SPRINGVILLE CITY, UTAH
WATER RECLAMATION FACILITY

MASTER PLAN &
IMPACT FACILITY FEE PLAN
UPDATE

2024

Published by:

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DEFINITIONS & ABBREVIATIONS

The following is a list of definitions for terms and abbreviations used throughout this plan for reference, presented in alphabetical order.

ADF: Average Daily Flow or the total average flow received by the plant over a typical 24-hour period.

Aerobic: An environment with sufficient dissolved oxygen to allow aerobic microorganisms to thrive.

Anaerobic: An environment with little to no available oxygen. This environment is required by certain microorganism and is used primarily for certain types of digestion and for biological phosphorus removal from wastewater.

Anoxic: An environment with relatively low dissolved oxygen levels in which typical aerobic microorganisms cannot thrive.

BNR: Biological Nutrient Removal – term used to describe biological (i.e. non-chemical) treatment processes to remove nutrients such as phosphorous and nitrogen. BNR traditionally consists of anaerobic and anoxic processes.

BOD: Biological Oxygen Demand, the amount of dissolved oxygen needed by aerobic microorganisms in water to break down and process organic material. This is a typical measure of the loading or "strength" of wastewater entering a wastewater treatment plant.

Biosolids: Nutrient rich organic material produced from waste sludge at wastewater treatment plants, frequently used as compost.

CMU Concrete Masonry Unit – concrete block commonly used in building construction.

DAF: Dissolved Air Flotation – a treatment process that utilizes to float constituents to the surface of a tank for easy concentration and/or removal.

DAFT: Dissolved Air Flotation Thickening – a treatment processes that uses dissolved air to float waste activated sludge (WAS) to the surface to thicken the sludge prior to digestion or dewatering/disposal.

Denitrification: The anoxic (low oxygen environment) process by which nitrates (e.g. NO_3, NO_2 etc.) are converted to nitrogen gas (N_2) by special denitrifying bacteria that thrive in anoxic environments. Conversion of nitrates to N_2 essentially removes nitrogen from wastewater, reducing the overall total nitrogen content of the water.

GPD: Gallons Per Day.

GPCD: Gallons Per Capita (per) Day.

Effluent: Term used for the treated wastewater from the treatment plant that is being discharged from the plant to its discharge point, typically an adjacent stream, canal, or other surface waterway.

ERU: Equivalent Residential Unit, a standard unit that represents wastewater flow and demand from one typical residential household.

HRT: Hydraulic Retention Time, references the design average storage time a given basin or volume provides for a given flow rate.

Influent: Term used for the raw, untreated wastewater flow from the sewer collection system into the wastewater treatment plant.

MGD: Million Gallons (per) Day.

MLSS: Mixed Liquor Suspended Solids, a measurement of the concentrations of the suspended solids in an aeration or other biological treatment basin at a wastewater treatment plant.

NH_3: Chemical formula for ammonia, a common component of wastewater.

NO_x: Generic chemical formula for the family of nitrate/nitrite type compounds, essentially any dissolved compound in wastewater that consists of a combination of nitrogen and oxygen atoms.

Nitrification: The aerobic (oxygen rich environment) process by which ammonia is converted to nitrates (e.g. NO_3) by nitrifying microorganisms.

O_2: Chemical formula for oxygen gas.

PHF: Peak Hour Flow or the anticipated maximum flow rate occurring during the peak hour over a typical 24-hour period.

P: Phosphorus; can represent orthophosphate or total phosphorous depending on the context.

RAS: Return activated sludge.

Sludge: Mixture of solids from clarifiers and biological process basins and other solids removal processes consisting of a mixture of organic and inorganic material. Sludge is routinely removed from the main processes basins and sent to digesters for additional treatment.

TN: Total nitrogen, a measurement of the total nitrogen in a given water sample.

TKN: Total Kjeldahl Nitrogen is the total concentration of organic nitrogen and ammonia in a given water sample. This specific parameter is commonly measured for wastewater applications as it gives more accurate nitrogen loading in terms of impact and capacity for wastewater treatment plants.

TSS: Total Suspended Solids, a measurement of all solids, both organic and inorganic, contained in a given water or wastewater sample. This is another standard measure of the loading or "strength" of wastewater entering a wastewater treatment plant.

TWAS: Thickened waste activated sludge (WAS)

UAC: Utah Authority Code.

UPDES Utah Pollution Discharge Elimination System

UV: Ultraviolet light, UV light is a common method used to disinfect wastewater.

WAS: Waste activated sludge

WRF: Water reclamation facility, another name referencing the Springville City's wastewater treatment plant.

EXECUTIVE SUMMARY

This plan reviews the capacity and condition of the existing Springville City Water Reclamation Facility (WRF) and identifies equipment, facilities, and processes that require updates or expansion to meet current and future projected demands. Population growth and design criteria used in this plan were adopted from the 2020 Sewer Master Plan as published by Hansen, Allen, and Luce Engineers (HAL, 2020) and the 2022 WRF Capital Facility Plan (AQUA, 2022).

The existing WRF's rated flow capacity is 6.6 MGD with a peak hour capacity of 9.3 MGD, including flow from Nestle. The facility is designed to treat 22,300 #BOD/day (including 12,500 #/day from Nestle), 10,100 #TSS/day (including 2,345 #/day from Nestle), 1,410 #TKN/day (TKN from Nestle is negligible), and 990 # phosphorous/day (including 188 #/day from Nestle). The facility has an effluent phosphorous limit of 1.0 mg/L (annual average) which it meets with chemical addition that was implemented in 2020-2021. There is no permit limit for total nitrogen (TN), but a TN limit is anticipated within 10 years. In general, the WRF appears to have sufficient capacity for at least the next 15 years with current permit requirements as long as aging equipment is maintained or replaced proactively.

Current average daily flow to the plant is 3.6 MGD, including 0.5 MGD from Nestle. Based on established flow and growth projections, the recommended 2043 design average daily and peak hour flows are 6.4 MGD and 9.7 MGD respectively. Recommended current (2023) peak hour design flow is 7.3 MGD. The facility has adequate hydraulic capacity for an estimated 20 years. New equipment, facilities, and piping should accommodate higher peak flow rates (up to 11 MGD for a 2060 target design) per the 2020 Sewer Master Plan recommendations.

Influent BOD loading from the main collection system averages 5,340 #/day, with some months averaging over 6,500 #/day. The recommended current and 2043 design daily BOD loads are 7,432 and 10,282 #/day provide a conservative estimate for peak demand days. Nestle BOD loading averages 5,650 #/day, with only a few data points exceeding 12,000 pounds; thus the current design load of 12,500 #/day for Nestle still appears adequate. Total recommended 2023 and 2043 BOD loading are 19,932 and 22,477 #/day. Thus, the WRF has adequate BOD capacity for an estimated

18 years. Total TSS loading averages 4,345 #/day, with some months averaging 6,500 #/day. This represents loading lower than previous design criteria would predict. However, some days show high TSS loading (in excess of 10,000 #/day), and AQUA recommends that the current per capita and Nestle TSS design criteria be maintained. Assuming 2,345 #/day from Nestle, 2023 and 2043 design TSS loads are 8,000 and 10,169 #/day.

TKN loading averages 1,070 #/day, with municipal concentrations ranging from 35 to 51 mg/L. Previous design assumed TKN concentrations of 30 mg/L. Based on data, the recommended minimum design concentration is 35 mg/L. TKN and ammonia loading from Nestle is negligible (< 20 #/day). Resulting design TKN loading for 2023 and 2043 are 1,163 and 1,609 #/day. Phosphorus is removed chemically (with alum or ferric). P concentrations average 4.8 mg/L with a total loading of 356 #/day, including an assumed 188 #/day from Nestle. Recommended design criteria for influent P are 6.5 mg/L, resulting in 398 and 479 #/day for 2023 and 2043 respectively. Complete design criteria are summarized in the following table. Items *highlighted in yellow* indicate design values that exceed the current rated capacity of the WRF.

Parameter	2023	2043	2060
Population	36,772	50,875	58,378
Collection System ERUs (Excludes 3,400 ERUs dedicated to Nestle)	16,156	22,353	25,649
Total Design ADF @ 250 gpm/ERU (Design ADF Capacity is 6.6 MGD)	4.89 MGD	6.44 MGD	**7.26 MGD***
Calculated Total Peak Flow** (Design PHF Capacity is 9.3 MGD)	7.3 MGD	**9.7 MGD***	**11.0 MGD***
Domestic/Collection System BOD Load (Design BOD Capacity is 9,800 #/day)	7,432 #/day	**10,282 #/day***	**11,799 #/day***
Total Influent BOD Loading (Total Design BOD Capacity is 22,300 #/day)	19,932 #/day	**22,782 #/day***	**24,299 #/day***
BOD Loading to Secondary Process† (Design Secondary BOD Capacity is 12,625 #/day)	11,086 #/day	**12,939 #/day***	**13,924 #/day***
Total TSS Loading (Design TSS Capacity is 10,100 #/day)	8,000 #/day	**10,169 #/day**	**11,323 #/day**
Total TKN Loading (Design TKN Capacity is 1,416 #/day)	1,163 #/day	**1,609 #/day**	**1,847 #/day**
Total Phosphorus Loading	398 #/day	**479 #/day**	**521 #/day**

Generally, the existing facility is operating well and meeting permit requirements. The process occasionally struggles to meet effluent ammonia limits during winter months. Most major processes have the capacity to treat anticipated loads for at least 15 more years assuming no changes to current permit requirements. Projected design loads from the previous table indicate that design capacity for most constituents will be reached sometime between 2040 and 2043. However, some equipment needs to be repaired or replaced because it is either undersized, has reached the end of its reliable service life, or is not performing reliably. These improvements should be implemented within the next 6 years and are collectively presented as Phase 1 herein. Phase 1 projects are further separated into more urgent, *Immediate Needs* and time-sensitive *Recommended Near-Term* projects. Immediate needs projects should not be delayed as they address aging equipment that is at or past its reliable service life. Operators have already budgeted and begun preliminary planning for some of the immediate needs projects. Phase 1 immediate needs improvements include:

- Replacing the screens and grit removal equipment in the headworks.
- Rehabilitating the primary clarifier mechanisms; unless critical components are severely corroded, rehabilitation should extend clarifier life until Phase 2 is implemented.
- Rehabilitating the sand filter media beds or updating the process to tertiary disk filtration.
- Replacing biogas handling piping, valves, and appurtenances.
- Replacing aging electrical gear in the older pumphouse building.

Near-term projects are less time sensitive but address deficiencies (such as standby generators) or aging infrastructure that should be proactively replaced (such as digester coating, digester heating systems, or replacing the STM Aerotor wheels). The timing of these projects will depend on the available budget, city priorities, and whether certain equipment requires more immediate attention than anticipated. Recommended near-term projects include:

- Installing a boiler to improve digester sludge heating and rehabilitating the digester lid coatings and insulation.
- Replacing the STM Aerotor wheels with fine bubble diffusers (and blowers). This conversion could be delayed until Phase 2, but scheduled repairs and maintenance require a

nearly $1,000,000 rehabilitation. This repair cost would likely cover most of the expense of replacing the Aerotor wheels.

- Installing rotary fan presses to replace the smaller sludge dewatering belt press.
- Installing standby power generators.

Preliminary cost estimates for these improvements are summarized in the following table.

Springville WRF Phase 1 Upgrade - Cost Estimate Summary	
Immediate Needs Projects	
Item	**Cost**
Influent Flow & Headworks Upgrades*	$ 3,329,040.00
Recoat Exisitng Primary Clarifier Mechanisms**	$ 310,200.00
Tertiary Filtration Upgrades	$ 2,437,600.00
Digester & Biogas Handling Upgrades	$ 591,662.00
Replace Pump Bldg. MCCs, PLC, and Transformer	$ 483,000.00
Immediate Needs Subtotal	**$ 7,151,502.00**
Recommended Near-Term Projects	
Item	**Cost**
Digester Heating & Lid Rehabilitation	$ 1,903,687.00
Retrofit STM Aerotor Basins w/ Fine Bubble Diffusers	$ 1,270,150.00
Standby Generators	$ 1,322,520.00
Sludge Dewatering Upgrades	$ 1,468,038.00
Near-Term Projects Subtotal	**$ 5,964,395.00**
PHASE 1 TOTAL	**$ 13,115,897.00**

Phase 2 improvements mostly address a new level of service required for a future total nitrogen permit limit and long-term capacity and expansion needs of the WRF. The existing process is not suited for total nitrogen reduction and this permit change is expected within the next 10 years. Likewise, biological phosphorus (P) removal can be implemented, significantly reducing the chemical demand needed for P removal. Recommended Phase 2 improvements include:

- Replace primary clarifier mechanisms; additional rehabilitation may be possible, but plans should be made to eventually replace the mechanisms.

- Replace the trickling filters with new biological nutrient removal (BNR) basins for phosphorous and total nitrogen reduction.
- Install new aeration basins (and upgrade existing STM Aerotor to aeration basins if not completed in Phase 1).
- Replace the sand filters with disk filters (allows for Type I reuse as well) if not completed during Phase 1.
- Expand the capacity of the UV disinfection system and upgrade for Type I reuse if desired.
- Incorporate side stream P removal from the digested sludge flow stream.
- Replace digester lids and recoat digester tank interiors.
- Expand compost facility capacity.

Replacing the sand filters with disc filters (or other advanced tertiary filtration) and installing a higher-dose UV disinfection system are optional but would allow the WRF to produce Type I reuse water. A new covered tank and odor control for the Nestle roughing tower are also recommended as part of Phase 2. Preliminary cost estimates for these improvements are summarized in the following table. Finally, it is noted that the State is requiring all cities interested in securing reuse water rights to submit applications to the State Engineer by November 2023. This does not necessarily require that plans or equipment be in place to produce reuse water by then, but the application must be submitted to keep the option available to the City in the future.

Springville WRF Phase 2 Upgrade - Cost Estimate Summary	
Item	**Cost**
Replace Primary Clarifier Mechanisms	$ 2,955,095.00
BNR & Aeration Basins Replacing Trickling Filters*	$ 14,019,720.00
UV Disifinfection Expansion (Type I Reuse)	$ 4,298,937.00
Digester Sidestream Treatment	$ 348,562.00
Digester, Sludge Handling & Building Rehabilitation	$ 2,927,925.00
Expand Composting Facility Area	$ 1,569,750.00
Miscellaneous Phase 2 Civil Upgrades	$ 2,302,300.00
TOTAL	**$ 28,422,289.00**
Nestle Roughing Tower Upgrades**	$ 2,976,545.00

* Assumes that STM Aerotors were replaced as part of Phase 1.

** Expenses associated with roughing tower improvements will likely be covered or at least shared with Nestle, depending on the City's agreement with them.

CHAPTER 1 - INTRODUCTION

1.1 Introduction and Purpose

This document is a Master Plan for the Springville City Water Reclamation Facility (WRF), located in Utah County, Utah. This plan is adapted from the 2022 Capital Facility Plan (CFP) prepared by AQUA Engineering (AQUA, 2022) and utilizes growth projections and design criteria established in the CFP. The purpose of this plan is to review the design capacity and condition of existing process equipment at the WRF against recommended design criteria and anticipated growth to assess the current and future needs of the facility. Recommended upgrades and expansions are categorized into immediate, near-term, and long-term projects to assist the City with prioritizing and scheduling.

Information from sources including the 2022 CFP (AQUA, 2022), 2020 *Springville City Wastewater Collection System Master Plan* (CSMP) prepared by Hansen, Allen, and Luce Engineers (HAL, 2020), raw data furnished by City operating staff, and preliminary design work by AQUA Engineering are referenced and adopted in this plan. Some cost estimates for critical improvements to existing infrastructure are adopted from the 2019 *Springville Water Reclamation Facility Risk Assessment* prepared by Waterworks Engineers (WWE, 2019).

As the WRF handles influent from the sewage collection system, flow estimates and projections from the 2020 Collection System Master Plan are utilized in this document and confirmed or adjusted based on recent data available from the plant. Data for common influent constituents of concern such as biological oxygen demand (BOD) and total suspended solids (TSS) are compared against previously established design criteria to confirm or justify changing these criteria. Recommended design criteria are analyzed against the current capacity of the WRF processes to determine recommended upgrades and expansion.

This plan summarizes available data and our analysis to:

- Confirm design criteria for average daily flow (ADF), peak hour flow (PHF), BOD loading, TSS loading, and nutrient loading (ammonia, total nitrogen, and phosphorus).
- Establish demand for current, 20-year, and long-term needs of the WRF based on established design criteria and growth projections.

- Review the condition and capacities for all major processes and equipment at the WRF.
- Provide recommended equipment, processes, and upgrades at the WRF to accommodate projected growth and address operational issues.
- Establish preliminary engineer budgets for recommended upgrade projects and provide a timeline and priority for upgrades.
- Develop preliminary design and site plans for the recommended upgrades.

A common unit used to equate population growth to sewage flow rates and loading is an equivalent residential unit (ERU). One ERU represents the contribution of a typical, detached single-family dwelling to the sewer collection system and WRF. Relating current and future flow and loading in terms of ERUs facilitates assigning costs of expansion to new and future connections. As established in the CSMP, CFP, and summarized in Chapter 2, loading from a single ERU is quantified as follows:

- 250 gallons per day (peak flow)
- 0.46 lbs. BOD/day (at 0.20 lbs. BOD/day per person)
- 0.35 lbs. TSS/day (at 0.156 lbs. TSS /day per person)
- 0.072 lbs. TKN/day (at an influent concentration of 45 mg/L)
- 0.013 lbs. Phosphorus/day (at an influent concentration of 6.5 mg/L)

The WRF as currently installed is designed to treat ADF of 6.6 million gallons per day (MGD) and peak hour flows (PHF) up to 9.3 MGD equivalent. The facility removes solids, organic material, nutrients, and other constituents from wastewater as required by the plant's operating permit, issued to Springville by the State of Utah Department of Water Quality (November 2019 Permit UT0020834). Treatment of wastewater is required before effluent is discharged into Little Spring Creek. Effluent requirements from the permit are summarized in Table 1-1.

Table 1-1: Permit requirements summary.

Parameter	Units	Monthly Average	Max Weekly Average	Daily Min	Daily Max
Total Flow	MGD	6.6	-	-	-
BOD5	mg/L	25	35	-	-
BOD5	% Removal	85%	-	-	-
TSS	mg/L	25	35	-	-
TSS	% Removal	85%	-	-	-
Dissolved Oxygen	mg/L	-	-	5.0	-
Ammonia	mg/L	1.8	-	-	8
E.Coli	#/100mL	126	157	5.0	-
Oil & Grease	mg/L	-	-	-	10
pH	STD	-	-	6.5	9.0
Total Phosphorous	mg/L	1.0 (Overall Annual Average)			

In summary, the existing facility includes reduction of BOD, TSS, ammonia, total phosphorus, and disinfection to meet permit requirements. When discussing growth, future connections, and loading, an ERU is used to represent treating the loading and demand on the plant associated with a detached, single-family home connecting to the WRF to be treated to this effluent standard.

Connections that are not straight forward to compare to an ERU (such as schools, commercial connections, industrial connections, etc.) can be related to an ERU by evaluating their flow, BOD, TSS, ammonia (nitrogen), and phosphorous loading. An equivalent ERU is then assigned to the connection based on whichever constituent represents the largest contributing load. For example, a connection with high flow but low or typical constituent loading (i.e. low or typical BOD, TSS, nitrogen, and phosphorous) would use its flow to assign an equivalent ERU to the connection. Another connection may have typical or lower flow, but higher concentrations of BOD, TSS, or nutrients. Accordingly, it would be assigned an equivalent ERU based on whichever constituent had the highest impact on the WRF. In this manner, non-residential connections can be assigned an appropriate and fair impact fee relative to the demand and capacity they require from the WRF.

1.2 Wastewater Treatment Facility Overview

The WRF is located at 700 North and 500 West in Springville City, Utah County, Utah (Figure 1-1). The facility incorporates mechanical bar screens, grit removal, primary clarifiers, trickling filters, STM Aerotor basins, secondary clarifiers, chemical addition (for phosphorous removal), sand filters, UV disinfection, anaerobic digestion, solids dewatering, and composting. Influent from the Nestle-Stouffers industrial connection is pre-treated in a with screens, a dissolved air floatation (DAF) process, and a roughing tower prior to mixing with main collection system wastewater.

The WRF uses a series of mechanical and biological processes to treat wastewater to an acceptable standard prescribed by the State of Utah Department of Water Quality. After mechanical removal of larger debris and heavier solids with screens, grit traps, and primary clarifiers, wastewater is pumped to pass through trickling filters. Blowers push air through stacked fixed media that house bacteria that consume BOD and other nutrients from the waste stream. Effluent from the trickling filters continues to an activated sludge process to further breakdown and remove organic materials and nutrients. Operators monitor the conditions in these basins to maintain the ideal conditions under which these key microorganisms thrive. The microorganisms produce biosolids waste that is periodically removed (wasted) from the activated sludge process and sent to anaerobic digesters for additional treatment and dewatering/disposal. Flow from biological process continues to secondary clarifiers and sand filters to remove remaining solids. Finally, wastewater is disinfected using ultraviolet (UV) light prior to discharging to the outfall located on South Pasture Road.

Solids from the primary clarifiers are sent to the anaerobic digesters along with waste sludge from the secondary process (secondary clarifiers) where bacteria break down some of the remaining organic material. Residual and inert solids from the digesters continue to belt presses that separate water from the solids in preparation for composting. Dewatered biosolids are combined with green waste for composting; finished product compost is offered for residents to purchase and land apply. The condition, capacity, and any recommended upgrades for each of these major processes are discussed in Chapter 3. A plan of the existing WRF is provided in Figure 1-2.

Figure 1-1: Springville City WRF service area and plant location.

Figure 1-2: Existing Springville City WRF site plan.

CHAPTER 2 - DESIGN CRITERIA SUMMARY

2.1 Population and Loading Estimates

The Springville WRF serves the incorporated area of Springville including residential, commercial, and industrial connections (Figure 1-1). This plan summarizes the capacity of the existing WRF as it relates to current and future demands from the service area. Influent wastewater to the plant is a mix of typical municipal wastewater and industrial flow from separately permitted manufacturing facilities including Nestle/Stouffers (Nestle), Duris, Flowserve, Altaview, and SupraNaturals. Influent flow data including flow rates, BOD, TSS, and nutrient loading, along with effluent water quality measurements from 2018 thru September 2022 were used to establish per capita loading and estimate future loads. Flow rates and population growth in the service area were adopted from the 2020 CSMP and 2022 CFP (HAL, 2020; AQUA, 2022). These growth projections and available influent data are used in this plan to compare current and future demands against the rated capacity of the WRF. The primary design criteria to be established and confirmed are herein include:

- Average daily and peak hour flows
- BOD
- TSS
- Ammonia
- Other nutrients (total nitrogen and phosphorous)

Design flow rates from the CSMP and CFP, including average daily flow (ADF) and peak hour flow (PHF), were compared with influent data from the plant to confirm whether established design criteria are valid and reasonable. This plan relates flow and loading in terms of ERUs for reference and planning purposes. The following sections summarize the analysis of available data and recommended design criteria.

2.1.1 Existing Population, Projected Growth & ERU's

The 2020 Census reports a 2020 population of 35,379 in the service area; the estimated 2022 population is 36,772 representing an annual growth rate of ~2.3% over the past two years. The 2020 CSMP estimated equivalent growth at 2.3% through 2022, gradually reducing to 0.67% by 2050 and through 2060. These estimates are close to but slightly lower than the Utah Governor's Office of Management and Budget for Springville. However, given the detailed review of remaining developable land and its potential use in the service area provided in the CSMP, the CSMP estimates are considered more refined and therefore utilized in this master plan. The 2020 CSMP and 2022 CFP relate population growth to ERUs by assuming 1 ERU is equivalent to 2.3 persons. ERUs are further divided into two categories:

1. ***Residential & Other*** – connections from typical households such as single-family homes, apartments, etc. and normal municipal connections including schools, businesses, and hospitals. These connections increase with population growth in the service area.

2. ***Nestle*** – ERUs dedicated to the Nestle industrial connection. This connection is assumed to remain fix and is not expected to increase.

Growth is assumed for residential and other ERUs, while flows and loading from Nestle are expected to remain stable (AQUA, 2022). Table 2-1 provides a summary of projected population and ERUs for Springville through 2060 using growth rates as established in the 2020 CSMP. To stay consistent with the 2020 CSMP and 2022 CFP, 1 ERU has an equivalent peak day flow of 250 gpd. Growth and increased loading to the WRF will be evaluated in terms of additional flow, which is estimated from new ERUs based on population growth. These growth estimates project when sewage flow rates and loading will reach critical values that require expansion of the WRF. This plan focuses on growth and recommended improvements for the next 20 years while providing guidance for long-term expansion over the next several decades. In addition, this plan discusses facilities and equipment that are nearing the end of their reliable service life that will require replacement or major upgrades.

Table 2-1: Summary of projected population growth.

Year	Population	Residential & Other ERUs	Nestle ERUs	Total ERUs
2022	36,772	16,156	3,400	19,556
2025	38,966	17,120	3,400	20,520
2030	42,915	18,855	3,400	22,255
2035	46,902	20,223	3,400	23,623
2040	49,365	21,689	3,400	25,089
2043	**50,875**	**22,353**	**3,400**	**25,753**
2045	51,909	22,807	3,400	26,207
2050	54,585	23,982	3,400	27,382
2055	56,448	24,802	3,400	28,202
2060	58,378	25,650	3,400	29,050

2.1.2 Influent Flow

The permitted and current design hydraulic capacity of the WRF is 6.6 MGD ADF and peak flow up to 9.3 MGD equivalent. Monthly average influent flow data collected from January 2018 through September 2022 are shown in Figure 2-1. The overall monthly median daily influent flow since 2018 is 3.57 MGD and varies from 2.98 to 4.37 MGD. Individual peak day flow as high as 5.82 MGD was noted, with monthly peak day flow averaging just under 4.0 MGD. This total includes influent from the collection system and Nestle.

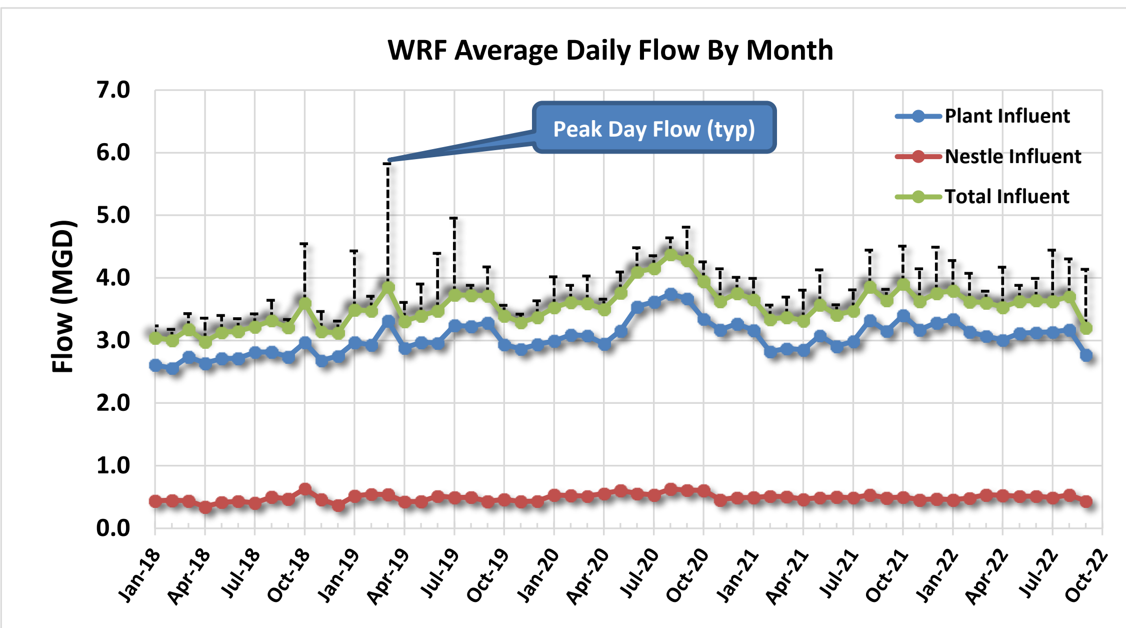

Figure 2-1: Average monthly influent flow from 2018 thru September 2022. Peak day events are noted with dashed error bar lines.

Median influent from the collection system alone is 3.0 MGD (3.10 MGD in 2022); flow from Nestle averages 0.5 MGD and ranges from 0.34 to 0.63 MGD. The City has set aside 3,400 ERUs for Nestle, equivalent to 850,000 gpd. Nestle has stated that they hope to eventually increase production by 10-20%, with an ultimate expansion of 30% possible. Based on their current average (0.5 MGD) and peak flows (0.63 MGD), an assumed hydraulic flow of 850,000 gpd from Nestle is still appropriate. This document continues to dedicate 850,000 gpd to Nestle to accommodate some growth. The CSMP lists a 2018 peak day flow of 4.4 MGD, including 3.67 MGD from 14,850 ERUs (at 250 gpd per ERU) and a concurrent peak influent from Nestle of 688,000 gpd. Using 2022 ERU estimates of 16,156 ERUs and the 3,400 ERUs (850,000 gpd) from Nestle, an equivalent 2022 design flow of 4.89 MGD (including Nestle) is established.

The CSMP quantifies average infiltration, or leakage into collection pipes and manholes, at 0.2 MGD and recommends a design infiltration of 0.4 MGD. Likewise, peak inflow from storm events is established at 2.0 MGD, for a total potential infiltration and inflow (I&I) of 2.4 MGD. This yields a design peak hydraulic load of 6.8 based on 2018 connections. The CSMP mentions that I&I is assumed to remain constant with growth but then estimates a 2060 peak hydraulic flow of 11 MGD. For flow to reach 11 MGD by 2060, I&I must be assumed to increase at the same rate as ERUs in the service area. This is a reasonable approach as growth in the collection system includes additional collection lines and manholes which would add more points for I&I. However, flow data from the past 5 years have not identified any peak flow event approaching 6.8 MGD. Furthermore, newer connections tend to be more water efficient with collection systems more watertight, and the City has invested some time in eliminating suspect points of high I&I. Extended drought conditions will likely decrease per capita water demand (and therefore flow to the plant) as well. Thus, while this study assumes that I&I increases proportionately with new residential and other ERUs to estimate an 11 MGD peak hour flow by 2060, actual peak flows should be reassessed over time to avoid overestimating peak flow. Calculated peak daily flows based on population (ERU) growth, 250 gpd per ERU, and 3,400 ERUs from Nestle is summarized in Figure 2-2. Calculated peak hour flow is shown in Figure 2-3.

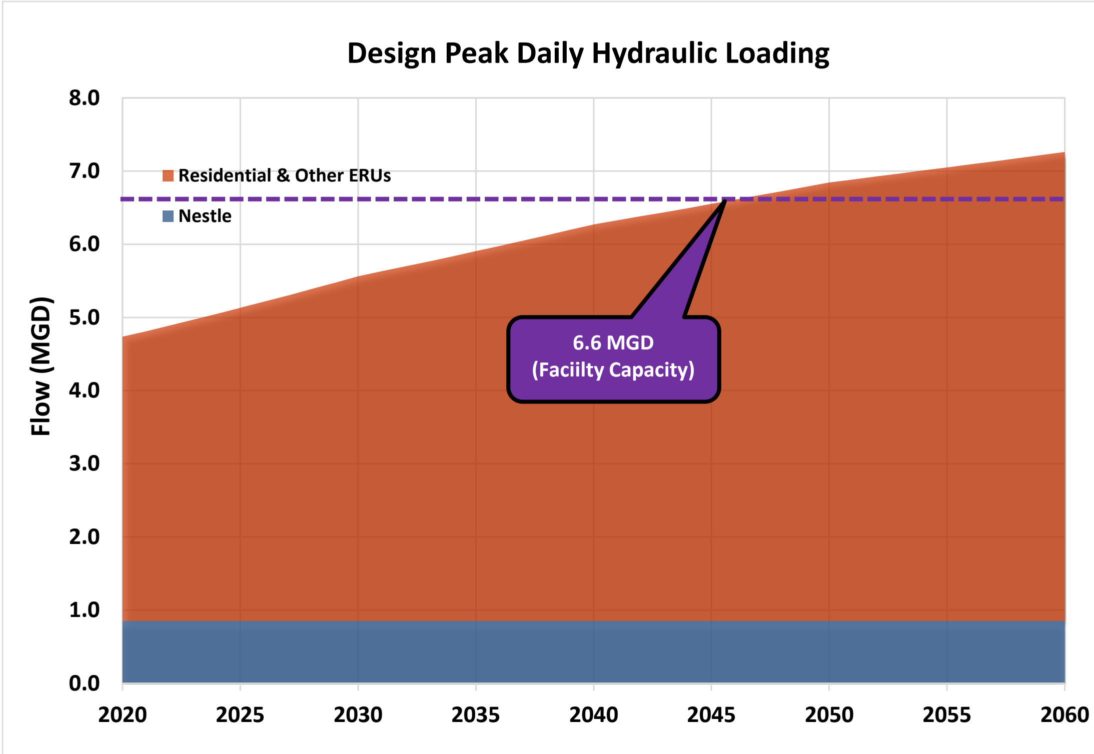

Figure 2-2: Average daily flow estimates.

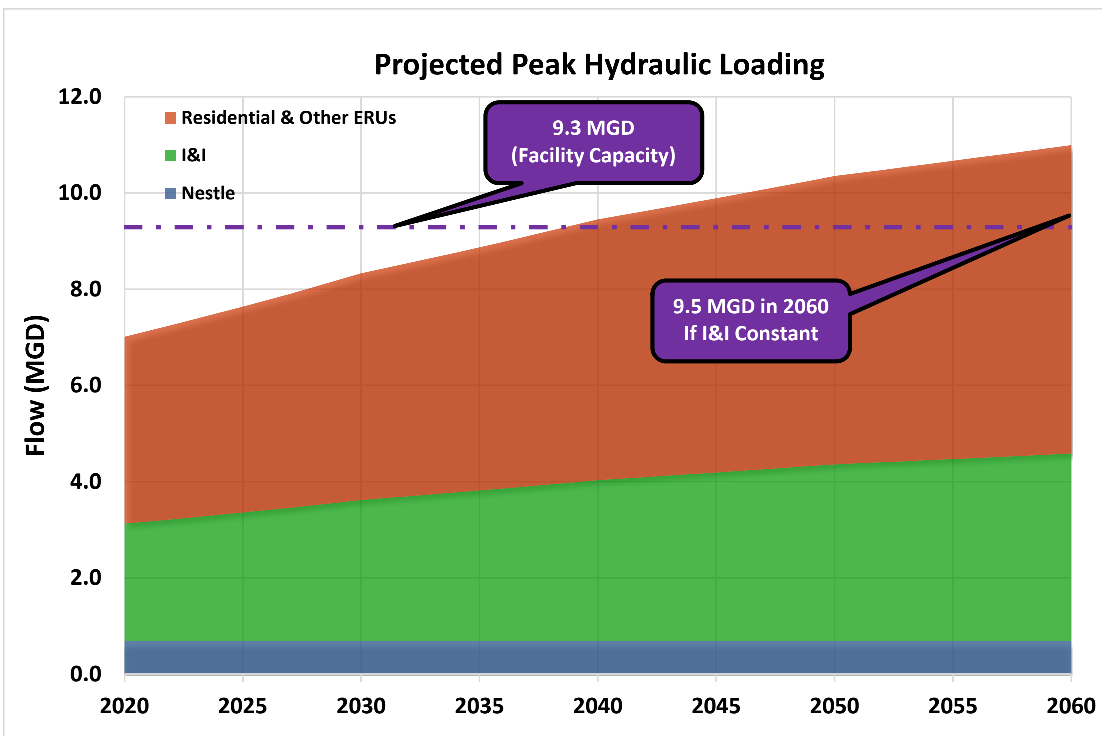

Figure 2-3: Peak flow rate estimates.

In summary, the recommended average and peak day hydraulic flows for current connections are 3.6 and 4.89 MGD respectively. Current design peak hour flows would be 7.3 MGD. Twenty-year (2043) target hydraulic design criteria are 6.4 MGD and 9.7 MGD (Table 2-2). For reference, the current rated peak hydraulic capacity of the WRF is 9.3 MGD, meaning any improvements intended for a 20-year plus service life should accommodate additional hydraulic capacity. As growth patterns and the true impact of I&I can be verified, the actual peak hydraulic demand should be reevaluated and adjusted as merited. The design average daily hydraulic capacity of the existing facility is adequate for current and projected demand for another 20 years. Peak hydraulic capacity may be exceeded in roughly 15 years based on projected peak hour flow. The capacity of equipment, pumps, and especially pipelines should be analyzed prior to implementing any major upgrades or new facilities to ensure that long-term peak hydraulic flow can be handled.

Table 2-2: Summary of projected average daily and peak flows.

Year	Residential & Other ERUs	Nestle ERUs	Total ERUs	ADF MGD	Peak Flow MGD
2022	16,156	3,400	19,556	4.89	7.26
2025	17,120	3,400	20,520	5.13	7.64
2030	18,855	3,400	22,255	5.56	8.33
2035	20,223	3,400	23,623	5.91	8.87
2040	21,689	3,400	25,089	6.27	**9.45**
2043	**22,353**	**3,400**	**25,753**	**6.44**	**9.71**
2045	22,807	3,400	26,207	6.55	9.89
2050	23,982	3,400	27,382	**6.85**	10.35
2055	24,802	3,400	28,202	7.05	10.67
2060	25,650	3,400	29,050	7.26	11.00

* Values highlighted in yellow cells represent flows that exceed the current rated capacity of the WRF.

2.1.3 Influent BOD Loading

Influent flow is only one parameter when considering the WRF's capacity. The concentration or strength of constituents in the wastewater also determine loading on the plant. A plant may be within its hydraulic capacity but exceeding its design biological or solids loading capacity. Specific components of interest contained in wastewater include biological oxygen demand, total suspended solids, and nutrient loading such as ammonia, nitrogen, and phosphorous. The total daily load, determined in pounds of BOD and TSS per day, is a function of each component's concentration and the flow rate. BOD and TSS are monitored for flow from Nestle, and BOD has an established permit limit. As with flow, these loads must be considered in addition to loading from residential and commercial connections to establish the total demand on the WRF.

Design BOD loading is 0.2 #/day per person (0.46 #/day per ERU). This equates to a 2022 load of 7,430 #/BOD based on the estimated 16,156 existing ERUs. Using established growth projections, residential BOD loading will increase to 10,282 #/day by 2043 and 11,800 #/day by 2060. The facility is designed to handle a raw influent BOD load of 9,800 #/day from residential and other connections and an additional 12,500 #/day from Nestle (total 22,300 #/day).

Nestle sends their wastewater to the Springville WRF under the Springville City Industrial Wastewater Discharge Permit No. 3 (valid through 2026). The permit details allowable maximum loading for BOD, TSS, and FOG, and includes surcharges beyond their typical fee for BOD concentrations exceeding 250 mg/L. Design raw BOD concentration from Nestle is 1,500 mg/L or up to 12,500 #/day while the existing permit limits BOD from Nestle to 8,340 #/day. The City also maintains a wastewater discharge permit for SupraNaturals, Flowserve, Altaview, and Duris Electroplating. Unlike Nestle, flow from these connections is not measured separately but combines with influent in the main collection system and is accounted for in the main collection system flow and loading estimates. If additional industrial connections are considered or conditions from any active permit change, impact on the WRF and BOD loading must be considered, and design parameters updated accordingly. A summary of total BOD loading from 2018 through summer 2022 is summarized in Figure 2-4.

Calculated BOD loading from the municipal collection system averages 5,340 #/day, with some months averaging over 6,500 #/day. Given that these values represent monthly averages for daily loading, maintaining the current design daily BOD load at 7,430 #/day is conservative but justified to capture potential peak loading days. Figure 2-4 includes maximum loading from Nestle. To reduce demand on the main WRF, Nestle's flow passes through a roughing tower prior to combining with flow from the collection system ahead of the secondary biological process. The net load from Nestle after the roughing tower is a more critical design parameter for the WRF. Total net loading to the secondary biological process that accounts for roughing tower and primary clarifier BOD reduction is discussed in Section 2.1.6 Effluent BOD data show that the plant met permit requirements for all but one sample (Figure 2-5), which is considered an outlier. This indicates that BOD loading and process capacity/performance has been within expected limits.

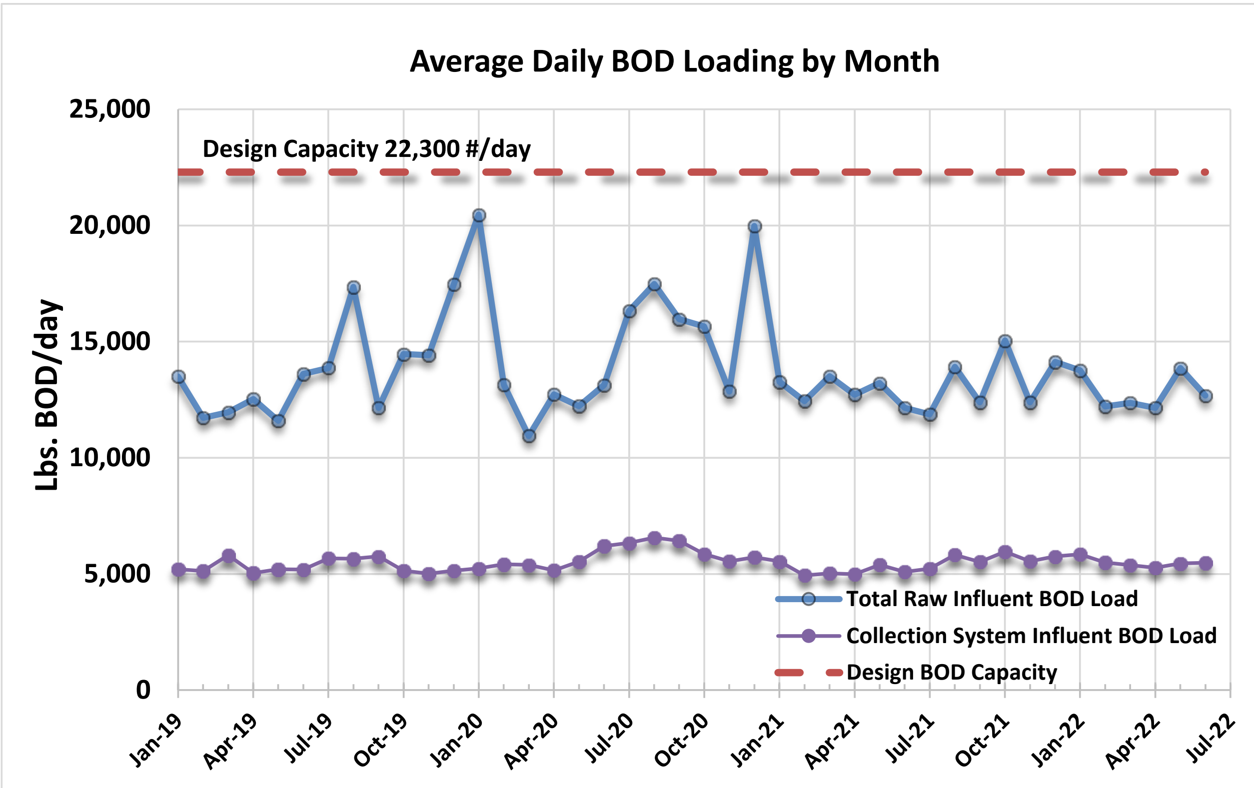

Figure 2-4: Influent BOD Loading to the WRF.

In conclusion, measured BOD concentration and loading are normally at or below previously established design criteria for municipal ERU connections as well as Nestle. There does not appear to be an immediate or near-term need to increase the BOD capacity of the WRF. However, the design capacity of the existing facility will likely be reached within the next 20 years (estimated to be by 2040), and any long-term expansion plans should accommodate more BOD loading. Table 2-3 summarizes projected BOD loading to the WRF. Finally, it should be noted that while the 3,400 ERUs dedicated to Nestle represent a reasonable estimate for their hydraulic load (850,000 gpd), the equivalent BOD load would be 1,564 #/day, significantly less than the actual load from Nestle. In other words, Nestel's impact to the WRF with regards to BOD loading must continue to be analyzed and tracked separately from the 3,400 hydraulic ERUs.

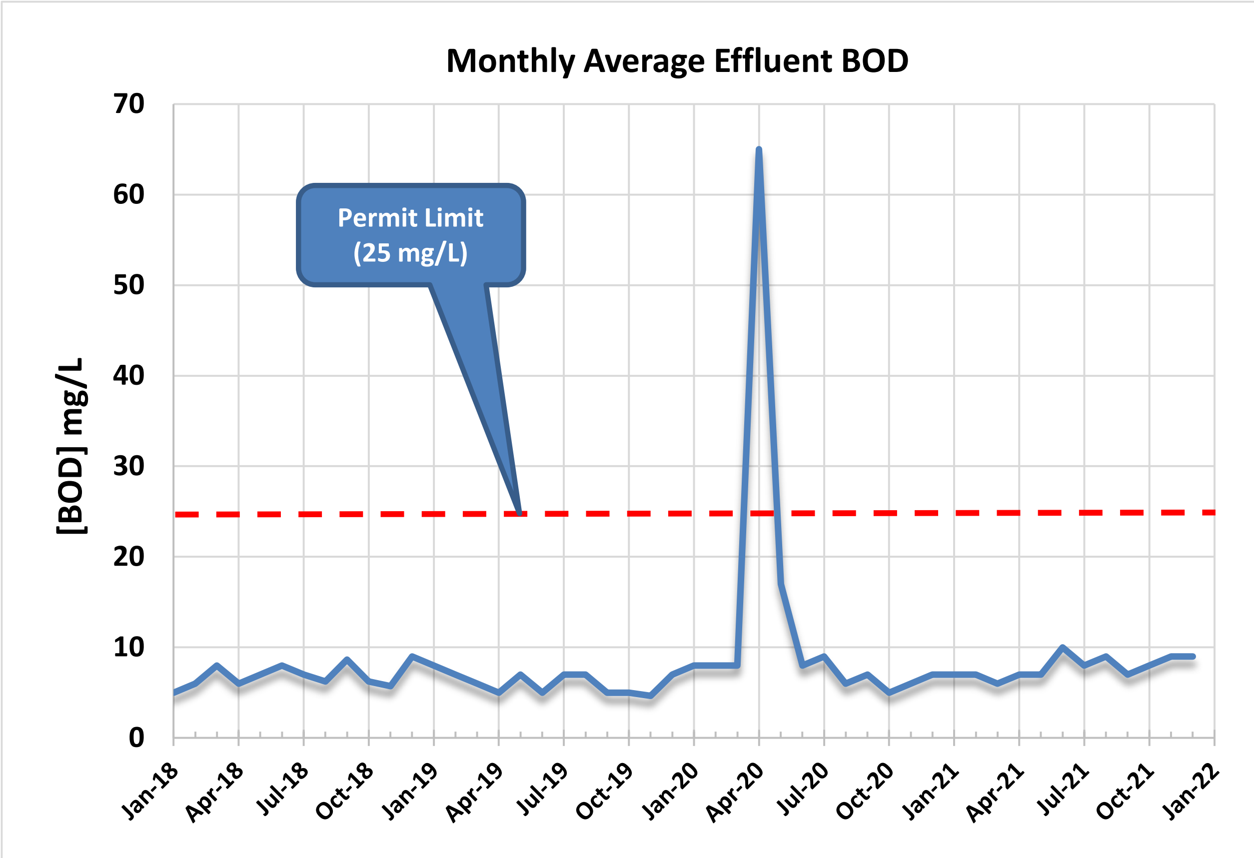

Figure 2-5: BOD effluent data.

Table 2-3: Projected BOD loading.

Year	Residential & Other ERUs	Nestle ERUs	BOD #/day
2022	16,156	3,400	19,932
2025	17,120	3,400	20,375
2030	18,855	3,400	21,173
2035	20,223	3,400	21,803
2040	21,689	3,400	**22,477**
2043	**22,353**	**3,400**	**22,782**
2045	22,807	3,400	22,991
2050	23,982	3,400	23,532
2055	24,802	3,400	23,909
2060	25,650	3,400	24,299

* Assumes 0.46 #BOD/day per residential/other ERU and 12,500 #/day from Nestle. BOD capacity is estimated to be reached by 2040.

2.1.4 Influent TSS Loading

Another wastewater constituent of interest is Total Suspended Solids (TSS). The WRF is designed to handle 7,750 #TSS/day (165 mg/L) from residential connections and 2,345 #TSS/day (280 mg/L) from Nestle (roughing tower effluent) for a total design TSS load of 10,100 #TSS/day. This assumes a TSS load of 0.156 lbs. per person per day (or 0.35 #TSS/day per ERU). Based on current and future populations, this yields a recommended TSS design load of 8,000 #/day for current loading and a 2043 TSS design load of 10,170 #/day, which slightly exceeds the WRF's current design capacity. Data for monthly total TSS loading from 2018 through September 2022 average 4,345 #/day and range from 2,440 to 6,500 #/day (Figure 2-6). Individual daily samples show loading as high as 15,852 #/day, but these events appear rare and may not represent actual loading conditions to the facility. Regardless, no adverse impacts to effluent TSS are noted during these events. TSS loading has been trending down over the past 3 years. The previously established design TSS loading per capita appears higher than reality based on influent data, but AQUA recommends continuing with previously established design TSS criteria to be conservative.

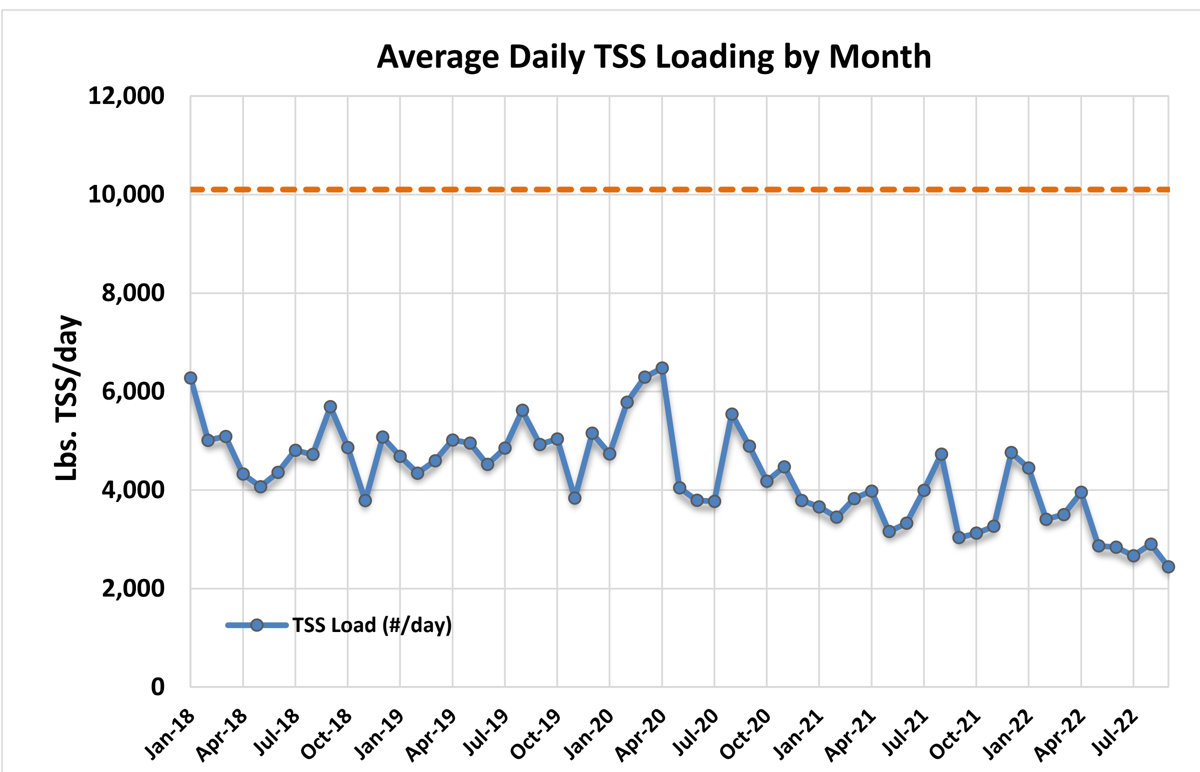

Figure 2-6: Average daily TSS loading.

Design for TSS capacity and removal is approached differently than with other constituents such as BOD or nutrients. While BOD/nutrients have specific design criteria based on oxygen demand, hydraulic retention time (HRT), and sludge retention time (SRT) that must be considered, solids removal is based on desired removal efficiencies and the capacity of solids handling equipment to separate, transfer, wash, and handle the solids. Properly sized primary clarifiers remove 50-65% of TSS (Metcalf, 2003); remaining TSS is separated in the secondary clarifiers. Tertiary filtration, such as sand filters, removes most residual solids prior to discharge. If TSS loading frequently exceeds design capacity, there may not be a direct, negative impact on the WRF's performance, but operators may notice issues with certain aspects of the plant such as high levels of solids settling in clarifiers, grit accumulation in channels, pump stations, and processes basins, and high volume of solids that must be dewatered and hauled off-site for disposal. Certain facilities like clarifiers, sand filters, digestion, and solids handling/dewatering equipment may have decreased performance and efficiency if TSS loading is consistently too high. This can result in higher effluent TSS levels and higher water content in dewatered sludge.

Effluent TSS (Figure 2-7) is consistently well under permit requirements, indicating that existing facilities are operating as expected and properly sized. Effluent TSS averages 6 mg/L and is normally less than 10 mg/L. A few individual data points record 15-23 mg/L, but these are rare and still meet permit. In summary, the existing WRF can handle current TSS loading and existing clarifiers and facilities appear properly sized to accommodate growth in terms of solids handling for at least another 15 to 20 years (Table 2-4). Once loading consistently approaches the design capacity, additional dewatering, composting capacity, and other solids handling equipment may be required to ensure efficient operation of solids handling equipment.

Table 2-4: Projected TSS loading.

Year	Residential & Other ERUs	Nestle ERUs	TSS #/day
2022	16,156	3,400	8,000
2025	17,120	3,400	8,337
2030	18,855	3,400	8,944
2035	20,223	3,400	9,423
2040	21,689	3,400	9,936
2043	**22,353**	**3,400**	**10,169**
2045	22,807	3,400	10,327
2050	23,982	3,400	10,739
2055	24,802	3,400	11,026
2060	25,650	3,400	11,323

* Assumes 0.35 #TSS/day per residential/other ERU and 2,345 #/day from Nestle. TSS capacity is estimated to be reached by 2043.

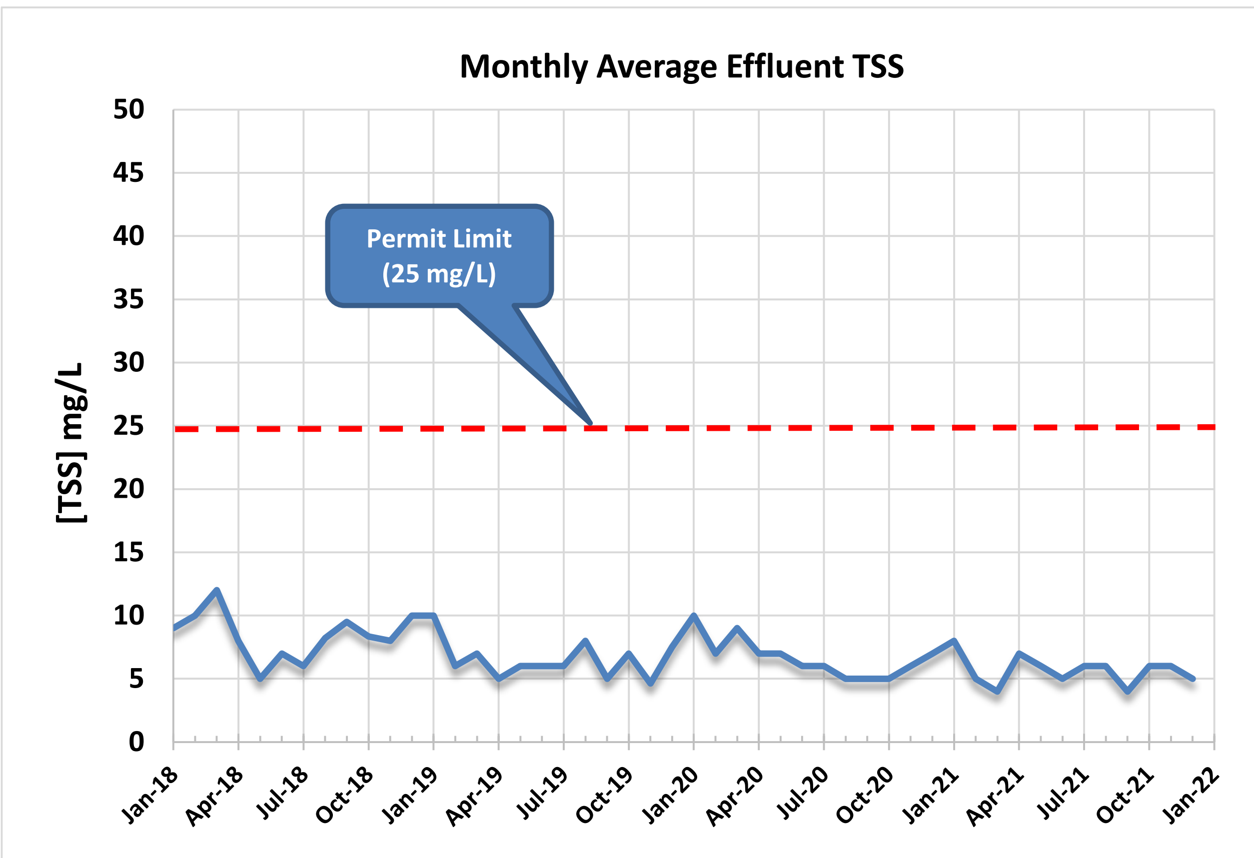

Figure 2-7: Effluent TSS data.

2.1.5 Influent Nutrient Loading

Nutrient loading for the purposes of this plan encompasses total nitrogen (TN), ammonia and phosphorous (P). Influent concentrations for total nitrogen, commonly reported as Total Kjeldahl Nitrogen (TKN), range from 30 to 51 mg/L with an average of 35 mg/L. This is within normal limits for typical municipal wastewater and an equivalent load of 0.072 # TKN per ERU has been established for this document. TKN loading from Nestle is relatively trivial (< 20 #/day).

Influent phosphorous averages 4.8 mg/L and ranges from 2 to 7 mg/L, which is also typical for municipal wastewater. Using an assumed concentration of 6.5 mg/L from the municipal collection system, an ERU equivalent of 0.013 # TP per ERU is established. Total design phosphorous loading from Nestle is 250 #/day, with a net 188 pounds passing on to combine with collection system flow. Limited discharge phosphorus data from Nestle is available, but actual loading ranges from 20 to 50 #/day, which is less than anticipated. Influent concentration and loading data from 2018 through 2021 are summarized in Figure 2-8 and Figure 2-9.

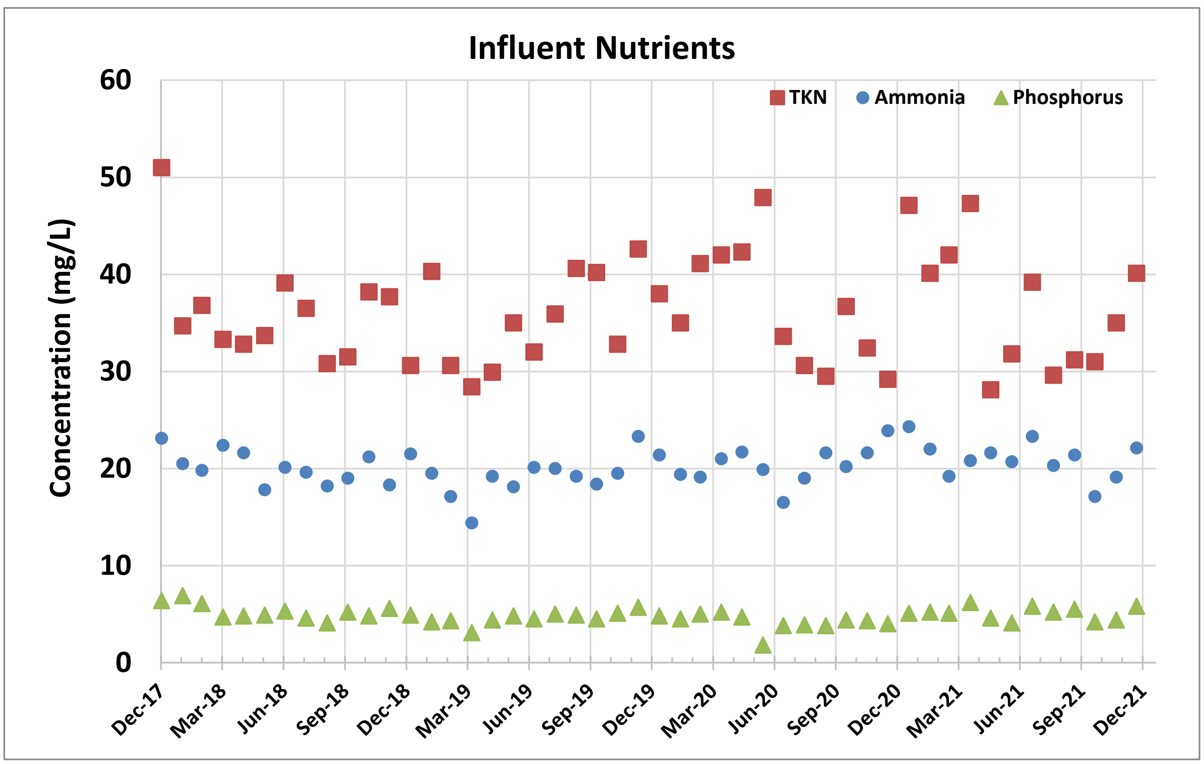

Figure 2-8: Average daily influent nutrient concentrations.

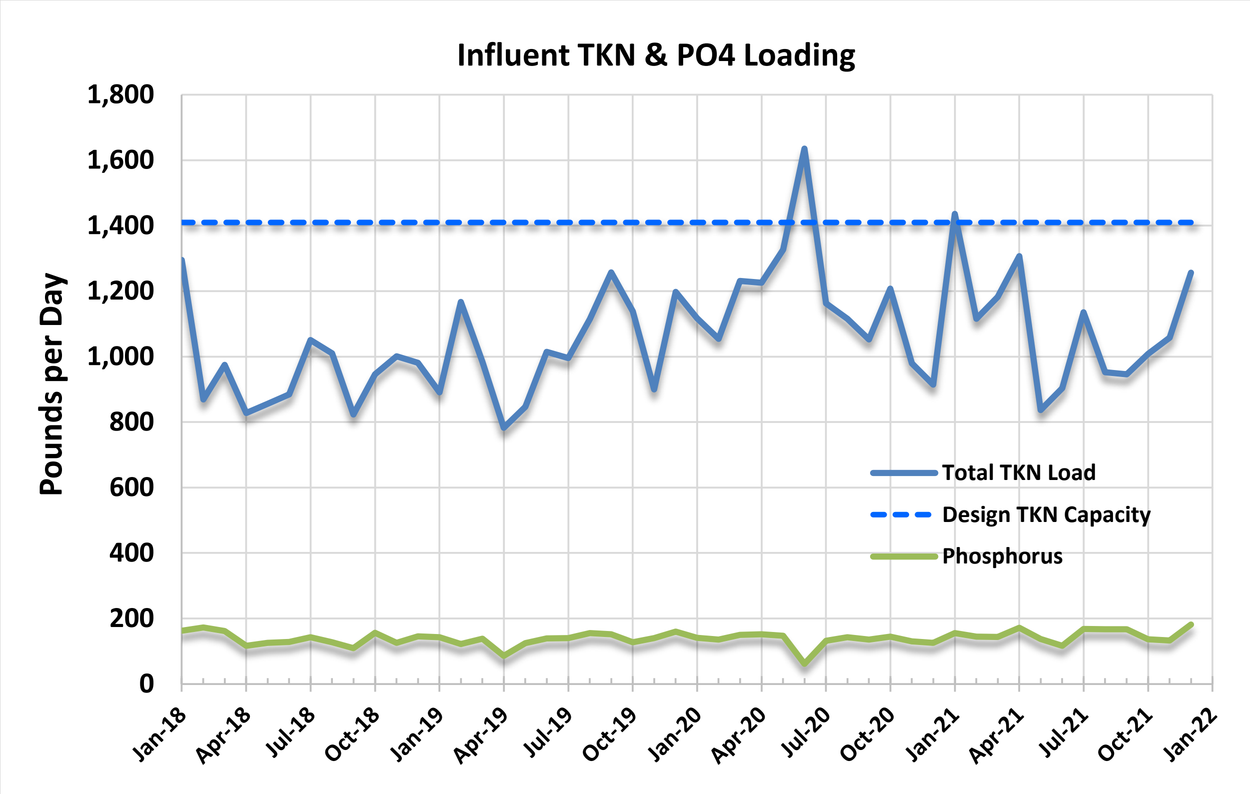

Figure 2-9: Influent ammonia and orthophosphate loading.

The WRF is designed to treat 1,416 #/day of TKN at an average influent concentration of 30 mg/L from the collection system. Based on the data presented in Figure 2-8, a minimum 35 mg/L is recommended for flow from the municipal collection system. TKN loading from 2018 through 2021 averages 1,070 #/day (0.066 #/day per ERU). June 2020 averaged over 1,600 #/day, however no issues with treatment process or effluent qualities were noted at that time. For phosphorous, an influent concentration of 6.5 mg/L (based on recent data) plus the 188 #/day from Nestle is recommended. Phosphorus removal is achieved with chemical addition introduced ahead of the primary and secondary clarifiers. No firm design limit for influent phosphorus has been established here as higher phosphorus load can be handled with more chemical injection, however, anticipated phosphorus loads are provided for reference and future planning purposes. Projected nutrient loading is summarized in Table 2-5.

Table 2-5: Projected average influent TKN and total phosphorous loading.

Year	Residential & Other ERUs	TKN #/day	TP #/day
2022	16,156	1,163	398
2025	17,120	1,233	411
2030	18,855	1,358	433
2035	20,223	**1,456**	451
2040	21,689	1,562	470
2043	**22,353**	**1,609**	**479**
2045	22,807	1,642	484
2050	23,982	1,727	500
2055	24,802	1,786	510
2060	25,650	1,847	521

* Assumes 0.072 #TKN/day & 0.013 #/TP/day per residential/other ERU.

TKN loading is anticipated to exceed the current design capacity by 2035. Additional oxygen may be required at that time to ensure that adequate air is available for complete BOD removal and nitrification. Note that when insufficient air is available in an activated biological process, typically ammonia removal (nitrification) degrades before BOD removal as the nitrifiers are more sensitive to low oxygen conditions. In this sense, the oxygen budget for BOD and TKN/ammonia must be considered in tandem to ensure the processes provides adequate air.

Effluent data show that the WRF normally meets permit limits for ammonia, though the process struggles during November and December most years (Figure 2-10). Effluent TN is also shown in the figure for reference; high levels of nitrate and TN indicate that complete nitrification with minimal denitrification is taking place in the current process. Since the current process is not designed to provide denitrification and total nitrogen removal, the effluent results are expected.

Nitrification is temperature sensitive, and it can be difficult to maintain reliable nitrification in cold weather. Nitrification is more efficient at higher DO levels; thus one operational consideration to improve ammonia reduction is maintaining higher dissolved oxygen (DO) concentrations in colder months (i.e. 2.5-3.0+ mg/L) rather than 1.5 - 2.0 mg/L. Operators may need to run higher mixed liquor (MLSS) concentrations during winter months to increase sludge retention time (SRT) in the process. Other factors that impact nitrification include the availability of critical components such as alkalinity and carbon. For example, if too much BOD is removed upstream (tricking filters), there may be insufficient carbon available to completely nitrify the ammonia. Finally, the nature of the upstream trickling filters may cool the wastewater (due to air flow and exposure to outdoor temperature) sufficiently to inhibit nitrification. Ammonia removal in January and February are improved, so temperature may not be the only substantial factor in this case.

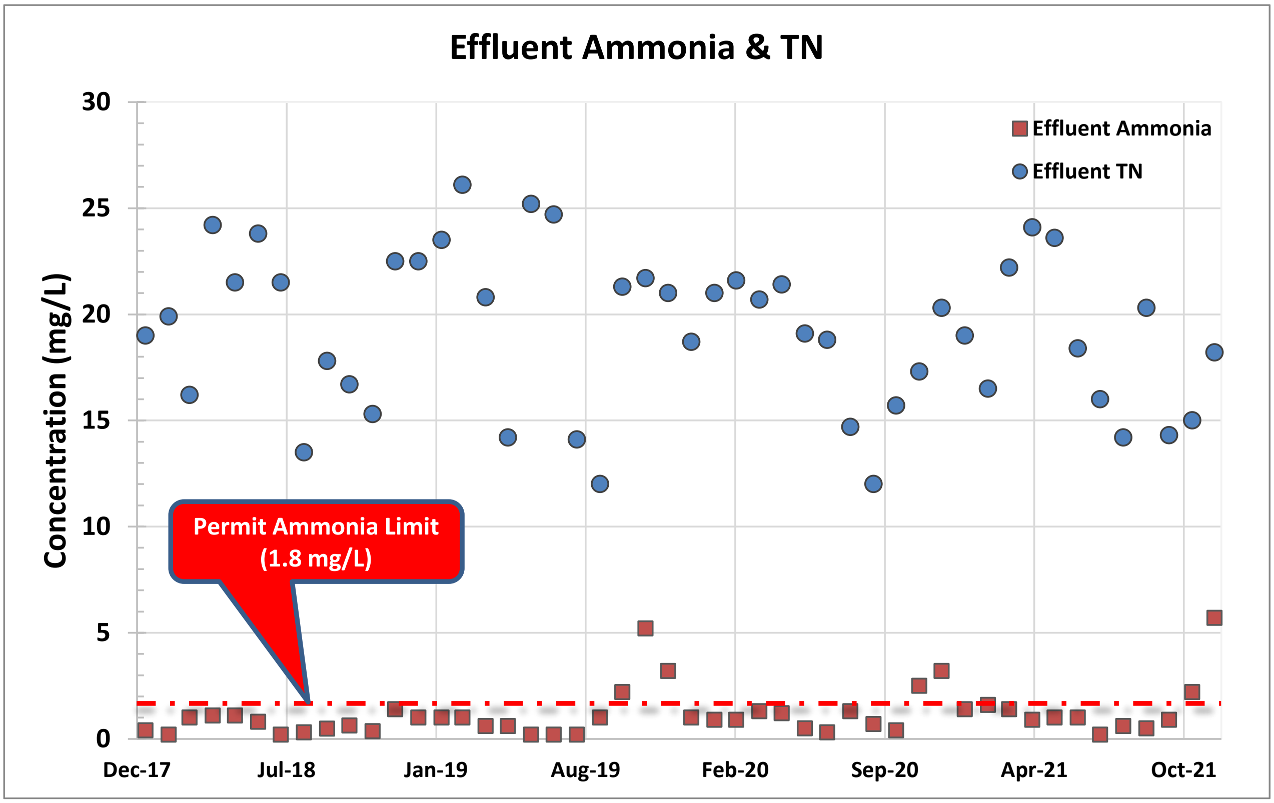

Figure 2-10: effluent ammonia and total nitrogen data.

The permit requires that the annual effluent phosphorus be less than 1.0 mg/L. Effluent phosphorus is measured in terms of orthophosphate (dissolved, chemically available form) and total phosphorus (TP), which includes soluble/available and unavailable forms of phosphorus. Chemical P removal was recently installed and began regular operation in fall 2021. As noted in effluent data, orthophosphate and TP show reduced levels starting at this time, though TP measurements through the end of 2021 are still sometimes above 1.0. Operational issues with the chemical dosing pumps were identified and addressed in the summer of 2022, and the system has since operated more effectively. Thus, while some measurements do slightly exceed 1.0 mg/L, the overall average has been below 1.0 since the issue with the chemical pumps was identified. Currently, operators can inject chemical (either ferric or alum) ahead of the primary clarifiers to remove most of the influent orthophosphate. Secondary injection is available before the secondary clarifiers to remove additional phosphorus if necessary. Normally, operators only utilize the primary injection point.

The City should implement biological phosphorous removal if and when expansion for biological nitrogen removal is implemented. This process requires sufficient nutrients, correct biology, and proper hydraulic retention time in an anaerobic environment to promote development of volatile fatty acids (VFAs) with specialized phosphorous absorbing organisms (PAOs). With proper operation, these PAOs utilize carbon and the VFAs in aerobic environments to uptake phosphorus into their cell structure, reducing the phosphorus in the waste stream. The phosphorus remains in solid form within the organisms in the sludge, which is removed with waste sludge (WAS). Biological phosphorus removal can achieve effluent levels of around 0.8 – 1.0 mg/L (MPCA, 2006). Chemical addition can still be used for secondary phosphorus removal to ensure adequate or enhance P removal performance. Expansion of the WRF should consider anaerobic tank hydraulic capacity to maximize biological P removal.

In summary, the existing facilities (including chemical injection) are adequate to meet current and future demand with current permit requirements until 2035 for TKN. However, if a total nitrogen limit is introduced in future permit renewals, a major upgrade to the biological process would be needed to reduce total nitrogen. If TN requirements are not implemented, additional aeration capacity (in the form of another aeration basin) may be required provide adequate oxygen to the system sometime between 2035-2040. The exact timing of this will depend on the combined BOD and TKN loading as both constituents consume oxygen.

Phosphorus removal can be maintained by managing chemical injection, meaning that TP capacity is not limited by the existing facilities as more chemical can be added. Chemical addition for P remove yields more sludge which settles in the primary and secondary clarifiers. Eventually, the increased impact of chemical P removal may require additional solids handling and dewatering capacity, but no major improvements of the exiting WRF are required for continued phosphorus removal. If the City elects to replace the trickling filters with an activated sludge process, the replacement process should be designed to handle the design loading listed above in Table 2-5. Biological nutrient removal in the form of anaerobic and anoxic basins should also be installed at this time to reduce chemical demand and effluent TN.

2.1.6 BOD & Nutrient Loading for Secondary Biological Process

While total raw BOD loading to the facility is important to note, loading to the secondary biological process is another key design consideration. The WRF process includes primary clarifiers which remove 35% of normal municipal-sourced BOD loading ahead of the trickling filters and aeration basin (Metcalf, 2003). Primary clarification will continue with future WRF expansion, and thus this same level of BOD removal is assumed for future residential/collection system loading. This yields a net design BOD of 6,684 #/day for 2043 and 7,670 #/day for 2060. Details on primary clarifier and BOD loading are further discussed in Chapter 3.

As noted above, influent from Nestle passes through a roughing tower prior to mixing with primary clarifier effluent ahead of the trickling filters. The roughing tower reduces influent BOD by 75% and essentially removes all ammonia and TKN, resulting in an effluent BOD concentration of 375 mg/L (2,085 #/day at 0.67 MGD). Combined with potential bypass flow, the net design BOD load from Nestle to the secondary biological treatment process is 6,255 #/day. When blended with remaining BOD from the collection system in primary clarifier effluent, the total net design BOD load for secondary treatment is as summarized in Table 2-6.

Table 2-6: Summary of projected net BOD loading to secondary biological process.

Year	Residential & Other ERUs	Collection System Influent # BOD/day	Residual #BOD/day Post PC	Nesetle #BOD/day	Total #BOD to Secondary Process
2022	16,156	7,432	4,831	6,255	**11,086**
2043	22,353	10,282	6,684	6,255	**12,939**
2060	25,650	11,799	7,669	6,255	**13,924**

* Current capacity of the WRF secondary biological process is 12,625 # BOD/day.

BOD measurements are collected from flow entering the primary clarifiers, meaning post-roughing tower for Nestle flow and prior to primary clarifier BOD removal for municipal flow. Monthly average BOD data from 2018 through September 2022 indicate that actual loading to the secondary process averages 8,600 #/day, ranging from 5,500 to 11,800 #/day (Figure 2-11). Data summarized in Figure 2-11 represent monthly averages. Thus, while most months and days average 8,600 #/day which is less than the calculated 2022 design load of 11,035, the system should be designed to handle higher loading months to be conservative. Accordingly, the secondary process design BOD load presented in Table 2-6 is considered justifiable and reasonably conservative.

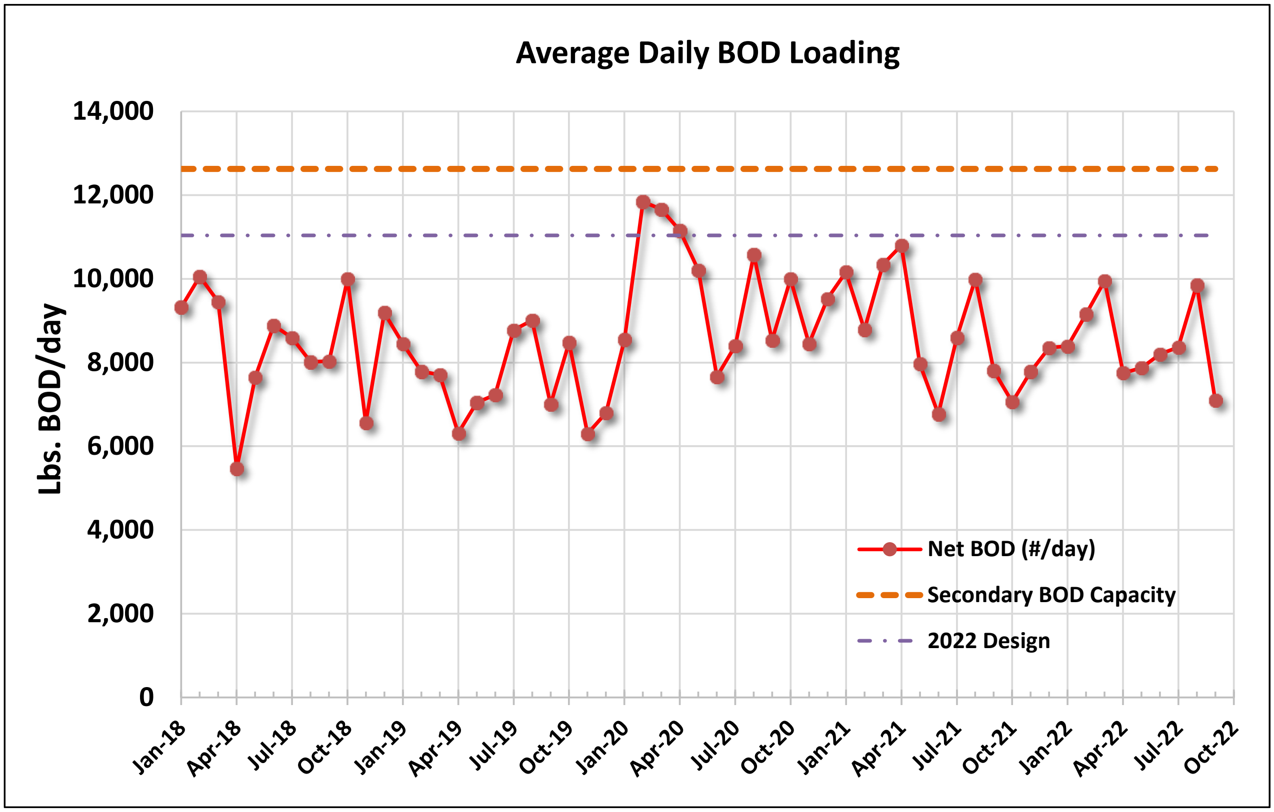

Figure 2-11: Average daily BOD loading.

The secondary biological process is designed to treat 12,625 #BOD/day. BOD loading is expected to reach this capacity by the early 2040s. In other words, the existing process appears adequate for the next 15-20 years. Any replacement, expansion, or upgrade to the secondary process should be designed to increase the BOD capacity to at least ~13,000 #/day with the ability to accommodate additional future expansion.

2.2 Summary of Proposed Design Criteria

AQUA recommends the following design criteria to guide expansion and upgrades for the Springville WRF. Criteria are listed for current demands, 20-year (2043) design, and 2060 design in Table 2-7. Permit requirements are anticipated to remain as listed in the 2019 permit; a TN effluent limit may eventually be required, but the timing of this is unknown. All design recommendations discussed herein are based on continuing to meet these effluent requirements with projected future loads. Long-term recommended expansions include incorporation of total nitrogen reduction. Thus, if a TN effluent limit is eventually required, the facility will already be designed to reduce TN. Biological phosphorus removal would be incorporated at that time as well to reduce the cost and chemical demand associated with chemical P removal.

Table 2-7: Summary of recommended design parameters.

Parameter	2023	2043	2060
Population	36,772	50,875	58,378
Collection System ERUs	16,156	22,353	25,649
Nestle ERUs	3,400	3,400	3,400
Total Design ADF @ 250 gpm/ERU (Design ADF Capacity is 6.6 MGD)	4.89 MGD	6.44 MGD	**7.26 MGD***
Calculated Total Peak Flow** (Design PHF Capacity is 9.3 MGD)	7.3 MGD	**9.7 MGD***	**11.0 MGD***
Domestic/Collection System BOD Load (Design BOD Capacity is 9,800 #/day)	7,432 #/day	**10,282 #/day***	**11,799 #/day***
Design Nestle BOD Load (Max)	12,500 #/day	12,500 #/day	12,500 #/day
Total Influent BOD Loading (Design Total BOD Capacity is 22,300 #/day)	19,932 #/day	**22,782 #/day***	**24,299 #/day***
BOD Loading to Secondary Process† (Design Secondary BOD Capacity is 12,625 #/day)	11,086 #/day	**12,939 #/day***	**13,924 #/day***
Total TSS Loading (Design TSS Capacity is 10,100 #/day)	8,000 #/day	**10,169 #/day**	**11,323 #/day**
Total TKN Loading (Design TKN Capacity is 1,416 #/day)	1,163 #/day	**1,609 #/day**	**1,847 #/day**
Total Phosphorus Loading	398 #/day	**479 #/day**	**521 #/day**

* Values highlighted in yellow indicate parameters that exceed the current rated capacity of the WRF.
** Assumes increasing I&I with growth. If I&I remains stable, projected peak 2060 flow is 9.5 MGD.
† Accounts for Nestle BOD reduction in roughing tower and municipal BOD removal in primary clarifiers.

Table 2-7 indicates that capacity limits for many design criteria will be reached by 2043 or in the early 2040s. Note that actual or average values may still be below these estimates at this time, but peak day flow and loading may approach or begin to exceed these capacities. Accordingly, the City should implement planning and design strategies ahead of these dates to provide adequate time for design and construction of recommended expansion and upgrades.

CHAPTER 3 - RECOMMENDED WRF UPGRADES & IMPROVEMENTS

This chapter discusses the recommended upgrade and improvement strategy for the WRF to properly treat the current and projected loading discussed in Chapter 2. Each major process at the facility is described in terms of condition and capacity, followed by recommended improvements. This plan discusses improvements strategy for a 20-year design window, a typical focus for wastewater treatment planning.

3.1 Review of Existing Facilities

The following sections discuss the condition and capacity of each major process at the WRF. Recommended expansion, replacement, and upgrades for each area are summarized for reference. Details of the cost, preliminary equipment options, and recommended phasing of these upgrades are detailed in Section 3.2.

3.1.1 Influent & Flow Measurements

Influent from the collection system is supplied via a main 24" gravity line and three (8", 10", and 12") pressure sewage mains. All raw influent combines and is measured with a Parshall flume prior to entering the headworks building (Figure 3-1). The influent flume and headworks were installed in 1985. The inlet channel and flume are in good condition and function adequately as long as influent does not submerge the flume. Wastewater from Nestle is measured separately and does not pass through this flume or the headworks.

During peak flow events, especially if both pressure mains are active at high flow rates, the water surface in the headworks backs up, submerging the influent flume. This is in part due to decreased performance of the headworks screens, but even with the screens operating as intended, high flows can still submerge the flume. This leads to inaccurate flow measurement which has made quantifying true peak events difficult. If the existing headworks is to remain in service, this issue should be addressed. The least expensive alternative entails adding a second level transmitter on the downstream side of the flume. A submerged Parshall flume can still reasonably measure flow, but depth must be measured before and after the flume. Alternatively, the pressure lines could be equipped with flow meters (in vaults) with discharge rerouted either before or after the flume. For the gravity line, either a new flume could be installed farther upstream, or a flow meter installed by lowering the elevation of a small segment of upstream pipe. The flow meters could be incorporated regardless of whether the City elects to construct a new headworks building or continue using the existing structure. This plan assumes that the City will continue using the existing headworks indefinitely and that the least expensive alternative, namely installing a second flow transmitter, will be installed. Otherwise, the 2019 Risk Assessment (WWE, 2019) recommends inspection and rehabilitation or replacement of the 36-inch piping and pressure vaults associated with the headworks influent.

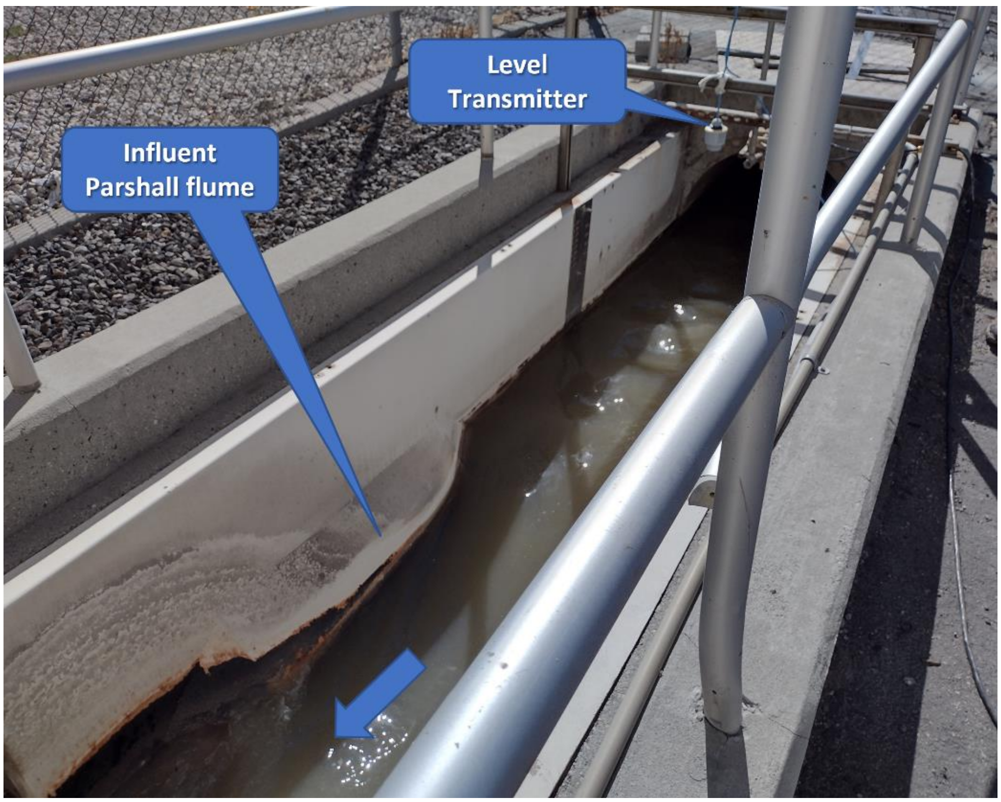

Figure 3-1: Influent Parshall flume.

3.1.2 Headworks

The headworks is the first step in treatment and removes large and/or heavy inorganic material from the waste stream that cannot be treated biologically. Target removal includes large, solid debris, rags, hair, grit, and sand. The Springville headworks includes a screening building and an adjacent aerated grit chamber. The screening building houses two (2) HydroPress model SSL 3000 step screens (Figure 3-2) with built in screenings washers. Both screens feed into a single Huber WAP BG4 washer/compaction unit. Each screen has a peak hydraulic capacity of at 5.1 MGD. The screens have reached the end of their reliable service life and should be replaced soon. The capacity of the screens also limits flow during peak events, which contributes to submerging the upstream flume. While the building itself is nearly 40-years old, the structure and concrete channels appear to be in good condition and should last for the foreseeable future. The doors, windows, and some non-potable water (NPW) piping show signs of corrosion and should be inspected and replaced eventually. The grit classifier screw and trough were severely corroded and were replaced in late 2022. The HVAC/ventilation for the building is inadequate (operators frequently just leave the large overhead door open) and should be upgraded to protect equipment and meet modern standards. Forced ventilation and odor scrubbing serving covered channels and other odor/gas sources should also be added to protect equipment, align the building with current code, and improve the longevity of equipment and safety of operators.

Figure 3-2: Headworks screens and screenings washer/compactor.

In terms of screen capacity, state regulations require that the headworks be able to treat peak design flow with one unit offline. This regulation is not always enforced on existing facilities, but replacement screens should be sized to maximize the capacity of the existing channels. Ideally, screens with a peak hydraulic capacity of at least 8.6 MGD each would be installed, noting that influent from Nestle does not pass through these screens. If a new headworks building is constructed, the new building and equipment should be designed to accommodate peak flow with one unit offline.

Grit removal consists of a 16' x 17' aerated grit chamber with a rated peak hydraulic capacity of 9.3 MGD. As with the screens, flow from Nestle does not enter the grit chamber. Blowers for the grit chamber diffusers and grit airlift pumps are housed in the headworks building, along with the grit classifier screw. The blower equipment and associated piping is aging and shows signs of wear and corrosion. Piping should be replaced (or at least sanded and repainted) and the blower equipment replaced to extend the service life of this equipment. Given the age and style of the grit chamber, its capacity and efficiency are less than newer equipment. Modern grit removal equipment would significantly reduce the solids load and accumulation in the digesters, especially with regards to finer grit particles. In terms of capacity, there is no urgent need to upsize or replace the existing grit chamber as its rated capacity is sufficient for at least the next 15 years. However, rather than investing in new blowers (and possibly diffusers), piping, and other rebuilds, the City should consider dedicating these funds into new grit removal technology.

As with screening, state regulations technically require redundancy for grit removal in new installations. This is not always enforced for improvement of existing installations, but the City should have provisions in place to accommodate a future second grit chamber. A new headworks facility would most likely need a dual duty/standby grit chamber configuration. The footprint of the aerated grit chamber could likely accommodate one replacement grit chamber. A new grit pump and grit washer would be installed in the headworks building to replace the in-floor classifier screw. A new grit washer will perform much better in terms of washing and discharging clean grit. This will also help reduce odors and corrosive gases. If required, the second grit chamber would need to be located somewhere near the headworks building; this plan assumes that only one chamber will be needed at the existing headworks and two chambers required for a new building.

Regarding grit removal efficiency, typical aerated grit chambers capture 80-85% of 100 mesh (149 micron) particles, with little to no removal of finer particles. New technologies, such as the HeadCell grit removal system from Hydro International, claim 95% removal of 140 mesh (105 micron) for peak flow, and 95% removal of 200 mesh (74 micron) at average flows. In other words, a new grit system could remove particles one third the size of the current installation at a higher overall efficiency. Better grit removal would reduce the inorganic solids load in primary sludge, protect downstream pumps, and prevent excessive buildup in downstream basins. This would ultimately reduce the volume of solids sent to the digesters and dewatering equipment. Note that grit solids are still collected, washed, and disposed of with a grit washer, but reducing the inert solids load to the digesters and dewatering equipment help maximize their capacity. Reduced solids to the digesters also improves their performance and reduces maintenance associated with removing grit from the digester tanks. Reduced inorganic solids enhances dewatering efficiency and increases the organic content and quality of the compost.

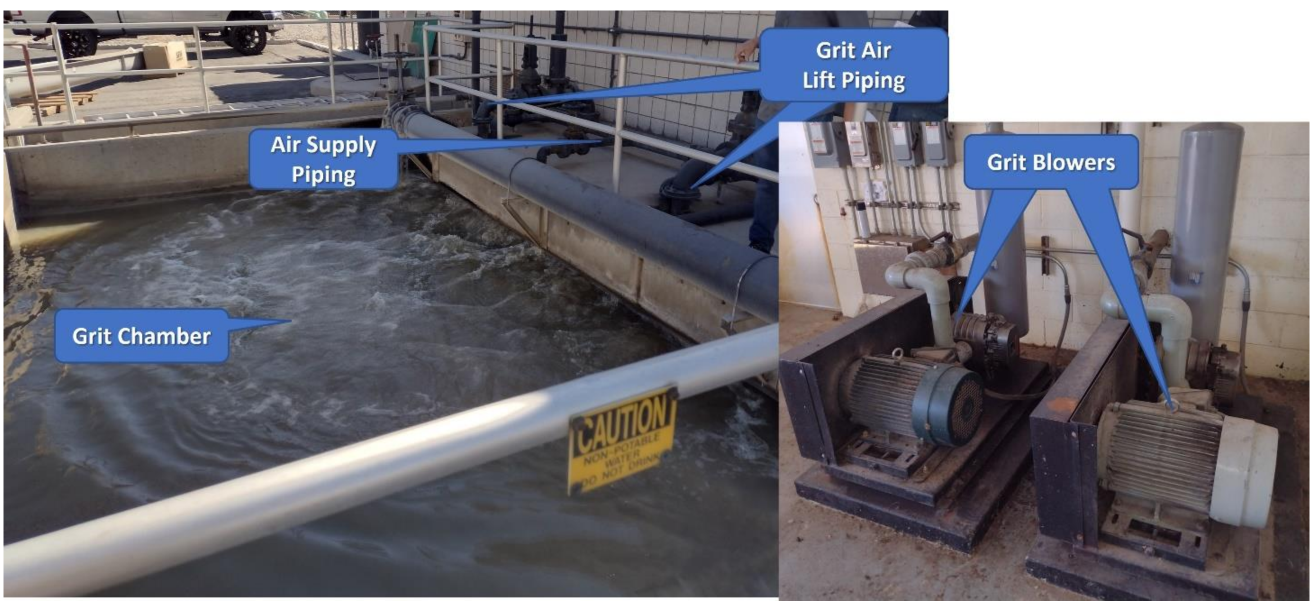

Figure 3-3: Aerated grit chamber (exterior) and blowers (interior).

3.1.3 Nestle Roughing Tower

Raw influent from Nestle is passed through a 50-foot diameter roughing tower prior to combining with the main waste stream from the headworks/grit chamber effluent. A portion of the flow from Nestle can bypass the tower to provide additional carbon/BOD for downstream processes if necessary. The roughing tower consists of a steel tank housing plastic crossflow media and a mechanical rotary distribution arm (Figure 3-4). The tower is serviced by two (2) 30-HP blower units that furnish supplemental air to the fixed film bacteria housed in the media. The roughing tower includes a feed/recirculation pump that mixes raw influent with roughly 2Q of recycle (total flow of up to 2 MGD) to feed to the top of the tower.

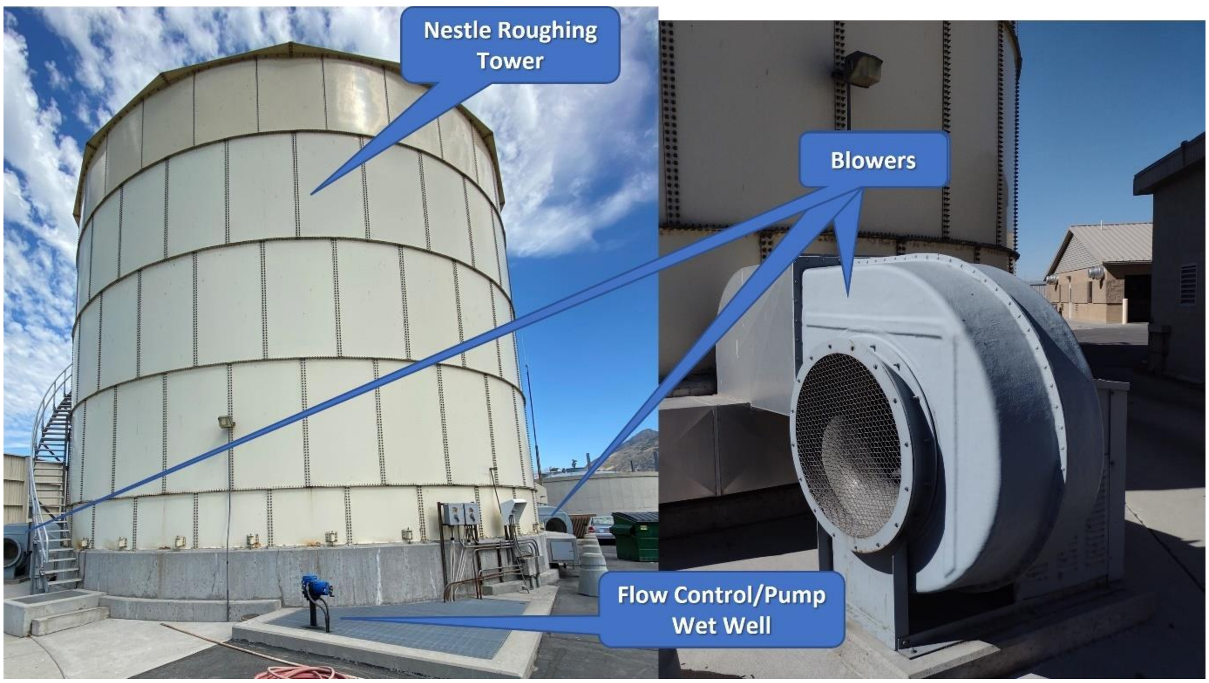

Figure 3-4: Roughing tower with blower (inset).

The tower, pump, and media are adequately sized for flow and loading from Nestle and could . As long as loading and flow from the source do not change, no increase to capacity is necessary. Initial estimates on the biotowers capacity indicate that some growth from Nestle (~10%) could likely be handled by the tower without adversely impacting its performance. Growth beyond 10% would require a detailed review of the towers operation and monitoring of how much flow is allowed to bypass the tower. With optimization of tower operation and bypassing 15-30% of the flow, a net increase of loading from Nestle of up to 20% is possible. The steel tank itself shows signs of corrosion and wear due to the high loading and anaerobic conditions contained within. The upper most ring of the tank was recently replaced, and other panels (or the entire tank) may need to be replaced eventually. The blower units, submersible pump, and flow meter are in relatively good condition but will require maintenance and replacement over the life of the WRF. The plastic media and distribution mechanism were commissioned in 1998. No specific signs of wear on the media or distribution mechanism have been noted by staff, but the media will eventually need to be replaced and the distribution mechanism rebuilt or replaced sometime over the next 15-20 years.

Odors are also a noted concern and the roughing tower, along with the headworks, are localized sources of strong offensive odors. In addition, odors from Nestle's pre-treatment facility (located near the roughing tower at the WRF site) have been cause for complaints to the City from offsite locations. With a replacement tank, the City should cover the tank and install blowers to feed an odor scrubber. Also, alternative tank panel materials such as stainless steel or more robust coatings should be priced when replacing the tank structure. These improvements do not appear urgent but should be planned proactively to avoid extreme corrosion or failure of the tank structure. The urgency of odor abatement may also advance the schedule of this upgrade. Costs associated with upgrading the tank should be discussed and negotiated with Nestle. Nestle may also invest in odor control improvements at their pre-treatment DAFT process.

3.1.4 Primary Clarifiers

Primary clarification reduces the footprint and oxygen (energy) demand of downstream biological processes by removing settleable BOD and solids load (TSS) from the waste stream. The WRF has two 80-foot diameter primary clarifiers. Each clarifier has a rated capacity of 5.0 MGD ADF and 10 MGD peak flow (Figure 3-5). Given projected demand, these clarifier units have sufficient capacity for the foreseeable future. Flow from Nestle combines with the main waste stream after the primary clarifiers and prior to the secondary biological process.

Both clarifiers are operating well. The drive motors mechanisms are 30 (PC #2) and 40 (PC #1) years old and are reaching the end of their reliable service life. The drive mechanisms show signs of moderate corrosion. The condition of the submerged mechanisms was not observed, but they are likely showing signs of corrosion as well. While there is no indication of imminent failure, given the critical role primary clarification plays in the overall process, the mechanisms should be inspected as soon as possible and rehabilitated/recoated within the next 2-3 years. The concrete structures should also be inspected when it is feasible to drain each tank. No obvious signs of spalling, extreme wear, or corrosion of the concrete were noted during AQUA's site visits.

Primary clarifier capacity is sufficient such that one clarifier can be offline for an extended time without adversely impacting the process under normal flow and loading conditions. Thus, inspection and mechanism replacement/repair should be coordinated and timed when high flow or loading is not expected. In conclusion, the structures' condition and size appear adequate to serve the City's needs through the current 20-year planning period. The mechanisms should be recoated in the near-term to prolong service life, and the City should budget to replace the mechanisms within 10 years after recoating. The concrete tanks should also be inspected when feasible, and any necessary repair work or protective coatings installed at that time.

Figure 3-5: Primary clarifiers – PC #1 (top) and PC #2 (bottom).

3.1.5 Trickling Filters

The WRF process includes two trickling filter towers (Figure 3-6). Tower #1 is 86-foot diameter with 95,000 ft^3 of media. Tower #2 is 100-diameter and contains 110,000 ft^3 of media. Both towers are served by the nearby trickling filter pump station that includes three (3) 75-HP, 4,500 gpm pumps. The previous vertical turbine style pumps had issues with vortexing and are in the process of being replaced with submersible pumps. The adjacent STM Aerotor pump station had similar issues and those pumps are also being replaced. The tanks, mechanisms, blowers, and media are in relatively good shape considering their 40+ year age. As noted in the loading section above, the rated capacity of the biological system (trickling filters and STM Aerotors combined) is sufficient for the next 10-15 years as well. However, this technology is not compatible with achieving traditional biological nutrient removal (BNR) of phosphorous and nitrogen. Given the age of the trickling filters and the plan to incorporate BNR into the process, it is anticipated the trickling filters will be removed from service within the next 8 to 10 years.

Figure 3-6: Trickling filter #1.

Replacing the trickling filters with an activated sludge process would incorporate BNR into the secondary process. Anaerobic tanks allow for biological P removal which would greatly reduce or eliminate chemical demand. Biological P removal can reliably reduce effluent levels to < 1.0 mg/L; combined with chemical polishing ahead of the secondary clarifiers or tertiary filtration, P levels < 0.1 mg/L are possible. In addition, total nitrogen removal will likely eventually be required with an anticipated limit of 10 mg/L. Biological nitrogen removal is achieved by incorporating anoxic tanks to the activated sludge process which allow for denitrification (break down and removal of nitrates).

Effluent from the trickling filters passes through a “snail trap” – a structure similar in size and function to a vortex grit trap, prior to being pumped to the STM Aerotors. Snails are an unfortunate nuisance associated with trickling filter and fixed media processes that must be removed to avoid fouling and plugging downstream processes and piping. The snail trap includes the circular tank, drive mechanism, grit/snail pump, and grit/snail classifier (Figure 3-7). The pump and classifier are located in the adjacent pump building that houses the tricking filter and STM Aerotor pumps. The snail trap equipment was installed with the STM Aerotor equipment in 2010, is in good condition, and operating normally. The grit trap structure and associated equipment can be decommissioned and either abandoned, removed, or repurposed once the trickling filter processes is removed.

Figure 3-7: Trickling filter snail trap (right) and snail/grit classifier (left).

In summary, while the trickling filters are still functional, this technology is not compatible with the biological nutrient removal processes needed to achieve low effluent P and TN levels. When the City is ready to implement BNR, these towers can be decommissioned, and the footprint used for new anaerobic, anoxic, and aeration basins. The STM Aerotor structure will be utilized with this future process though the Aerotor wheels themselves will likely be replaced with a different technology. Details and cost estimates for these upgrades are discussed in Section 3.2.

3.1.6 STM Aerotor Basins

Effluent from the trickling filters is pumped to the STM Aerotor basins. The STM Aerotor basins include four (4) 230,000-gallon tanks, each tank housing 4 Aerotor wheels (Figure 3-8). The tanks and original equipment were commissioned in 2010. These basins provide additional oxygen and an aerobic environment to reduce carbon/BOD, nitrify ammonia, and break down other volatile constituents in the waste stream. When all wheels operate as intended, the system appears to function as anticipated and delivers its design capacity oxygen.

Figure 3-8: Northern STM Aerotor tanks.

Input from City staff and operators indicates that the equipment requires major repair and rebuilds more frequently than anticipated. The drive motors, sprockets, and chains have been replaced multiple times, often with larger and more robust substitutes intended to improve longevity and reliability. Recently, operating staff reported that the equipment is in need of major repairs with an estimated cost in excess of $900,000. Even with these repairs, the City anticipates no more than 5-6 years' service life before another similar rebuild is required. The City is investigating whether replacing the wheels with fine bubble diffusers sooner rather than later is merited. Eventually, the City plans to remove the wheels and retrofit the existing structures with fine bubble diffusers.

3.1.7 Secondary Clarifiers

Effluent from the STM Aerotors flows to the secondary clarifiers. Secondary clarifiers settle sludge (and residual solids), leaving relatively clean and clear water as effluent. Settled sludge flows back to the STM pump station as return activated sludge (RAS) to mix with effluent from the trickling filters/snail trap. The recycle stream is needed to provide the biology to break down constituents in the raw waste stream from upstream processes.

The WRF has three (3) 80-foot diameter secondary clarifiers. Based on state guidelines for surface loading rates (500 gallons per day per square foot at average flow), the clarifiers have a rated capacity of 2.5 MGD each, for a total 7.5 MGD (ADF) capacity. For peak flow conditions, the tanks provide 12 MGD capacity with one of three units offline. The structure for secondary clarifier #1 has been in service for over 50 years, and the mechanism is nearing its expected 20-year service life. Accordingly, the mechanism and structure should be inspected and recoated/rehabilitated similar to the recommendation above for the primary clarifier mechanisms. The two newer clarifiers have been in service for ~13 years and are in good operating condition. The concrete structures should be drained, and the mechanisms inspected annually to assess their condition and prolong their service life. Other appurtenances such as RAS control gates, RAS level probes, and older service valves and piping will eventually require replacement as well (WWE, 2019). Properly maintained, these mechanisms and structures should adequately serve the WRF at least through the 20-year design window of this plan.

3.1.8 Sand Filters

The sand filters were installed in 1985 and consist of 2 parallel low head traveling bridge style sand filter basins. Each basin has a total surface area of 1,472 ft^2. The filters have a combined design capacity of 6.6 MGD (at 1.55 gpm/ft^2). The filters can handle peak flows up to 5 gpm/ft^2. Per operators and the 2019 Risk Assessment, the filters require refurbishment as soon as possible to reduce backwash time and improve performance. The bridge mechanisms (and associated electrical controls) are functional but also should be inspected and repaired or replaced if the sand filters are to remain operational for another 5+ years. The sand filter building itself is in reasonably good condition; minor corrosion, ventilation, and aesthetic/maintenance issues should be addressed to prolong the life of the building. Properly maintained, the filters could provide beneficial service for the foreseeable future.

To provide Type I reuse quality effluent the sand filters would likely need to be replaced with higher performing technology. Disc filters or pressure membrane filtration would provide Type I effluent quality and either could be installed within the footprint of the sand filter building. This filtration could be combined with chemical addition to polish P removal and achieve very low effluent P if needed (<0.1 mg/L). This upgrade is not urgent but could be incorporated as part of a larger upgrade to the WRF, or whenever the City decides to produce Type I water. In summary, the sand filters should continue to be operated and maintained for the next 5-10 years until the City is ready to replace them with newer technology or whenever Type I water production is desired. If a more expensive repair is required for the traveling bridges or other components of the sand filter, the funds may be better served contributing to replacement technology.

3.1.9 UV Disinfection

The final treatment step disinfects wastewater to meet permit levels for e. coli bacteria. Springville utilizes UV disinfection, which transmits UV light through the treated flow stream at specific wave lengths to deactivate bacteria and virus organisms. UV light damages the genetic code of microorganisms, eliminating their ability to function and reproduce. The UV disinfection system consists of two (2) dual-unit Trojan Signa inclined in-channel UV banks (Figure 3-9). The system was installed in 2018 and has a peak hydraulic capacity of 9.3 MGD. The system is operating reliably, and operators did not report any major concerns with the system. Depending on actual peak flow conditions, the process is adequately sized for the next 15 years. The concrete structure housing the equipment also appears in good condition.

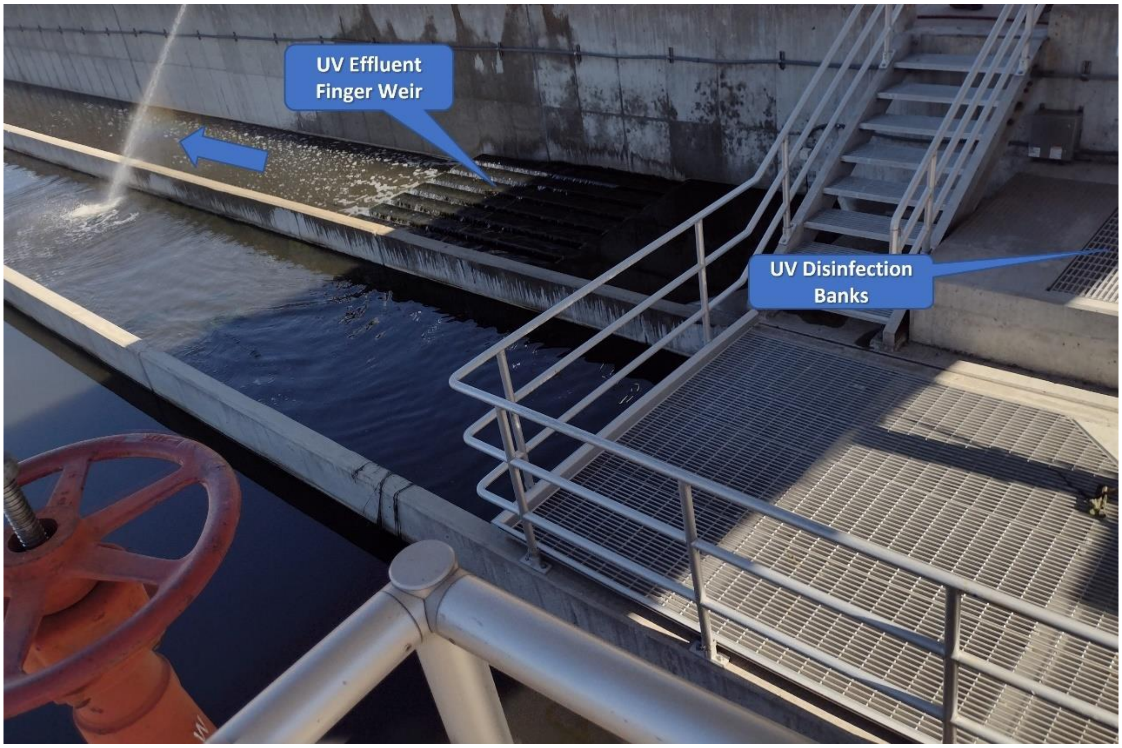

Figure 3-9: UV disinfection channel.

If the City intends to produce Type I reuse water during summer months, the UV system will need to be upsized to provide non-detect e. coli disinfection. This would require roughly tripling the current UV dose. The old chlorine contact channels have ample space to accommodate additional UV modules. One approach is to install UV modules in a second (western-most) channel. Thus, during irrigation season when Type I water is needed, flow can be directed to the second channel with higher UV dose. Depending on the tertiary filtration equipment installed, closed vessel units could also be housed in the sand filter building. Regardless, when Type I water is not needed, flow can be directed to the existing (eastern) UV channel. This would provide redundancy and offer some energy savings as the higher dose system would only be utilized when needed. Options are detailed in Section 3.2.

3.1.10 Solids Handling & Dewatering

Settled sludge from the primary clarifiers, along with waste activated sludge (WAS) from the secondary clarifiers are sent to the anaerobic digesters for additional solids reduction. Primary sludge normally consists of 3-5% solids content by weight and is suitable to pump directly to the digesters. Secondary sludge is thinner, normally 0.75 – 1.25% dry solids, and is thickened to ~4-5% prior to being pumped to the digesters. Thickening WAS is beneficial as it reduces the total volume sent to the digesters, increasing their hydraulic retention time (HRT) which increases their capacity and improves their performance and solids destruction.

The WAS thickening building contains a Huber Model HDF-S8 dissolved air floatation thickening (DAFT) skid (Figure 3-10). The unit can handle up to 581 #/hr of solids at a hydraulic loading rate of 232 gpm. The unit is fed by two (duty/standby) 15 HP progressive cavity pumps with a rated capacity of 250 gpm each. The DAFT is intended to thicken WAS to 4-6% prior to being pumped to the digesters. The building also houses two (duty/standby) 3 HP progressive cavity thickened WAS (TWAS) pumps, each with a 30 gpm capacity. WAS is injected with polymer prior to entering the DAFT to improve solids coagulation and achieve the desired thickened consistency.

Figure 3-10: WAS thickening DAFT (left) and TWAS pumps (right).

The DAFT was commissioned in 2020 and is sized to last through the 20-year design window of this plan and beyond. Sludge pumps for primary sludge are older and located in the dry pump pit beneath the control building adjacent to the Nestle roughing tower. This pump pit includes transfer piping and valving for TWAS as well. The primary sludge transfer pumps are operating normally and should be maintained per manufacturer recommendations. The older primary sludge transfer pumps will need to be replaced within the next 20 years.

Primary sludge and TWAS are pumped to the largest digester tank (Digester #3). Sludge is mixed, heated, and recirculated in this 66-foot diameter (520,000 gallon) tank. Digested sludge from this tank flows to Digester #2 (50-foot diameter; 290,000 gallon) for continued mixing, heating, and digestion. Digestate from digester #2 flows into Digester #1 (36-foot diameter; 170,000 gallon), which currently serves as solids holding/EQ tank; this tank is not heated or mixed and therefore does not provide true anaerobic digester capacity.

For optimal performance, anaerobic digesters should be well mixed and maintained at 95 – 98°F. To meet Class A biosolids vector attractant reduction (VAR) of at least 38% and to optimize solids reduction for composting/land disposal needs, an HRT of at least 15-days is needed. With all 3 tanks the system provides a 27-day HRT, assuming a daily influent load of up to 37,000 gallons. Using the first 2 tanks, an HRT of 22 days is still provided. Digested sludge usually consists of 2-4% solids. Digester #3 was installed in 1985; the other two tanks have been in service since the 1960s. The digester tanks, lids, and associated pumps, process rooms, and piping are still serviceable but will require some replacement and rehabilitation over the next several years (WWE, 2019). Priorities and phasing of major rehabilitation work are summarized in Section 3.2.

Sludge is heated in heat exchangers using hot water from the site's hydronic hot water system. Hot water for the system is cooling water from the Springville City Power Department generators jacket/cooling system. When the generators are not active, a natural gas-fueled boiler located in the generator room provides hot water. This configuration has been unreliable, resulting in wide temperature swings and frequent low temperatures in the digester tanks. Unstable conditions and low temperatures both impact digester performance, causing reduced solids destruction and higher solids loading for dewatering equipment and disposal/composting. A primary issue with this configuration is the timing of generator operation. The generators usually operate during the summer when electricity demand is high. However, during the summer, sludge heating demand is minimal as it requires little heat to maintain 95-98^{o}F. The generators do not operate as much in the winter, so the natural gas boiler is utilized. Flow balancing of the system is difficult to manage, contributing to reliability issues.

Several buildings at the WRF site previously utilized the hydronic system for building heating. Many of these heaters have been replaced with natural gas heaters as it made little sense to operate a boiler with natural gas to indirectly heat these spaces and as noted, the system is difficult to properly balance and operate. The same logic applies to digester heating. Accordingly, the digester system should incorporate its own boiler, either natural gas or biogas fueled, to provide consistent hot water dedicated to the digesters. Establishing correct and stable temperatures will significantly improve digester performance.

Digesters #3 and #2 are equipped with mechanical mixers mounted to fixed lid structures (Figure 3-11). These mixers were functional but were recently replaced as they had reached the end of their reliable service life. Digester #1 includes a floating lid that moves with stored sludge levels but does not have mixing or heating (Figure 3-12). Mixing and heating for digester #1 does not appear necessary based on available HRT in digesters #3 and #2. Digester #1 was constructed in the 1960s, with digester #2 structure installed shortly after. Digester #3 was installed in the mid-1980s. All three structures have undergone multiple rehabilitations with new coatings, lids, mixers, and some replacement sludge handling and biogas piping. Presently, all three concrete structures appear to be in good condition with no obvious signs of corrosion or spauling. The exterior surfaces of the insulated lids are also in reasonably good condition but will require some rehabilitation and eventual replacement. Annual inspections are recommended for the exterior and interior concrete surfaces and lid structures to pro-actively maintain protective coatings in good condition. While these structures will eventually need to be replaced, there is currently no obvious indication that the structures are not serviceable for the planning window encompassed in this plan.

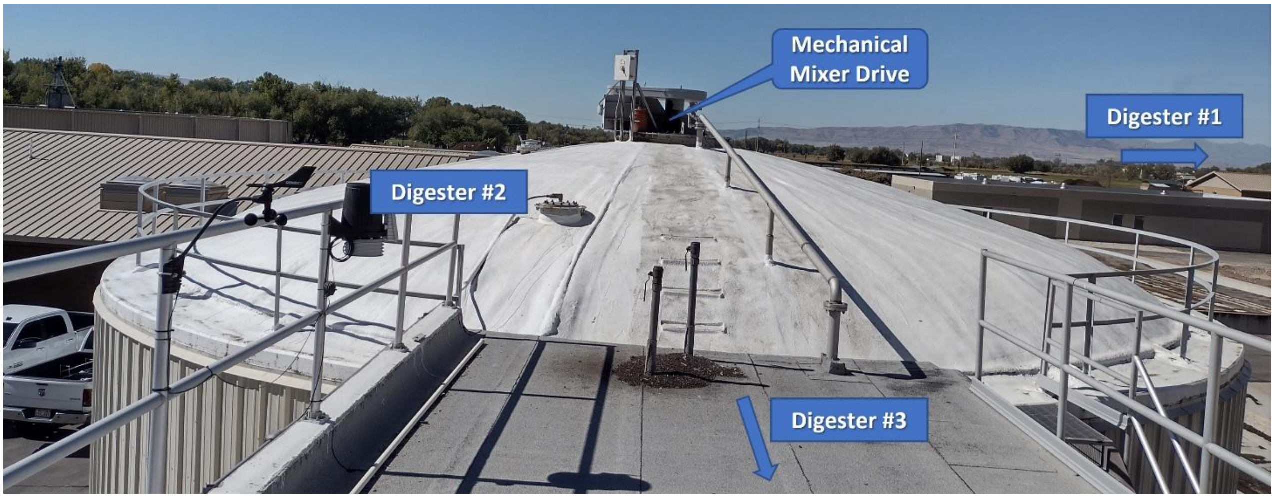

Figure 3-11: Digester #2.

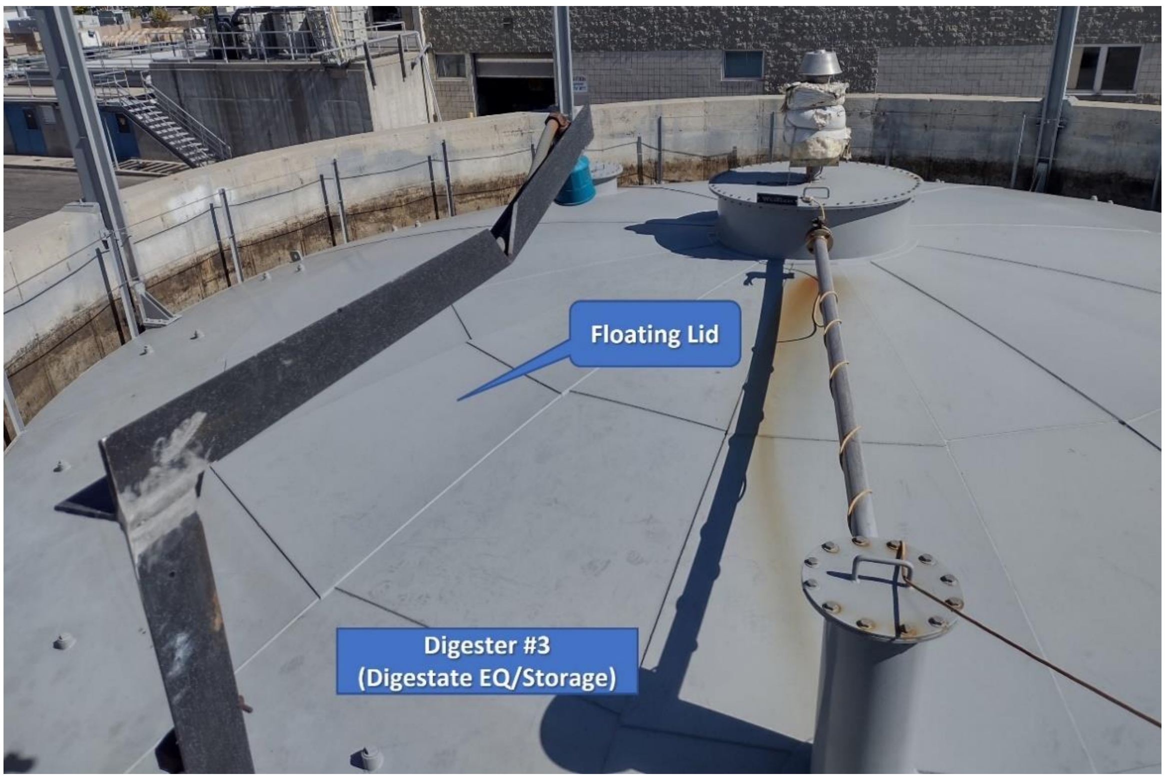

Figure 3-12: Digester #3 (sludge storage and EQ).

Digested sludge from Digester #1 is pumped to two dewatering belt presses in the belt press building, Figure 3-13. Sludge dewatering significantly reduces the volume to be dried (80%+ volume reduction), transported, or composted for disposal. The building houses one 2-meter and one 1-meter belt presses. Sludge is injected with polymer to improve water separation, and then pumped to belt presses. Sludge is spread along the width of the belt, the gravity belt section, allowing water to separate and drain away from the solids. After this initial step, sludge passes through tensioned porous belts that squeeze additional water from the sludge. Belt presses typically yield solids content of ~20-25% from an influent of ~3-4% of anaerobically digested sludge.

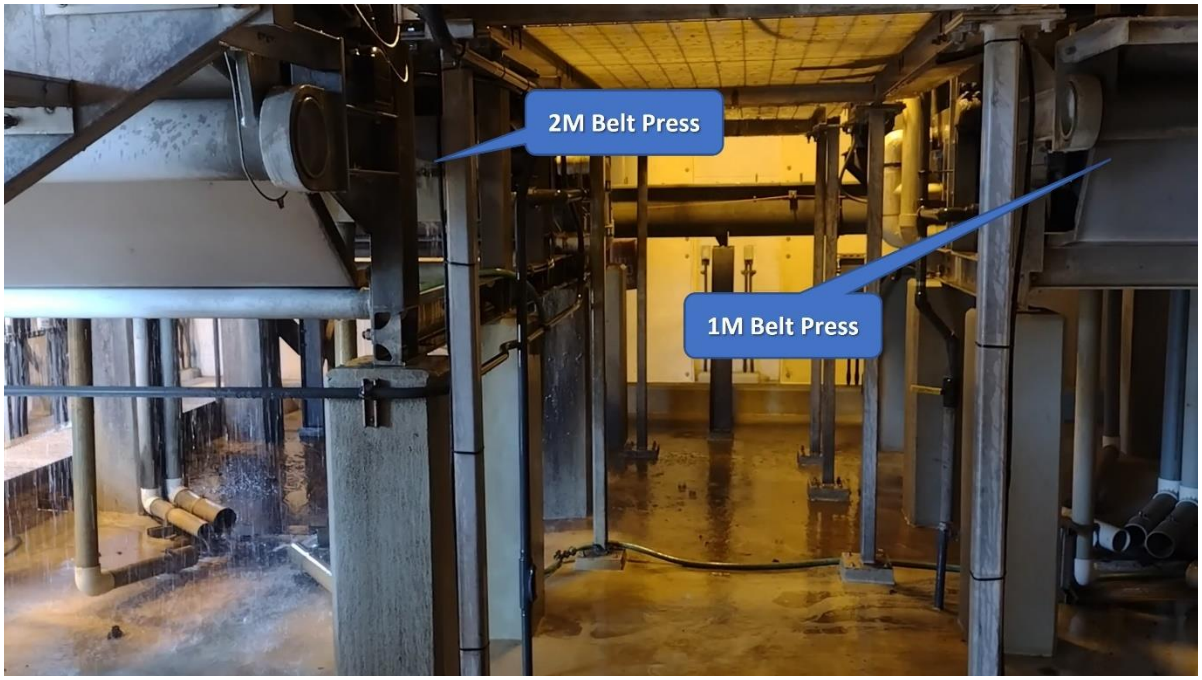

Figure 3-13: Beltpress units.

The 2-meter belt press has a rated dry solids capacity of 1,200 #/hour; the 1-meter press's capacity is 300 #/hour. Anticipated digested solids loading at full 6.6 MGD ADF is 12,350 #/day, meaning the two belt press units can handle all digestate flow by operating 8-9 hours per day. Sludge from the Digester #3 tank can also be pumped to sludge drying beds, though this option is not typically utilized unless the belt press units are down, or the digester tanks need to be drained rapidly. Dewatered sludge is conveyed out of the building where it transported to the adjacent composting area to be mixed with green waste for composting. Compost is available for sale to the general public at the site and is suitable for land application.

The belt press building, and equipment were commissioned in 2010. The building and equipment are in good shape and are anticipated to have another 10-15 years of service life. However, operating staff would like to reduce the footprint and attention needed to operate the dewatering equipment.

Belt press operation is relatively messy (dripping water, splashing, and drainage) and requires more observation and attention compared with other technology. Accordingly, operators intend to replace the smaller unit with a screw press or rotary press. This equipment would fit in the building and could address operator concerns. Options for dewatering equipment are discussed in Section 3.2.

Composting to achieve Class A biosolids is conducted on site. To achieve pathogen destruction, composting is performed with dewatered sludge by mixing it with green waste and allowing it to decompose. The mixed piles of compost are turned frequently to ensure even composting and expedite the process as much as possible. Operators have noted that space to expand composting is limited. Thus, additional area will need to be graded and paved to increase composting capacity as sludge production increases. City staff indicate that expansion could take place on the north side of the existing site and/or utilize some of the sludge drying bed area. Otherwise, there is potential to obtain land near the WRF site to relocate or expand composting.

3.1.11 Miscellaneous Infrastructure

This Master Plan focuses on major process equipment and structures. However, other key components of the WRF site must be maintained. The 2019 Risk Assessment (WWE, 2019) identified several other small but critical components such as manholes and aging yard piping/valving that will reach the end of their reliable service life within the time frame discussed in this plan. These items are not detailed here, but cost estimates and recommended replacement schedules are highlighted in Section 3.2 as adopted from the 2019 Risk Assessment.

3.2 Recommended Upgrades & Phasing

Recommended upgrades are separated into two phases. Phase 1 upgrades are needed within the next 1 to 6 years to address deficiencies, aging equipment, improve performance, or otherwise maintain the facility in reliable operating condition. Phase 1 is subdivided into *immediate needs* and *near-term* projects. *Immediate needs* projects replace aging equipment that is at risk of failure or address existing deficiencies and issues that are hindering the WRF's performance and reliability. Immediate needs improvements should be planned, designed, and implemented as soon as possible, ideally within the next 1-2 years. *Near-Term* improvements proactively replace aging equipment and processes that are not at a high-risk of failure but that are approaching the end of their reliable service life. These upgrades also address capacity and performance issues that may arise due to changing conditions, increased loading, or operator needs. Near-term improvements should be planned and implemented within the next 3-6 years. Phase 1 projects are summarized as follows:

Immediate Needs Projects:

1. **HEADWORS:**
   a. Install downstream level transmitter to address submerging influent Parshall flume.
   b. Replace headworks screening equipment and either rehabilitate aerated grit chamber equipment or replace with modern grit removal equipment.
   c. Rehabilitate HVAC and add odor control to the headworks building to bring up to current standards.

2. **PRIMARY CLARIFIERS:** Recoat and refurbish primary clarifier mechanisms.
3. **TERTIARY FILTRATION:** Refurbish sand filter media and traveling bridge system or replace sand filters with disc/cloth filter equipment.
4. **SOLIDS HANDLING:** Replace biogas handling appurtenances.
5. **SITE ELECTRICAL:** Replace aging electrical gear in the older pumphouse building.

Near-term Projects:

1. **SOLIDS HANDLING:**
   a. Install a boiler to replace sludge hydronic heating system and stabilize anaerobic digestion process.
   b. Recoat/refurbish digester lids.
   c. Replace smaller belt press with screw press or rotary press dewatering equipment.

2. **SECONDARY TREATMENT:** Replace the STM Aerotor wheels with fine bubble diffusers (and blowers). This conversion could be delayed until Phase 2, but operators report that the STM Aerotors require a nearly $1,000,000 rehabilitation within the next

year. This repair cost would likely cover most of the expense to replace the Aerotor wheels.

3. **SITE ELECTRICAL:** Install standby generators.

Phase 2 focuses on long-term needs and goals of the WRF including incorporating BNR, providing more BOD removal capacity, and the ability to produce Type I reuse water. These improvements would likely be implemented in 10-15 years, depending on when new permit requirements are implemented and actual growth, flow and loading conditions noted over the next 5-10 years. Phase 2 projects are summarized as follows:

1. Replace Nestle roughing tower tank, media, and distribution mechanism; add odor control to roughing tower.
2. Replace primary clarifier mechanisms.
3. Decommission trickling filters and construct new anaerobic, anoxic, and aeration basins.
4. Replace STM Aerotor wheels with fine bubble diffusers if not completed with Phase 1 projects.
5. Replace sand filters with disc filters for Type I reuse water and P removal polishing if not implemented in Phase 1.
6. Add additional UV disinfection modules for Type I reuse requirements and expand existing UV system to increase peak hydraulic capacity.
7. Add side stream treatment for P removal from digestate/dewatered sludge pressate stream. Rehabilitate aging sludge pumps and older digester process buildings. Replace lids for digester #3 and #2 and recoat interior of digester tanks.
8. Increase paved area to increase composting area.

3.3 Phase 1 Upgrades

These projects should begin planning and design as soon as possible. These upgrades will improve dependability for critical equipment that has reached the end of its reliable service life or is in need of higher capacity to meet projected peak loading.

3.3.1 Influent Flow Measurement & Headworks

Based on operator input, influent flow submerges the influent Parshall flume, causing inaccurate readings during peak events. This is primarily due to the limited (5.1 MGD) capacity of the screens and their decreasing performance as they age; flows above 6-6.5 MGD are projected to submerge the flume even with higher capacity screens installed due to required water surfaces in the screening channels. This can be addressed by installing a second level instrument on the downstream side of the flume, allowing for submerged flume flow calculations. Replacing the screens with new, higher capacity units will also reduce the frequency and severity of backup.

Another more costly options involves installing a combined flow meter to measure flow from the two sewage pressure lines and a new flume or flow meter farther upstream on the gravity line. This upgrade would provide more accurate flow measurement but is more costly. Unless the accuracy of the submerged flume calculation proves inadequate, the new flume and flow meters do not appear necessary. If a new headworks building is eventually constructed, new influent measurement can be incorporated at that time as well.

The existing headworks building itself is serviceable. Aside from needing new process equipment, the man doors and overhead door have moderate corrosion and should be replaced. The building does not have adequate ventilation, resulting in more severe corrosion, potentially hazardous conditions from accumulation of explosive gasses, and excessively noisome odors. Also, current ventilation does not meet current NFPA 820 safety guidelines. Accordingly, the HVAC system should be upgraded to increase ventilation rates to 12 exchanges per hour and include both intake and exhaust fans. The influent channels should also be covered and ventilated to a small odor scrubbing skid to reduce odors and protect interior equipment, piping, conduits, etc. Bagging systems should also be added to screening compactors and grit classifier discharge units to reduce odors and corrosive gases.

The screening equipment is aging, undersized for design flows, and needs to be replaced soon. New screens should be sized to maximize the capacity of the existing channels. Ideally, a capacity of at least 8.7 MGD per channel can be furnished to meet projected peak flow demand for the next 20 years. Regarding grit removal, the facility would benefit from replacing the grit equipment with a newer, more efficient system. New vortex-style grit chambers are more energy efficient (no blowers needed), and much more efficient at removing medium and finer grained grit. This would reduce solids loading in the clarifiers and digesters, which would reduce solids buildup and loading in the dewatering equipment. The new chamber would have a higher hydraulic capacity (at least 11 MGD). This installation could include a new grit washer, which would provide superior organics removal and discharge solids compared to the in-floor classifier. This would reduce odors and corrosive gases in the headworks building itself.

If replacement of the grit removal equipment is postponed for more than 2-3 years (or delayed until Phase 2), the existing installation will require some rehabilitation to prolong its life. The grit chamber blowers are older and should be replaced. Exposed piping for the air line and grit/air lift lines shows signs of coating wear and moderate corrosion and should be recoated or replaced. Cost estimates for alternatives with new grit removal equipment and rehabilitating existing grit equipment are provided in Table 3-1 and Table 3-2. Planning and design for this improvement should commence as soon as possible. These improvements would prolong the service life of the existing headworks for the next 20 years.

Table 3-1: Cost estimate for influent & headworks improvements with new grit removal equipment.

Influent & Headworks Upgrades w/ New Grit Equipment	
Item	**Cost**
Additional Level Sensor for Influent Flume	$ 12,000.00
Influent Piping/Vaults Rehabilitation	$ 68,750.00
Influent Screens (x2)	$ 500,000.00
Washpactors (x2)	$ 325,000.00
Remove Aerated Grit Chamber Equipment	$ 25,000.00
New Grit Equipment & Washer	$ 518,750.00
Mechanical/Piping & Installation	$ 393,750.00
HVAC	$ 162,500.00
Headworks Building Modifications & Repairs	$ 206,250.00
Odor Control	$ 143,750.00
Yard Piping	$ 25,000.00
Site/Civil Work	$ 43,750.00
Electrical, Controls & Instrumentation (20%)	$ 485,500.00
Subtotal	**$ 2,910,000.00**
Engineering & Design	$ 186,240.00
Construction Management	$ 162,960.00
Legal & Administrative	$ 69,840.00
TOTAL	**$ 3,329,040.00**

Table 3-2: Cost estimate for headworks improvements with no new grit equipment.

Influent & Headworks Upgrades w/ Old Grit Equipment	
Item	**Cost**
Additional Level Sensor for Influent Flume	$ 12,500.00
Influent Piping/Vaults Rehabilitation	$ 68,750.00
Influent Screens (x2)	$ 500,000.00
Washpactors (x2)	$ 325,000.00
Rehabilitate Grit Equipment	$ 137,500.00
Mechanical/Piping & Installation	$ 306,250.00
HVAC	$ 162,500.00
Headworks Building Modifications & Repairs	$ 206,250.00
Odor Control	$ 143,750.00
Yard Piping	$ 25,000.00
Site/Civil Work	$ 43,750.00
Electrical, Controls & Instrumentation (20%)	$ 386,250.00
Subtotal	**$ 2,317,500.00**
Engineering & Design	$ 148,320.00
Construction Management	$ 129,780.00
Legal & Administrative	$ 55,620.00
TOTAL	**$ 2,651,220.00**

As discussed above, an entirely new headworks facility could also be installed (Table 3-3). The facility would accommodate higher capacity equipment with a redundant third channel and second grit removal chamber. The cost for a new building is significantly higher than retrofitting the existing building. Advantages of a new building include increased hydraulic capacity, modern design for ventilation and odor control, and the ability to add redundant screening channels and grit removal chambers. However, the need for a building beyond 8.7 MGD does not appear necessary for at least another 15 years. Moreover, as discussed above, the peak hydraulic flow may not in fact exceed 8.7 MGD depending on how I&I and influent actually increase over time. It appears that the existing facility can be upgraded to meet demand for the target design window of this plan; the higher cost of a new building does not appear necessary or prudent. Thus, this plan recommends upgrading and retrofitting the existing building. A new structure can be installed later if deemed necessary.

Table 3-3: Cost estimate for a new headworks building.

New Headworks Building	
Item	**Cost**
Pressure Main Flow Mag Meter	$ 43,750.00
New Gravity Line Flow Measurement	$ 68,750.00
New Influent Screens (x3)	$ 1,062,500.00
New Screenings Washpactors (x3)	$ 450,000.00
Grit Chambers (x2) & Washer (x1)	$ 750,000.00
Mechanical/Piping & Installation	$ 706,250.00
HVAC	$ 281,250.00
New Headworks Building Structure (CMU)	$ 1,043,750.00
Screen Channel & Grit Chamber Concrete	$ 856,250.00
Yard Piping	$ 181,250.00
Site/Civil Work	$ 218,750.00
Electrical, Controls & Instrumentation (20%)	$ 1,132,500.00
Subtotal	**$ 6,795,000.00**
Engineering & Design	$ 434,880.00
Construction Management	$ 380,520.00
Legal & Administrative	$ 163,080.00
TOTAL	**$ 7,773,480.00**

3.3.2 Primary Clarifiers

The two existing clarifiers have sufficient capacity for current and future loading; however the mechanisms are ageing (30 and 40 years old respectively) and should be inspected and either recoated or replaced soon. Each clarifier has sufficient capacity that one tank can be taken offline at a time during normal (3-5 MGD) flows and loading without significantly hindering downstream processes. AQUA recommends draining each tank individually to conduct a thorough inspection of the concrete structure, mechanism, drive motor, rake arms, and submerged piping. If the steel is still in good condition, each mechanism could be removed from the basin, sand blasted, and recoated to extend its service life; a cost estimate for clarifier rehabilitation is provided in Table 3-4.

Inspection may reveal excessive corrosion of the mechanism, in which case they should be replaced. Given the age of the mechanisms, even if they are recoated now, the City should plan and budget to replace both mechanisms within the next 10-15 years to prolong reliable service. The concrete structures do not show any obvious signs of damage or spalling, but an inspection of the structure will determine if any concrete repair and/or coating system is required. This plan assumes that rehabilitation will be conducted as a project in Phase 1, with full mechanism replacement conducted as part of Phase 2. Cost estimates for new clarifier mechanisms, concrete repair/coatings, and other recommended refurbishments are summarized in Table 3-5.

Table 3-4: Cost estimate for primary clarifier rehabilitation.

Prmiary Clarifier Mechanism Rehabilitation		
Item	**Cost**	
Sand Blast & Repaint Clarifier Mechanisms (x2)	$	268,750.00
Subtotal	**$**	**268,750.00**
Engineering & Design	$	25,000.00
Construction Management	$	10,000.00
Legal & Administrative	$	6,450.00
TOTAL	**$**	**310,200.00**

Table 3-5: Cost estimate for primary clarifier mechanism replacement.

Prmiary Clarifier Mechanism Replacement		
Item	**Cost**	
Clarifier Mechanisms (x2)	$	1,062,500.00
Removal & Disposal of Old Mechanisms	$	68,750.00
Replace Sludge Pumps	$	118,750.00
PC Yard Piping Rehabilitation	$	168,750.00
Mechanical Installation	$	343,750.00
Concrete Repair & Coating*	$	556,250.00
Electrical, Controls & Instrumentation (15%)	$	264,375.00
Subtotal	**$**	**2,583,125.00**
Engineering & Design	$	165,320.00
Construction Management	$	144,655.00
Legal & Administrative	$	61,995.00
TOTAL	**$**	**2,955,095.00**

* Assumes concrete repair and coating system for all clarifier walls and floors at $25/SF.

3.3.3 STM Aerotor Aeration Basins

Retrofitting the STM Aerotor basins with fine bubble diffusers is part of the City's long-term expansion plan for the WRF. This upgrade would involve removing the Aerotor wheels, drive motors/chains, and installing floor-mounted fine bubble diffusers in all 4 tanks. The conversion includes installing blowers (i.e. three 75 to 100 HP blower units) and associated mechanical and electrical installation work (Table 3-6).

Table 3-6: Cost estimate to convert STM Aerotor basins to fine bubble diffusers.

Convert STM Basins to Fine Bubble Diffusers		
Item		**Cost**
Decomission & Remove STM Aerotor Wheels	$	132,250.00
Diffuser Equpment for STM Basins	$	92,000.00
Blowers	$	373,750.00
Mechanical Installation	$	120,750.00
Electrical, Controls & Instrumentation	$	379,500.00
Subtotal	**$**	**1,098,250.00**
Engineering & Design	$	76,400.00
Construction Management	$	66,850.00
Legal & Administrative	$	28,650.00
TOTAL	**$**	**1,270,150.00**

This conversion was originally discussed as part of the Phase 2 upgrades. However, it was recently determined that the STM Aerotor system requires a major refurbishment, with an estimated cost exceeding $900,000. This expense could potentially pay for converting the basins (or at least a significant portion of the cost) and using the funding to convert the basins may be in the City's long-term interest. Thus, this plan recommends that the STM basins be converted sooner rather than later. Nonetheless, this upgrade can be pushed to Phase 2. Finally, if this conversion is commissioned as part of Phase 1, it is recommended that the ability to add additional oxygen (as much as practical) be discussed with fine bubble diffuser suppliers, this could prolong the life of the existing secondary biological process if a major upgrade to complete BNR is not planned for an extended time.

3.3.4 Sand Filters & Tertiary Filtration

The sand filters have adequate capacity for current and future flows. However, many components including the media, traveling bridges, and underdrains are well past their reliable service life. Sand filter media should normally be replaced every 5 to 12 years depending on loading and backwashing rates. The existing media needs to be replaced within the next year based on performance and backwash frequency reported by operating staff. The traveling bridges are also noted to have some reliability issues related to exposure/protection of the electrical system. In April 2023, the traveling bridge, bridge rails, festoons, under drains, and other major components of the sand filter system were inspected by representatives from Aqua Aerobics (the original supplier of the system). Aqua Aerobics published a report based on their inspection, which recommends replacement of all major components in addition to new sand media. The total cost for their replacement/installation scope was $1,027,498. The building itself is in relatively good condition, but some ventilation equipment and entrance doors are aging and may need to be replaced. A summary of cost estimates for repairs and rehabilitation of the sand filter system is provided in Table 3-7.

Table 3-7: Cost estimate for sand filter rehabilitation.

Sand Filter Rebuild & Rehabilitation		
Item	**Cost**	
Removal/Disposal of Old Media	$	31,250.00
Sand Media, Underdrain, & Bridge Rehab	$	1,375,000.00
Building Rehabilitation	$	81,250.00
Sand Filter MCC	$	90,625.00
Electrical, Controls & Instrumentation	$	315,625.00
Subtotal	**$**	**1,893,750.00**
Engineering & Design	$	121,200.00
Construction Management	$	106,050.00
Legal & Administrative	$	45,450.00
TOTAL	**$**	**2,166,450.00**

As an alternative, the sand filters could be replaced with cloth media disc filters or a pressure membrane system. Several manufacturers including Aqua Aerobics, Ovivo, and WesTech offer disc filter systems designed specifically to retrofit into sand filter basins. This type of equipment offers improved reliability for solids removal compared to sand filtration and would be easier to incorporate in a future Type I reuse system if so desired. Preliminary pricing of suitable equipment packages ranges from $650,000 to $1,200,000.00. Design and installation are more involved than the sand filter replacement, and overall estimated project cost (Table 3-8) is higher than the major sand filtration rebuild in Table 3-7. However, these systems are easier to maintain long-term, offer better performance, and likely represent a better long-term investment for the City when considering a 15-20+ year service life. A preliminary cost estimate for disc filter installation is provided in Table 3-8. The cost estimate assumes disc filters are sized to treat peak flow through at least 2043, with the ability to expand capacity by adding discs to the filter tanks.

Table 3-8: Cost estimate to install disc filters in sand filter beds.

Tertiary Disc Filter Filtration	
Item	**Cost**
Removal of Sand & Bridge Equipment	$ 60,000.00
Disc Filter Equipment Package	$ 1,080,000.00
Concrete Retrofit Work	$ 102,000.00
Mechanical Installaton	$ 390,000.00
Sand Filter Building Rehabilitation	$ 210,000.00
Electrical, Controls & Instrumentation	$ 342,000.00
Subtotal	**$ 2,184,000.00**
Engineering & Design	$ 140,000.00
Construction Management	$ 59,000.00
Legal & Administrative	$ 54,600.00
TOTAL	**$ 2,437,600.00**

Sand filter replacement with Suez/Xylem ZeeWeed (ZW) pressure membrane filtration skids was explored. Pressure membranes provide reliable, superior water quality, meeting and exceeding Type I reuse requirements, but are more costly and complex to operate compared to disc filters. The membrane skids require backwash pumps, clean in place chemical pumps, blowers, backwash and chemical cleaning recirculation tanks, chemical storage tanks, and feed pumps. Most of this equipment should fit within the sand filter building, though the larger storage tanks would need to be installed outdoors or in a new auxiliary building. As noted, pumps would need to be added to pump secondary clarifier effluent through the membranes. The membranes would be sized to handle average daily flow or to accommodate whatever reuse capacity is desired by the City. A cost estimate for this filtration upgrade is provided in Table 3-9. Unlike the disc filters (and sand filters), this cost estimate is only sized to handle flows up to ~6 MGD. Any flows beyond this capacity would bypass tertiary filtration and continue directly to disinfection.

Disc filters are not as effective at total solids removal as membranes can remove finer particles than disc filters. However, they still provide Type I quality effluent and are adequate for this application. The sand filter basins can easily be retrofitted to accommodate disc filter equipment, reducing the need for standalone tanks, and thus providing savings on equipment capital and installation costs. The disc filter equipment should easily be accommodated within the footprint of the sand filter beds. Minor retrofit improvements such as concrete divider walls, piping, backwash pump equipment, and other potential building retrofits would need to be installed. Based on the cost, and the fact that disc filters will provide required performance and can be sized to handle full peak flow, this plan recommends installing disc filters with the Phase 1 upgrade work or when the City is ready to produce Type I water, which may be before Phase 2 is implemented.

Table 3-9: Cost estimate for pressure membrane tertiary filtration.

Tertiary Pressure Membrane Filtration		
Item	**Cost**	
Removal of Sand & Bridge Equipment	$	75,000.00
Membrane Equipment Package	$	5,437,500.00
Membrane Supply Pumps	$	156,250.00
Mechanical Installation	$	1,437,500.00
Sand Filter Building Rehabilitation	$	187,500.00
Electrical, Controls & Instrumentation	$	1,312,500.00
Subtotal	**$**	**8,606,250.00**
Engineering & Design	$	550,800.00
Construction Management	$	481,950.00
Legal & Administrative	$	206,550.00
TOTAL	**$**	**9,845,550.00**

Finally, it should be noted that the State of Utah is requiring that all cities submit applications for reuse water by November 2023. These applications do not necessarily require that the City's have plans or equipment in place to produce reuse water at that time, but the intent and application must be provided by then. Beyond this deadline, it would be difficult for the City to keep the option of reuse available.

3.3.5 Digester/Biogas Equipment

The digester tanks themselves appear to be in good condition. It is recommended that the tanks be drained and inspected periodically (every 1 to 2 years) to proactively address any concrete wear and coating repair concerns. This also provides an opportunity to remove residual solids to maximize HRT in the tanks. As noted above, operators have already purchased and installed replacement mixers for the two active tanks. Otherwise, the digester system has some deficiencies and aging components that need to be addressed. The most urgent issues with the digesters are sludge heating/temperature control and biogas handling equipment.

Many components of the biogas handling process including piping, pressure relief valves, flame arrestors, drip traps, and valves, have reached the end of their reliable service life. Operators intend to refurbish and replace most of these components within the next few years to ensure the safety and efficiency of the biogas system. Most of the piping is stainless steel and is likely still serviceable. However, many of the valves and biogas handling/safety equipment should be replaced. The pressure relief safety valves (PRVs) installed on the top of each tank should also be replaced with new dual safety selector PRVs. Given safety concerns associated with biogas handling, these improvements should be designed and implemented within the year. Estimated costs for all recommended digester and biogas improvements are summarized in Table 3-10.

Table 3-10: Cost estimate for digester biogas handling upgrades.

Digester Biogas Handling	
Item	**Cost**
Replace Biogas Piping/Valves	$ 81,250.00
Replace Biogas Handling Equipment & PRVs	$ 262,500.00
Mechanical Installation	$ 87,500.00
Electrical, Controls & Instrumentation (25%)	$ 85,937.00
Subtotal	**$ 517,187.00**
Engineering & Design	$ 33,100.00
Construction Management	$ 28,963.00
Legal & Administrative	$ 12,412.00
TOTAL	**$ 591,662.00**

To address issues with hot water supply and sludge heating, a dedicated boiler (natural gas and/or biogas fueled) should be installed near the digesters. A new heat exchanger could also be installed, but there does not appear to be an urgent need to replace the heat exchanger itself. Demand on the system is estimated to require from 10 to 15 million BTUs per day (MMBTU/d), which could easily be furnished with expected biogas production from the digesters. Currently, all biogas is sent to a flare for disposal. The boiler would need to be installed outside of the classified envelopes of the digesters, most likely in a new building. The new building could house new biogas conditioning equipment (if a biogas boiler is installed), sludge pumps, heat exchangers, and be sized to accommodate future improvements to the digester/solids handling process. These needs are less urgent than the biogas upgrades but are still considered near-term projects to be implemented within the next 2-3 years. Preliminary cost estimates for these upgrades are included in Table 3-11.

Table 3-11: Cost estimate for digester sludge heating upgrades and digester tank rehabilitation.

Digester Heating & Lid Rehabilitation	
Item	**Cost**
Biogas Conditioning Equipment	$ 231,250.00
Boiler	$ 118,750.00
New CMU Equipment Building	$ 237,500.00
Building HVAC	$ 50,000.00
Refinish Digester Lids Interior (x3)	$ 275,000.00
Refinish Digester #1 Lid Exterior	$ 43,750.00
Reinsulate Digester Lids (x2)	$ 143,750.00
Mechanical Installation	$ 231,250.00
Electrical, Controls & Instrumentation (25%)	$ 332,812.00
Subtotal	**$ 1,664,062.00**
Engineering & Design	$ 106,500.00
Construction Management	$ 93,188.00
Legal & Administrative	$ 39,937.00
TOTAL	**$ 1,903,687.00**

The digester tank structures should be inspected annually. No obvious signs of significant corrosion, spalling, or damage to the concrete were obvious during our inspection. The exterior concrete masonry unit block (CMU) looks to be in good condition as well. No indication of damage to the underlying insulation was observed. The wall foam insulation is covered by insulated CMU. The CMU block should be cleaned, and new sealant (or coatings) should be applied periodically to extend protection and life of the insulation. Each tank should be drained when conditions allow to conduct a thorough inspection of the interior concrete surfaces and lids. Concrete and steel lid repair and coating systems should be applied as needed to prolong the life of these structures. The exterior surfaces of the lids are in acceptable condition, though the exterior coating on the oldest tank (digester #1) may need to be removed and replaced within the design window of these upgrades. Based on our inspection and the 2019 Risk Assessment, this plan budgets for refinishing the interior surface of all three lids and replacing lid insulation on tanks #2 and #3 in the near-term. Long-term recommendations include eventual lid replacement and recoating of interior concrete surfaces. Robust 3-part steel coating and concrete systems typically cost from $20-$30 per square foot installed.

3.3.6 Sludge Dewatering

The two belt press units have sufficient capacity to handle projected solids loading from the digesters. However, the smaller 1-meter unit is offline and inoperable currently, and operators intend to replace it with more compact and lower maintenance equipment. In reviewing sludge flow and solids loading with multiple equipment suppliers, rotary fan press skids appear to offer the most cost-effective alternative. For example, Fournier rotary fan presses could handle all current and future 20-year digested sludge with a single 8-skid rotary press unit. At current solids loading, the unit would need to operate ~40 hours per week. For 2043 loading, operational times is estimated at 55-60 hours per week. For loading beyond 2043, the supplier would recommend a second 8-unit skid to provide adequate redundancy and maintain operating hours to less than 40 per week. Preliminary cost estimates to replace the smaller belt press with a rotary press unit is provided in Table 3-12.

Table 3-12: Cost estimate for sludge dewatering upgrades.

Sludge Dewatering Upgrades	
Item	**Cost**
8-Skid Rotary Press	$ 625,000.00
Demolition/Removal of 1M Press	$ 43,750.00
Building HVAC Upgrades	$ 96,875.00
Screw Conveyor Upgrades	$ 97,500.00
Mechanical Installation	$ 175,000.00
Platform Modifications	$ 31,250.00
Electrical, Controls & Instrumentation (20%)	$ 213,875.00
Subtotal	**$ 1,283,250.00**
Engineering & Design	$ 82,128.00
Construction Management	$ 71,862.00
Legal & Administrative	$ 30,798.00
TOTAL	**$ 1,468,038.00**

3.3.7 Miscellaneous Site Electrical Upgrades

The Phase 1 upgrade cost estimates include some costs for new electrical gear, conduit, and integration directly associated with each project. However, the WRF site itself includes many electrical components that are 30-40+ years old. These components are beyond typical reliable service life, can be difficult to maintain, and pose a moderate risk as a failure point for dependable operation. Specifically, the older pumphouse (adjacent to the Nestle roughing tower) includes some MCC components and obsolete PLC panels that should be replaced as soon as possible; these are considered immediate need items with an estimated replacement cost of $350,000. Previous assessments (WWE, 2019) also recommend replacing the transformer in the old pump building.

Otherwise, operators are concerned that no backup power generation is available to operate critical components of the WRF during power outages. Given the current location and arrangement of electrical gear and conduit at the site, two generators are recommended. This is considered a near-term need and should be installed within the next 2-3 years. A preliminary scope and cost estimate for standby power generators is provided in Table 3-13.

Table 3-13: Cost estimate for miscellaneous site electrical upgrades.

Phase 1 Misc. Electrical Upgrades	
Item	**Cost**
Replace Old MCCs and PLC Panels	$ 350,000.00
Old Pumphouse 277/400 Transformer	$ 133,000.00
Standby Generators	
500 KW Generators & ATS	$ 278,300.00
1 MW Generator & ATS	$ 459,800.00
Conduit, Wire, Concrete Pads	$ 145,200.00
Generator Installation	$ 48,400.00
Startup & Commissioning	$ 24,200.00
Contractor Markup	$ 194,900.00
Subtotal	**$ 1,150,800.00**
Engineering & Design	$ 76,320.00
Construction Management	$ 66,780.00
Legal & Administrative	$ 28,620.00
Standby Generators Subtotal	**$ 1,322,520.00**
Total Phase 1 Misc. Electrical Work	**$ 1,805,520.00**

3.3.8 Phase 1 Summary

The "immediate needs" upgrades should begin design within the next year, with intent to have them installed and operating no later than 2024. Near-term projects should begin design within the next 1-2 years, with installation complete within 5 years. Priority should be given to procuring replacement headworks equipment and addressing biogas handling/safety issues with the digesters. Rehabilitation of the sand filters should also be done as soon as possible. Refurbishing or replacing the primary clarifier equipment and replacing the solids dewatering equipment are less urgent, but the City should budget for and plan on completing these upgrades within the next 3-4 years. Table 3-14 is a summary of all cost estimates for all recommended Phase 1 upgrades. A preliminary site plan (Figure 3-14) highlighting the upgraded processes and new facilities is provided at the end of this chapter.

Table 3-14: Summary of recommended Phase 1 upgrades.

Springville WRF Phase 1 Upgrade - Cost Estimate Summary	
Immediate Needs Projects	
Item	**Cost**
Influent Flow & Headworks Upgrades*	$ 3,329,040.00
Recoat Exisitng Primary Clarifier Mechanisms**	$ 310,200.00
Tertiary Filtration Upgrades	$ 2,437,600.00
Digester & Biogas Handling Upgrades	$ 591,662.00
Replace Pump Bldg. MCCs, PLC, and Transformer	$ 483,000.00
Immediate Needs Subtotal	**$ 7,151,502.00**
Recommended Near-Term Projects	
Item	**Cost**
Digester Heating & Lid Rehabilitation	$ 1,903,687.00
Retrofit STM Aerotor Basins w/ Fine Bubble Diffusers	$ 1,270,150.00
Standby Generators	$ 1,322,520.00
Sludge Dewatering Upgrades	$ 1,468,038.00
Near-Term Projects Subtotal	**$ 5,964,395.00**
PHASE 1 TOTAL	**$ 13,115,897.00**

* Assumes replacement of grit removal with new system and classifier. Cost estimate without new grit equipment is $2.55 million.

** Replacement is included with Phase 2 improvements but may be required sooner depending on the condition of the mechanisms.

3.4 Phase 2 Upgrades

As highlighted in Chapter 2, the WRF appears to have sufficient hydraulic and BOD capacity to accommodate growth through the next 18 years. With the addition of chemical phosphorous removal in 2020, the facility can reliably meet current permit requirements in this time frame by implementing Phase 1 upgrades and maintaining existing processes and equipment. However, a new total nitrogen limit is expected sometime within the next 8 to 10 years, and the existing trickling filter processes is not conducive to total nitrogen reduction and BNR. Furthermore, chemical phosphorous removal has significant chemical expense that can be reduced with BNR. Phase 2 upgrades focus on implementing BNR at the WRF as well as increasing hydraulic and BOD capacity to meet loading through at least 2043 with room to facilitate more expansion. These upgrades are considered long-term improvements and should be planned and designed within 8-10 years in anticipation of new total nitrogen limits. This timeline could be delayed slightly depending on the State's timing for implementing TN effluent limits. The following sections summarize major processes upgrades and estimated costs for this Phase. As with Phase 1 upgrades, all cost estimates are provided in today's dollars and not adjusted for inflation.

3.4.1 Nestle Roughing Tower

As discussed above, the Nestle tower tank shows signs of corrosion, and the top row of the tank was recently replaced. Given the highly corrosive environment, it is expected that the tank will need to be replaced within the 20-year timeframe reviewed in this plan. Furthermore, odor control and abatement are becoming common issues that wastewater facilities are required to address. The roughing tower is a major acute source of odors. A replacement tank should include a closed top and budget for odor control. Cost estimates for replacement tanks range from $315,000 for a painted carbon steel tank with covered top to $685,000 for a covered stainless-steel tank. The blowers, distribution mechanism, and media are in good condition though they will eventually need to be replaced. Costs to replace the tank, media, mechanism, and to address odor issues would primarily be the responsibility of Nestle, depending on the details of City's agreement. Cost estimates are provided in this plan (Table 3-15) for reference and coordination/planning purposes.

Table 3-15: Cost estimate Nestle roughing tower upgrades.

Roughing Tower Upgrades	
Item	**Cost**
Replacement Carbon Steel Tank*	$ 406,250.00
Replacement Process Blowers (x2)	$ 68,750.00
Replacement Pump & Flow Meter	$ 168,750.00
Replacement Media Package	$ 593,750.00
Replacement Distribution Mechanism	$ 231,250.00
Odor Control Blower & Scrubber	$ 437,500.00
Mechanical/Piping & Installation	$ 356,250.00
Electrical, Controls & Instrumentation	$ 339,375.00
Subtotal	**$ 2,601,875.00**
Engineering & Design	$ 166,520.00
Construction Management	$ 145,705.00
Legal & Administrative	$ 62,445.00
TOTAL	**$ 2,976,545.00**

* For stainless-steel tank option add $370,000.

3.4.2 Primary Clarifiers

Recoating of the clarifier mechanisms will help prolong the life of the equipment, but the mechanisms should eventually be replaced to ensure reliable service. The concrete structures themselves should be inspected annually and this plan assumes that the concrete surfaces will be coated and rehabilitated concurrent with replacing the mechanisms for ~$3 million as summarized in Table 3-5 above.

3.4.3 Biological Nutrient Removal

The focus of the Phase 2 upgrades is implementation of BNR for P and TN removal. This work requires decommissioning and removal of the trickling filters and constructing a new BNR process, including aeration tanks, within their footprint. This effort will require phasing and coordination with operators and regulators. Temporary permits for reduced effluent quality may need to be issued for construction. The STM Aerotor basins would function as the main secondary process during this time. The City also intends to retrofit the STM Aerotor basins as needed to complete the upgrade of this process.

BNR provides biological removal of phosphorous and nitrogen. Biological P reduction is implemented by mixing effluent from the primary clarifiers with RAS from the secondary clarifiers in anaerobic basins or by utilizing an internal recycle stream from the process. Anaerobic means environments with limited or no oxygen available, including dissolved oxygen (O_2) and easily accessible oxygen associated with nitrates, nitrites, and nitrous oxides. This environment promotes growth of specialized bacteria that produce VFA's. These bacteria metabolize the VFA's in aerobic environments which promotes a net uptake of phosphorous. The phosphorus remains as part of the cell structure in the organisms, which settle with the sludge and are eventually wasted to the digesters and dewatering. With biological nutrient removal, phosphorous can be reliably reduced to < 1 mg/L (Metcalf, 2003 & MPCA, 2006). Anaerobic basins are sized based on hydraulic retention time (HRT), with one hour (at ADF) required to achieve efficient phosphorous removal. HRTs in excess of three hours are not desirable as prolonged exposure to the environment can cause excessive phosphorus release back into the waste stream. Thus, the basins are ideally sized to provide a minimum of 45 minutes HRT during peak flow events, while preventing HRT's of more than three hours during normal flow.

Based on flow projections, a total anaerobic volume of 360,000 gallons (e.g. three 120,000-gallon tanks) would provide 2.4 hours HRT at current (2022) HRT and 1.8 hours HRT for 2043 ADF. A fourth tank would be needed for 2060 ADF. The minimum HRT remains just under 1 hour for peak flow events, which is adequate, especially given the low frequency with which the true peak is anticipated. Basins could be equipped with submerged mechanical mixers or incorporate eductor type mixers utilizing air from the main aeration basin blowers.

Total nitrogen removal, using denitrification, involves the conversion of oxygen-bearing nitrogen molecules (NO_3, NO_2, N_2O, etc.) into nitrogen gas (N_2). This is achieved in anoxic basins, or environments where free oxygen (O_2) is not readily available, promoting the growth of denitrifying bacteria that utilize the oxygen in nitrous oxide molecules. Nitrates are formed when ammonia is nitrified in aerobic environments (i.e. aeration basins). Thus, denitrification for TN removal cannot occur until ammonia is nitrified. Accordingly, the anoxic basins must be installed either after the aeration basins, or internal recycle from aeration basin effluent must be recycled back to the anoxic basins in order to effectively denitrify. Anoxic basins are usually installed before aeration tanks, as tanks installed post aeration, or in between aeration steps, are usually carbon poor, meaning insufficient carbon is available for denitrification to occur. However, the Springville WRF includes carbon rich influent from Nestle; a portion of this influent could bypass the initial aeration basin and combine in a post-aeration anoxic tank, prior to entering a second aeration tank (i.e. the converted STM Aerotor basins). Detailed processes modeling will help determine whether pre-aeration anoxic tanks (with internal recycle) or an anoxic tank installed between two aeration steps is optimal. For this plan, it is assumed that the anoxic tanks will be installed pre-aeration, mixing with effluent (and RAS) from the anaerobic tanks and internal recycle from the aeration basins.

Requirements for anoxic basins are based on multiple factors including minimum water temperatures, mixed liquor suspended solids (MLSS) concentration, sludge retention time (SRT), and other site-specific operating parameters. Preliminary design estimates show that three (3) 225,000-gallon tanks would provide adequate volume for 2043 design loading. Depending on performance and operating conditions, this volume could be suitable for loading beyond 2043, though a fourth tank could eventually be installed if necessary. These basins would utilize the same mixing equipment selected for the anaerobic tanks.

The anoxic basins require internal recycle (usually 3 to 4 times average daily flow) from the aeration basins to effectively achieve denitrification and TN reduction. A new internal recycle pump station would be installed in the same building housing new blower equipment for the aeration basins. For 2043 design criteria, four (4) 4,500 gpm pumps would be installed, providing 4Q internal recycle at 4.7 MGD ADF, with one redundant pump. Future growth can be accommodated by either upsizing pumps over time or installing additional pumps. Preliminary cost estimate for BNR and aeration basin upgrades are provided in Table 3-16 below.

3.4.4 Aeration Basins

New aeration basins are needed to replace the BOD reduction capacity of the trickling filters. Fine bubble diffusers (with blowers) offer a cost-effective method to deliver the necessary oxygen for BOD reduction and nitrification of ammonia. This phase includes replacing the STM Aerotor wheels with fine bubble diffusers as well; this retrofit will not be completed until after installation of the new BNR and aeration tanks as the Aerotors are needed to provide oxygen and nitrification treatment.

For typical design, 1.2 pounds of dissolved oxygen (O_2) are required for every pound of BOD removed. Likewise, 4.6 pounds of O_2 are required for each pound of ammonia that is nitrified. Denitrification yields a net oxygen credit to the process, up to 2.8 pounds of O_2 per pound of nitrogen denitrified. However, this plan assumes no net denitrification oxygen credit to be conservative. Aeration basin tanks are sized based on several criteria including HRT, sludge retention time (SRT), operating MLSS, among other factors. Preliminary estimates for tank sizing show that three (3) 350,000-gallon aeration tanks combined with the ~905,000 gallons available in the STM Aerotor basins would provide adequate capacity for 2043 loading. As with BRN, the ability to install a future fourth tank for growth through 2060 and beyond is possible.

Table 3-16: Cost estimates for BNR, new aeration basins, and STM basin conversion.

BNR & Aeration Basin Installation	
Item	**Cost**
Demolish & Remove Trickling Filters	$ 281,250.00
BNR & Aeration Basins Concrete	$ 5,312,500.00
Mixers for Anaerobic & Anoxic Basins	$ 562,500.00
New Aeration Basin Diffusers	$ 543,750.00
Blowers	$ 437,500.00
Internal Recycle Pumps	$ 262,500.00
Blower/IR Pump Building	$ 456,250.00
Mechanical/Piping & Installation	$ 1,343,750.00
Site/Civil Work	$ 593,750.00
Yard Piping	$ 418,750.00
Electrical, Controls & Instrumentation (20%)	$ 2,042,500.00
Subtotal	**$ 12,255,000.00**
Engineering & Design	$ 784,320.00
Construction Management	$ 686,280.00
Legal & Administrative	$ 294,120.00
TOTAL	**$ 14,019,720.00**

Finally, as previously discussed, the City intends to convert the STM Aerotor basins into fine bubble diffusers with the aeration basin/BNR upgrade. If convenient, this conversion could take place earlier with Phase 1 (as mentioned above), or after installation of the new BNR/aeration basins. Cost estimates for all new BNR and aeration tank improvements are summarized in Table 3-16. Costs for converting the STM Aerotor basin are summarized above in Table 3-6.

3.4.5 Sand Filters/Tertiary Filtration

With completion of the BNR and new aeration tanks, tertiary filtration will be needed to enhance P removal. More reliable filtration is also recommended if production Type 1 reuse water is planned. Type I reuse requires reliable tertiary filtration to meet stringent (< 2 NTU) turbidity requirements. The sand filters have been in service since the 1980s. By the time Phase 2 is implemented, the sand media will have been replaced 1 or 2 additional times if disc filters were not installed as part of Phase 1. Chemical addition for enhanced P removal would also increase load and backwash demand on the system, increasing operators' effort to manage the process. More efficient technologies better suited for this application are available and recommended in this plan as part of Phase 1. Detailed costs and comparisons are discussed above in Section 3.3.4

3.4.6 UV Disinfection

The existing open channel UV system is sized for 9.3 MGD for normal permit discharge (i.e. non-Type I reuse). For Type I reuse, higher UV dosing is required to provide zero (non-detect) e. coli in the water. The old chlorine contact channels have ample space to accommodate additional UV equipment. The reuse UV equipment could be installed in a separate (i.e. western-most) channel, providing the City with a redundant channel. During period where reuse water is not required, flow could pass through the older UV channel, with the reuse channel available as backup. If Type I water is needed, flow would normally pass through the new UV channel, but could always be diverted to the older channel if needed. Operators would discharge to the creek rather than sending flow the reuse system under this circumstance. Otherwise, the existing UV system is adequately sized for the next 15 years. Additional UV banks will need to be added to increase capacity beyond 9.3 MGD. The 2019 Risk Assessment also identified components of the chlorine chamber such as gates, mud valves, etc. that will need replacement eventually to maintain ease of operation of this process. A cost estimate for UV system improvements is provided in Table 3-17.

Table 3-17: Cost estimate UV disinfection system upgrades & expansion.

UV Disinfection Upgrades	
Item	**Cost**
Open Channel Type I UV System	$ 1,437,500.00
Expand Existing UV System	$ 375,000.00
Equipment Room Modifications	$ 118,750.00
Chlorine Channel Upgrades/Rehab	$ 231,250.00
Utility Water Pump Station Rehab	$ 368,750.00
Mechanical Installation	$ 475,000.00
Electrical, Controls & Instrumentation	$ 751,562.00
Subtotal	**$ 3,757,812.00**
Engineering & Design	$ 240,500.00
Construction Management	$ 210,438.00
Legal & Administrative	$ 90,187.00
TOTAL	**$ 4,298,937.00**

3.4.7 Digesters

The Phase 1 upgrades address the current issues with the digester/biogas processes. However, with the introduction of biological P removal, more upgrades are needed. Phosphorus removed biologically is captured in sludge. Sludge is wasted from the biological process, thickened, and pumped to the anaerobic digesters. In anaerobic conditions, the phosphorous-bearing biomass releases phosphorous back into aqueous form. Secondary phosphorous release can result in up 60-80% of captured P being released back into the soluble state. Thus, pressate from the dewatering processes must be treated to remove soluble phosphorous prior to returning this flow back to the front of the main wastewater treatment process. If this phosphorus is not removed, it will continue to recirculate and accumulate in the flow stream. Eventually, critical saturation points are reached, and phosphorus begins to precipitate out in various forms (e.g. struvite), potentially fouling pipes, pumps, heat exchangers, and others. This also renders biological P removal ineffective, as residual P in secondary clarifier effluent will also increase, requiring that all P be removed chemically prior to tertiary filtration.

Phosphorus removal from sludge/dewatering flows is known as side stream treatment. Many options are available for side stream treatment, most involve chemical addition ahead of sludge dewatering and/or pressate to recapture phosphorus prior to returning drainage water from sludge dewatering processes to the front of the treatment plant. Three options are briefly discussed in this plan. First, the introduction of ferric or alum can reprecipitate most of the residual phosphorus in the side stream flow. Chemical demand is much lower than is required for treating the full WRF flow as flow volumes are much smaller and P levels more concentrated. If this chemical is introduced ahead of dewatering, much of the P will precipitate out and be removed with the dewatered sludge. Second, chemical addition into the post dewatering liquid stream would settle in the primary clarifiers. Third, introduce magnesium chloride either before or after dewatering to promote struvite formation. Struvite is a phosphorous-bearing crystal that can be removed with sludge or settled in tanks prior to returning flow to the main WRF process.

This plan assumes installation of a chemical storage tank and chemical pumps to provide side stream P removal. Potentially, the chemical storage and pumps used for enhanced P removal ahead of the secondary clarifiers could be expanded to provide this service, though the required yard piping may not merit this approach. The chemical equipment currently utilized for primary chemical injection could also be relocated and repurposed for this application. This equipment could be housed in the new boiler building associated with Phase 1. A cost estimate for this addition is provided in Table 3-18.

As noted above and referenced in the 2019 Risk Assessment, the digesters and associated piping, sludge pumps, and equipment buildings will require rehabilitation or replacement to prolong reliability (WWE, 2019). Major items recommended for replacement within the next 10-15 years include updating the HVAC for both sludge pump/processes spaces, replacing sludge pumps, replacing the lids for digesters #3 and #2, and replacement of older, critical yard piping and transfer valving. These expenses are summarized in Table 3-19.

Table 3-18: Cost estimate for digestate side stream P removal.

Digestate Sidestream Treatment & Lid Replacement	
Item	**Cost**
Chemical Storage Tank	$ 50,000.00
Chemical Injection Pump Skid	$ 75,000.00
Mechanical Installation	$ 68,750.00
Yard Piping	$ 50,000.00
Electrical, Controls & Instrumentation (25%)	$ 60,937.00
Subtotal	**$ 304,687.00**
Engineering & Design	$ 19,500.00
Construction Management	$ 17,063.00
Legal & Administrative	$ 7,312.00
TOTAL	**$ 348,562.00**

Table 3-19: Cost estimate for digester rehabilitation work.

Digester, Sludge Handling & Building Rehabilitation	
Item	**Cost**
Sludge Buildings HVAC Upgrades	$ 106,250.00
Replace 5 HP Sludge Pumps (x2)	$ 156,250.00
Replace Digester #3 & #2 Lids	$ 762,500.00
Recoat Digester Tank Interiors	$ 656,250.00
Mechanical Installation	$ 247,500.00
Yard Piping	$ 118,750.00
Electrical, Controls & Instrumentation (25%)	$ 511,875.00
Subtotal	**$ 2,559,375.00**
Engineering & Design	$ 163,800.00
Construction Management	$ 143,325.00
Legal & Administrative	$ 61,425.00
TOTAL	**$ 2,927,925.00**

Operators have also noted that the space available for composting activities is limited and cannot accommodate much growth. The current composting area, excluding access for private citizens to access green waste dumping sites and compost pickup, utilizes roughly 140,000 square feet for compost piles and green waste storage. The entire area dedicated for the complete composting operation is roughly 230,000 square feet (5.3 acres). This includes space north and east of the dewatering building. The sludge drying beds could provide another ~50,000 feet of space for composting, though some of the beds should still be reserved for auxiliary solids handling/drying purposes. Additional expansion would require obtaining more land. Ideally, any additional composting space, would be located as close to the WRF as possible to minimize hauling costs of dewatered sludge. The new site could serve to supplement composting activity, or the entire operation could be relocated, though this would require a substantially larger piece of land. At a minimum, it is assumed that 175,000 square feet of land would need to be graded and paved (Table 3-20). If the City intends to relocate the entire composting operation offsite, at least 9-10 acres of new land are recommended. Costs to obtain the land are not included in this estimate as a specific site has yet to be identified and property value is variable and difficult to estimate.

Table 3-20: Cost estimate to expand composting operation.

Compost Facility Expansion	
Item	**Cost**
Site Work & Grading	$420,000.00
Asphalt Work	$945,000.00
Subtotal	**$ 1,365,000.00**
Engineering & Design (8%)	$ 91,000.00
Construction Management (7%)	$ 79,625.00
Legal & Administrative (3%)	$ 34,125.00
TOTAL	**$ 1,569,750.00**

As already discussed, biogas could be utilized to fuel boilers for the digester process. Other uses for biogas include installing a local generator. This generator could be used to power (or at least supplement) the energy demand of the WRF. Hot water from generator jacket/cooling system could be used in heat exchangers as well, reducing demand on the boiler. The WRF would remain connected to the main grid as backup, but this alternative could eliminate the need to install standby generators. Exploring the numerous options is beyond the scope of this plan but are mentioned here to guide discussions as Phase 2 enters detailed planning.

There are other potential enhancements to the digester/biogas system that would increase the efficiency of biogas production, improve solids destruction, and reduce overall volume of solids for disposal. Depending on if and how the City intends to utilize biogas, increased methane production could be beneficial. For example, pre-conditioning of TWAS with the Verde Process can increase volatile suspended solids (VSS) destruction of WAS from 45% to 75%. If primary sludge is also preconditioned, primary VSS destruction can increase from 65% to over 80%. This process requires heating sludge to 170°F and holding/mixing the slurry for ~2 days prior to entering the anaerobic digester. Incorporating this process would require additional sludge transfer pumps, another (larger) boiler and heat exchanger, along with a ~100,000-gallon storage tank.

3.4.8 Miscellaneous Site Upgrades

Most of the major civil, yard piping, and electrical work required to incorporate Phase 2 improvements is included in the individual cost estimate tables provided above. Nonetheless, certain existing facilities may not be directly related to these projects, but their continued operation is critical to the long-term operability of the WRF. Most of these improvements are captured in the 2019 Risk Assessment (WWE, 2019) and are not discussed in detail here. However, a summary and cost estimate (Table 3-21) are listed herein to facilitate planning and budgeting. These recommended upgrades are associated with Phase 2 projects and include:

- Replace HVAC equipment in older operator (pumphouse building) structure.
- Reline or replace critical yard piping components including: 18-inch and 24-inch primary clarifier influent and effluent piping that will be utilized to connect to future aeration/BNR processes; 36" piping connecting secondary clarifiers, tertiary filtration, and disinfection.
- Update and replace aging HVAC equipment associated with the main pump station structure.
- Restore/recoat aging manholes that are needed for long-term (10-year plus) service.

Table 3-21: Cost estimate for miscellaneous Phase 2 civil rehabilitation projects.

Phase 2 Misc. Civil Projects	
Item	**Cost**
Replace Operator/Pumphouse HVAC Equipme	$ 118,750.00
Main Pump Station HVAC Updates	$ 150,000.00
Yard Piping Rehabilitation/Replacement	$ 343,750.00
Rehabilitate/Recoat Aging Manholes	$ 1,400,000.00
Subtotal	**$ 2,012,500.00**
Engineering & Design (8%)	$ 128,800.00
Construction Management (7%)	$ 112,700.00
Legal & Administrative (3%)	$ 48,300.00
TOTAL	**$ 2,302,300.00**

3.4.9 Phase 2 Summary

Many facilities and equipment at the plant are operating well and have many years of reliable service life remaining. The WRF has sufficient hydraulic and biological capacity to meet *current* permit requirements for an estimated 15 years. Future anticipated nutrient limits are expected sooner however and will require significant changes to the secondary biological process. Phase 2 incorporates BNR to address anticipated total nitrogen limits and provide biological phosphorous removal. Recommended upgrades to tertiary filtration will enhance phosphorous removal and add the ability to produce Type I reuse water. Additional UV disinfection capacity is also required for Type I water. Side stream nutrient removal from the digester process will also be required once biological P removal is implemented. The composting area would need to be expanded to handle additional solids from growth and the expanded activated sludge process. Other enhancements to the digesters such as sludge conditioning (Verde process), an onsite cogeneration, would further enhance the biogas production and provide energy savings to the WRF if the City intends to harness the biogas. Table 3-22 provides a summary of Phase 2 cost estimates; a conceptual site plan is shown in Figure 3-15.

Table 3-22: Summary of Phase 2 expansion cost estimates.

Springville WRF Phase 2 Upgrade - Cost Estimate Summary	
Item	**Cost**
Replace Primary Clarifier Mechanisms	$ 2,955,095.00
BNR & Aeration Basins Replacing Trickling Filters*	$ 14,019,720.00
UV Disifinfection Expansion (Type I Reuse)	$ 4,298,937.00
Digester Sidestream Treatment	$ 348,562.00
Digester, Sludge Handling & Building Rehabilitation	$ 2,927,925.00
Expand Composting Facility Area	$ 1,569,750.00
Miscellaneous Phase 2 Civil Upgrades	$ 2,302,300.00
TOTAL	**$ 28,422,289.00**
Nestle Roughing Tower Upgrades**	$ 2,976,545.00

* Timing would coincide with permit changes associated with total N limits.
** Costs may be shared with or even completed covered by Nestle rather than the City.

These improvements will maintain necessary hydraulic and biological capacity while adding BNR to the process stream. Some interconnecting yard piping may need to be replaced, upsized, or supplemented with parallel lines if peak hydraulic capacity exceeding 9.3 MGD is required. A detailed hydraulic analysis of the entire plant should be conducted during Phase 2 design to identify any deficient infrastructure. All new facilities and equipment should be installed to either handle higher peak flows or accommodate straightforward expansion to increase capacity as necessary. Most existing processes are sized to handle peak flows of at least 11 MGD. The existing headworks channels may not easily accommodate screening equipment with capacity much over 9.0 MGD per screen. As Nestle flow does not pass though the headworks, the peak hydraulic capacity of the headworks may not need to exceed this amount. However, a new headworks building may eventually become necessary depending on I&I and actual peak flow conditions.

3.5 Summary of Recommended Upgrades

Phase 1 upgrades address aging equipment and deficiencies at the WRF including headworks screens, grit removal, primary clarifier mechanisms, and digester heating concerns. Phase 2 is intended to install BNR when required by future permit requirements, as well as improve effluent quality to meet Type I reuse standards. Improvements for Type I reuse could be implemented sooner if desired. A recommended timetable to execute the upgrades recommended in this plan is as follows:

<u>PHASE 1</u>

Immediate Needs Projects: *To be completed within the next 1-2 years*

1) Add second level transmitter to influent flume to address submerged flow conditions: 2024
2) Replace headworks screening and grit removal equipment: 2024-25
3) Inspect and recoat primary clarifier mechanisms: 2024
4) Rehabilitate place sand filter system or replace with disc filtration: 2024-25
5) Replace digester biogas handling piping, valves, and appurtenances; recoat digester lids: 2024-25
6) Replace pump building MCCs and PLC display panel: 2024-25

Near-Term Projects: *To be completed within the next 3-6 years*

1) Install boiler and replace/upgrade digester sludge heating process: 2025-2026
2) Replace STM Aerotor wheels with fine bubble diffusers 2025-2026

3) Replace small belt press with rotary press dewatering equipment: 2026-2027
4) Install standby generators: 2025-2028

PHASE 2

1) Secure financing, begin preliminary design 2028 (sooner if permit requirements are confirmed before then).
2) Conduct equipment procurement for major process equipment: 2029-2030
3) Complete detailed design work: 2030-2031
4) Bidding to select installation contractor: 2032
5) Construction: 2032-2034
6) Complete startup/commissioning: 2035

Figure 3-14: Phase 1 upgrades preliminary site plan.

Figure 3-15: Phase 2 upgrades preliminary site plan.

CHAPTER 4 - IMPACT FEE FACILITY PLAN

This chapter summarizes the recommended immediate and near-term improvements for the Springville City WRF service as they relate to impact fees. Recommended projects are evaluated to determine whether each is eligible for impact fees and, if so, the proportion of the total cost that is subject to impact fees. This chapter identifies the costs for improvements that are recommended and anticipated to be implemented within the next 5-6 years.

For consistency, existing and future capacities are discussed in terms of equivalent residential units (ERUs) which aid in establishing impact fees. For reference, a single ERU represents typical flow, loading, and service associated with a typical single-family dwelling in the service area. The following is the defined existing levels of service for one ERU:

- Flow: One ERU is equivalent to 250 gpd (Section 2.1.2).
- BOD: One ERU is equivalent to 0.46 lbs. BOD/day (220 mg/L) (Section 2.1.3)
- TSS: One ERU is equivalent to 0.35 lbs. TSS/day (Section 2.1.4)
- TKN: One ERU is equivalent to 0.072 lbs. TKN/day (Section 2.1.5)
- Phosphorous: One ERU is equivalent to 0.013 lbs. TP/day (Section 2.1.5)

In general, costs that are eligible for impact fees are associated with improvements that increase capacity or otherwise provide the existing level of service for new (future) ERUs. Improvements that change the level of service by providing additional treatment beyond the current standards and ability of the WRF are not eligible for impact fees. Impact fees were calculated for Phase 1 projects that represent immediate and near-term improvements that are intended to be implemented within the next 5-6 years. Costs for these projects are divided between existing and future connections based on the ratio of existing connections to new connections served by the improvement. Many Phase 1 projects entail replacing aging equipment that will continue to serve existing ERUs while ensuring capacity to provide the existing level of service to future connections.

Phase 2 projects focus on long-term expansion and treatment upgrades to the WRF and are beyond the timeline and scope of this IFFP. Revisions to the impact fee will be required once a firm timeline and scope for Phase 2 upgrades are established.

From Table 2-1 (and Table 4-1), the WRF currently serves 19,556 total ERUs including 16,156 ERUs from the domestic system (residential, commercial, and other industrial connections) and 3,400 ERUs from Nestle. The WRF is designed to handle ADF up to 6.6 MGD, equivalent to 26,400 total ERUs at 250 gpd per ERU. Flow from Nestle is anticipated to remain stable (i.e. at 3,400 ERUs), meaning an additional 6,844 ERUs would be served by maintaining the WRFs capacity at 6.6 MGD ADF.

Table 4-1: Summary existing and future ERUs.

Year	Population	Residential & Other ERUs	Nestle ERUs	Total ERUs
2022	36,772	16,156	3,400	19,556
2025	38,966	17,120	3,400	20,520
2030	42,915	18,855	3,400	22,255
2035	46,902	20,223	3,400	23,623
2040	49,365	21,689	3,400	25,089
2043	**50,875**	**22,353**	**3,400**	**25,753**
2045	51,909	22,807	3,400	26,207
2050	54,585	23,982	3,400	27,382
2055	56,448	24,802	3,400	28,202
2060	58,378	25,650	3,400	29,050

4.1 Phase 1 Upgrades – Existing Capacity and Future Loading

Phase 1 upgrades address aging equipment, infrastructure, processes deficiencies, and other improvements critical to the continued reliable operation of the WRF. Costs must be divided based on the proportion of each upgrade intended to serve existing versus future users. Furthermore, impact fees must be established on the portion of the design capacity dedicated to the domestic collection system. Costs and terms for the 3,400 ERUs committed to flow from Nestle have been negotiated separately. Certain processes, such as the headworks and primary clarifiers, do not treat flow from Nestle and are therefore associated entirely with domestic connections. Other facilities such as the secondary biological basins, tertiary filtration, sludge dewatering, and disinfection, are designed for the total 6.6 MGD flow and treat flow from Nestle and the domestic collection system.

In this case, the impact from Nestle's 3,400 ERUs (roughly 13%) are excluded from the impact fee calculation. In other words, the remaining ~87% of the costs are proportioned between existing and future ERUs.

4.1.1 Headworks Upgrades

Improvements recommended for the headworks will allow the WRF to provide the existing level of service to existing and future ERU connections. Wastewater from Nestle is measured separately and does not pass through the influent flow measurement flume or the headworks. Upgrades to influent flow measurement and replacing major equipment such as screens, washer/compactors, grit removal, and grit classifiers will serve exiting and new connections. Likewise other improvements to the headworks building (i.e. HVAC improvements) ensure the facility's longevity and reliability. These improvements will serve the estimated 16,156 existing ERU connections as well as the projected 6,844 future ERUs. In other words, 70.24% of the improvements serve existing connections, with the remaining 29.76% serving future connections, meaning 29.76% of the total estimated costs ($3,329,040) are considered eligible for impact fees. This yields a total estimated impact fee of $990,606.51.

4.1.2 Primary Clarifiers

As with the headworks, recommended recoating/rehabilitation work for the primary clarifiers will allow the WRF to continue to provide the existing level of service to existing and future connections. This project rehabilitates the existing concrete tanks and clarifier mechanisms to extend their service. Flow from Nestle bypasses the primary clarifiers, so projected costs are divided between the 23,000 remaining ERUs (16,156 existing and 6,844 new). Based on the estimated project cost of $310,200, a total of $92,304.73 is considered impact fee eligible.

4.1.3 Tertiary Filtration

After primary clarification, all downstream processes treat combined flow from Nestle and the domestic collection system. Thus, upgrades to the tertiary filtration system must also consider the 3,400 ERUs associated with Nestle. The recommended project removes the sand filter system (including sand media, under drains, travelling bridges, etc.), installing disc filter skids in the reaming filter concrete basins. This upgrade extends the life of the filter building and provides the existing level of service (i.e. tertiary filtration) for current and future connections. Accordingly, costs for this project are divided between new and existing users assuming a total of 26,400 ERUs. Accounting for Nestle, 61.20% is assigned to existing domestic users, and 25.92% to future connections. The remaining ~12.9% is associated with Nestle's ERUs. In summary, $631,929 of the total estimated cost is considered impact fee eligible.

4.1.4 Aeration Basins

Given the high cost of maintaining and replacing wear components of the STM Aerotor equipment associated with the aeration basins, the City is considering replacing this equipment with fine bubble diffusers and blowers. This conversion will service existing, future, and Nestle ERUs and costs are divided as described above for the tertiary filtration upgrades. Based on the cost estimate for this project, 25.92% or $329,277 is considered eligible for impact fees.

4.1.5 Solids & Biogas Handling

The solids handling processes includes sludge pumping (primary and waste activated sludge), WAS thickening, three (3) anaerobic digester tanks, heat exchangers, sludge heating/recirculation pumping systems, hot water recirculation systems, biogas handling (condensation and flaring), digested sludge dewatering/drying, and composting. Recommended projects include replacing worn piping/pumps, updating the sludge heating/recirculation system (including boilers and heat exchangers), rehabilitating digester tanks and lids, replacing worn biogas handling appurtenances such as condensate traps and flame traps, upgrading and expanding the sludge dewatering equipment. Each of these processes are sized and intended to service existing (domestic and Nestle) and future connections. Accordingly, costs for these upgrades projects are portioned as described for the tertiary filtration and aeration basin projects above. The total estimated cost for recommended Phase 1 upgrades to solids handling and biogas systems is $3,963,388, of which $1,027,478 is considered eligible for impact fees.

4.1.6 Site Electrical

Many structures and electrical components of the WRF were originally commissioned in the 1960s, 70s, and 80s. Accordingly, much of the gear and electrical components are past their reliable service life, incompatible with modern monitoring systems, and/or difficult to maintain and repair. The most critical of these components have been identified as immediate needs items. As with most of the plant, this electrical gear serves Nestle, existing, and future connections, and costs are portioned accordingly. The recommended replacement electrical work includes an estimated $125,214 that is considered impact fee eligible.

Likewise, the proposed standby generator would serve existing and future connections, including Nestle. The estimated impact fee eligible portion of this project is $342,853.

4.2 WRF Treatment Impact Fee Summary

Phase 1 upgrades are estimated to accommodate growth until 2043, serving a total of 26,400 ERUs. Impact fees have been calculated based on the 6.6 MGD capacity and ERU flow/loading as summarized at the beginning of this Chapter. This report recommends that Phase 1 upgrades begin planning and design within the next 1-2 years, with all improvements installed and operational within the next 6 years. Capital costs to install Phase 1 improvements will be shared between existing and future connections, with the portions associated with future connections assessed as impact fees as summarized in Table 4-2.

Table 4-2: Summary of Phase 1 upgrade expenses and impact fee eligibility.

SPRINGVILLE WRF PHASE 1 UPGRADES TOTAL COST & IMPACT FEE SUMMARY										
	Phase 1 Upgrade/Project Item	Planning (Year)	Installation (Year)	Existing ERUs	Nestle ERUs Served	New ERUs Served	% Impact Fee Eligible	Estimated Total Cost	Impact Fee Eligible	Expense for Existing Users
Immediate	Headworks Upgrades	2023	2024	16,156	-0-	6,844	29.76%	$ 3,329,040.00	$ 990,606.51	$ 2,338,433.49
	Primary Clarifier Rehabilitation	2024	2024-25	16,156	-0-	6,844	29.76%	$ 310,200.00	$ 92,304.73	$ 217,895.27
	Tertiary Filtration Upgrades	2023-24	2024-25	16,156	3,400	6,844	25.92%	$ 2,437,600.00	$ 631,929.33	$ 1,805,670.67
	Digester Biogas Handling	2023-24	2024-25	16,156	3,400	6,844	25.92%	$ 591,662.00	$ 153,383.89	$ 438,278.11
	MCC, PLC, & Transformer Replacement	2023-24	2024-25	16,156	3,400	6,844	25.92%	$ 483,000.00	$ 125,214.09	$ 357,785.91
Near-Term	Digester Sludge Handling Upgrades	2024	2025	16,156	3,400	6,844	25.92%	$ 1,903,687.00	$ 493,516.43	$ 1,410,170.57
	Convert STM to Aeration Basin	2024	2025-26	16,156	3,400	6,844	25.92%	$ 1,270,150.00	$ 329,276.77	$ 940,873.23
	Standby Generator	2025	2026-27	16,156	3,400	6,844	25.92%	$ 1,322,520.00	$ 342,853.29	$ 979,666.71
	Sludge Dewatering Upgrades	2025	2026-27	16,156	3,400	6,844	25.92%	$ 1,468,038.00	$ 380,577.73	$ 1,087,460.27
TOTAL COST FOR ALL IMPROVEMENTS								$13,115,897.00		
SUBTOTAL OF IMPACT FEES FOR NEW CONNECTIONS FROM PROPOSED IMPROVEMENTS									$3,539,662.78	
SUBTOTAL OF IMPACT FEES FROM PREVIOUS IMPROVEMENTS									$14,013,572.90	
TOTAL IMPACT FEE ELIGIBLE COSTS (PAST & PROPOSED)									$17,553,235.68	
TOTAL COST FOR EXISTING CONNECTIONS ASSOCIATED WITH PROPOSED IMPROVEMENTS										$9,576,234.22

4.3 Combined Sewer Collection & Wastewater Treatment Impact Fee

The 2020 Wastewater Collection System Masterplan (HAL, 2020) establishes an impact fee for sewage collection at $652.75. This impact fee is in addition to those established previously and herein for wastewater treatment.

The final calculation of the allowable impact fee will be formalized in the Impact Fee Analysis (IFA) provided by Zions Bank Public Finance. Additional improvements are anticipated to be required in the next 10 years to accommodate some growth and address likely changes to the WRFs discharge permit. These upgrades encompass Phase 2 and are not considered in this impact fee analysis as their timing/necessity is not established, and many of those improvements would represent a new level of service, meaning their eligibility for impact fees may be more limited.

Several funding options are available for the improvements and expansion required at the WRF. To date, the City has used a combination of fees, impact fees, and contributions from industries to finance the majority of improvements to the WRF. Based on 2020 census data, the median household income for Springville is $76,982. State grant money is available where annual user rates would exceed 1.4% of the median household income, equating to a monthly user rate of $89.81, which is lower than the anticipated user rates. Funding must therefore come from user rate increases, bonds, impact fees, or other sources.

Funding for improvements of existing connections will likely come from bonding that will be repaid with increased user rates. As the improvements to accommodate growth must be planned and constructed before any of the new connections they serve are in place, the most likely funding source for larger improvements is also bonding. Impact fees from future connections then pay back these bonds. Accordingly, Springville City finds it is necessary to impose an impact fee on development activities to maintain the exiting level of service for new connections.

EXHIBIT A

Certification of Impact Fee Facility Plan by Consultant

In accordance with Utah Code Annotated, 11-36a-306(2), Brad Rasmussen on behalf of Aqua Engineering, makes the following certification:

I certify that the attached impact fee facilities plan:

1. includes only the costs of public facilities that are:

    a. allowed under the Impact Fees Act; and

    b. actually incurred; or

    c. projected to be incurred or encumbered within six years after the day on which each impact fee is paid;

2. does not include:

    a. costs of operation and maintenance of public facilities;

    b. costs for qualifying public facilities that will raise the level of service for the facilities, through impact fees, above the level of service that is supported by existing residents; or

    c. an expense for overhead, unless the expense is calculated pursuant to a methodology that is consistent with generally accepted cost accounting practices and the methodological standards set forth by the federal Office of Management and Budget for federal grant reimbursement; and

3. complies in each and every relevant respect with the Impact Fees Act.

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Brad Rasmussen, Aqua Engineering

REFERENCES

AQUA Engineering, 2022; *Springville Water Reclamation Facility Capital Facility Plan*; (AQUA, 2022)

Hansen Allen & Luce, Inc. Engineers, 2020; *Springville Wastewater Collection System Master Plan*; (HAL, 2020).

Metcalf & Eddy, 2003; *Wastewater Engineering Treatment and Reuse*; 2003 Edition (Metcalf, 2003)

Minnesota Pollution Control Agency, 2006; *Phosphorus Treatment and Removal Technologies* by the Minnesota Pollution Control Agency www.pca.state.mn.us; (MPCA, 2006)

Springville City, 2015; *Economic Development Master Plan*; City published document.

Waterworks Engineers, 2019; *Technical Memorandum No. 1 – Springville Water Reclamation Facility Risk Assessment*; (WWE, 2019).

APPENDIX A

Preliminary Equipment Information

- Headworks Equipment: Screening and grit removal equipment options.
- Headworks Odor Control
- Rotary Press – Sludge Dewatering Equipment
- Fine Bubble Diffusers
- Tertiary Disc Filtration
- UV Disinfection
- Roughing Tower Media

APPENDIX B

2019 Risk Assessment - Reference Tables