45,000
Total Annual O&M	$	163,500
20-Year Present Worth O&M (@ 4%)	**$**	**2,222,000**



PLAN VIEW OF REUSE FILTER AND PUMP STATION

FIGURE 5.2

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

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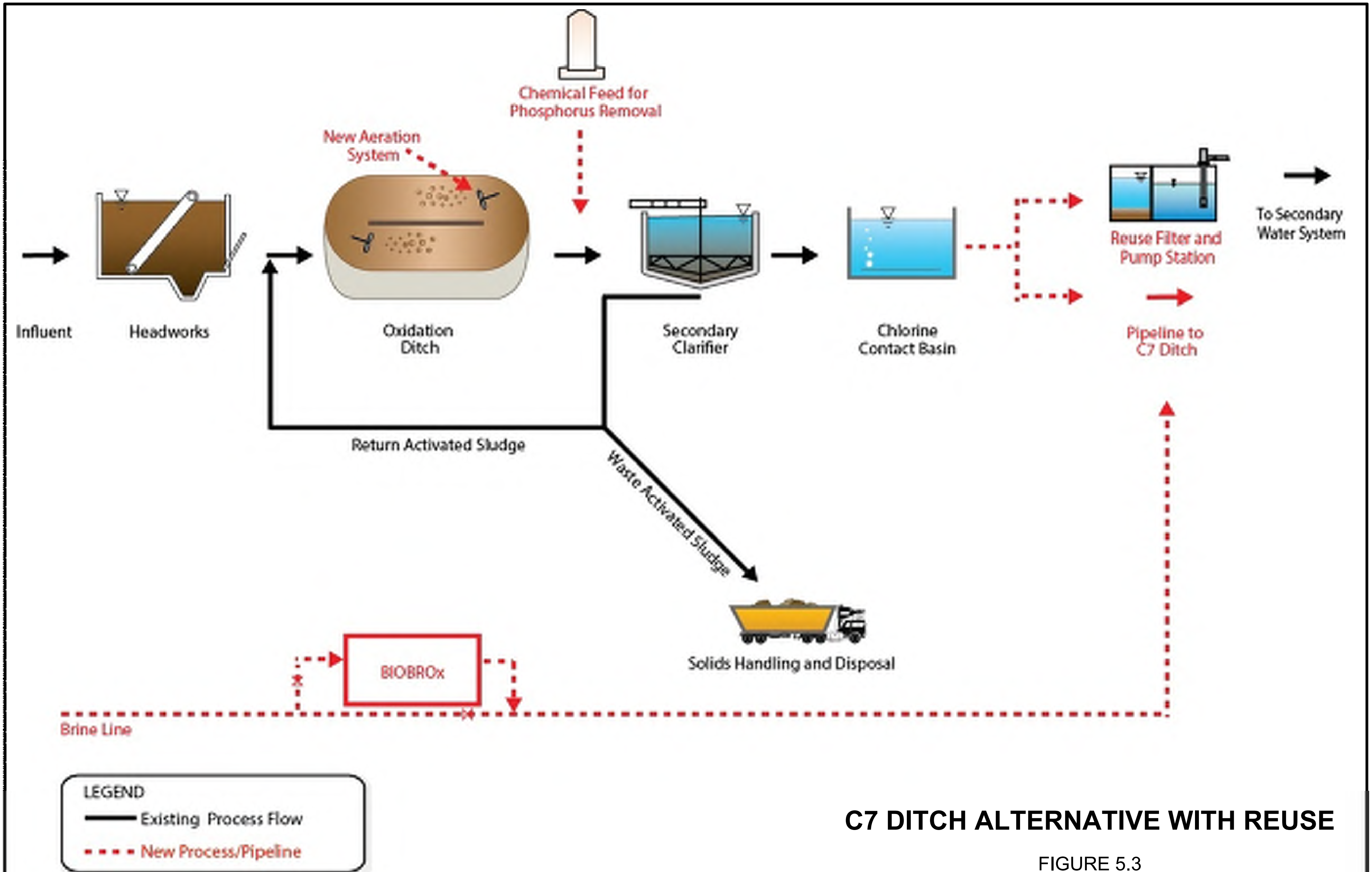
5.5 INTEGRATION WITH TREATMENT ALTERNATIVES

The reuse system will integrate with each treatment alternative after the chlorination facilities. Tertiary filtration will occur immediately preceding the reuse pump station. Process flow diagrams illustrate integration of reuse within each treatment alternative shown in Figure 5.3, Figure 5.4 and Figure 5.5.



C7 DITCH ALTERNATIVE WITH REUSE

FIGURE 5.3

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

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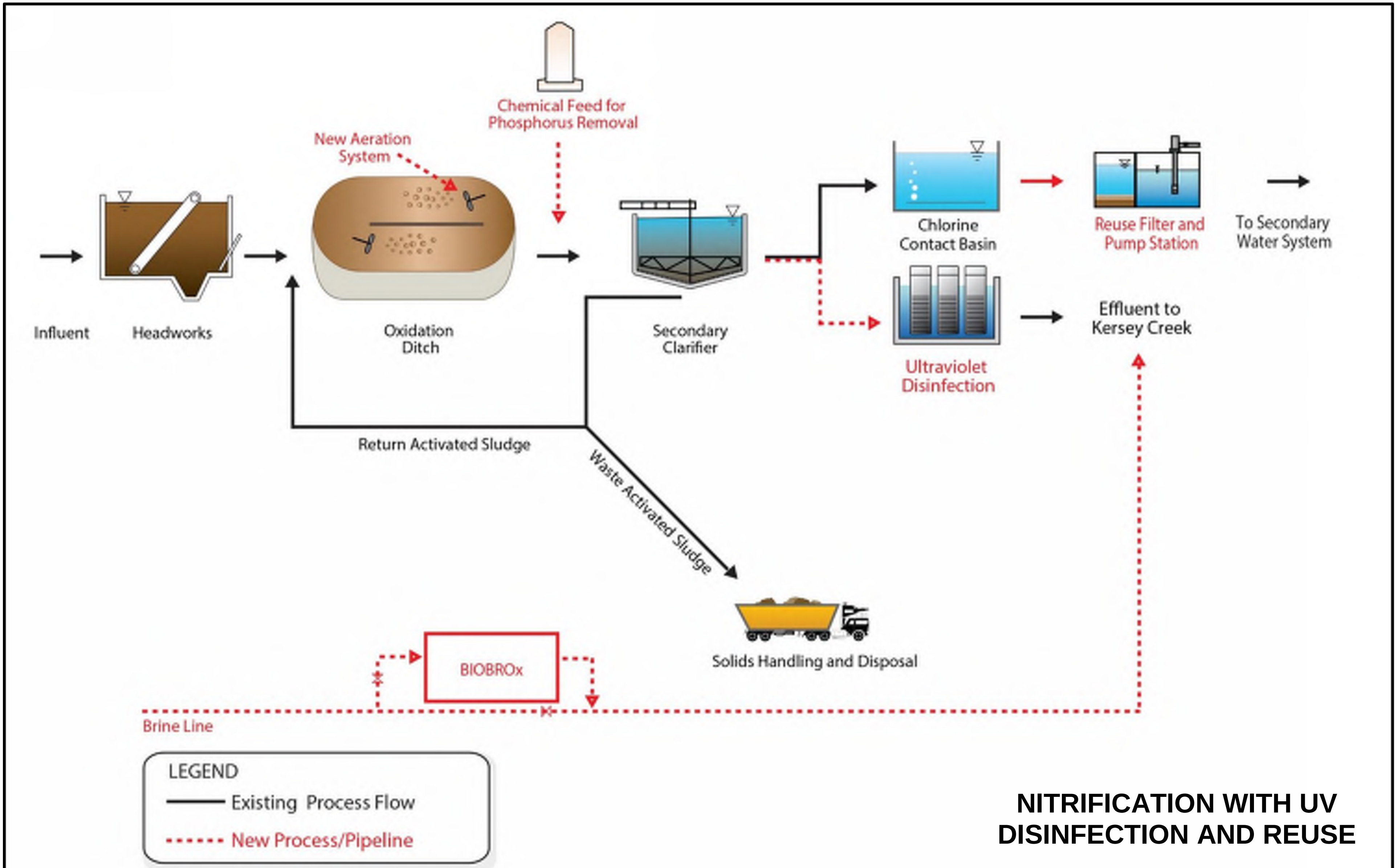
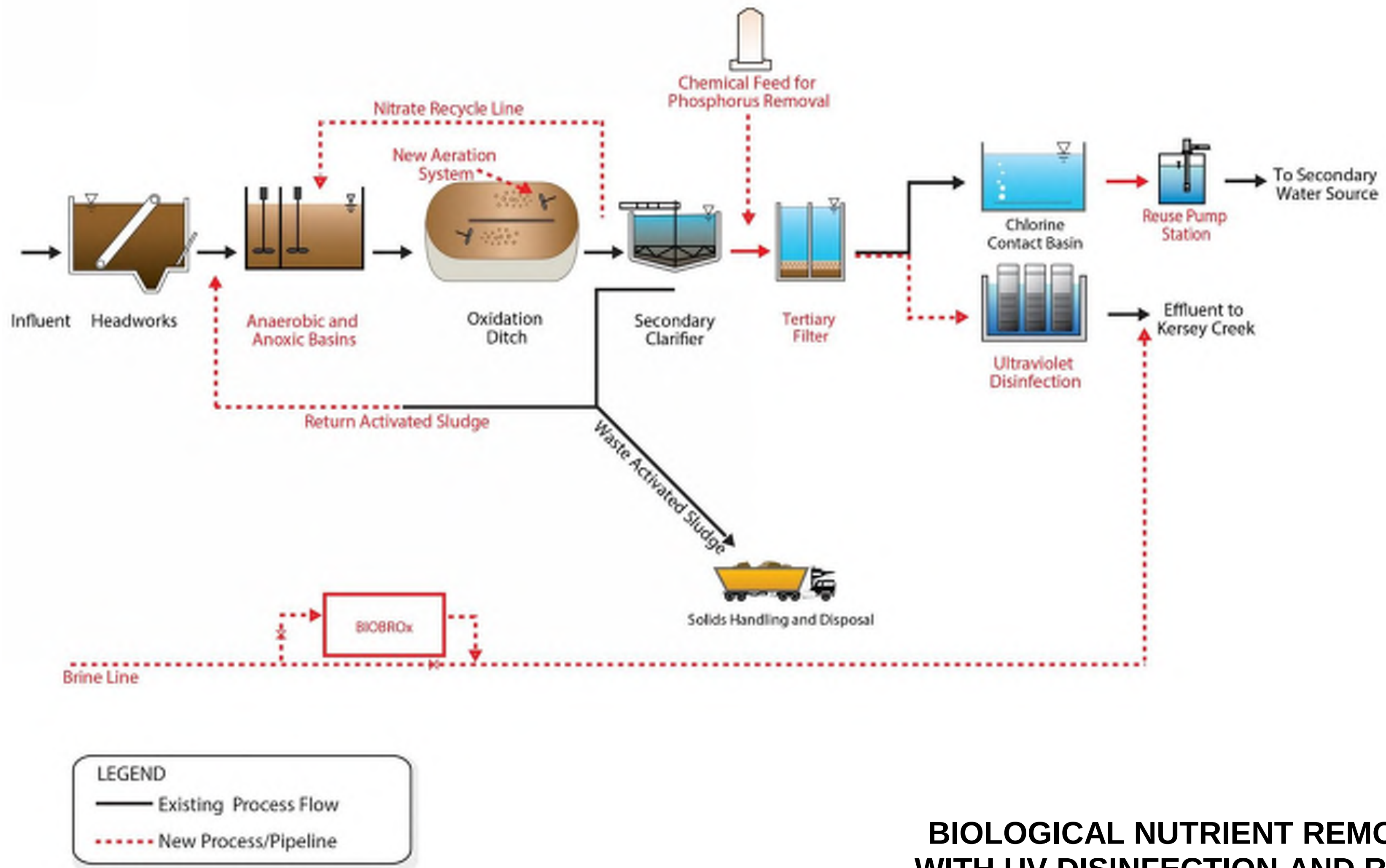
pw://Carollo/Documents/Client/UT/Magna/9910B00/Deliverables/Figure 5.3



NITRIFICATION WITH UV DISINFECTION AND REUSE

FIGURE 5.4

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017



BIOLOGICAL NUTRIENT REMOVAL WITH UV DISINFECTION AND REUSE

FIGURE 5.5

MAGNA WATER DISTRICT
WASTEWATER FACILITY PLAN 2017

BIOBROX AND BRINE LINE PLANNING

6.1 INTRODUCTION

Perchlorate, a chemical used in the manufacture of propellants for rockets and missiles, has contaminated the groundwater aquifer used by the Magna Water District (MWD) to supply drinking water to their customers. This contamination is a result of a munitions manufacturer in the area. This contamination was first identified in the late 1990s and contaminated wells were not used by MWD. Arsenic is naturally occurring in groundwater but requires treatment in order to meet the EPA maximum contaminant limit for drinking water. In response to the presence of both contaminants in the supply wells, MWD constructed an EDR (electrodialysis reversal) water treatment plant specially designed for removal of both perchlorate and arsenic. The concentrate stream from the EDR process is combined with municipal sewage in a sewer trunk line and sent to MWD's wastewater treatment facility (WWTF). A new process at the WWTF was developed for perchlorate destruction called Biodestruction of Blended Residual Oxidants or BIOBROx®. This novel process was implemented as a proactive approach to eliminating perchlorate from the waste stream. Under current USEPA regulations, perchlorate could be discharged to the sewer system with no additional treatment.

The BIOBROx® process works by growing a biofilm of bacteria on granular activated carbon (GAC) in an anaerobic (no oxygen) reactor where there is a carbon source (food). The oxygen-deprived bacteria reduce the perchlorate (electron donor) to metabolize the carbon source.

6.2 BIOBROX PLANNING

6.2.1 Existing Condition

Initial piloting of the fixed-bed bioreactor process (BIOBROx®) showed perchlorate removal to be below detection limits, using a 1.5:1 wastewater flow to EDR brine flow blend ratio. The success of this pilot study led to the full-scale implementation of BIOBROx® at the wastewater plant. The full-scale system has not worked the way it was intended due to rapid reactor plugging. Increased headloss across the GAC bed is due to a change in raw water characteristics, including an observed increase in total suspended solids (TSS) from when the original pilot work was performed.

In an effort to understand the changes in wastewater quality and to optimize the BIOBROx® accordingly, an 18-month pilot study was conducted. Shortly after the study began, it was apparent that a full flow of screened raw sewage to the BIOBROx® system was no longer viable. Fibrous, mesh-like material passing the two-millimeter finescreen in the headworks facility caused a significant increase in headloss over a short period of time. This initial test confirmed what was observed at the full-scale plant. Subsequent testing focused on treating brine only (100 percent EDR concentrate) and finding the most effective carbon dose for perchlorate removal.

The results from the pilot testing showed that high carbon doses (> 100 mg/L) of acetic acid or glycerin will be needed to achieve perchlorate removal from the brine, if regulations require.

6.2.2 Brine-Only Treatment at the Wastewater Facility

As demonstrated in the most recent pilot study, the existing BIOBROx® system can be used to treat brine only (without municipal waste) with the addition of an external carbon source. This could be accomplished by routing a dedicated brine line from the EDR plant to the BIOBROx® building at the wastewater plant. The dedicated brine line will be discussed in the next section.

To convert the existing BIOBROx® facility to fixed bed bioreactors with an external carbon source, a new chemical feed system will need to be installed. This will include two new HDPE tanks for acetic acid storage, chemical metering pumps, chemical transfer pumps, an in-line static mixer at the chemical injection point, associated piping, and electrical and instrumentation. The storage tanks and chemical feed equipment will be installed in a new chemical storage building near the BIOBROx® building, adjacent to the bioreactors. A preliminary capital cost estimate to convert the existing system to a brine treatment process is shown in Table 6.1. Acetic acid is relatively expensive compared to glycerin, which is also a viable option. However, additional testing may be required prior to substituting glycerin for acetic acid to verify its performance. This estimate assumes 24 hour per day operation year round at an average acetic acid dose of 100 mg/L, 56 percent acetic acid concentration. Annual operational costs are estimated to be $200,000, which is the purchase cost of acetic acid.

Table 6.1	Cost Estimate for Treatment of Brine at WW Facility Wastewater Facility Plan Magna Water District	
Item		**Total**
Brine Chemical Building, 23'X39'	$	216,000
HDPE Tanks, 5,000 gal.	$	10,000
Chemical Metering Pumps	$	24,000
Transfer Pump	$	6,000
Static Mixer	$	10,000
Piping	$	10,000
Electric and I&C (25%)	$	69,000
Site Work	$	23,000
Contingency (30%)	$	129,000
Direct Cost Subtotal	**$**	**497,000**
General Contractor OH&P (15%)	$	75,000
Engineering (16%)	$	80,000
Indirect Cost Subtotal	**$**	**155,000**
Total Project Cost	**$**	**652,000**

Notes:

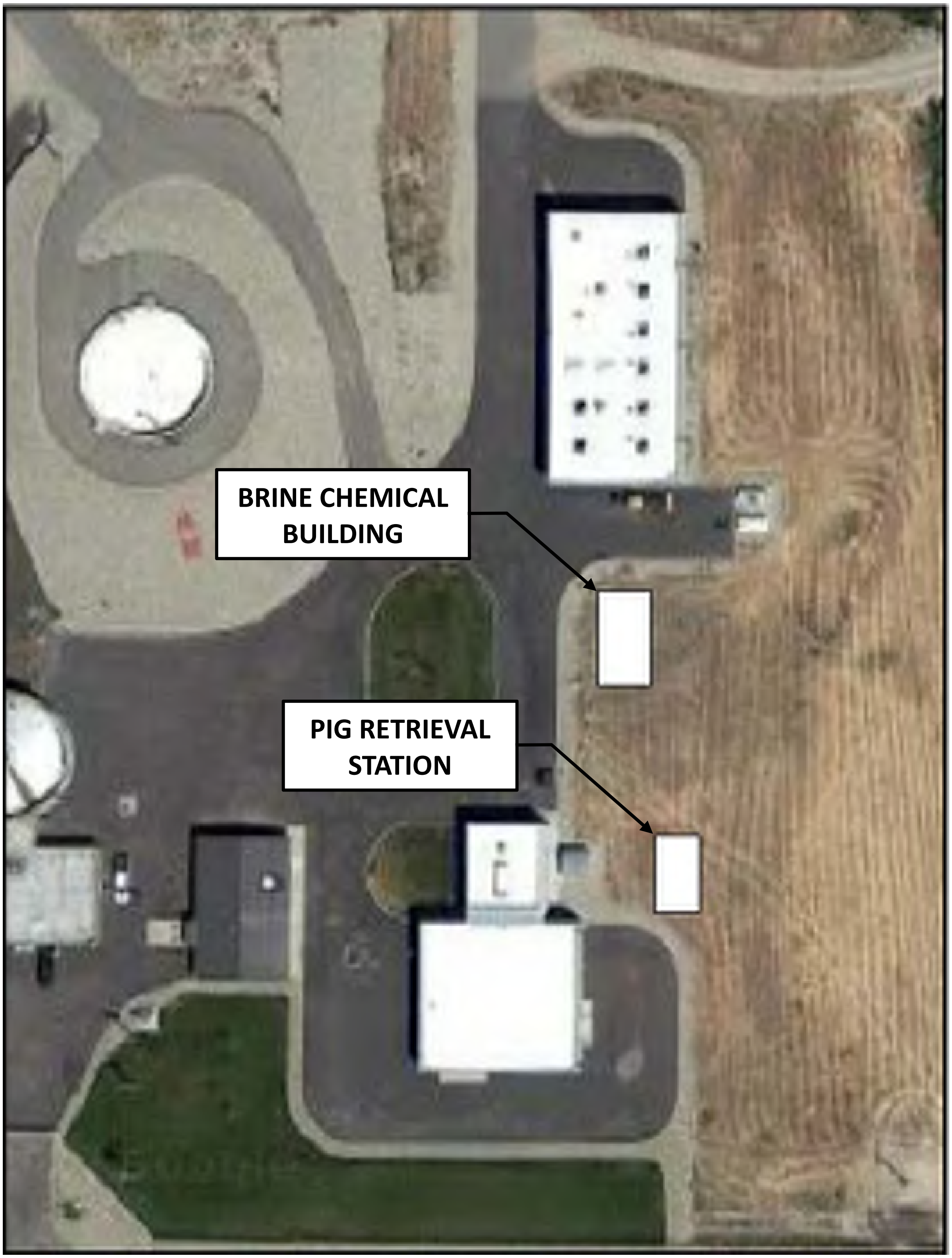
(1) This estimate does NOT include the cost for the dedicated brine line from the EDR plant to the wastewater plant, which is a necessary component for this option.

6.3 BRINE LINE PLANNING

Magna has seen increased flow in the trunk line that serves the EDR plant since 2009 due to population growth in the area. This has resulted in capacity issues in the sewer line during peak flow. EDR concentrate is groundwater with higher total dissolved solids and does not require or benefit from traditional wastewater treatment. Therefore, it has been proposed that the EDR concentrate be separated from the wastewater collection system and routed to the wastewater outfall through a new pipeline. The brine line will be connected to the BIOBROx® for future perchlorate treatment if needed, however it will continue to be blended at the wastewater outfall until then due to the high cost of artificial carbon addition and absence of regulation. Benefits of a dedicated brine line include:

- Increased capacity in the sewer trunk line.
- Decreased flows through the WWTF.
- Potential to treat brine-only for perchlorate removal if required.

A pre-design report for the brine line was completed by Carollo in 2015. Figure 6.1 shows the plan view of the brine chemical building and the pig retrieval vault discussed in the pre-design report.



PLAN VIEW OF BRINE TREATMENT PROJECTS

FIGURE 6.1

MAGNA WATER DISTRICT
WASTEWATER FACILITIES PLAN 2017

carollo

Chapter 7

RECOMMENDATION AND IMPLEMENTATION

7.1 INTRODUCTION

In Chapter 4, three treatment alternatives for the Magna Water District's (MWD) Wastewater Treatment Facility (WWTF) were evaluated based on new nutrient removal regulations, project costs, both capital and operations and maintenance (O&M), and non-economic considerations such as process reliability. Alternative No. 1, the C7 pipeline, was determined to have the lowest cost, but the viability of this alternative was conditional upon acceptance by the Utah Division of Water Quality (DWQ).

This chapter details the process MWD and Carollo Engineers, Inc. (Carollo) conducted with DWQ to review the C7 pipeline alternative and define new permit limits as a result of a proposed new effluent discharge and compliance point. Recommendations for project implementation including a proposed permitting and construction schedule are also presented.

7.2 DWQ PERMITTING AND TREATMENT ALTERNATIVE REVIEW

In 2014, MWD received a new discharge permit from the DWQ that required lower effluent ammonia (less than 5 mg/L in the winter) and total residual chlorine (TRC) (less than 0.011 mg/L) concentrations by April 2017 as a result of new chronic toxicity regulations from the EPA. Despite efforts to optimize existing WWTF processes, MWD is not able to meet these new regulations without significant upgrades.

In late summer of 2016, MWD presented the treatment alternatives in this master plan to DWQ staff and discussed the feasibility of the C7 Pipeline Alternative. DWQ staff responded with a preliminary wasteload analysis (WLA) (dated September 30, 2016, see Appendix E) indicating that the C7 pipeline alternative would likely only require a 7 mg/L year round limit versus seasonal limits of 5 mg/L in the winter and 2.5 mg/L in the summer proposed in the 2017 permit. The TRC limit remained unchanged at 0.011 mg/L, but because of the proposed move of the compliance point to where C7 ditch meets Lee Creek, DWQ allowed MWD and Carollo to perform a field study on the decay rate for chlorine between the current discharge point and Lee Creek. Based on the results of that field study (see Appendix E), MWD requested that their current discharge limit for TRC of less than 1 mg/L remain unchanged as the field study suggests that TRC will be less than the limit of 0.011 mg/L as a result of decay during conveyance to Lee Creek.

DWQ finalized the WLA and TRC limits based on the C7 alternative and chlorine decay study in a letter dated January 30, 2017 (see Appendix E). Permit limits for ammonia and TRC are 7 mg/L and 1.3 mg/L, respectively. Given the work performed by Magna, and adjustments from DWQ regarding the chlorine and ammonia permit limits, Table 7.1 shows the permit conditions of 2014, changes to the 2017 permit, and potential future permit conditions. Future permit conditions were based on correspondence with DWQ regarding more stringent ammonia limits based on presence of sensitive species of mussels or snails in Lee Creek (see Appendix E).

Table 7.1 Effluent Discharge Requirements
Wastewater Facility Plan
Magna Water District

Constituent	Units	2014 Permit	2017 Permit	2019 Permit Extension	2020 C-7 Permit	Potential Future Permit Limits
BOD_5	mg/L	25	25	25	25	25
TSS	mg/L	25	25	25	25	25
Total Residual Chlorine	mg/L	1	0.011	1	1.3	1.3
Ammonia	mg/L	monitor	2.5 – 5	monitor	7	2
Total Phosphorus	mg/L	-	monitor	monitor	1	0.1
Total Nitrogen	mg/L	-	monitor	monitor	monitor	10

As part of discussions in early summer 2016, DWQ staff recommended for ease of permitting that MWD submit the final master plan along with a request for a new 5-year permit based on the C7 Alternative WLA, a new permitted compliance point (i.e. intersection of C7 ditch with Lee Creek), and project compliance schedule outlining the time MWD requires to design, construct, and start up facilities necessary to comply with the new limits. In order to remain in compliance with their UPDES permit, MWD requested, and was granted, a 2-year extension on their permit, valid until April 2019 (see Appendix E). This will allow MWD time to complete the necessary predesign activities before the new 5-year compliance schedule is established.

The proposed project and compliance schedule should also include provision for meeting the technology based effluent limit (TBEL) for phosphorus of 1 mg/L. All alternatives considered for this master plan rely on chemical addition for phosphorus removal.

7.3 RECOMMENDED ALTERNATIVE

Based on the favorable WLA received from the DWQ, the C7 Pipeline alternative is recommended for MWD's WWTF process upgrade. The major advantage of this alternative is that building a pipeline to convey the effluent to C7 ditch is less expensive than building the treatment facilities, like UV disinfection and biological nutrient removal outlined in Alternatives 2 and 3, required to continue to discharge to Kersey Creek under new regulations. Additionally, the C7 alternative does not prevent MWD from adding or phasing in future projects such as the brine line, effluent reuse, or Alternative 3, should regulations require more stringent nutrient removal. A conceptual site plan and process flow diagram for the C7 Pipeline Alternative are shown in Chapter 3, in Figures 3.2 and 3.3, respectively.

7.3.1 Permitting

While significant progress has been made with DWQ towards the C7 Pipeline Alternative, permitting for this project remains a major task and involves multiple agencies. The project has two major components, construction inside the fence or plant work, and construction activities outside the fence, or pipeline work. The following permitting work is anticipated for both areas, although this may not be a complete list, given the complexity and nature of obtaining proper approvals.

Plant Work:

- DWQ approval of master plan: This includes treatment concepts, new compliance point location, and implementation schedule. Anti-degradation report also required.
- DWQ Construction Permit: A review of construction documents prior to advertising project for bid with general contractors.
- DWQ Operational Permit: Must be obtained once construction is complete.
- Salt Lake County Building Permit: Requires review of structural, civil, geotechnical, and stormwater design calculations and plans.

Pipeline Work (In addition to the permits listed above for Plant Work):

- Easement Negotiation for Pipeline Alignment – Pipeline would cross Rio Tinto property and easement needs to be agreed upon. MWD should consider impacts of wetland area as part of this negotiation.
- Environmental Permitting:
  - Wetlands: Delineation to be performed along proposed pipeline alignment to quantify impacts to existing wetland areas and submitted to the Army Corp of Engineers. Depending on the wetlands impacted, a national permit and

mitigation may be required. DWQ has a Section 401 permit requirement that must be submitted as well when considering wetland impacts.

  – Cultural Resources Study: Project must file with State Historic Preservation Office and perform field work to verify no impact to historic or cultural resources as a result of the project.
  – NEPA: Preparation of an Environmental Assessment at a minimum to be prepared and submitted to DWQ, and the permitting verifying that alternatives for the project were considered in order to avoid impacts to the environment, including water quality, wildlife, air quality, and visual aesthetics.

- Salt Lake County Flood Control Permit: As a result of pipeline connection to C7 ditch.

7.3.2 Estimated Project Cost

As outlined in Chapter 4, the project needs to include at a minimum the following items:

- Retrofit existing oxidation ditches with new aeration system.
- Electrical building and SCADA improvements to support new aeration system.
- 3,660 feet of 42-inch pipeline and tie-in structures (see Epic Engineering Study in Appendix C).
- Chemical storage and feed facility for phosphorus removal.
- Construction of tie-in structures at the treatment facility and C7 ditch.
- Site work and common facility improvements.

Design efforts for the C7 alternative should start with a hydraulic study that provides a more detailed consideration of the C7 pipeline inlet, brine line outlet, and reuse facilities, all of which are proposed to converge at the end of the existing WWTF.

Table 7.2 shows the estimated project for the C7 alternative. This is the similar to the project costs that were shown in Chapter 4, but has been updated to include costs required for permitting, geotechnical work, and the recommended hydraulic study not previously included.

Table 7.2	Cost Estimate for Alternative 1 - C7 Ditch at 3.7 mgd Flow Wastewater Facility Plan Magna Water District	
Item		**Total**
Eight 60 hp Triton Mixers with Blowers	$	998,000
Chemical Feed Building, 25' x 35'	$	235,000
Electrical Building, 25' x 35'	$	185,000
Common Improvements (1)	$	1,810,000
Electric and I&C (25%)	$	807,000
Site Work	$	250,000
Contingency (30%)	$	1,286,000
Total Direct Cost	**$**	**5,571,000**
General Contractor OH&P (15%)	$	836,000
Engineering (16%)	$	891,000
Permitting, Geotechnical, Hydraulic Study	$	120,000
Total Indirect Cost	**$**	**1,847,000**
42" Pipeline, Installed with inlet/outfall (2)	$	1,229,000
Total Project Cost	**$**	**8,647,000**

Notes:
(1) See Chapter 2 for details on common elements to all alternatives.
(2) Preliminary cost estimate from Epic Engineering.

7.3.3 Schedule

An anticipated implementation schedule for the near term improvements are shown in Table 7.3 and Figure 7.1. These correspond to improvements necessary to bring the facility in compliance over the next permit cycle. Other improvements should be phased according to district needs and timing of resources

7.3.4 Project Funding

A renewal of an existing bond was proposed to the citizens of Magna Water District in 2016 and was approved during the November election. This bond renewal secured funds sufficient for implementing the recommended alternative.

Table 7.3	Facility Design and Construction Schedule Wastewater Treatment Plant Facility Plan Magna Water District			
Project Schedule				
Item #	**Task**	**Start Date**	**Months**	**Finish**
1	Easement/Delineation/ Permitting	Apr-2017	6	Oct-2017
2	Hydraulic Study/Predesign	Apr-2017	6	Oct-2017
3	Geotech Study	Oct-2017	3	Jan-2018
4	Plant Design	Jan-2018	6	Jul-2018
5	Pipeline Design	Jan-2018	6	Jul-2018
6	Permitting/Approvals	Jul-2018	2	Sep-2018
7	Bidding	Sep-2018	4	Jan-2019
8	Construction/Startup	Jan-2019	12	Jan-2020
9	Project Complete	Jan-2020	-	

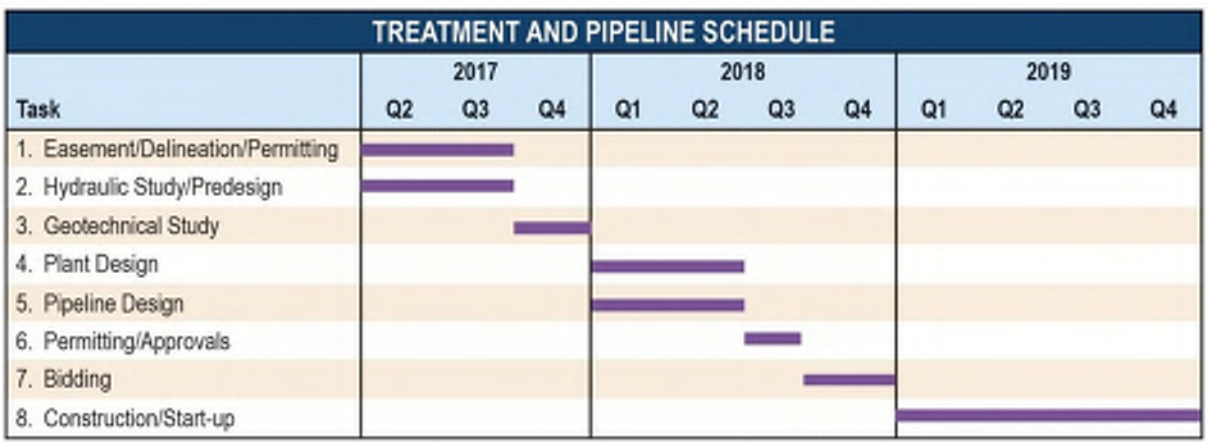


Figure 7.1 Treatment and Pipeline Schedule

7.3.5 Long-Term Planning

The improvements suggested for the 20-year planning period are presented in Table 7.4. They include capital, O&M present worth values, and total 20-year life cycle cost estimates. Should the District combine the C-7 Pipeline project and the reuse filter project, the combined cost may be less due to cost savings realized using a single contractor and design firm. Brine treatment for perchlorate removal would not be required until perchlorate became a regulated contaminate.

Table 7.4 Capital Improvement Plan for 3.7 mgd Flow Wastewater Treatment Plant Facility Plan Magna Water District				
Item	**Description**	**Total Capital Cost**	**O&M Present Worth**	**Total Life-Cycle Cost**
01	C-7 Pipeline	$ 8,647,000	$ 2,541,000	$ 11,188,000
02	Reuse Filter and Pump Station	$ 7,061,000	$ 2,222,000	$ 9,283,000
03	Brine Treatment for Perchlorate	$ 652,000	$ 2,718,000	$ 3,370,000

APPENDIX A – FLOW AND LOADING DATA

Table A.1 2014 Influent Flow Data (mgd), without EDR flow
Wastewater Facility Plan 2016
Magna Water District

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1	2.13	1.65	1.58	2.10	2.17	2.23	2.29	2.21	1.35	2.37	2.24	2.17	2.37
2	2.11	1.67	1.59	2.21	2.11	2.33	2.30	2.17	1.61	2.28	2.44	2.03	2.44
3	2.14	1.79	1.47	2.10	2.21	2.12	2.25	2.19	1.84	2.18	2.13	2.08	2.25
4	2.18	1.56	1.55	2.14	2.24	2.09	2.14	2.18	2.19	2.26	2.09	2.02	2.26
5	2.29	1.61	1.49	1.97	2.22	2.03	2.12	2.26	2.17	2.40	2.04	1.99	2.40
6	2.13	1.52	1.19	2.39	2.21	2.05	2.15	2.24	2.65	2.18	2.01	2.13	2.65
7	2.11	1.47	1.49	2.20	2.33	2.19	2.17	2.23	2.56	2.29	1.95	2.25	2.56
8	2.09	0.85	1.61	2.16	2.47	2.23	2.13	2.23	2.30	2.24	2.09	2.06	2.47
9	2.17	0.88	1.65	2.18	2.21	2.22	2.21	2.28	2.49	2.09	2.27	2.05	2.49
10	2.05	0.58	1.65	2.12	2.31	2.09	2.10	2.19	2.23	2.10	2.21	1.96	2.31
11	2.27	0.45	1.58	2.06	2.33	2.02	2.20	2.25	2.15	2.26	2.12	1.02	2.33
12	2.27	1.13	1.65	2.18	2.28	2.05	2.19	2.21	2.21	2.29	2.06	0.57	2.29
13	2.21	1.61	1.51	2.29	2.22	2.12	2.19	2.22	2.32	2.12	2.07	0.80	2.32
14	2.15	1.51	1.49	2.12	2.27	2.08	2.20	2.28	2.45	2.07	1.99	1.08	2.45
15	2.17	1.13	1.60	2.11	2.25	2.08	2.19	2.29	2.37	2.07	2.21	1.01	2.37
16	2.15	1.17	1.64	2.06	2.24	2.02	2.17	2.36	2.29	2.07	2.29	1.67	2.36
17	2.10	1.23	1.58	2.05	2.29	2.20	2.41	2.44	2.21	2.12	2.16	1.92	2.44
18	2.23	1.22	1.51	2.02	2.34	2.14	2.14	2.35	2.18	2.13	2.05	1.97	2.35
19	2.25	1.27	1.47	2.11	2.20	2.35	2.16	2.27	2.17	2.27	2.05	1.95	2.35
20	2.24	1.28	1.44	2.16	2.13	2.09	2.18	2.25	2.29	2.34	2.05	2.07	2.34
21	2.17	1.35	1.43	2.16	2.20	2.15	2.17	2.21	2.57	2.05	2.02	2.26	2.57
22	2.16	1.58	1.66	2.16	2.14	2.16	2.16	2.36	2.25	2.08	2.27	2.24	2.36
23	2.12	1.68	1.71	2.28	1.93	2.11	2.20	2.37	2.10	2.05	2.31	2.13	2.37
24	2.16	1.51	1.59	2.12	2.31	2.05	2.21	2.39	2.13	2.03	2.07	2.17	2.39
25	2.26	1.51	1.57	2.06	2.32	2.03	2.22	2.40	2.10	2.13	2.03	2.04	2.40
26	2.04	1.41	1.53	2.32	2.27	2.05	2.08	2.34	2.13	2.26	2.10	2.13	2.34
27	1.04	1.42	1.48	2.35	2.24	2.06	2.15	2.31	2.66	2.11	2.29	2.17	2.66
28	1.28	1.36	1.47	2.18	2.18	2.14	2.20	2.26	2.57	2.05	2.03	2.21	2.57
29	0.99	-	1.53	2.15	2.17	2.16	2.28	2.26	2.39	2.03	2.16	2.13	2.39
30	1.49	-	1.86	2.09	2.16	2.33	2.28	2.28	2.28	2.01	2.37	2.07	2.37
31	1.52	-	1.74	-	2.24	-	2.22	2.24	-	2.02	-		2.24
MAX	**2.02**	**1.33**	**1.56**	**2.15**	**2.23**	**2.13**	**2.20**	**2.27**	**2.24**	**2.16**	**2.14**	**1.88**	**2.66**

Table A.2 **2014 Influent Flow Data (mgd), with EDR Flow**
Wastewater Facility Plan 2016
Magna Water District

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1	2.47	1.99	1.92	2.23	2.85	3.22	3.28	3.17	2.88	2.71	2.56	2.43	3.28
2	2.46	2.00	1.94	2.42	2.79	3.33	3.33	3.14	3.15	2.62	2.77	2.27	3.33
3	2.45	2.13	1.79	2.29	2.88	3.11	3.25	3.19	3.55	2.53	2.46	2.41	3.55
4	2.49	1.94	1.69	2.25	2.92	3.13	3.15	3.18	3.18	2.61	2.42	2.35	3.18
5	2.64	1.86	1.62	2.29	2.91	3.01	3.14	3.03	3.15	2.74	2.37	2.32	3.15
6	2.47	1.63	1.54	2.71	2.90	3.01	3.17	2.92	3.25	2.61	2.33	2.46	3.25
7	2.44	1.80	1.83	2.54	2.72	3.15	3.19	2.91	3.16	2.63	2.28	2.58	3.19
8	2.42	1.18	1.96	2.51	2.72	3.18	3.14	2.91	2.88	2.50	2.42	2.40	3.18
9	2.38	1.23	1.99	2.52	2.53	3.23	3.23	2.97	3.07	2.43	2.60	2.24	3.23
10	2.27	0.92	1.81	2.45	2.63	3.09	3.09	3.10	2.59	2.44	2.56	2.09	3.10
11	2.60	0.68	1.77	2.39	2.65	3.05	3.18	3.25	2.70	2.61	2.48	1.24	3.25
12	2.59	1.14	2.04	2.52	2.60	3.08	3.17	3.12	2.86	2.72	2.40	0.90	3.17
13	2.55	1.90	1.86	2.63	2.57	3.16	3.17	3.00	2.98	2.46	2.32	1.13	3.17
14	2.49	1.84	1.85	2.47	2.59	3.12	3.18	2.94	3.11	2.42	2.01	1.41	3.18
15	2.51	1.46	1.65	2.46	2.79	3.12	3.14	2.95	3.03	2.41	2.54	1.34	3.14
16	2.48	1.50	1.84	2.40	2.90	3.06	3.14	2.97	2.90	2.42	2.62	1.80	3.14
17	2.43	1.56	1.94	2.39	2.95	3.04	3.17	2.91	2.89	2.45	2.48	2.05	3.17
18	2.55	1.56	1.74	2.36	3.00	2.49	3.13	2.78	2.86	2.46	2.38	2.30	3.13
19	2.58	1.52	1.58	2.65	2.86	2.71	3.14	2.65	2.87	2.55	2.38	2.27	3.14
20	2.57	1.40	1.78	2.85	2.80	3.06	3.17	2.63	3.00	2.61	2.39	2.40	3.17
21	2.50	1.65	1.77	2.86	2.85	3.12	3.16	2.68	3.13	2.40	2.34	2.58	3.16
22	2.48	1.88	2.01	2.86	2.91	3.12	3.15	3.01	2.61	2.40	2.60	2.57	3.15
23	2.46	1.80	2.06	2.84	2.93	3.11	3.19	3.02	2.50	2.40	2.64	2.37	3.19
24	2.50	1.65	1.94	2.45	3.15	3.02	3.22	3.03	2.72	2.36	2.41	2.42	3.22
25	2.60	1.83	1.86	2.39	3.04	3.02	3.23	3.06	2.74	2.46	2.38	2.37	3.23
26	2.38	1.75	1.65	2.65	2.99	3.01	3.08	3.01	2.68	2.59	2.43	2.45	3.08
27	1.39	1.67	1.83	2.68	3.24	3.02	3.15	2.95	2.99	2.45	2.62	2.50	3.24
28	1.62	1.47	1.81	2.53	3.17	3.09	3.18	2.91	2.90	2.45	2.36	2.54	3.18
29	1.23	-	1.87	2.48	3.16	3.13	3.06	2.91	2.77	2.36	2.49	2.35	3.16
30	1.63	-	1.98	2.66	3.15	3.31	3.04	2.93	2.62	2.34	2.70	2.18	3.31
31	1.85	-	2.07	-	3.18	-	2.98	2.87	-	2.33	-	0.06	3.18
MAX	**2.34**	**1.60**	**1.84**	**2.52**	**2.88**	**3.08**	**3.16**	**2.97**	**2.92**	**2.50**	**2.46**	**2.09**	**3.55**

Table A.3 **2014 Influent BOD_5 Data (mg/L)**
Wastewater Facility Plan 2016
Magna Water District

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1	-	-	-	104	107	-	69	-	-	-	-	103	107
2	122	-	-	-	-	-	-	-	71	106	-	131	131
3	-	-	-	111	-	114	71	-	-	-	-	-	114
4	-	138	107	-	-	-	-	-	74	-	112	-	138
5	-	-	-	-	-	136	-	97	-	-	-	-	136
6	-	163	146	-	72	-	-	-	-	-	100	-	163
7	99	-	-	-	132	-	-	85	-	136	-	-	136
8	-	-	-	103	-	-	-	-	-	-	-	140	140
9	104	-	-	-	-	-	-	-	87	104	-	152	152
10	-	-	-	127	-	104	82	-	-	-	-	-	127
11	-	62	137	-	-	-	-	-	107	-	198	-	198
12	-	-	-	-	-	81	-	104	-	-	-	-	104
13	-	216	129	-	112	-	-	-	-	-	97	-	216
14	107	-	-	-	-	-	99	110	-	114	-	-	114
15	-	-	-	125	110	-	70	-	-	-	-	-	125
16	145	-	-	-	-	-	-	-	139	107	-	155	155
17	-	-	-	153	-	65	-	-	-	-	-	-	153
18	-	196	105	-	-		-	-	91	-	102	137	196
19	-	-	-	-	-	77	-	130	-	-	-	-	130
20	-	129	153	-	53	-	-	-	-	-	121	123	153
21	194	-	-	-	-	-	-	100	-	122	-	-	194
22	-	-	-	86	86	-	87	-	-	-	-	126	126
23	114	-	-	-	-	-	-	-	116	107	-	104	116
24	-	-	-	107	-	60	80	-	-	-	124	-	124
25	-	105	82	-	-	-	-	-	99	-	127	-	127
26	-	-	-	-	-	57	-	84	-	-	-	-	84
27	-	105	100	-	98	-	-	-	-	-	-	-	105
28	147	-	-	-	-	-	72	97	-	153	-	-	153
29	-	-	-	107	94	-	95	-	-	-	-	128	128
30	115	-	-	-	-	-	-	-	84	124	-	-	124
31	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX	**127**	**139**	**120**	**114**	**96**	**87**	**81**	**101**	**96**	**119**	**123**	**130**	**216**

Table A.4 2014 Influent Total Suspended Solids (TSS) Data (mg/L)
Wastewater Facility Plan 2016
Magna Water District

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1	-	-	-	80	66	-	68	-	-	-	-	40	80
2	50	-	-	-	-	-	-	-	44	238	-	86	238
3	-	-	-	76	-	274	50	-	-	-	-	-	274
4	-	374	70	-	-	-	-	-	57	-	280	-	374
5	-	-	-	-	-	136	-	170	-	-	-	-	170
6	-	134	80	-	92	-	-	-	-	-	50	-	134
7	62	-	-	-	120	-	-	230	-	166	-	-	230
8	-	-	-	48	-	-	-	-	-	-	-	71	71
9	46	-	-	-	-	-	-	-	33	35	-	112	112
10	-	-	-	126	-	84	74	-	-	-	-	-	126
11	-	44	78	-	-	-	-	-	44	-	484	-	484
12	-	-	-	-	-	82	-	232	-	-	-	-	232
13	-	168	122	-	98	-	-	-	-	-	53	-	168
14	42	-	-	-	-	-	156	106	-	49	-	-	156
15	-	-	-	124	110	-	56	-	-	-	-	-	124
16	98	-	-	-	-	-	-	-	116	56	-	73	116
17	-	-	-	162	-	34	-	-	-	-	-	-	162
18	-	164	94		-	-	-	-	118	-	47	372	372
19	-	-	-	-	-	44	-	312	-	-	-	-	312
20	-	74	112	-	248	-	-	-	-	-	52	116	248
21	200	-	-	-	-	-	-	126	-	55	-	-	200
22	-	-	-	76	72	-	90	-	-	-	-	108	108
23	54	-	-	-	-	-	-	-	434	67	-	46	434
24	-	-	-	76	-	54	90	-	-	-	40	-	90
25	-	54	74	-	-	-	-	-	54	-	48	-	74
26	-	-	-	-	-	44	-	62	-	-	-	-	62
27	-	68	37	-	78	-	-	-	-	-	-	-	78
28	110	-	-	-	-	-	60	54	-	516	-	-	516
29	-	-	-	66	112	-	82	-	-	-	-	54	112
30	60	-	-	-	-	-	-	-	47	92	-	-	92
31	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX	**80**	**135**	**83**	**93**	**111**	**94**	**81**	**162**	**105**	**142**	**132**	**108**	**516**

Table A.5 2014 Influent Ammonia (NH_3) Data (mg/L)
Wastewater Facility Plan 2016
Magna Water District

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1	-	-	-	21	25	-	16	-	-	-	-	24	25
2	28	-	-	-	-	-	-	-	19	20	-	27	28
3	-	-	-	23	-	15	16	-	-	-	-	-	23
4	-	24	22	-	-	-	-	-	16	-	24	-	24
5	-	-	-	-	-	18	-	16	-	-	-	-	18
6	-	23	27	-	19	-	-	-	-	-	23	-	27
7	29	-	-	-	23	-	-	20	-	34	-	-	34
8	-	-	-	23	-	-	-	-	-	-	-	23	23
9	29	-	-	-	-	-	-	-	19	24	-	23	29
10	-	-	-	25	-	16	17	-	-	-	-	-	25
11	-	17	26	-	-	-	-	-	25	-	30	-	30
12	-	-	-	-	-	17	-	14	-	-	-	-	17
13	-	29	22	-	24	-	-	-	-	-	24	-	29
14	27	-	-	-	-	-	19	17	-	24	-	-	27
15	-	-	-	24	23	-	17	-	-	-	-	-	24
16	25	-	-	-	-	-	-	-	19	20	-	20	25
17	-	-	-	31	-	17	-	-	-	-	-	-	31
18	-	18	23	-	-	-	-	-	24	-	23	26	26
19	-	-	-	-	-	21	-	13	-	-	-	-	21
20	-	24	28	-	19	-	-	-	-	-	25	27	28
21	23	-	-	-	-	-	-	20	-	24	-	-	24
22	-	-	-	20	19	-	16	-	-	-	-	26	26
23	26	-	-	-	-	-	-	-	29	20	-	23	29
24	-	-	-	19	-	16	15	-	-	-	26	-	26
25	-	25	17	-	-	-	-	-	22	-	26	-	26
26	-	-	-	-	-	17	-	18	-	-	-	-	18
27	-	23	21	-	18	-	-	-	-	-	-	-	23
28	16	-	-	-	-	-	16	18	-	25	-	-	25
29	-	-	-	23	18	-	16	-	-	-	-	25	25
30	26	-	-	-	-	-	-	-	20	23	-	-	26
31	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX	**26**	**23**	**23**	**23**	**21**	**17**	**16**	**17**	**22**	**24**	**25**	**24**	**34**

Table A.6 2014 Influent Total Phosphorus (TP) Data (mg/L)
Wastewater Facility Plan 2016
Magna Water District

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1	-	-	-	4	4	-	3	-	-	-	-	4	4
2	4	-	-	-	-	-	-	-	3	4	-	5	5
3	-	-	-	4	-	3	3	-	-	-	-	-	4
4	-	4	4	-	-	-	-	-	3	-	4	-	4
5	-	-	-	-	-	3	-	5	-	-	-	-	5
6	-	4	5	-	3	-	-	-	-	-	4	-	5
7	4	-	-	-	4	-	-	4	-	6	-	-	6
8	-	-	-	3	-	-	-	-	-	-	-	4	4
9	4	-	-	-	-	-	-	-	3	4	-	5	5
10	-	-	-	4	-	3	3	-	-	-	-	-	4
11	-	2	6	-	-	-	-	-	4	-	6	-	6
12	-	-	-	-	-	3	-	3	-	-	-	-	3
13	-	5	5	-	4	-	-	-	-	-	4	-	5
14	4	-	-	-	-	-	4	4	-	4	-	-	4
15	-	-	-	5	5	-	3	-	-	-	-	-	5
16	4	-	-	-	-	-	-	-	3	4	-	4	4
17	-	-	-	6	-	3	-	-	-	-	-	-	6
18	-	4	5	-	-	-	-	-	4	-	4	4	5
19	-	-	-	-	-	4	-	6	-	-	-	-	6
20	-	4	6	-	4	-	-	-	-	-	4	4	6
21	6	-	-	-	-	-	-	4	-	4	-	-	6
22	-	-	-	3	3	-	3	-	-	-	-	4	4
23	4	-	-	-	-	-	-	-	5	3	-	4	5
24	-	-	-	3	-	3	3	-	-	-	4	-	4
25	-	4	4	-	-	-	-	-	4	-	4	-	4
26	-	-	-	-	-	3	-	9	-	-	-	-	9
27	-	4	17	-	3	-	-	-	-	-	-	-	17
28	3	-	-	-	-	-	3	3	-	5	-	-	5
29	-	-	-	3	3	-	3	-	-	-	-	4	4
30	3	-	-	-	-	-	-	-	3	4	-	-	4
31	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX	**4**	**4**	**6**	**4**	**4**	**3**	**3**	**5**	**4**	**4**	**4**	**4**	**17**

APPENDIX B – HYDRAULIC AND TREATMENT CAPACITY EVALUATION

Table B.1 Hydraulic and Treatment Capacity Evaluation
Wastewater Facility Plan 2016
Magna Water District

PROCESS	HYDRAULIC OR TREATMENT CRITERIA	DESIGN CAPACITY	NEEDED CAPACITY: 2015 CURRENT DESIGN	NEEDED CAPACITY: 2035 DESIGN MAGNA WD ONLY	NEEDED CAPACITY: 2035 DESIGN MWD + PRISON + NW CORR.
East Influent Lift Station	PHF (MGD), (2+1)	3.7	4.6	5.9	8.9
East + West Lift Station	PHF (MGD), (5+1)	12.0	4.6	5.9	8.9
Oxidation Ditch	Aeration (LB O_2/DAY)				
	BOD_5 at MMDF	7,680	2,800	3,600	6,300
	NH_3 and BOD_5 (MMDF)	7,680	5,400	6,900	12,100
	HRT > 24 hours (MMDF)	24	35.5	27.7	18.3
Clarifiers	Overflow Rate < 400 gal/ft^2-d at AADF	400	260	334	504
	Solids Loading Rate < 24 lb/ft^2/day at AADF	24	17.4	22.3	33.6
Chlorination	Req'd Basin Volume 60 min. at AADF (GAL)	140,000	96,000	123,000	185,000
	30 min at MMDF (GAL)	140,000	60,000	77,000	116,000
RAS Pumps	MMDF (MGD)	5.0	2.3	3.0	4.5
WAS Pumps	WAS Flow at MMDF (MGD)	0.5	0.07	0.09	0.13
Screw Press	Loading Rate < 600 lb/hour at AADF	600	95	120	185

APPENDIX C – C7 PRE-DESIGN STUDY

3341 South 4000 West
West Valley City, Utah 84120

MEMO

To: Terry Pollock, General Manager

From: Trevor Andra, P.E.

Cc: Don Olsen, P.E., Epic Engineering

Date: 06/15/2016

Re: WWTP Outfall Bypass Pipeline – Alternative Comparison Summary Memo

Two alternative alignments were evaluated for changing the receiving water of treated wastewater effluent produced by Magna Water District's Wastewater Treatment Plant (WWTP). The attached alignment show a new outfall pipeline that would change the point of discharge from Kersey Creek to the C-7 Ditch to the west of the WWTP. This memo includes a comparison between the two alignments with respect to pipe size and slope, easement requirements, and cost estimate.

FLOW ANALYSIS

We have performed an analysis for both alternatives and have recommended that the pipe size for each alignment be 42" RCP. The total length and slopes of the two alternatives differ along with estimated water surface elevation in the C-7 Ditch as shown in the table below.

Table 1: Hydraulic Design

Alternative Alignment	1	2
Length of pipe (ft)	2,830	3,660
Slope	0.05%	0.068%
Water Surface Elevation (ft)	4219.60	4218.50

COST ANALYSIS

Cost estimates for each alignment have been completed including pipe cost, construction material cost, easement cost along with contingencies and engineering and legal. Table 2 shows the total cost of each alignment.

Table 2: Cost Estimate

Alignment	Estimated Cost
1	$927,000.00
2	$1,229,000.00
Difference	**$302,000.00**

As shown in Table 2, Alignment 2 or the more northern alignment has an added cost of $302,000. The difference in cost between the two alignments is primarily from the additional length of 42" pipe, added construction costs for the length and additional easements required.

It is recommended that a 30-ft utility easement(s) be obtained for the proposed alignments through the KUC properties. Table 3 shows the required acreage of easement and pipe length for each alignment.

Table 3: Required Easements and Pipe Lengths

Alignment	1	2	Addition for Alignment 2
Easement Required (Acre)	0.67	1.5	**0.83**
Pipe Length (ft)	2830	3660	**830**

In analyzing both alignment we recommend that the District pursue Alignment 1. Alignment has a more direct route to the C-7 Ditch, is more economical and requires less easement acquisition.

Note that these cost does not include the required permitting and paperwork for changing the receiving water source, administration cost for easement recording or the cost for any other applicable permits. Appendix A includes the line item cost estimate for each alignment.

ATT: Appendix

- *App A: Cost Estimate*
- *App B: Plan and Profile Drawings*

APPENDIX A

COST ESTIMATE

MAGNA WATER DISTRICT
WWTP Outfall Bypass Pipeline - Preliminary Cost Estimate

Prepared By: Epic Engineering, P.C. as of 1/18/2016

Alignment Alternative 1 with Flow at PDF of 13.22 MGD							
Item	**Material**	**Quantity**	**Unit**	**Unit Cost**		**Total**	
1	Mobilization	1	LS	$	30,000.00	$	30,000.00
2	Traffic Control	1	LS	$	3,000.00	$	3,000.00
3	42" RCP Pipe w/ Installation	2830	LF	$	165.00	$	466,950.00
4	Fabricated Overflow Weir	1	LS	$	2,500.00	$	2,500.00
5	New Outlet Box	1	LS	$	20,000.00	$	20,000.00
6	Outfall Structure at C-7 Ditch	1	LS	$	28,000.00	$	28,000.00
7	72" Manhole (400-ft Spacing)	8	EA	$	9,500.00	$	76,000.00
8	Asphalt Replacement	1	LS	$	2,500.00	$	2,500.00
9	A1a Import Fill Material	615	TN	$	15.00	$	9,225.00
10	Easement Acquisition (30-ft Easement)	0.67	ACRE	$	50,000.00	$	33,402.20
	Subtotal					**$**	**671,577.20**
	Contigency - 20%					$	134,315.44
	Engineering and Legal - 15%					$	120,883.90
	Total Cost					**$**	**926,776.54**
	Rounded Total					**$**	**927,000.00**

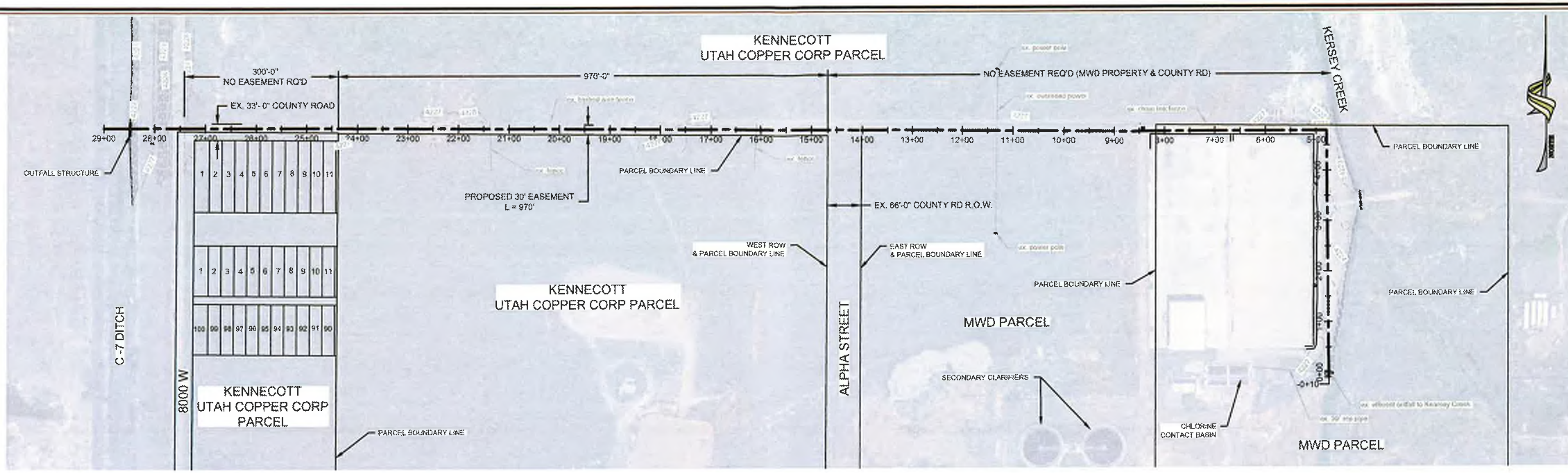
MAGNA WATER DISTRICT
WWTP Outfall Bypass Pipeline - Preliminary Cost Estimate

Prepared By: Epic Engineering, P.C. as of 6/15/2016

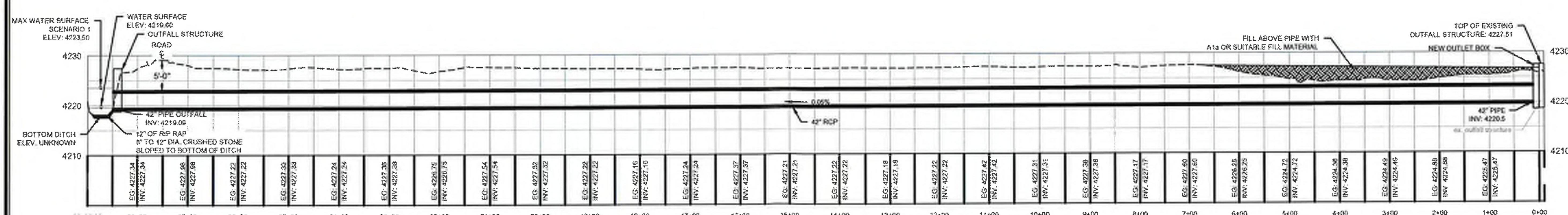
Alignment Alternative 2 with Flow at PDF of 13.22 MGD					
Item	**Material**	**Quantity**	**Unit**	**Unit Cost**	**Total**
1	Mobilization	1	LS	$ 42,421.11	$ 42,421.11
2	Traffic Control	1	LS	$ 3,000.00	$ 3,000.00
3	42" RCP Pipe w/ Installation	3660	LF	$ 165.00	$ 603,900.00
4	Fabricated Overflow Weir	1	LS	$ 2,500.00	$ 2,500.00
5	New Outlet Box	1	LS	$ 20,000.00	$ 20,000.00
6	Outfall Structure at C-7 Ditch	1	LS	$ 28,000.00	$ 28,000.00
7	72" Manhole (400-ft Spacing)	11	EA	$ 9,500.00	$ 104,500.00
8	Asphalt Replacement	1	LS	$ 2,500.00	$ 2,500.00
9	A1a Import Fill Material	590	TN	$ 15.00	$ 8,850.00
10	Easement Acquisition (30-ft Easement)	1.50	ACRE	$ 50,000.00	$ 75,172.18
				Subtotal	**$ 890,843.29**
				Contigency - 20%	$ 178,168.66
				Engineering and Legal - 15%	$ 160,351.79
				Total Cost	**$ 1,229,363.73**
				Rounded Total	**$ 1,229,000.00**

<u>APPENDIX B</u>

PLAN AND PROFILE DRAWINGS



A PLAN



B PROFILE

DRAFT
NOT FOR CONSTRUCTION

epic ENGINEERING
3341 SOUTH 4000 WEST
WEST VALLEY CITY, UTAH 84120
(801) 955-5605
50 EAST 100 SOUTH
HEBER CITY, UTAH 84032
(435) 654-6600

REVISION			
NO	DATE	REV. BY	ISSUE

MAGNA WATER DISTRICT
2711 SOUTH 8600 WEST
P.O. BOX 303
MAGNA, UTAH 84044-0303
(801) 250-2118

PROJECT NAME
WWTP OUTFALL BYPASS PIPELINE PRELIMINARY DESIGN

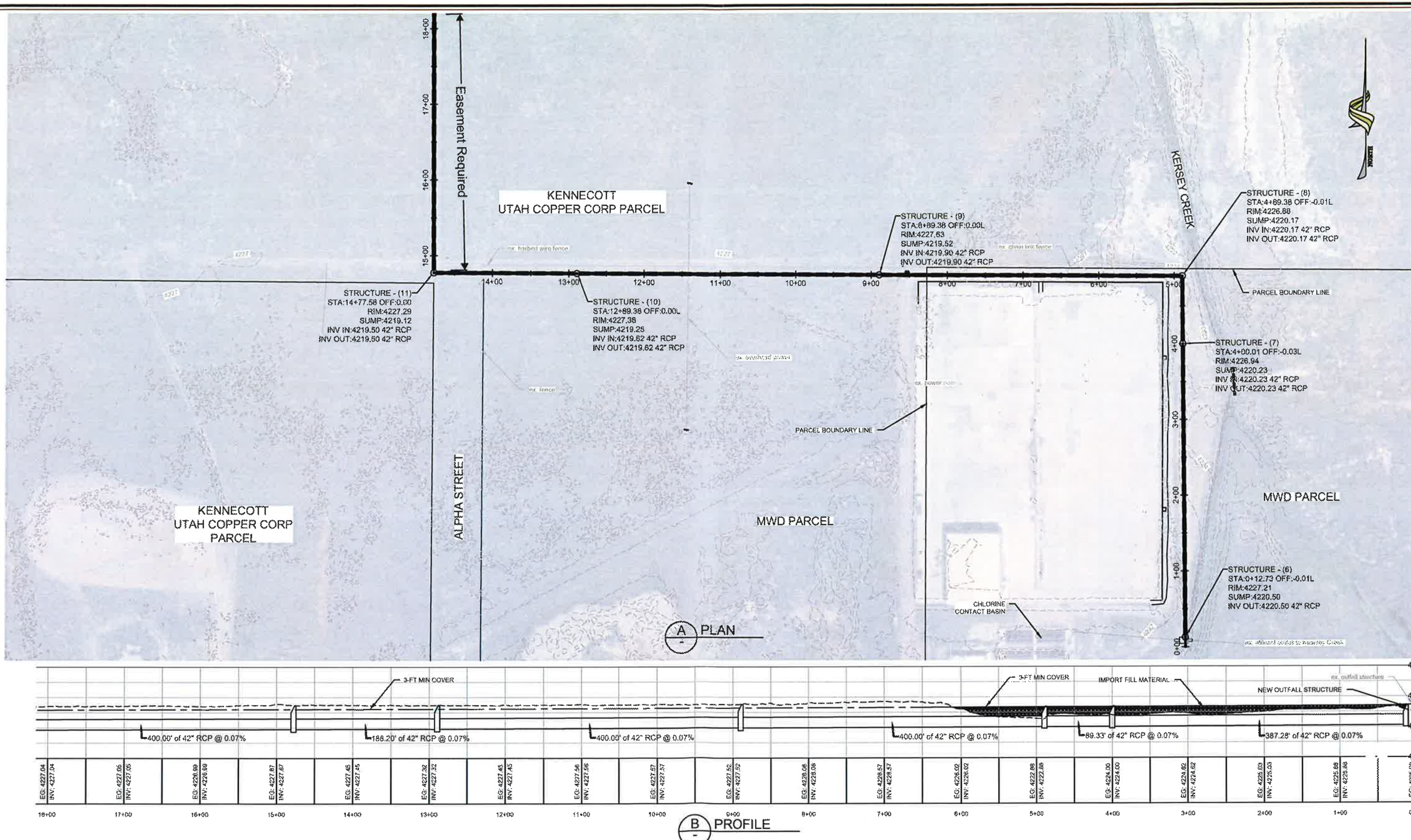
PROJECT LOCATION
MAGNA, UTAH

SCALES
11"x17": V: 1" = 40' H: 1" = 200'
24"x36": V: 1" = 20' H: 1" = 100'

DRAWN: WM
DESIGNER: TLA
REVIEWED: KDC
PROJECT # 15-MW-232
DATE: SEP 2015

SHEET TITLE
PROPOSED ALIGNMENT

DWG.
PP.01
1 OF 3



DRAFT
NOT FOR CONSTRUCTION

epic ENGINEERING

3341 SOUTH 4000 WEST
WEST VALLEY CITY, UTAH 84120
(801) 955-5605

50 EAST 100 SOUTH
HEBER CITY, UTAH 84032
(435) 654-6600

REVISION			
NO	DATE	REV. BY	ISSUE

MAGNA WATER DISTRICT
2711 SOUTH 8600 WEST
P.O. BOX 303
MAGNA, UTAH 84044-0303
(801) 250-2118

PROJECT NAME: WWTP OUTFALL BYPASS PIPELINE PRELIMINARY DESIGN

PROJECT LOCATION: MAGNA, UTAH

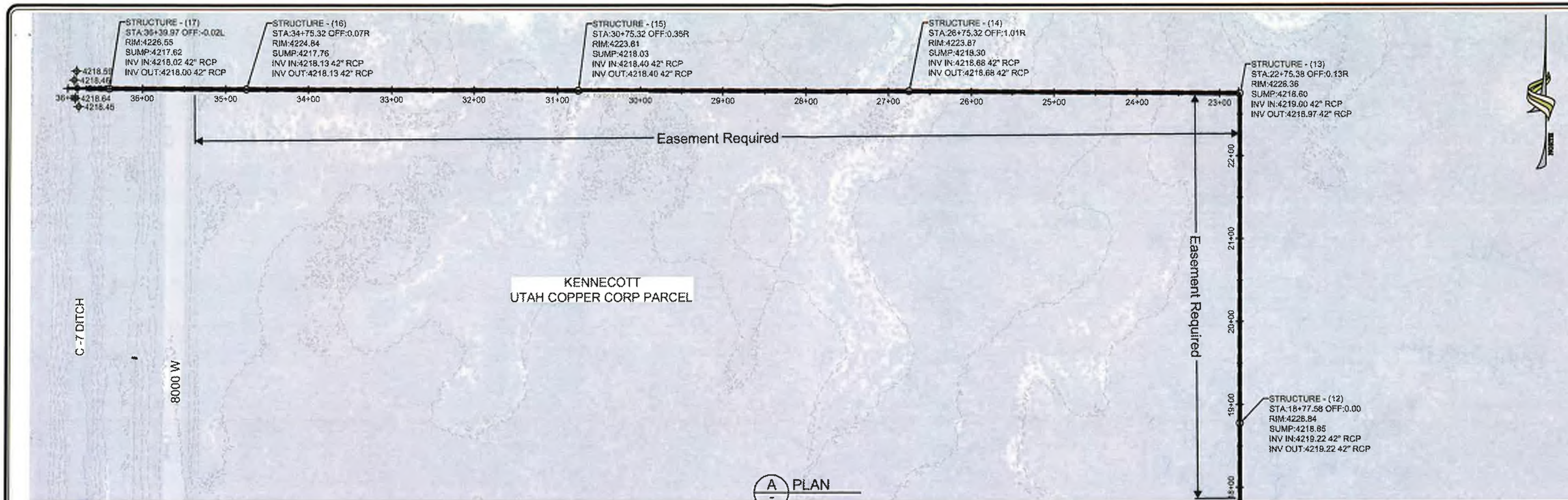
SCALES: 11"x17": V: 1" = 20' H: 1" = 120'; 24"x36": V: 1" = 10' H: 1" = 60'

SHEET TITLE: PROPOSED NORTHERN ALIGNMENT

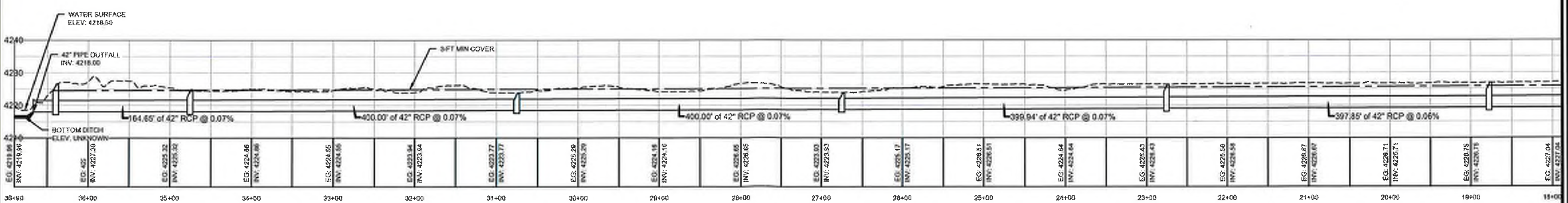
DRAWN: WM
DESIGNER: TLA
REVIEWED: KDC

PROJECT #: 15-MW-232
DATE: SEP 2015

DWG: PP.01
1 OF 2



A PLAN



B PROFILE

DRAFT
NOT FOR CONSTRUCTION

epic ENGINEERING
3341 SOUTH 4000 WEST
WEST VALLEY CITY, UTAH 84120
(801) 955-5605
50 EAST 100 SOUTH
HEBER CITY, UTAH 84032
(435) 654-6600

REVISION			
NO	DATE	REV. BY	ISSUE

MAGNA WATER DISTRICT
2711 SOUTH 8600 WEST
P.O. BOX 303
MAGNA, UTAH 84044-0303
(801) 250-2118

PROJECT NAME
WWTP OUTFALL BYPASS PIPELINE PRELIMINARY DESIGN

PROJECT LOCATION
MAGNA, UTAH

SCALES
11"x17": V: 1" = 20' H: 1" = 120'
24"x36": V: 1" = 10' H: 1" = 60'

DRAWN: WM
DESIGNER: TLA
REVIEWED: KDC
PROJECT # 15-MW-232
DATE: SEP 2015

SHEET TITLE
PROPOSED NORTHERN ALIGNMENT

DWG
PP.02
2 of 2

APPENDIX D – DETAILED COST ESTIMATES

Project	Magna WWTP Facilities Plan				
Client	Magna Water District				
Location	Magna, UT				

Capital Cost Estimate for Pipeline to C-7, 3.7 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Eight 60 hp Triton Mixers w/ blowers	**1**	**LS**	$ 998,000	$ 998,000
02	Chemical Feed Building, 25' x 35'	**1**	**LS**	$ 235,000	$ 235,000
03	Electrical Building, 25' x 35'	**1**	**LS**	$ 185,000	$ 185,000
04	Common Improvements (excluding optional)	**1**	**LS**	$ 1,810,000	$ 1,810,000
	SubTotal				*$ 3,228,000*
05	Electric and I&C			25.0%	$ 807,000
06	Site Work				$ 250,000
	SubTotal				*$ 4,285,000*
07	Contingency			30.0%	$ 1,286,000
	Direct Cost Subtotal				*$ 5,571,000*
08	General Contractor OH&P			15.0%	$ 836,000
09	Engineering			16.0%	$ 891,000
	Indirect Cost Subtotal				*$ 1,727,000*
	Epic Pipeline Cost				
10	42" Pipeline, Installed with inlet/outfall	**1**	**LS**	$ 1,229,000	$ 1,229,000
	Total Project Cost				***$ 8,527,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

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Project	Magna WWTP Facilities Plan
Client	Magna Water District
Location	Magna, UT

Capital Cost Estimate for Pipeline to C-7, 5.8 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Twelve 60 hp Triton Mixers w/ blowers	**1**	**LS**	$ 1,397,000	$ 1,397,000
02	Chemical Feed Building, 25' x 35'	**1**	**LS**	$ 235,000	$ 235,000
03	Electrical Building, 25' x 35'	**1**	**LS**	$ 185,000	$ 185,000
04	Common Improvements (excluding optional)	**1**	**LS**	$ 1,810,000	$ 1,810,000
	SubTotal				*$ 3,627,000*
05	Electric and I&C			25.0%	$ 907,000
06	Site Work			8.0%	$ 291,000
	SubTotal				*$ 4,825,000*
07	Contingency			30.0%	$ 1,448,000
	Direct Cost Subtotal				*$ 6,273,000*
08	General Contractor OH&P			15.0%	$ 941,000
09	Engineering			16.0%	$ 1,004,000
	Indirect Cost Subtotal				*$ 1,945,000*
	Epic Pipeline Cost				
10	42" Pipeline, Installed with inlet/outfall	**1**	**LS**	$ 1,229,000	$ 1,229,000
	Total Project Cost				***$ 9,447,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

Project	Magna WWTP Facilities Plan
Client	Magna Water District
Location	Magna, UT

Capital Cost Estimate for Nitrification upgrade, 3.7 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Eight 60 hp Triton Mixers w/ blowers	**1**	**LS**	$ 998,000	$ 998,000
02	UV system for 3.7 mgd	**1**	**LS**	$ 850,000	$ 850,000
03	Chemical Feed Building, 25' x 35'	**1**	**LS**	$ 235,000	$ 235,000
04	Electrical Building, 25' x 35'	**1**	**LS**	$ 185,000	$ 185,000
05	Common Improvements (excluding optional)	**1**	**LS**	$ 1,810,000	$ 1,810,000
	SubTotal				*$ 4,078,000*
06	Electric and I&C			25.0%	$ 1,020,000
07	Site Work				$ 318,000
	SubTotal				*$ 5,416,000*
08	Contingency			30.0%	$ 1,625,000
	Direct Cost Subtotal				*$ 7,041,000*
09	General Contractor OH&P			15.0%	$ 1,056,000
10	Engineering			16.0%	$ 1,127,000
	Indirect Cost Subtotal				*$ 2,183,000*
	Total Project Cost				***$ 9,224,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

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Project	Magna WWTP Facilities Plan				
Client	Magna Water District				
Location	Magna, UT				

Capital Cost Estimate for Nitrification upgrade, 5.8 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Twelve 60 hp Triton Mixers w/ blowers	**1**	**LS**	$ 1,397,000	$ 1,397,000
02	UV system for 5.6 mgd	**1**	**LS**	$ 1,050,000	$ 1,050,000
03	Chemical Feed Building, 25' x 35'	**1**	**LS**	$ 235,000	$ 235,000
04	Electrical Building, 25' x 35'	**1**	**LS**	$ 185,000	$ 185,000
05	Common Improvements (excluding optional)	**1**	**LS**	$ 1,810,000	$ 1,810,000
	SubTotal				*$ 4,677,000*
06	Electric and I&C			25.0%	$ 1,170,000
07	Site Work			8.0%	$ 375,000
	SubTotal				*$ 6,222,000*
08	Contingency			30.0%	$ 1,867,000
	Direct Cost Subtotal				*$ 8,089,000*
09	General Contractor OH&P			15.0%	$ 1,214,000
10	Engineering			16.0%	$ 1,295,000
	Indirect Cost Subtotal				*$ 2,509,000*
	Total Project Cost				***$ 10,598,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

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Project	Magna WWTP Facilities Plan				
Client	Magna Water District				
Location	Magna, UT				

Capital Cost Estimate for Biological Nutrient Removal, 3.7 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Anaerobic Basin, 3.7 mgd	**1**	**LS**	$ 440,000	$ 440,000
02	Anoxic Basin, 3.7 mgd	**1**	**LS**	$ 560,000	$ 560,000
03	RAS Pipeline	**800**	**LF**	$ 100	$ 80,000
04	Influent Pump Upsize	**3**	**EA**	$ 50,000	$ 150,000
05	Nitrate Recycle Pipeline, Pumps and Building	**1**	**LS**	$ 400,000	$ 400,000
06	Eight 60 hp Triton Mixers w/ blowers	**1**	**LS**	$ 998,000	$ 998,000
07	UV system for 3.7 mgd	**1**	**LS**	$ 850,000	$ 850,000
08	Chemical Feed Building, 25' x 35'	**1**	**LS**	$ 235,000	$ 235,000
09	Electrical Building, 25' x 35'	**1**	**LS**	$ 185,000	$ 185,000
10	Common Improvements (excluding optional)	**1**	**LS**	$ 1,810,000	$ 1,810,000
	SubTotal				*$ 5,708,000*
11	Electric and I&C			25.0%	$ 1,427,000
12	Site Work				$ 449,000
	SubTotal				*$ 7,584,000*
13	Contingency			30.0%	$ 2,275,000
	Direct Cost Subtotal				*$ 9,859,000*
14	General Contractor OH&P			15.0%	$ 1,479,000
15	Engineering			16.0%	$ 1,578,000
	Indirect Cost Subtotal				*$ 3,057,000*
	Total Project Cost				***$ 12,916,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

Project Magna WWTP Facilities Plan
Client Magna Water District
Location Magna, UT

Capital Cost Estimate for Biological Nutrient Removal, 5.8 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Anaerobic Basin, 5.6 mgd	**1**	**LS**	$ 560,000	$ 560,000
02	Anoxic Basin, 5.6 mgd	**1**	**LS**	$ 690,000	$ 690,000
03	RAS Pipeline	**800**	**LF**	$ 100	$ 80,000
04	Influent Pump Upsize	**3**	**EA**	$ 50,000	$ 150,000
05	Nitrate Recycle Pipeline, Pumps and Building	**1**	**LS**	$ 400,000	$ 400,000
06	Twelve 60 hp Triton Mixers w/ blowers	**1**	**LS**	$ 1,397,000	$ 1,397,000
07	UV system for 5.6 mgd	**1**	**LS**	$ 1,050,000	$ 1,050,000
08	Chemical Feed Building, 25' x 35'	**1**	**LS**	$ 235,000	$ 235,000
09	Electrical Building, 25' x 35'	**1**	**LS**	$ 185,000	$ 185,000
10	Common Improvements (excluding optional)	**1**	**LS**	$ 1,810,000	$ 1,810,000
	SubTotal				*$ 6,557,000*
11	Electric and I&C			25.0%	$ 1,640,000
12	Site Work			8.0%	$ 525,000
	SubTotal				*$ 8,722,000*
13	Contingency			30.0%	$ 2,617,000
	Direct Cost Subtotal				*$ 11,339,000*
14	General Contractor OH&P			15.0%	$ 1,701,000
15	Engineering			16.0%	$ 1,815,000
	Indirect Cost Subtotal				*$ 3,516,000*
	Total Project Cost				***$ 14,855,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

Engineers...Working Wonders With Water™

Project	Magna WWTP Facilities Plan
Client	Magna Water District
Location	Magna, UT

Capital Cost Estimate for Reuse Filters and Pump Station, 3.7 mgd

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Filter Building, 75'X48' with sand filters	**1**	**LS**	$ 2,440,000	$ 2,440,000
02	Reuse Pump Building, 28'X38'	**1**	**LS**	$ 375,000	$ 375,000
03	1,300 gpm, 350' TDH, 150 hp pump + VFD	**3**	**EA**	$ 112,000	$ 336,000
	SubTotal				*$ 3,151,000*
04	Electric and I&C			25.0%	$ 788,000
05	Site Work				$ 207,000
	SubTotal				*$ 4,146,000*
06	Contingency			30.0%	$ 1,244,000
	Direct Cost Subtotal				*$ 5,390,000*
07	General Contractor OH&P			15.0%	$ 809,000
08	Engineering			16.0%	$ 862,000
	Indirect Cost Subtotal				*$ 1,671,000*
	Total Project Cost				***$ 7,061,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

Project Magna WWTP Facilities Plan
Client Magna Water District
Location Magna, UT

Capital Cost Estimate for Brine Treatment

No.	Description	Qty	Unit	Unit Cost	Subtotal
01	Brine Chemical Building, 23'X39'	**1**	**LS**	$ 215,280	$ 216,000
02	HDPE Tanks, 5,000 gal.	**2**	**EA**	$ 5,000	$ 10,000
03	Chemical Metering Pumps	**2**	**EA**	$ 12,000	$ 24,000
04	Transfer Pump	**1**	**EA**	$ 6,000	$ 6,000
05	Static Mixer	**1**	**EA**	$ 10,000	$ 10,000
06	Piping	**1**	**EA**	$ 10,000	$ 10,000
	SubTotal				*$ 276,000*
07	Electric and I&C			25.0%	$ 69,000
08	Site Work			8.0%	$ 23,000
09	*SubTotal*				*$ 368,000*
10	Contingency			35.0%	$ 129,000
11	*Direct Cost Subtotal*				*$ 497,000*
12	General Contractor OH&P			15.0%	$ 75,000
13	Engineering			16.0%	$ 80,000
14	*Indirect Cost Subtotal*				*$ 155,000*
	Total Project Cost				***$ 652,000***

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown

APPENDIX E – DWQ CORRESPONDENCE

Utah Division of Water Quality
Addendum to Statement of Basis
Wasteload Analysis and Antidegradation Level I Review
PRELIMINARY – Discharge to C-7 Ditch

Date: **September 30, 2016**

Facility: **Magna Wastewater Treatment Plant**
UPDES No. UT0021440

Receiving water: **C-7 Ditch**

This addendum summarizes the wasteload analysis that was performed to determine water quality based effluent limits (WQBEL) for this discharge. Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses (UAC R317-2-8). Projected concentrations are compared to numeric water quality standards to determine acceptability. The numeric criteria in this wasteload analysis may be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

<u>Discharge</u>
Outfall 001: C-7 Ditch → Lee Creek → Great Salt Lake
The maximum design flow for the discharge is 4.0 MGD average monthly and 8.0 MGD maximum daily, as provided by the treatment plant.

This wasteload allocation is for the proposed effluent pipeline alignment as shown in Figure 1. The 42-inch diameter reinforced concrete pipe is 2,830 feet long at 0.0005 foot/foot slope (Epic Engineering 2016).

<u>Receiving Water</u>
The receiving water for Outfall 001is the C-7 Ditch, which does not have designated beneficial uses. The C-7 Ditch was determined to be a drainage ditch that does not have downstream agricultural users of the water. Therefore, per UAC R317-2-13.10, the presumptive beneficial uses for all drainage canals and ditches statewide are 2B and 3E.

- *Class 2B: Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.*
- *Class 3E: Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.*

The C-7 Ditch is tributary to Lee Creek, which does not have designated beneficial uses. Per UAC R317-2-13.13, the presumptive beneficial uses for all waters not specifically classified are 2B and 3D.

- *Class 3D: Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.*

The critical flow for the wasteload analysis is typically considered the lowest stream flow for seven consecutive days with a recurrence interval of once every ten years (7Q10). Flow records from USGS stream gage #10172640 Lee Creek Near Magna, UT, for the period 1971 – 1982 and 2006 – 2008 was obtained. The 7Q10 was estimated as the lowest seven day average from 5/24/2006 to 4/10/2008. This more recent period of record of the gage was considered more representative of the current higher flow regime in the creek; however, it is insufficient to statistically calculate the 7Q10 flow.

The discharge at the gage includes flows from C-7 Ditch, Kersey Creek, Magna WWTP, Lee Creek and groundwater (Table 1). The average discharge from Magna WWTP was calculated from DWQ monitoring records from 1999 – 2008. Critical low flow from Kersey Creek and groundwater was assumed to be zero. No flow records were available for C-7 Ditch and Lee Creek above the confluence with C-7 Ditch; the critical low flow was assumed to be 67% from C-7 Ditch and 33% from Lee Creek above C-7 Ditch.

Table 1: Annual Critical Low Flow

Source	Critical Low Flow (cfs)
C-7 Ditch	9.5
Kersey Creek above Magna WWTP	0.0
Magna WWTP	3.7
Lee Creek above C-7 Ditch	4.7
Groundwater	0.0
Lee Creek at USGS Gage	*17.9*

Receiving water quality data was obtained from sampling stations 4991430 Lee Creek at I-80 Crossing, 4991560 C-7 Ditch at 8000 West, and 4991590 C-7 Ditch above Confluence with Kersey Creek. The seasonal annual value was calculated for each constituent with available data in the receiving water.

<u>Protection of Downstream Uses</u>

Per UAC R317-2-8, *all actions to control waste discharges under these rules shall be modified as necessary to protect downstream designated uses*. For this discharge, numeric aquatic life use criteria do not apply to the immediate receiving water (C-7 Ditch), but do apply to downstream receiving waters (Lee Creek). Therefore, Lee Creek is considered the limiting condition in this wasteload allocation to ensure protection of aquatic life uses.

Mixing Zone
The allowable mixing zone is 15 minutes of travel time for acute conditions, not to exceed 50% of stream width, and 2,500 feet for chronic conditions, per UAC R317-2-5. Water quality standards must be met at the end of the mixing zone.

The actual length of the mixing zone was not determined; however, it was presumed to remain within the maximum allowable mixing zone dimensions. Acute limits were calculated using 50% of the annual critical low flow.

Parameters of Concern
The potential parameters of concern identified for the discharge and receiving water were total suspended solids (TSS), dissolved oxygen (DO), BOD5, total phosphorus (TP), total nitrogen (TN), total ammonia nitrogen (TAN), E. coli, pH, and total residual chlorine (TRC) as determined in consultation with the UPDES Permit Writer.

TMDL
The receiving waters are not listed as impaired for any parameters according to the 303(d) list in the *2012/2014 Utah Integrated Report*.

Water Quality Modeling
A QUAL2Kw model of the receiving water was populated based on physiographic information from Google Earth and site data collected by DWQ staff. The model extends from C-7 Ditch through Lee Creek to the outlet to Gilbert Bay (Figure 1). The QUAL2Kw model was used for determining WQBELs related to eutrophication of the receiving waters, including BOD5, phosphorus, nitrogen and dissolved oxygen. The QUAL2Kw model was also used to determine the limits for ammonia toxicity. The water quality criterion for chronic ammonia toxicity is dependent on temperature and pH, and the water quality criterion for acute ammonia toxicity is dependent on pH. Effluent concentrations were adjusted so that water quality standards were not exceeded in the receiving water. QUAL2Kw rates, input and output are summarized in Appendix A.

Insufficient observed data was available for model calibration. The rate parameters used in the model were the same as those used for the Box Elder Creek/Brigham City WWTP QUAL2Kw, which was calibrated under contract by Utah State University (Neilson et al. 2012). C-7 Ditch and Lee Creek was considered to have similar stream characteristics to Box Elder Creek. Synoptic data needs to be collected in order to calibrate the model.

A mass balance mixing analysis was calculated for conservative constituents such as dissolved metals. The WQBELs determined using the mass balance mixing analysis are summarized in Appendix B.

The limits for total residual chlorine were determined assuming a decay rate of 20 /day (at 20 ºC) and a travel time in the effluent pipe of 25 minutes (2,830 lineal feet at 1.9 feet per second velocity) and a travel time in C-7 Ditch prior to confluence with Lee Creek of 335 minutes

(12,045 lineal feet at 0.6 feet per second velocity). The analysis for TRC is summarized in Appendix C.

Where WQBELs exceeded secondary standards or categorical limits, the concentration in the model was set at the secondary standard or categorical limit.

Models and supporting documentation are available for review upon request.

<u>WET Limits</u>

The percent of effluent in the receiving water in a fully mixed condition, and acute and chronic dilution in a not fully mixed condition are calculated in the WLA in order to generate WET limits. The LC_{50} (lethal concentration, 50%) percent effluent for acute toxicity and the IC_{25} (inhibition concentration, 25%) percent effluent for chronic toxicity, as determined by the WET test, needs to be below the WET limits, as determined by the WLA. The WET limit for LC_{50} is typically 100% effluent and does not need to be determined by the WLA.

Table 2: WET Limits for IC_{25}

Season	Percent Effluent
Annual	30%

<u>Effluent Limits</u>

The effect of the effluent on the DO in the receiving water was evaluated using the QUAL2Kw model. A DO sag in C-7 Ditch downstream from the plant discharge was predicted by the model; however, the DO concentration recovered by the confluence with Lee Creek and secondary standards for BOD5 are sufficient to meet criteria.

Table 3: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		8.0	1 day		4.0	30 days
Ammonia (mg/L)	Varies	30.0	1 hour	Varies	7.0	30 days
Min. Dissolved Oxygen (mg/L)[2]	3.0	5.0	Instantaneous	5.0	5.0	30 days
BOD$_5$ (mg/L)	NA	35	7 days	NA	25	30 days
Total Residual Chlorine (mg/L)						
Summer		5.5			5.3	
Fall	0.019	1.1	1 hour	0.011	1.1	4 days
Winter		0.6			0.6	
Spring		1.1			1.1	

Antidegradation Level I Review

The objective of the Level I ADR is to ensure the protection of existing uses, defined as the beneficial uses attained in the receiving water on or after November 28, 1975. No evidence is known that the existing uses deviate from the designated beneficial uses for the receiving water. Therefore, the beneficial uses will be protected if the discharge remains below the WQBELs presented in this wasteload.

A Level II Antidegradation Review (ADR) is required for this discharge, as this wasteload is for a new outfall to a different receiving water.

Prepared by:
Nicholas von Stackelberg, P.E.
Standards and Technical Services Section

Documents

WLA Document: *magna_potw_c7ditch_wla_2016-09-30.docx*
QUAL2Kw Wasteload Model: *magna_potw_c7ditch_wla_2016.xlsm*

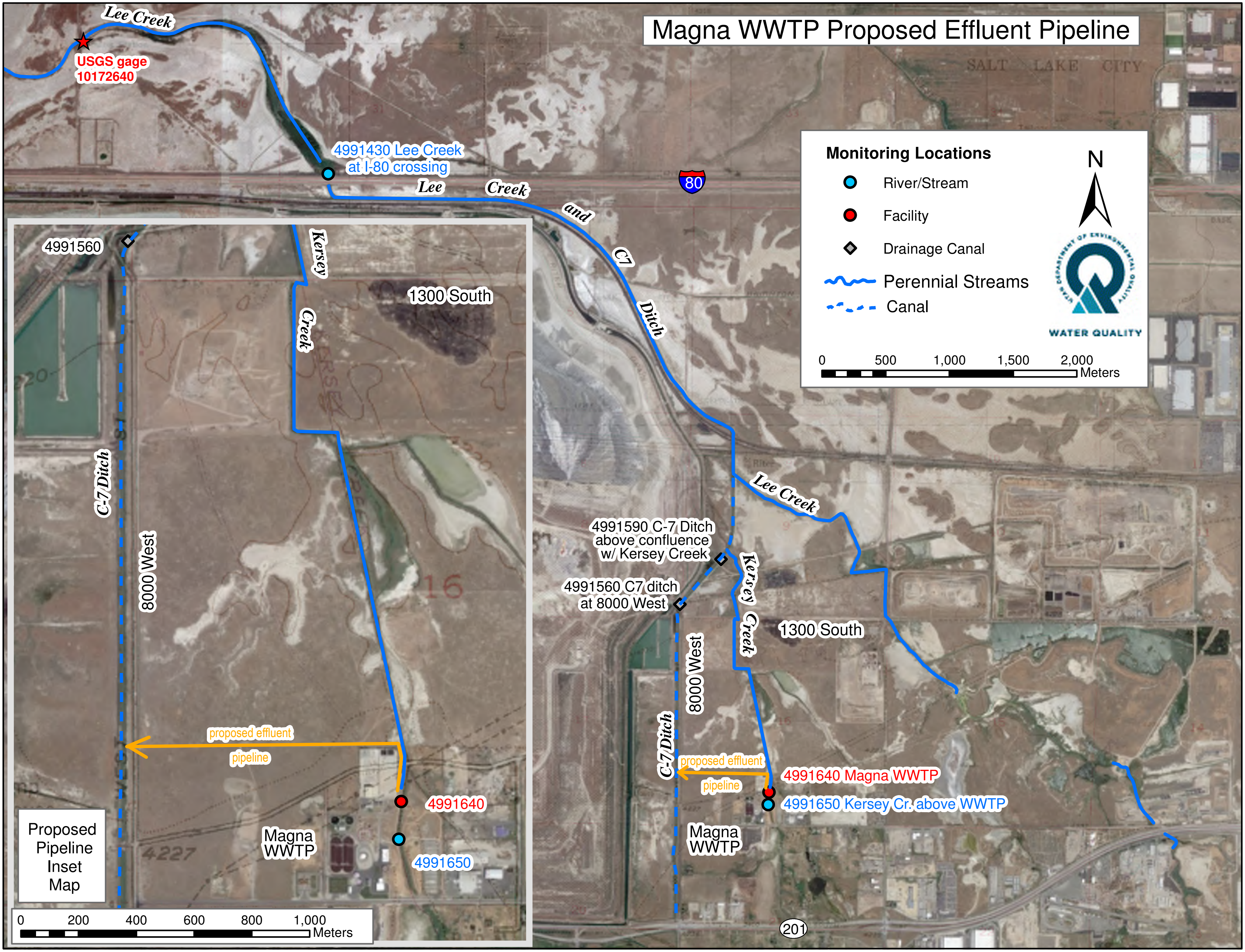
References:

Epic Engineering. 2016. *WWTP Outfall Bypass Pipeline – Alternative Comparison Summary Memo*. Prepared for Magna Water District.

Neilson, B.T., A.J. Hobson, N. von Stackelberg, M. Shupryt, and J.D. Ostermiller. 2012. *Using QUAL2K Modeling to Support Nutrient Criteria Development and Wasteload Analyses in Utah*.

Utah Division of Water Quality. 2012. *Utah Wasteload Analysis Procedures Version 1.0*.

Utah Division of Water Quality. *2012/2014 Utah Integrated Report.*



Magna WWTP Proposed Effluent Pipeline
Monitoring Locations
River/Stream
Facility
Drainage Canal
Perennial Streams
Canal
0 500 1,000 1,500 2,000 Meters
N
WATER QUALITY
Lee Creek
USGS gage 10172640
4991430 Lee Creek at I-80 crossing
80
Lee Creek and C7 Ditch
SALT LAKE CITY
Lee Creek
4991590 C-7 Ditch above confluence w/ Kersey Creek
4991560 C7 ditch at 8000 West
Kersey Creek
1300 South
8000 West
C-7 Ditch
proposed effluent pipeline
4991640 Magna WWTP
4991650 Kersey Cr. above WWTP
Magna WWTP
201
4991560
Kersey Creek
1300 South
C-7 Ditch
8000 West
proposed effluent pipeline
4991640
Magna WWTP
4991650
Proposed Pipeline Inset Map
0 200 400 600 800 1,000 Meters

WASTELOAD ANALYSIS [WLA] Date: 9/30/2016
Appendix A: QUAL2Kw Analysis for Eutrophication

Discharging Facility:	Magna WWTP		
UPDES No:	UT-0021440		
Permit Flow [MGD]:	4.00	Maximum Monthly Flow	
	8.00	Maximum Daily Flow	
Receiving Water:	C-7 Ditch/Lee Creek		
Stream Classification:	2B, 3D		
Stream Flows [cfs]:	9.50	Summer (July-Sept)	Critical Low Flow
	-	Fall (Oct-Dec)	
	-	Winter (Jan-Mar)	
	-	Spring (Apr-June)	
Acute River Width:	50.0%		
Chronic River Width:	100.0%		

Modeling Information

A QUAL2Kw model was used to determine these effluent limits.

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis.
Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Headwater Inputs - C-7 Ditch	Summer	Fall	Winter	Spring
Flow (cfs)	9.5			
Temperature (deg C)	22.1			
Specific Conductance (μmhos)	2,500			
Inorganic Suspended Solids (mg/L)	80.6			
Dissolved Oxygen (mg/L)	8.7			
$CBOD_5$ (mg/L)	3.5			
Organic Nitrogen (mg/L)	0.930			
NH4-Nitrogen (mg/L)	0.070			
NO3-Nitrogen (mg/L)	0.700			
Organic Phosphorus (mg/L)	0.130			
Inorganic Ortho-Phosphorus (mg/L)	0.110			
Phytoplankton (μg/L)	42.8			
Detritus [POM] (mg/L)	9.0			
Alkalinity (mg/L)	239			
pH	8.3			

Discharge Inputs - Chronic	Summer	Fall	Winter	Spring
Flow (cfs)	4.0			
Temperature (deg C)	22.2			
Specific Conductance (μmhos)	2,481			
Inorganic Suspended Solids (mg/L)	2.4			
Dissolved Oxygen (mg/L)	5.0			
$CBOD_5$ (mg/L)	25.0			
Organic Nitrogen (mg/L)	5.0			
NH4-Nitrogen (mg/L)	7.0			
NO3-Nitrogen (mg/L)	12.3			
Organic Phosphorus (mg/L)	0.0			
Inorganic Ortho-Phosphorus (mg/L)	5.0			
Phytoplankton (μg/L)	0.0			
Detritus [POM] (mg/L)	0.0			
Alkalinity (mg/L)	400			
pH	7.6			

Discharge Inputs - Acute	Summer	Fall	Winter	Spring
Flow (cfs)	8.0			
Temperature (deg C)	22.2			
Specific Conductance (μmhos)	2,481			
Inorganic Suspended Solids (mg/L)	2.4			
Dissolved Oxygen (mg/L)	5.0			
$CBOD_5$ (mg/L)	35.0			
Organic Nitrogen (mg/L)	10.0			
NH4-Nitrogen (mg/L)	30.0			
NO3-Nitrogen (mg/L)	12.3			
Organic Phosphorus (mg/L)	0.0			
Inorganic Ortho-Phosphorus (mg/L)	10.0			
Phytoplankton (μg/L)	0.0			
Detritus [POM] (mg/L)	0.0			
Alkalinity (mg/L)	400			
pH	7.8			

Tributary Inputs - Lee Creek	Summer	Fall	Winter	Spring
Flow (cfs)	4.7			
Temperature (deg C)	22.1			
Specific Conductance (μmhos)	2,500			
Inorganic Suspended Solids (mg/L)	80.6			
Dissolved Oxygen (mg/L)	8.7			
$CBOD_5$ (mg/L)	3.5			
Organic Nitrogen (mg/L)	0.930			
NH4-Nitrogen (mg/L)	0.070			
NO3-Nitrogen (mg/L)	0.700			
Organic Phosphorus (mg/L)	0.130			
Inorganic Ortho-Phosphorus (mg/L)	0.110			
Phytoplankton (μg/L)	42.8			
Detritus [POM] (mg/L)	9.0			
Alkalinity (mg/L)	239			
pH	8.3			

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

Effluent Limitations

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort reflect the environmental conditions expected at low stream flows.

Effluent Limitations based upon Water Quality Standards for DO and Ammonia Toxicity

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent limitation as follows:

Chronic	**Standard**	**Summer**	**Fall**	**Winter**	**Spring**
Flow (MGD)	N/A	4.0			
NH4-Nitrogen (mg/L)	Varies	7.0			
BOD_5 (mg/L)	N/A	25.0			
Dissolved Oxygen [30-day Ave] (mg/L)	5.0	5.0			

Acute	**Standard**	**Summer**	**Fall**	**Winter**	**Spring**
Flow (cfs)	N/A	8.0			
NH4-Nitrogen (mg/L)	Varies	30.0			
$CBOD_5$ (mg/L)	N/A	35.0			
Dissolved Oxygen [Minimum] (mg/L)	3.0	5.0			

Summary Comments

The mathematical modeling and best professional judgement indicate that violations of receiving water beneficial uses with their associated water quality standards, including important down-stream segments, will not occur for the evaluated parameters of concern as discussed above if the effluent limitations indicated above are met.

Coefficients and Other Model Information

Parameter	*Value*	*Units*
Stoichiometry:		
Carbon	40	gC
Nitrogen	7.2	gN
Phosphorus	1	gP
Dry weight	100	gD
Chlorophyll	1	gA
Inorganic suspended solids:		
Settling velocity	0.001	m/d
Oxygen:		
Reaeration model	Internal	
Temp correction	1.024	
Reaeration wind effect	None	
O2 for carbon oxidation	2.69	gO2/gC
O2 for NH4 nitrification	4.57	gO2/gN
Oxygen inhib model CBOD oxidation	Exponential	
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2
Oxygen inhib model nitrification	Exponential	
Oxygen inhib parameter nitrification	0.60	L/mgO2
Oxygen enhance model denitrification	Exponential	
Oxygen enhance parameter denitrification	0.60	L/mgO2
Oxygen inhib model phyto resp	Exponential	
Oxygen inhib parameter phyto resp	0.60	L/mgO2
Oxygen enhance model bot alg resp	Exponential	
Oxygen enhance parameter bot alg resp	0.60	L/mgO2
Slow CBOD:		
Hydrolysis rate	0	/d
Temp correction	1.047	
Oxidation rate	0.242802	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.2625675	/d
Temp correction	1.07	
Settling velocity	0.087906	m/d
Ammonium:		
Nitrification	2.817054	/d
Temp correction	1.07	
Nitrate:		
Denitrification	1.756367	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.24334	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.227735	/d
Temp correction	1.07	
Settling velocity	0.103774	m/d
Inorganic P:		
Settling velocity	0.06798	m/d
Sed P oxygen attenuation half sat constant	0.99342	mgO2/L

Phytoplankton:		
Max Growth rate	2.57133	/d
Temp correction	1.07	
Respiration rate	0.1432355	/d
Temp correction	1.07	
Death rate	0.45734	/d
Temp correction	1	
Nitrogen half sat constant	15	ugN/L
Phosphorus half sat constant	2	ugP/L
Inorganic carbon half sat constant	1.30E-05	moles/L
Phytoplankton use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	57.6	langleys/d
Ammonia preference	15	ugN/L
Settling velocity	0.0645665	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	8.663865	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.1046738	/d
Photo-respiration rate parameter	0.39	unitless
Temp correction	1.07	
Excretion rate	0.05015	/d
Temp correction	1.07	
Death rate	0.1437	/d
Temp correction	1.07	
External nitrogen half sat constant	127.576	ugN/L
External phosphorus half sat constant	89.161	ugP/L
Inorganic carbon half sat constant	1.10E-04	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Half saturation	
Light constant	71.6656	langleys/d
Ammonia preference	15.2922	ugN/L
Subsistence quota for nitrogen	0.9375732	mgN/gD
Subsistence quota for phosphorus	0.058037	mgP/gD
Maximum uptake rate for nitrogen	640.4095	mgN/gD/d
Maximum uptake rate for phosphorus	190.7675	mgP/gD/d
Internal nitrogen half sat ratio	1.8677685	
Internal phosphorus half sat ratio	4.4374015	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	3.773984	/d
Temp correction	1.07	
Settling velocity	0.097025	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

Atmospheric Inputs:	Summer	Fall	Winter	Spring
Min. Air Temperature, F	0.0	0.0	0.0	0.0
Max. Air Temperature, F	2500.0	0.0	0.0	0.0
Dew Point, Temp., F	89.5	0.0	0.0	0.0
Wind, ft./sec. @ 21 ft.	80.6	0.0	0.0	0.0
Cloud Cover, %	870%	0%	0%	0%

Other Inputs:	
Bottom Algae Coverage	s.u.
Bottom SOD Coverage	ug/L
Prescribed SOD, gO_2/m^2/day	0

WASTELOAD ANALYSIS [WLA] Date: 9/30/2016
Appendix B: Mass Balance Mixing Analysis for Conservative Constituents

Discharging Facility:	Magna WWTP	
UPDES No:	UT-0021440	
Permit Flow [MGD]:	4.0	Maximum Monthly Flow
	8.0	Maximum Daily Flow

Receiving Water:	C-7 Ditch/Lee Creek	
Stream Classification:	2B, 3D	
Stream Flows [cfs]:	Chronic	Acute
C-7 Ditch	9.5	9.5
Lee Creek	4.7	2.4
Total	14.2	11.9

Acute River Width:	50%
Chronic River Width:	100%

Modeling Information

A simple mixing analysis was used to determine these effluent limits.

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis.
Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Headwater/Upstream Information

	7Q10 Flow
	cfs
Summer	9.5
Fall	-
Winter	-
Spring	-

Discharge Information

	Flow
	MGD
Maximum Daily	8.0
Maximum Monthly	4.0

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

Effluent Limitations

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort reflect the environmental conditions expected at low stream flows.

Effluent Limitations for Protection of Recreation (Class 2B Waters)

Parameter	Maximum Concentration	
Physical		
pH Minimum	6.5	
pH Maximum	9.0	
Bacteriological		
E. coli (30 Day Geometric Mean)	206	(#/100 mL)
E. coli (Maximum)	668	(#/100 mL)

Effluent Limitations for Protection of Aquatic Wildlife (Class 3D Waters)

Parameter — **Maximum Concentration**

Physical

Inorganics	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
	Standard	Limit		Standard	Limit	
Total Residual Chlorine (TRC)	0.011	0.011	mg/L	0.019	0.019	mg/L
Phenol				0.010	0.010	mg/L
Hydrogen Sulfide (Undissociated)				0.002	0.002	mg/L

Total Recoverable Metals [µg/L]

	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter	Standard[1]	Background[2]	Limit	Standard[1]	Background[2]	Limit
Aluminum	87.0	58.0	154	750	58.0	1,413
Arsenic	150	100	265	340	100	570
Cadmium	0.5	0.3	0.8	4.3	0.3	8.2
Chromium VI	11.0	7.3	19.4	16.0	7.3	24.3
Chromium III	152	101	268	3,181	101	6,130
Copper	16.9	11.2	29.8	26.9	11.2	41.9
Cyanide	22.0	14.7	38.8	5.2	14.7	-3.9
Iron				1,000	667	1,319
Lead	7.7	5.1	13.6	197	5.1	381
Mercury	0.012	0.008	0.021	2.4	0.008	4.7
Nickel	93.8	62.5	165	843	62.5	1591
Selenium	4.6	3.1	8.1	18.4	3.1	33.1
Silver				12.5	8.3	16.4
Tributylin	0.072	0.048	0.127	0.46	0.048	0.85
Zinc	216	144	380	216	144	284

1: Based upon a Hardness of 200 mg/l as $CaCO_3$.

2: Background concentration assumed 2/3 of chronic limit.

Organics (Pesticides) [µg/L]

	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter	**Standard**	**Background[1]**	**Limit**	**Standard**	**Background[1]**	**Limit**
Aldrin				1.5	1.0	2.0
Chlordane	0.0043	0.0029	0.0076	1.2	0.0029	2.3
DDT, DDE	0.001	0.001	0.002	0.55	0.001	1.08
Diazinon	0.17	0.11	0.30	0.17	0.11	0.22
Dieldrin	0.0056	0.0037	0.0099	0.24	0.0037	0.47
Endosulfan, a & b	0.056	0.037	0.099	0.11	0.037	0.18
Endrin	0.036	0.024	0.064	0.086	0.024	0.145
Heptachlor & H. epoxide	0.0038	0.0025	0.0067	0.26	0.0025	0.51
Lindane	0.08	0.05	0.14	1.0	0.05	1.9
Methoxychlor				0.03	0.02	0.04
Mirex				0.001	0.001	0.001
Nonylphenol	6.6	4.4	11.6	28.0	4.4	50.6
Parathion	0.0130	0.0087	0.0229	0.066	0.0087	0.121
PCB's	0.014	0.009	0.025			
Pentachlorophenol	15.0	10.0	26.5	19.0	10.0	27.6
Toxephene	0.0002	0.0001	0.0004	0.73	0.0001	1.43

1: Background concentration assumed 2/3 of chronic limit.

Radiological

Parameter	Maximum Concentration
Gross Alpha	15 pCi/L

WASTELOAD ANALYSIS [WLA]
Appendix C: Total Residual Chlorine

Date: 9/30/2016

Discharging Facility: Magna WWTP
UPDES No: UT-0021440

CHRONIC

	Season	Receiving Water	Standard	Total Effluent	Mixing Zone Boundary	Effluent Limit Without Decay	Temperature (°C)	Decay Rate (/day) @ 20 deg C	Decay Rate (/day) @ T deg C	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	14.2		6.2	20.4							
	Fall	14.2		6.2	20.4							
	Winter	14.2		6.2	20.4							
	Spring	14.2		6.2	20.4							
TRC (mg/L)	Summer	0.000	0.011			0.036	20.0	20	20.0	360	0.01	5.379
	Fall	0.000	0.011			0.036	12.0	20	13.9	360	0.03	1.156
	Winter	0.000	0.011			0.036	8.0	20	11.5	360	0.06	0.647
	Spring	0.000	0.011			0.036	12.0	20	13.9	360	0.03	1.156

ACUTE

	Season	Receiving Water	Standard	Total Effluent	Mixing Zone Boundary	Effluent Limit Without Decay	Temperature (°C)	Decay Rate (/day) @ 20 ℃	Decay Rate (/day) @ T ℃	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	11.9		12.4	24.2							
	Fall	11.9		12.4	24.2							
	Winter	11.9		12.4	24.2							
	Spring	11.9		12.4	24.2							
TRC (mg/L)	Summer	0.000	0.019			0.037	20.0	20	20.0	360	0.01	5.520
	Fall	0.000	0.019			0.037	12.0	20	13.9	360	0.03	1.186
	Winter	0.000	0.019			0.037	8.0	20	11.5	360	0.06	0.664
	Spring	0.000	0.019			0.037	12.0	20	13.9	360	0.03	1.186

November 9, 2016

Matthew Garn
Utah Department of Environmental Quality
195 North 1950 West
Salt Lake City, UT 84116

Subject: Chlorine Decay Assessment

Dear Matthew,

Carollo Engineers and Magna Water District (MWD) completed a chlorine sampling event and chlorine decay assessment. A new decay rate was estimated from the data and applied to the chlorine decay model at 8 degrees Celsius, winter temperature. The results show MWD can discharge 1 milligram per liter (mg/L) chlorine without violating the 0.011 mg/L limit at the downstream compliance point in Lee Creek.

We ask for approval of 1 mg/L effluent limit at the treatment facility. We also request an ammonia effluent target be estimated using a wasteload analysis, should future ammonia standards be adopted lowering the proposed limit of 7 mg/L.

Sincerely,

CAROLLO ENGINEERS, INC.

Clint Rogers, P.E.
Vice President

Enclosures: Chlorine Decay Assessment

cc: Nick von Stackelberg

7090 S. Union Park Avenue, Suite 600, Salt Lake City, Utah 84047
P. 801.233.2500 F. 801.233.2501
carollo.com

REGISTERED PROFESSIONAL ENGINEER
No. 594577-2202
ANDREW J. HOBSON
11/09/16
STATE OF UTAH

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2016

CHLORINE DECAY ASSESSMENT

FINAL
November 2016

7090 S. UNION PARK AVENUE, SUITE 600 • SALT LAKE CITY, UTAH 84047 • P. 801.233.2500 • F. 801.233.2501

MAGNA WATER DISTRICT

WASTEWATER FACILITY PLAN 2016

CHLORINE DECAY ASSESSMENT

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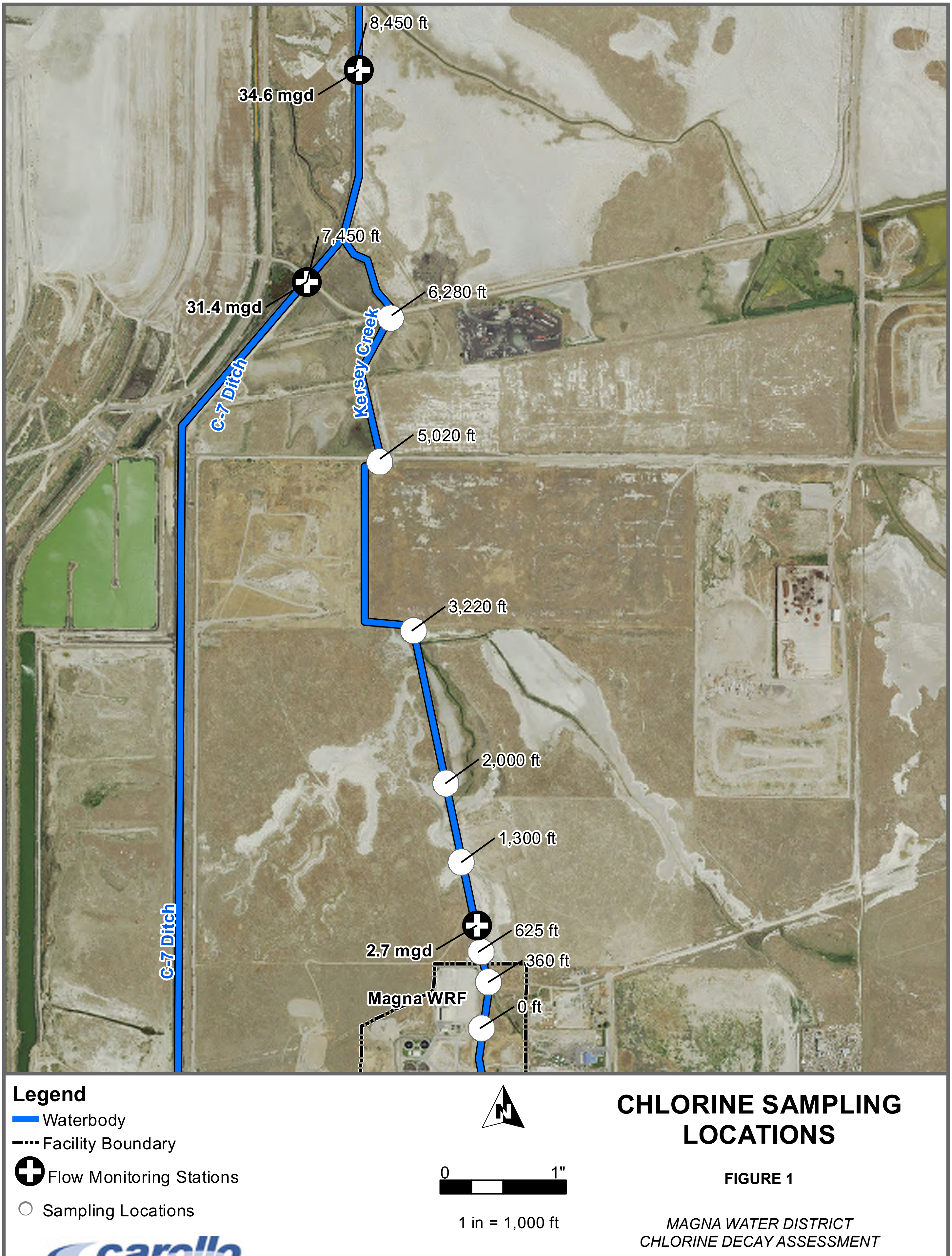
CHAPTER 1 SAMPLING PLAN

Carollo Engineers, Inc. (Carollo) prepared the 2016 Wastewater Facility Plan for the Magna Water District (MWD).The preferred alternative consists of transferring the effluent outfall from its existing location at Kersey Creek to the C-7 Ditch through a new pipeline. Transferring the outfall shifts the compliance point from Kersey Creek to further downstream at the confluence of C-7 Ditch and Lee Creek.

The Utah Division of Water Quality (DWQ) performed a wasteload allocation analysis and chlorine decay model on the proposed C-7 Ditch alternative. Preliminary model results indicate that a 0.6 milligram per liter (mg/L) residual chlorine concentration in the effluent meets the instream standard of 0.011 mg/L at the compliance point in Lee Creek.

MWD helped DWQ prepare a field investigation to determine a site-specific chlorine decay rate by means of the sampling plan proposed in this document. The objective of this effort was to accurately predict the impact of effluent chlorine concentrations on the chlorine residual standard at Lee Creek. This was accomplished by collecting chlorine samples along Kersey Creek to measure residual based on distance and time. A total of ten sampling locations were selected between the effluent outfall and confluence with C-7 ditch. The sampling locations were designed closest together nearest the effluent outfall because chlorine residual may decline in greater magnitude at higher concentrations. Figure 1 shows a map that details sample locations and distances from the effluent.

On October 20, 2016, Carollo and MWD conducted the sampling event. In addition to chlorine residual, they sampled for flow, pH, and temperature on each of the water sources including treatment plant effluent, Kersey Creek, and C-7 ditch upstream and downstream of Kersey Creek. Table 1 summarizes the sampling plan, including number of samples, location, frequency, and sampling method. Collecting the ten samples constituted one event. Table 2 shows the flow measurements taken at the treatment facility, downstream in Kersey Creek and in C-7 Ditch, both upstream and downstream of the confluence with Kersey Creek.



CHLORINE SAMPLING LOCATIONS

FIGURE 1

MAGNA WATER DISTRICT
CHLORINE DECAY ASSESSMENT

carollo

\\Client\UT\Magna\9910D00\Data\GIS\Chlorine Sampling Locations

Table 3 shows the results for temperature, pH, and chlorine residual listed by distance from the effluent outfall in Kersey Creek. The data show a final residual of 0.01 mg/L at 1.6 miles (8,450 feet) downstream of the outfall based on a temperature of 13.6 degrees Celsius, and a pH of 8.38. Because the chlorine residual met the standard before the confluence with Lee Creek, the chlorine was consumed faster than the DWQ model had predicted. Therefore, a new chlorine decay rate was needed more closely aligned with the conditions downstream of the Magna Water Reclamation Facility (WRF) effluent.

With the ten chlorine and temperature samples, a new chlorine decay coefficient was derived by fitting the data to a first order decay equation. This resulted in a site specific decay rate of 33.6 day^{-1} at 18 degrees Celsius, the average water temperature during the study. This site-specific decay rate was then temperature adjusted using the Arrhenius equation, which resulted in 37.0 day^{-1} at 20 degrees Celsius and compared to the DWQ model decay rate of 20.0 day^{-1} at 20 degrees Celsius. This comparison revealed that chlorine is consumed at a rate of almost twice that of the DWQ model so more chlorine can be discharged from Magna WRF while still maintaining the standard of 0.011 mg/L at the confluence with Lee Creek.

New decay coefficients were derived for remaining seasonal temperature targets listed in the draft 2016 Utah DWQ wasteload allocation analysis. The lowest decay rates correspond to the lowest seasonal temperatures in winter. Thus, wintertime produces the most conservative chlorine estimates for permitting. Using winter as the limiting condition, and projecting chlorine residual using a decay rate of 21.3 day^{-1} at 8 degrees Celsius, Magna WRF should be able to discharge up to 7 mg/L chlorine and still achieve the residual goal at Lee Creek. Rather than requesting DWQ to raise the permit limit to this level, we proposed instead to keep the total chlorine residual at 1 mg/L annually, which corresponds with the historical permitted effluent limit at Magna WRF. This limit will provide a long-term, manageable target for Magna WRF while providing Lee Creek with a margin of safety.

Table 1 Chlorine Sampling Protocol
2016 Wastewater Facility Plan
Magna Water District

Data	Location	Number of Samples	Frequency	Method/ Equipment
Flow	Effluent	1	Continuous	Area Velocity Flow
	C-7 Ditch upstream of Kersey Creek	1	Beginning and end of each sampling event	
Chlorine	End of Chlorine Contact Basin	1	During Sampling	DPD Method 8167 (total chlorine)
	Kersey Creek	8		
	C-7 Ditch downstream of Kersey Creek	1		
Temperature and pH	Kersey Creek	8	During Sampling	Hach HQ11d
	C-7 Ditch downstream of Kersey Creek	1		

Table 2 Flow Measurements in Kersey Creek and C-7 Ditch
2016 Wastewater Facility Plan
Magna Water District

Location	Area (ft^1)	Velocity (fps)	Flow (cfs)	Flow (mgd)
Magna Effluent	-	-	4.2	2.7
Kersey Creek	5.2	0.80	4.2	2.7
C-7 Ditch upstream of confluence	15.7	1.94	48.6	31.4
C-7 Ditch downstream of confluence	78.5	0.68	53.5	34.6

Table 3	Remaining Chlorine Residual in Kersey Creek and C-7 Ditch 2016 Wastewater Facility Plan Magna Water District		
Distance from Effluent Outfall	**Temperature (deg C)[1]**	**pH**	**Chlorine Residual (mg/L)**
8,450[1]	13.6	8.38	0.01
6,280	14.8	7.92	0.08
5,020	15.7	7.88	0.13
3,220	19.3	7.99	0.16
2,000	19.0	7.94	0.17
1,300	19.4	7.87	0.41
630	20.3	7.85	0.51
360	20.7	7.84	1.06
0	19.6	7.76	1.13

Notes:

(1) Temperature readings at stations 0 feet to 3,220 feet were taken in the afternoon; 5,020 feet to 8,450 feet were taken in the morning.

Table 4	Total Residual Chlorine Results Based on Field Study Decay Rate 2016 Wastewater Facility Plan Magna Water District						
CHRONIC - 2016 Utah DWQ Wasteload Analysis Results					**Concentration (mg/L)**		
Season	**Temperature (°C)**	**kd (1/day)**	**Time (min.)**	**Decay Coefficient = C_0 * exp (-kt)**	**Effluent**	**With Decay**	**With Mixing at Lee Creek**
Summer	20	20.0	360	0.00674	5.34	0.036	0.011
Fall	12	13.9	360	0.0309	1.16	0.036	0.011
Winter	8	11.5	360	0.0562	0.647	0.036	0.011
Spring	12	13.9	360	0.0309	1.16	0.036	0.011
CHRONIC - 2016 Magna Field Study Results					**Concentration (mg/L)**		
Season	**Temperature (°C)**	**kd (1/day)**	**Time (min.)**	**Decay Coefficient = C_0 * exp (-kt)**	**Effluent**	**With Decay**	**With Mixing at Lee Creek**
Oct. 10, 2016	18	33.8	360	0.000214	170	0.036	0.011
Summer	20	37.0	360	0.0000965	370	0.036	0.011
Fall	12	25.7	360	0.00161	22.5	0.036	0.011
Winter	8	21.3	360	0.00488	7.30	0.036	0.011
Spring	12	25.7	360	0.00161	22.5	0.036	0.011

Utah Division of Water Quality
Addendum to Statement of Basis
Wasteload Analysis and Antidegradation Level I Review
PRELIMINARY – Discharge to C-7 Ditch

Date:	**January 30, 2017**
Facility:	**Magna Wastewater Treatment Plant** **UPDES No. UT0021440**
Receiving water:	**C-7 Ditch**

This addendum summarizes the wasteload analysis that was performed to determine water quality based effluent limits (WQBEL) for this discharge. Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses (UAC R317-2-8). Projected concentrations are compared to numeric water quality standards to determine acceptability. The numeric criteria in this wasteload analysis may be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

Purpose
The purpose of this wasteload allocation is to determine WQBELs for planning a new outfall to C-7 Ditch. The limits should be considered preliminary that are subject to change based on collection of site-specific physiographic, flow and water quality data during the permit cycle.

Discharge
Outfall 001: C-7 Ditch → Lee Creek → Great Salt Lake
The maximum design flow for the discharge is 4.0 MGD average monthly and 8.0 MGD maximum daily, as provided by the treatment plant.

This wasteload allocation is for the proposed effluent pipeline alignment as shown in Figure 1. The 42-inch diameter reinforced concrete pipe is 4,000 feet long at 0.0005 foot/foot slope (Epic Engineering 2016).

Receiving Water
The receiving water for Outfall 001is the C-7 Ditch, which does not have designated beneficial uses. The C-7 Ditch was determined to be a drainage ditch that does not have downstream agricultural users of the water. Therefore, per UAC R317-2-13.10, the presumptive beneficial uses for all drainage canals and ditches statewide are 2B and 3E.

- *Class 2B: Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.*
- *Class 3E: Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.*

The C-7 Ditch is tributary to Lee Creek, which does not have designated beneficial uses. Per UAC R317-2-13.13, the presumptive beneficial uses for all waters not specifically classified are 2B and 3D.

- *Class 3D: Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.*

The critical flow for the wasteload analysis is typically considered the lowest stream flow for seven consecutive days with a recurrence interval of once every ten years (7Q10). Flow records from USGS stream gage #10172640 Lee Creek Near Magna, UT, for the period 1971 – 1982 and 2006 – 2008 was obtained. The 7Q10 was estimated as the lowest seven day average from 5/24/2006 to 4/10/2008. This more recent period of record of the gage was considered more representative of the current higher flow regime in the creek; however, it is insufficient to statistically calculate the 7Q10 flow.

The discharge at the gage includes flows from C-7 Ditch, Kersey Creek, Magna WWTP, Lee Creek and groundwater (Table 1). The average discharge from Magna WWTP was calculated from DWQ monitoring records from 1999 – 2008. Critical low flow from Kersey Creek and groundwater was assumed to be zero. No flow records were available for C-7 Ditch and Lee Creek above the confluence with C-7 Ditch; the critical low flow was assumed to be 67% from C-7 Ditch and 33% from Lee Creek above C-7 Ditch.

Table 1: Annual Critical Low Flow

Source	Critical Low Flow (cfs)
C-7 Ditch	9.5
Kersey Creek above Magna WWTP	0.0
Magna WWTP	3.7
Lee Creek above C-7 Ditch	4.7
Groundwater	0.0
Lee Creek at USGS Gage	*17.9*

Receiving water quality data was obtained from sampling stations 4991430 Lee Creek at I-80 Crossing, 4991560 C-7 Ditch at 8000 West, and 4991590 C-7 Ditch above Confluence with Kersey Creek. The seasonal annual value was calculated for each constituent with available data in the receiving water.

Protection of Downstream Uses

Per UAC R317-2-8, *all actions to control waste discharges under these rules shall be modified as necessary to protect downstream designated uses*. For this discharge, numeric aquatic life use criteria do not apply to the immediate receiving water (C-7 Ditch), but do apply to downstream receiving waters (Lee Creek). Therefore, Lee Creek is considered the limiting condition in this wasteload allocation to ensure protection of aquatic life uses.

Mixing Zone

The allowable mixing zone is 15 minutes of travel time for acute conditions, not to exceed 50% of stream width, and 2,500 feet for chronic conditions, per UAC R317-2-5. Water quality standards must be met at the end of the mixing zone.

The actual length of the mixing zone was not determined; however, it was presumed to remain within the maximum allowable mixing zone dimensions. Acute limits were calculated using 50% of the annual critical low flow.

Parameters of Concern

The potential parameters of concern identified for the discharge and receiving water were total suspended solids (TSS), dissolved oxygen (DO), BOD_5, total phosphorus (TP), total nitrogen (TN), total ammonia nitrogen (TAN), E. coli, pH, and total residual chlorine (TRC) as determined in consultation with the UPDES Permit Writer.

TMDL

The receiving waters are not listed as impaired for any parameters according to the 303(d) list in the *2012/2014 Utah Integrated Report.*

Water Quality Modeling

A QUAL2Kw model of the receiving water was populated based on physiographic information from Google Earth and site data collected by DWQ staff. The model extends from C-7 Ditch through Lee Creek to the outlet to Gilbert Bay (Figure 1). The QUAL2Kw model was used for determining WQBELs related to eutrophication of the receiving waters, including BOD_5, phosphorus, nitrogen and dissolved oxygen.

The QUAL2Kw model was also used to determine the limits for ammonia toxicity. The water quality criterion for chronic ammonia toxicity is dependent on temperature and pH, and the water quality criterion for acute ammonia toxicity is dependent on pH. Effluent concentrations were adjusted so that water quality standards were not exceeded in the receiving water. QUAL2Kw rates, input and output are summarized in Appendix A.

Insufficient observed data was available for model calibration. The rate parameters used in the model were the same as those used for the Box Elder Creek/Brigham City WWTP QUAL2Kw, which was calibrated under contract by Utah State University (Neilson et al. 2012). C-7 Ditch and Lee Creek were considered to have similar stream characteristics to Box Elder Creek. Synoptic data needs to be collected in the future in order to calibrate the model.

A mass balance mixing analysis was calculated for conservative constituents such as dissolved metals. The WQBELs determined using the mass balance mixing analysis are summarized in Appendix B.

The limits for total residual chlorine were determined assuming a decay rate of 37 /day (at 20 °C), based on a chlorine decay assessment (Carollo 2016). The chlorine decay in C-7 Ditch should be verified once the effluent pipeline is constructed and discharging. A total travel time of 240 minutes was estimated [35 minutes in the effluent pipe (4,000 lineal feet at 1.9 feet per second velocity) and 205 minutes in C-7 Ditch prior to confluence with Lee Creek (7,350 lineal feet at 0.6 feet per second velocity)]. The analysis for TRC is summarized in Appendix C.

Where WQBELs exceeded secondary standards or categorical limits, the concentration in the model was set at the secondary standard or categorical limit.

Models and supporting documentation are available for review upon request.

WET Limits

The percent of effluent in the receiving water in a fully mixed condition, and acute and chronic dilution in a not fully mixed condition are calculated in the WLA in order to generate WET limits. The LC_{50} (lethal concentration, 50%) percent effluent for acute toxicity and the IC_{25} (inhibition concentration, 25%) percent effluent for chronic toxicity, as determined by the WET test, needs to be below the WET limits, as determined by the WLA. The WET limit for LC_{50} is typically 100% effluent and does not need to be determined by the WLA.

Table 2: WET Limits for IC_{25}

Season	Percent Effluent
Annual	30%

Ammonia

The QUAL2Kw model was utilized to determine annual limits for ammonia based on summer season conditions. Ammonia exerts an oxygen demand on the water column through nitrification to nitrate and is toxic to aquatic life above certain thresholds that are pH and temperature dependent. Seasonal limits were determined that meet both in-stream DO criteria and in-stream toxicity criteria. Annual average pH and seasonal average temperature was used for determining chronic limits (30-day average) and maximum pH was used for determining acute limits (1-hour).

In 2013, EPA adopted new criteria for ammonia that are lower than current criteria based on the presence of unionid mussels and nonpulmonate snails. States are required to adopt the criteria or establish alternative, scientifically defensible criteria. Utah is initiating studies to support adoption of new ammonia criteria. For planning purposes, ammonia limits were calculated to meet the new criteria assuming presence of the most sensitive species (Table 3).

Table 3: Ammonia Limits to Meet EPA 2013 Ammonia Criteria with Mussels Present

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Ammonia (mg/l) [Toxicity]	Varies	12.0	1 hour	Varies	2.0	30 days

Effluent Limits

The effect of the effluent on the DO in the receiving water was evaluated using the QUAL2Kw model. A DO sag in C-7 Ditch downstream from the plant discharge was predicted by the model; however, the DO concentration recovered by the confluence with Lee Creek and secondary standards for BOD_5 are sufficient to meet DO criteria.

Table 4: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		8.0	1 day		4.0	30 days
Ammonia (mg/L)	Varies	30.0	1 hour	Varies	7.0	30 days
Min. Dissolved Oxygen (mg/L)[2]	3.0	5.0	Instantaneous	5.0	5.0	30 days
BOD_5 (mg/L)	NA	35	7 days	NA	25	30 days
Total Residual Chlorine (mg/L)	0.019		1 hour	0.011		4 days
Summer		17.3			17.7	
Fall		2.6			2.7	
Winter		1.3			1.3	
Spring		2.6			2.7	

Antidegradation Level I Review

The objective of the Level I ADR is to ensure the protection of existing uses, defined as the beneficial uses attained in the receiving water on or after November 28, 1975. No evidence is known that the existing uses deviate from the designated beneficial uses for the receiving water. Therefore, the beneficial uses will be protected if the discharge remains below the WQBELs presented in this wasteload.

A Level II Antidegradation Review (ADR) is required for this discharge, as this wasteload is for a new outfall to a different receiving water.

Prepared by:
Nicholas von Stackelberg, P.E.
Standards and Technical Services Section

Documents

WLA Document: *magna_potw_c7ditch_wla_2017-01-30.docx*
QUAL2Kw Wasteload Model: *magna_potw_c7ditch_wla_2017.xlsm*

References:

Carollo. 2016. *Chlorine Decay Assessment.* Magna Water District.

Epic Engineering. 2016. *WWTP Outfall Bypass Pipeline – Alternative Comparison Summary Memo.* Prepared for Magna Water District.

Neilson, B.T., A.J. Hobson, N. von Stackelberg, M. Shupryt, and J.D. Ostermiller. 2012. *Using QUAL2K Modeling to Support Nutrient Criteria Development and Wasteload Analyses in Utah.*

Utah Division of Water Quality. 2012. *Utah Wasteload Analysis Procedures Version 1.0.*

Utah Division of Water Quality. *2012/2014 Utah Integrated Report.*

Clint Rogers

From: Nicholas Von Stackelberg <nvonstackelberg@utah.gov>
Sent: Monday, February 27, 2017 2:59 PM
To: Clint Rogers
Cc: Andrew Hobson; Matthew Garn (mgarn@utah.gov)
Subject: Re: Seasonal variation of 2013 ammonia limit

Hello Clint:
I ran the QUAL2Kw model and determined the seasonal limits for ammonia to meet the 2013 EPA criteria with presence of sensitive mussels.

Summer: 2 mg/L
Fall: 3 mg/L
Winter: 3 mg/L
Spring: 2 mg/L

Due to the limited flow data, I used the same critical low flow for all seasons, which is likely conservative. Many assumptions had to be made due to the lack of data on C-7 Ditch and Lee Creek, but these limits should be suitable for planning purposes.
Nick

Nicholas von Stackelberg | Environmental Engineer | Standards and Technical Services Section
Phone: 801.536.4374

On Tue, Feb 21, 2017 at 9:19 AM, Clint Rogers <CRogers@carollo.com> wrote:

> Nick,
>
> If 2 mg/L ammonia is the critical summer time limit for the potential mussel limit, we should be ok. We are more worried about the winter time season, 2 mg/L in the winter would be the limit of the technology recommended to Magna for upgrade. We could meet it but there would be very little room for error.
>
> We would appreciate a forecast of what the potential seasonal limits could be if you have the time.
>
> Thanks,
>
> Clint

State of Utah
GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

MAR - 8 2017

CERTIFIED MAIL
(Return Receipt Requested)

Steve Williams, Manager
Magna Water District
P.O. Box 303
Magna, UT 84044

Dear Mr. Williams:

Subject: UPDES Permit Number UT0021440, Magna Water and Sewer District
Request for an extension of the UPDES permit

The Division of Water Quality (DWQ) has received and reviewed Magna Water District's letter, dated February 13, 2017, requesting a two year extension of the existing permit. The current UPDES permit was issued for a period of three years to give Magna time to update the wastewater facility plan to determine what actions are needed in order to meet the more stringent effluent limits that are expected. Magna has completed an ammonia optimization study, a total chlorine residuals study, and a predesign study for the C-7 ditch alternative.

The DWQ hereby approves of the request to allow Magna time to complete a level II antidegradation review for a change in the point of discharge to the C-7 ditch, conduct environmental permitting and wetland delineation, and to obtain easements. Once these tasks are complete, Magna will begin the UPDES renewal process. The permit will now expire on April 30, 2019. This extension of the UPDES permit complies with R317-8-5.1(1), which states "UPDES permits shall be effective for a fixed term not to exceed 5 years."

If you have any questions with regards to this matter, please contact Matthew Garn at mgarn@utah.gov or at (801) 536-4381.

Sincerely,

Kim Shelley, Manager
Permitting, Engineering, and Compliance Branch

KS/MG/blj

Enclosure (1): 1. Cover page of UPDES permit (DWQ-2014-003682)

DWQ-2017-001764

STATE OF UTAH
DIVISION OF WATER QUALITY
DEPARTMENT OF ENVIRONMENTAL QUALITY
SALT LAKE CITY, UTAH

UTAH POLLUTANT DISCHARGE ELIMINATION SYSTEM (UPDES) PERMITS

Major Municipal Permit No. **UT0021440**
Biosolids Permit No. **UTL-021440**
Storm Water Permit No. **UTR000000**

In compliance with provisions of the Utah *Water Quality Act, Title 19, Chapter 5, Utah Code Annotated ("UCA") 1953, as amended* (the *"Act"*),

MAGNA WATER RECLAMATION FACILITY

Is hereby authorized to discharge from its wastewater treatment facility to receiving waters named **KERSEY CREEK**,

To dispose of biosolids and to discharge storm water, in accordance with specific limitations, outfalls, and other conditions set forth herein.

This permit became effective on June 01, 2014

This permit expires at midnight on April 30, 2019

Signed this 7 day of March, 2017.

Walter L. Baker, P.E.
Director

APPENDIX 2B

UPDATED FACILITY PLAN

Magna Water District
Wastewater Facility Plan

UPDATED FACILITY PLAN

FINAL | December 2019

Magna Water District
Wastewater Facility Plan

UPDATED FACILITY PLAN

FINAL | December 2019

REGISTERED PROFESSIONAL ENGINEER
No. 10171598-2202
RYAN W. BENCH
STATE OF UTAH

Contents

Tables

Figures

Abbreviations

AADF	annual average daily flow
BOD	biochemical oxygen demand
Carollo	Carollo Engineers, Inc.
DWQ	Utah Division of Water Quality
EDR	electrodialysis reversal
gpcd	gallons per capita per day
gal/ft^2-d	gallons per square foot per day
HRT	hydraulic retention time
lbs/day	pounds per day
MWD	Magna Water District
mgd	million gallons per day
mg/L	milligrams per liter
MMDF	maximum month daily flow
O&M	operation and maintenance
PHF	peak hour flow
SS	sanitary sewer
TBPEL	technology based phosphorus limit
UV	ultraviolet

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Section 1

UPDATED FACILITY PLAN

1.1 Introduction

The 2017 Wastewater Facility Plan (Facility Plan) outlines a path forward for Magna Water District (MWD) to meet the new technology-based phosphorus limit (TBPEL) of 1 milligram per liter (mg/L), address aging infrastructure, and meet the steady growth excepted in the MWD service area. Based on the results of the Facility Plan, various process improvements were recommended to MWD to implement. These improvements include a new chemical and electrical building, new secondary clarifier, aeration equipment upgrades, and the C-7 pipeline. Now that construction of these improvements is nearing completion, an update to the 2017 Facility Plan is required to reflect the plant upgrades, incorporate updated population projections, and evaluate future projects for MWD. The objective of this document is to reflect those changes by updating specific sections of the Facility Plan. These specific sections are as follows:

- Update population projection.
- Update hydraulic and treatment capacity.
- Recommend alternative.
- Evaluate influent pump station modifications.
- Evaluate secondary reuse modifications at the plant
- Long-term planning.

Since the likelihood of wastewater treatment plant receiving wastewater flows from the new prison has diminished, any updated tables or discussion will exclude flows from the prison and Northwest Corridor. Refer to Chapter 1 of the Facility Plan for description on growth scenarios.

This report acts as a supplemental document to the Facility Plan. Therefore, many of the details about the wastewater plant such background information, wastewater characteristics, process flow diagrams, service area, and process descriptions will not be discussed. Refer to the 2017 Facility Plan for this information.

1.2 Population Projections and Future Flows

The updated population projections shown in Table 1 are based off the MWD Water and Sewer Master Plan (2019). The updated populations are slightly higher than the values listed in the Facility Plan, with the largest differential being 800 more people in 2030. Refer to Table 1.1 of the Facility Plan for previous population numbers.

Table 1 Magna Water District Service Area Population Projections

	2020	2025	2030	2035	2040	2050
Total(1)	32,430	35,012	38,047	40,254	42,323	46,662

Notes:
(1) All population values correspond to MWD Water and Sewer Master Plan (2019).

With the updated population numbers, future flows can be recalculated using the same flow of 74 gallons per capita per day (gpcd) used in the Facility Plan. The updated flow projections are show in Table 2. Refer to Table 1.4 of Chapter 1 for previous flow projections. The Facility Plan shows an annual average daily flow (AADF) of 2.95 million gallons per day (mgd) in 2035 and updated projected flows are 2.98 mgd for the same year.

Table 2 Projected Flows for Magna Water District Existing Service Area

	2020	2025	2030	2035	2040	2050
Annual Average Daily Flow (mgd)	2.40	2.59	2.82	2.98	3.13	3.45
Maximum Month Daily Flows (MMDF)(1) (mgd)	3.00	3.23	3.52	3.72	3.91	4.32
Peak Hour Flows (PHF)(2) (mgd)	4.80	5.18	5.64	5.96	6.26	6.90

Notes:
(1) AADF:MMDF peaking factor of 1.25 from Facility Plan.
(2) AADF:PHF peaking factor of 2.00 from Facility Plan.

1.3 Hydraulic and Treatment Capacity

Since many of the evaluations in the Facility Plan used a 20-year planning period, this updated facility plan will use 2020 to describe current flows and future flows for the year 2040. The following sections will assess the hydraulic and treatment capacity of each process. The Facility Plan outlined hydraulic and treatment capacity criteria for the plant in Table 2.1 of Chapter 2. The same criteria will be used in this evaluation. Flows will be based off AADF, maximum month daily flows (MMDF), and peak hour flows (PHF).

1.3.1 Influent Pumps

MWD has two influent pumping stations, the east and west lift stations. The west station pumps screened raw wastewater to either the oxidation ditch distribution box or unscreened wastewater to the east headworks. The east station pumps raw unscreened wastewater to the front of the east headworks. The capacity of each station is show in Table 3. The firm capacity of the east lift station does not meet the 2020 PHFs. The firm capacity of the west lift station meets the 2020 and 2040 PHFs. Because flows are split between the east and west lift stations, the east lift station has been able to accommodate the flows coming into the east wet well.

Table 3 Hydraulic Capacity of Influent Pumps

Process	Hydraulic/ Treatment Criteria	Current Capacity	2020 Required Capacity	2040 Future Required Capacity	Capacity Adequate?	
					2020	2040
East Influent Lift Station	PHF (mgd) Firm Capacity (2+1)	2.9	4.8	6.3	✗	✗
West Influent Lift Station	PHF (mgd) Firm Capacity (2+1)	6.6	4.8	6.3	✓	✓
East + West Influent Lift Station	PHF (mgd) Firm Capacity	9.5	4.8	6.3	✓	✓

1.3.2 East and West Headworks

The wastewater treatment facility has two separate headworks buildings. The flow can be distributed to either the west or east headworks. The west headworks has coarse screening and grit removal upstream of pumping. The east headworks pumps first, then goes through coarse screens, grit removal and fine screening. For each headworks, the capacity of coarse screening and grit removal is 6.0 mgd per channel. Table 4 shows the treatment capacity of each process for each headworks. With both channels in service, each headworks can treat the 2040 PHF. If a channel is down for maintenance, treatment for PHFs will not be met for 2040 at either headworks. The coarse and fines screens at the east headworks each have passive overflows should a channel be down for maintenance during the PHF. MWD is aware of reduced treatment during these times and is not considering upgrading headworks equipment for this facility plan.

Table 4 Hydraulic and Treatment Capacity of East and West Headworks

Process	Hydraulic/ Treatment Criteria	Current Capacity/ Criteria	2020 Required Capacity	2040 Future Required Capacity	Capacity Adequate?	
					2020	2040
East Coarse Screens	PHF (mgd) (1+1)	6.0	4.8	6.3	✓	✗
East Grit Chamber	PHF (mgd) (1+1)	6.0	4.8	6.3	✓	✗
East Grit Pumps	125 gpm per 6 mgd Chamber (1+1)	198	100	130	✓	✓
BIOBROx Feed Pumps	PHF (mgd) Firm Capacity (2+1)	3.7	4.8	6.3	✗	✗
East Fine Screens	PHF (mgd) (2+0)	8.0	4.8	6.3	✓	✓
West Coarse Screens	PHF (mgd) (1+1)	6.0	4.8	6.3	✓	✗
West Grit Chamber	PHF (mgd) (1+1)	6.0	4.8	6.3	✓	✗
West Grit Pumps	125 gpm per 6 mgd Chamber (2+0)	250	100	130	✓	✓

1.3.3 Oxidation Ditches

The C-7 Pipeline Project (2019) retrofitted the existing brush aerators with new surface aerators to reliably remove biochemical oxygen demand (BOD) and ammonia more efficiently. The new surface aerators also allow MWD to control the oxygen output into the system. Table 5 below shows the maximum oxygen output of the new surface aerators at 28,200 pounds per day (lbs/day). With the new upgrades, the aeration requirements for nitrification and BOD removal are met for the 2040 maximum month condition. This is assuming both basins are in service and one aerator is down for maintenance. Concentrations for BOD and Ammonia-N are based off Table 1.5 of the Facility Plan.

Each oxidation ditch has a volume of 1.7 million gallons. With the updated projected flows, the basin volumes still meet the hydraulic retention time (HRT) of 24 hours at AADF for the year 2040.

Table 5 Hydraulic and Treatment Capacity of Oxidation Ditches

Process	Hydraulic/ Treatment Criteria	Current Capacity/ Criteria	2020 Required Capacity	2040 Future Required Capacity	Capacity Adequate?	
					2020	2040
Oxidation Ditch	Aeration for BOD_5 at MMDF (lbs O_2/day)	28,200	13,800	17,000	✓	✓
Oxidation Ditch	Aeration for NH_3 at MMDF (lbs O_2/day)	28,200	5,600	6,900	✓	✓
Oxidation Ditch	Aeration for NH_3 and BOD_5 at MMDF (lbs O_2/day)	28,200	19,400	23,900	✓	✓
Oxidation Ditch	HRT > 24 hours at AADF	24	34.0	26.1	✓	✓

1.3.4 Secondary Clarifiers

With the addition of a third clarifier, the plant can now hydraulic pass more flow through the clarifiers and still meet the treatment criteria with one clarifier out of service. The hydraulic capacity criteria in the Facility Plan lists a not to exceed surface overflow rate of 400 gallons per square foot per day (gal/ft^2-d) at AADF and 800 gal/ft^2-d at PHF. Both the criteria are still met for the 2040 flow projections. Table 6 shows the updated treatment and hydraulic capacity of the secondary clarifiers with one clarifier out of service. The surface overflow rates are not exceeded until an AADF of 3.50 mgd and PHF of 7 mgd. These flows will not be expected at the treatment plant until past year 2050.

Table 6 Hydraulic and Treatment Capacity of Secondary Clarifiers

Process	Hydraulic/ Treatment Criteria	Current Capacity/Criteria	2020 Required Capacity	2040 Future Required Capacity	Capacity Adequate?	
					2020	2040
Secondary Clarifiers	Overflow Rate < 400 gal/ft^2-d at AADF	400	272	354	✓	✓
Secondary Clarifiers	Overflow Rate < 800 gal/ft^2-d at PHF	800	543	708	✓	✓
Secondary Clarifiers	Solids Loading Rate < 24 lb/ft^2/ day AADF	24	18.1	23.6	✓	✓
Secondary Clarifiers	Solids Loading Rate < 41.5 lb/ft^2/ hour at MMDF	41.5	22.7	29.5	✓	✓

1.3.5 Chlorination

MWD has two chlorine contact basins. Each one has a volume of 70,000 gallons. These basins are used for disinfection before discharging to the C-7 Ditch. The hydraulic capacity criteria in the Facility Plan lists an average and peak detention time of 60 for AADF and 30 minutes for MMDF.

The chlorine feed capacity of the system is 1,000 lbs/day of chlorine gas at a concentration of 25 mg/L. Table 7 shows the results of hydraulic and treatment capacity of the chlorine contract basins. Based on the updated flows, the basins have sufficient capacity through 2040.

Table 7 Hydraulic and Treatment Capacity of Chlorine Contact Basins

Process	Hydraulic/ Treatment Criteria	Current Capacity/ Criteria	2020 Required Capacity	2040 Future Required Capacity	Capacity Adequate?	
					2020	2040
Chlorination	Dosing System < 1,000 lbs/day at 25 mg/L, MMDF	1,000	626	816	✓	✓
Chlorination	2 Channels at 60 min. contact time at AADF	60	83	64	✓	✓
Chlorination	2 Channels at 30 min. contact time at MMDF	30	69	53	✓	✓

1.3.6 Hydraulic Evaluation

A hydraulic model using Hydraulix®, Carollo Engineer Inc. (Carollo)'s in-house hydraulic modeling software, was created based off C-7 Pipeline Project and the 1985 record drawings. This newest hydraulic model now reflects the addition of the third secondary clarifier and current conditions at the plant. For this evaluation, criteria used for the hydraulic capacity is defined as no control weirs being submerged or overflowing. Table 8 shows the maximum gravity flow between each process before a control weir is failing. The hydraulic choke point in the system is from the Effluent Box to the C-7 Ditch, with a maximum flow of 9.11 mgd. The evaluation shows that the plant has sufficient hydraulic capacity and will not be needing any hydraulic modifications for the foreseeable future.

Table 8 Hydraulic Evaluation

Flow From	Flow To	Control Point	Max Flow (mgd)	Hydraulic Condition
Effluent Box	C-7 Ditch	Effluent Box Weir	9.11(1)	Overflow(2)
Chlorine Contact Basin	Effluent Box	Chlorine Contract Basin Weir	13.9	Submerged
Metering Structure	Chlorine Contact Basin	Flume	20.8	Submerged
Secondary Clarifier	Metering Structure	Secondary Clarifier Weir	16.8	Submerged
Clarifier Distribution Box	Secondary Clarifier	Clarifier Splitter Weir	9.7(3)	Submerged
Oxidation Ditch	Clarifier Distribution Box	Oxidation Ditch Effluent Weir	12.7	Submerged
Oxidation Ditch Distribution Box	Oxidation Ditch	Oxidation Ditch Distribution Splitter Weir	8(4)	Submerged

Notes:
(1) Per Drawing C7-02 of the Water and Wastewater Treatment Upgrades Project (Oct 2018).
(2) Overflows to Kersey Creek.
(3) With two clarifiers ON, total flow from secondary distribution box to secondary clarifiers is 19.4 mgd.
(4) With two oxidation ditches ON, total flow from oxidation ditch distribution box to oxidation ditches is 16 mgd.

1.4 Recommended Alternatives

The Facility Plan outlines several treatment process alternatives for MWD to satisfy both the projected growth and the discharge permit issued by the Utah Division of Water Quality (DWQ). Refer to Chapter 3 of the Facility Plan for a description of each alternative. The listed alternatives evaluated are as follows:

- Alternative No. 1: Pipeline to C-7 Ditch.
- Alternative No. 2: Nitrification and Ultraviolet (UV) Disinfection.
- Alternative No. 3: Biological Nutrient Removal and UV Disinfection.
- Alternative No. 4: No Action.

Based on the results of the economic and non-economic analysis, Alternative 1 was the recommended treatment alternative to implement. The C-7 pipeline changes the point of discharge of the plant from Kersey Creek to the C-7 Ditch. The construction of the C-7 pipeline is very important for MWD as it alleviates the need for major process improvements to meet lower ammonia limits set by the DWQ for Kersey Creek.

With the updated population flow projections outlined in Table 1 and 2, Alternative 1 is still the recommended alternative to MWD.

1.5 Influent Pump Station Modifications

The west headworks, constructed in 1965, is very old and has reached the end of its useful life. The structure is deteriorating, and equipment involves high maintenance and operational stress. Any operational costs to maintain the west headworks are sunk costs because MWD plans are to demolish the west headworks and remove the existing west influent pumps. Current operations at the plant have flows bypassing the west headworks equipment entirely, and then pumped to the front of the east headworks. See Figure 1 for the process flow diagram for the east and west headworks.

Removal of the west headworks and influent pumps would require all influent sanitary sewer (SS) lines to be rerouted to the east headworks. The invert elevation of the exiting 30-inch SS line would allow the pipe to be rerouted by gravity to the existing distribution box, which then flows to the east headworks wet well. See Figure 2 and 3 for record drawings of invert elevations for the 30-inch SS line and the existing distribution box. All elevations will need to be verified in the field. Should the elevation of the 30-inch SS be lower than the distribution box, a new manhole with lift pumps will be installed to lift the wastewater to the distribution box. Other return process flows or existing SS lines would be rerouted to go directly to the east headworks wet well.

MWD also plans on receiving future flows at the plant. A new 24-inch SS line will be constructed in the next few years to receive flows from the Gateway to Little Valley development. This new line would need to be accommodated for as part of the influent pumping modifications.

The following items would be required should the west headworks be demolished:

- Reroute existing 30-inch SS line to the east lift station by gravity.
- Install a new sewer manhole to intercept future sewer line connections.
- Remove and replace east influent pumps with larger pumps.
- Evaluate headworks screening and grit removal equipment.

- Increase the east wet well pumping volume.
- Modify mechanical piping in east headworks.
- Remove and replace BIOBROx® feed pumps with larger pumps.
- Provide new yard piping for BIOBROx® feed pumps to feed directly into the oxidation ditch distribution box.
- Electrical and instrumentation improvements.

Figure 4 shows the proposed new primary treatment process flow diagram after the west headworks is demolished and the existing influent pumps are removed. All raw influent flows would go through the east headworks and directly pump to the oxidation ditch distribution box. A single lift station and headworks will provide many advantages to MWD and treatment operation staff.

The BIOBROx® feed pumps that sends screened wastewater from the east headworks to the oxidation ditch distribution box will also need to be replaced and upsized to meet the future PHF conditions. Yard piping modifications are required so pumped flows are sent straight to oxidation ditches instead of passing through the BIOBROx® building. This will allow MWD to utilize the BIOBROx® building to send treated effluent through the pressurized membranes to meet Type I reuse.

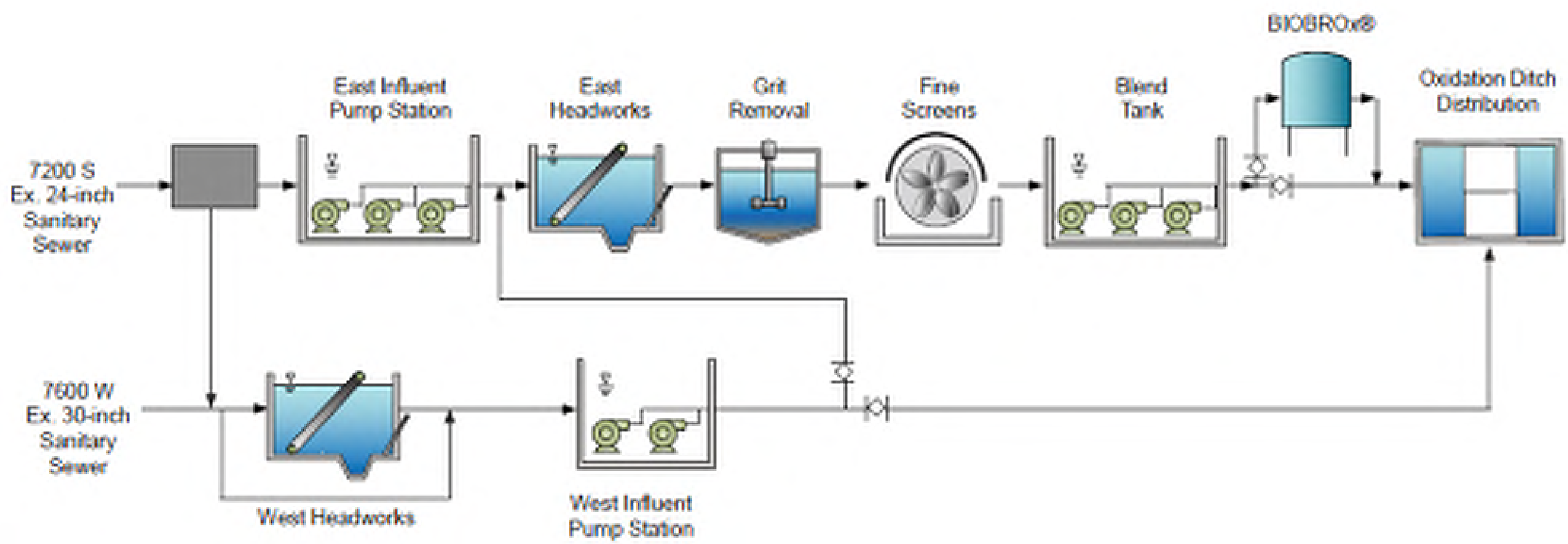

Figure 1 Existing Primary Treatment Schematic

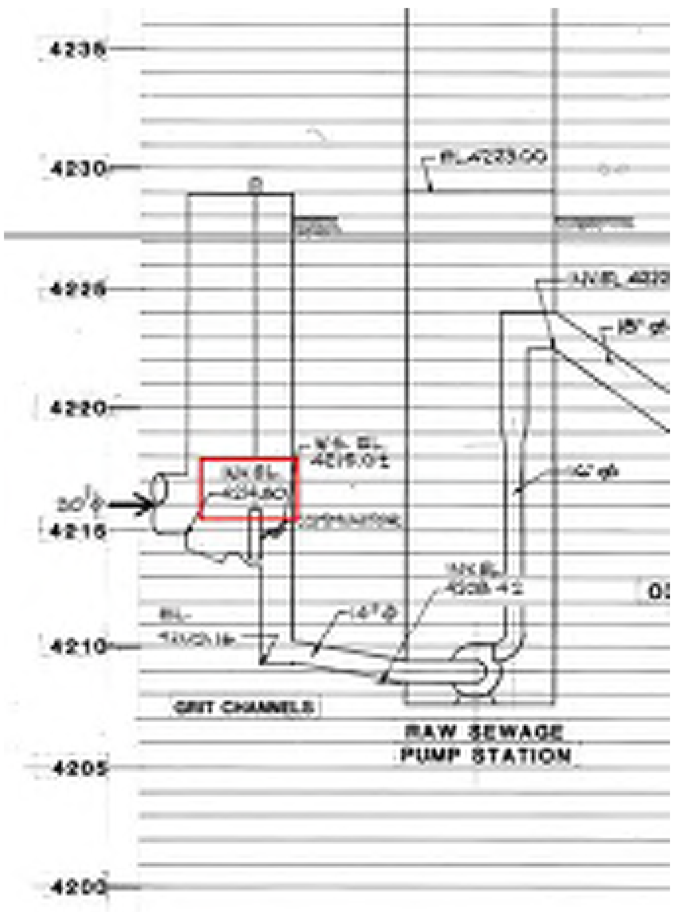

Figure 2 30-inch SS Invert Elevation

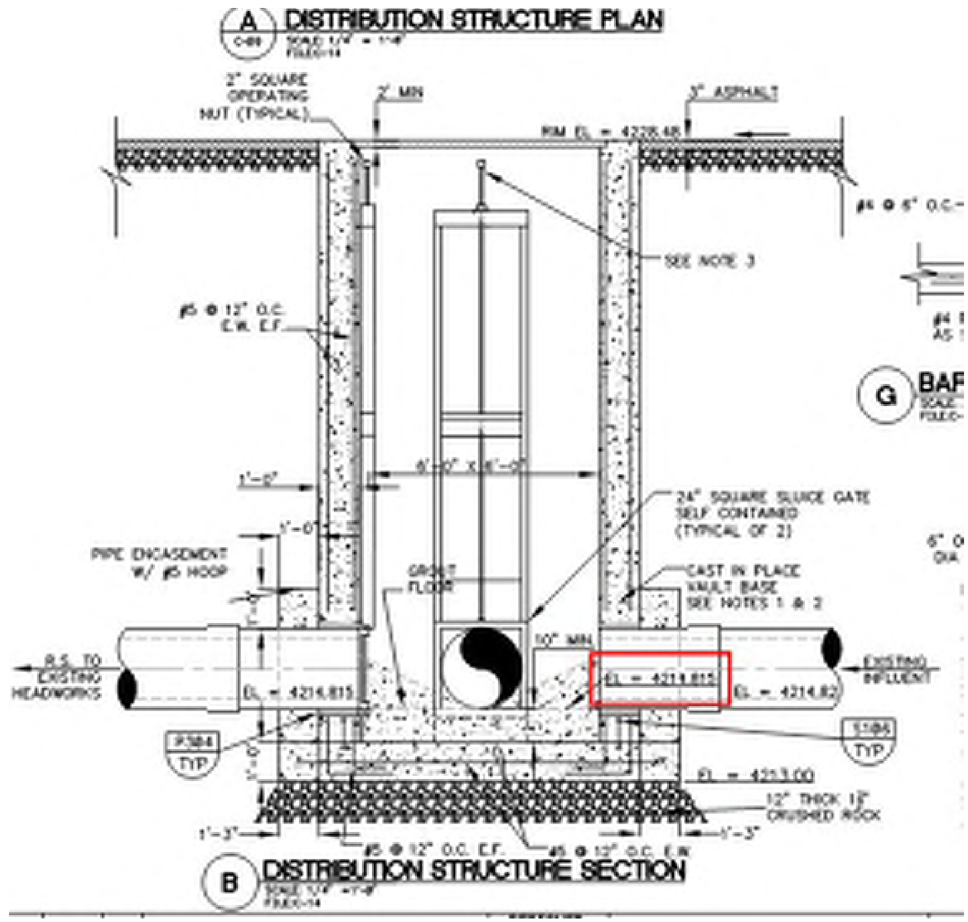

Figure 3 Distribution Structure Invert Elevation

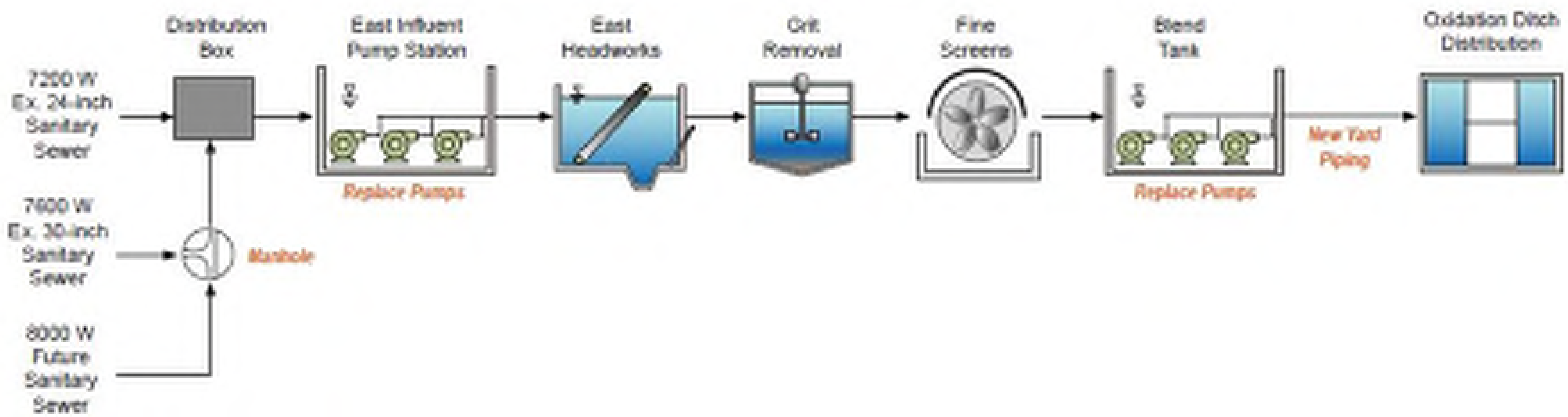

Figure 4 Influent Pumping Modifications

1.5.1 Cost and Schedule

The costs and proposed schedule associated with influent pump station modifications are shown in Table 9 and Figure 5 below. It has been indicated by MWD that the project would like to be completed at the same time the new 24-inch SS is tied into at the plant. This would require MWD to start pre-design report for the project sometime next year.

Table 9 Cost Estimate for Influent Pump Station Modifications

Item	Total
General Conditions(1)	$280,000
Demolition(2)	$350,000
Replace East Influent Pumps (3x)	$216,000
Replace Blend Tank Influent Pumps (3x)	$216,000
Headworks Mechanical Piping Modifications	$150,000
Yard Piping Modifications	$415,000
Site Work	$400,000
Electrical and I&C	$960,000
Contingency (30%)	$897,000
Total Direct Costs	**$3,884,000**
General Contractor OH&P (20%)	$776,800
Bid Market Allowance (5%)	$194,200
Total Construction Costs	**$4,855,000**
Admin and Engineering (18%)	$873,900
Total Project Costs	**$5,728,900**

Notes:
(1) Includes Contractor mobilization/demobilization, bonding, lifting equipment and temporary facilities.
(2) Demolition of West Headworks and West Influent Pump Station.

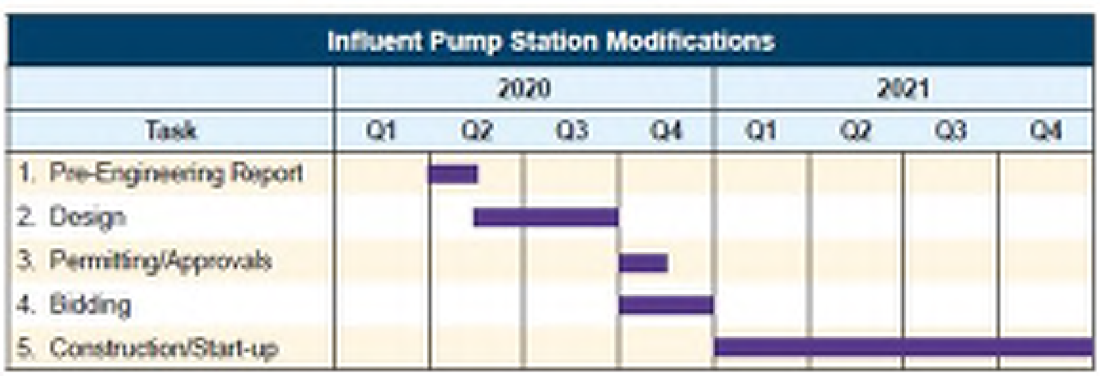

Figure 5 Influent Pump Station Modifications Proposed Schedule

1.6 Secondary Reuse

MWD has long desired to have reliable secondary reuse water for residential irrigation in place of culinary water or water from the Jordan River. The secondary reuse project has many important advantages for the district, one of them being replacing the demand at the electro dialysis reversal (EDR) facility with type I reuse water from the treatment plant. For the secondary reuse project, the project can be broken out into two parts: rehab at the wastewater treatment plant and upgrades to the distribution system. This updated facility plan will only focus on the upgrades required at the plant.

First a Project Plan for the reuse project must be submitted to DWQ for approval. The requirements for the Project Plan are outlined under Rule R317-3-11 on DWQ's website. Major elements of the report are description of the treated wastewater, assessment of the direct hydrologic effects of the action, nutrient management, and agronomic uptake analysis and a description of public notification and participation. A copy of the Project Plan must also be submitted and approved by the local health department.

In order to ensure the BIOBROx® pressurized filters can meet the project objectives, a pilot study can be conducted. The pilot study will help address media type and size, headloss, empty bed filter times, effluent turbidity and other important filter parameters. Results will need to be summarized in a formal report and be used to help make informed design decisions.

The design and construction of the plant upgrades for secondary reuse are as follows:

- Finished water effluent pipeline to a new BIOBROx® feed pump station.
- Mechanical upgrades at the BIOBROx® building and filter media replacement.
- New disinfection process for secondary reuse effluent.
- New finished water pumps and pipeline to distribution system.
- Chlorine system for residual.
- Electrical and instrumentation improvements.

Figure 6 shows the proposed secondary reuse treatment process flow diagram. For further information on the secondary reuse project, refer to Secondary Water Alternatives Report (2019) and Reclamation and Reuse Project Grant Proposal (2018).

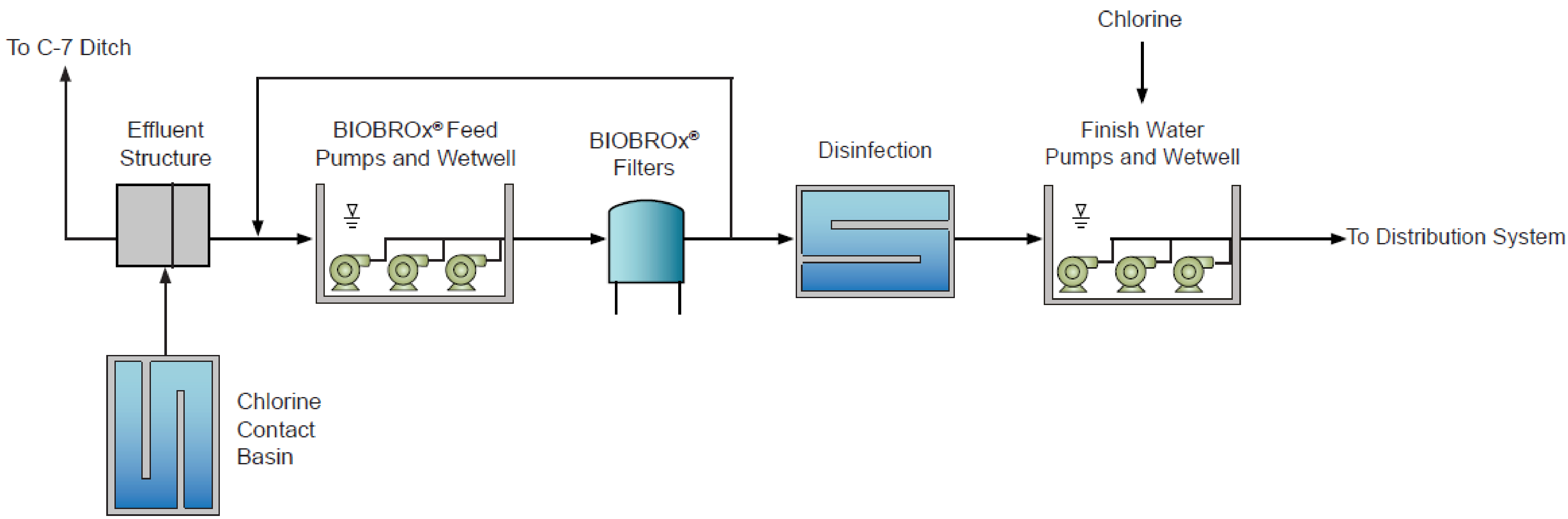

Figure 6 Secondary Reuse: BIOBROx®

1.6.1 Cost and Schedule

The costs and proposed schedule associated with secondary reuse project at the plant are shown in Table 10 and Figure 7 below. MWD has recently been informed that the DWQ will give the district a 5-year variance for TBPEL limit at the plant should the district move forward with the secondary reuse project.

Table 10 Cost Estimate for Secondary Reuse

Item	Total
General Conditions(1)	$600,000
BIOBROx® Rehab - Equipment and Mech	$300,000
BIOBROx® Feed Pump Station	$1,100,000
Disinfection	$950,000
BIOBROx® Feed Pumps (3x)	$168,000
Finished Water Pumps (3x)	$168,000
Yard Piping and Site Work	$1,500,000
Electrical and I&C	$1,721,000
Contingency (30%)	$1,953,000
Total Direct Costs	**$8,461,000**
General Contractor OH&P (20%)	$1,693,000
Bid Market Allowance (5%)	$423,000
Total Construction Costs	**$10,577,00**
Admin and Engineering (18%)	$1,903,900
Total Project Costs	**$12,480,900**

Notes:
(1) Includes Contractor mobilization/demobilization, bonding, lifting equipment and temporary facilities.

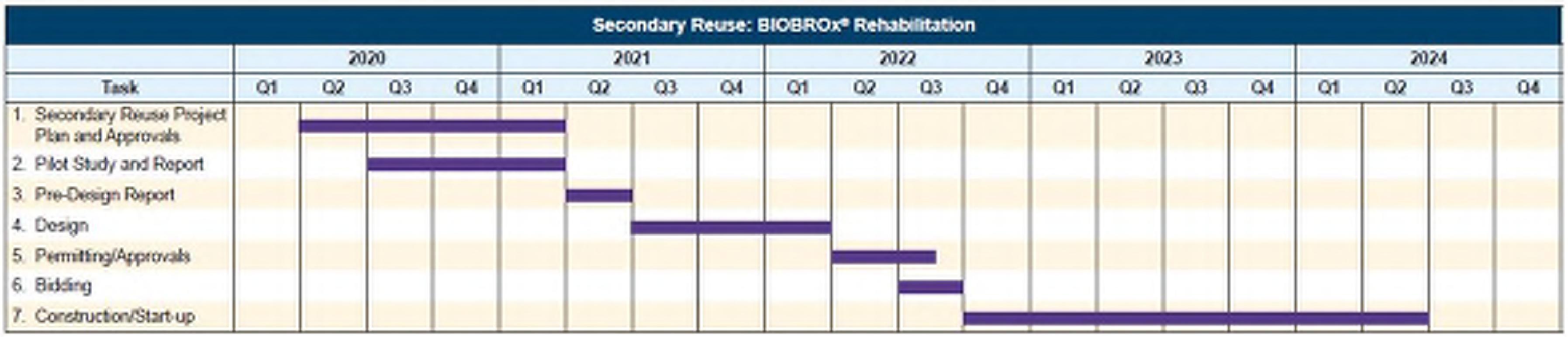

Figure 7 Secondary Reuse: BIOBROx® Rehabilitation Schedule

1.7 Long Term Planning

The improvements that have happened since the 2017 Facility Plan, and suggested improvements for the 20-year planning period are presented in Table 11. They include status of the project, capital costs, yearly operation and maintenance (O&M) costs, and annual lifecycle cost. The two near future projects for MWD are the influent pump station modifications and secondary reuse project.

1.7.1 State Nutrient Criteria

The Facility Plan discusses DWQ's potential plan for future statewide total nitrogen regulations for municipal wastewater treatment plants. Refer to Section 3.2.3 for discussion. Possible scenarios for regulated total nitrogen could be anywhere from 20 mg/L to as low as 10 mg/L. MWD would have to have considerable upgrades at the plant to meet either of these requirements. Though planning and costs associated for nitrogen removal are outside the scope of this report, discussions need to be start for MWD to evaluate modifying impact fees for upgrades to meet the new nitrogen limit should regulations be passed.

Table 11 Status of Facility Improvements

Item	Description	Status of Project	Total Project Costs	Yearly O&M Cost	Annual Lifecycle Cost(1)
01	Brine Pipeline	Complete	$1,587,227	$ -	$107,000
02	C-7 Pipeline Project	Nearing Completion	$15,928,000	$187,000	$1,258,000
03	Brine Pump Station	Nearing Completion	$3,342,762	$ -	$225,000
04	Influent Pump Station Modifications	Conceptual	$5,728,900	$15,000(2)	$400,000
05	Secondary Reuse: Plant Upgrades	Report	$12,480,900	$350,000	$1,189,000
06	Secondary Reuse: Distribution System	Conceptual	$22,760,000(3)	$ -	$1,284,000

Notes:
(1) Project and O&M cost annualized for 20 years at 3%.
(2) Difference in power cost associated with existing pumps to newer pumps.
(3) Updated from Reuse Grant Proposal (2018).
(4) Includes Pilot rental, setup, lab results, and report.