MOUNTAIN VILLAGE
TOWN COUNCIL
AGENDA MEMORANDUM

Item No. 6
Meeting Date: October 21, 2021

TITLE: TELLURIDE REGIONAL WASTEWATER TREATMENT PLANT UPDATE

SUBMITTED BY: Town of Telluride Public Works

ATTACHMENTS: TRWWTP Masterplan Executive Summary
H_2O Innovation/Carollo Engineering Proposal
TRWWTP PWA Tasks & Deliverables
PWA Telluride Kick Off Meeting Slides
Technical Memorandum 1
Technical Memorandum 2

TRWWTP Masterplan

The Town of Telluride completed the Telluride Regional Wastewater Treatment Plant Masterplan in 2017. This overarching document identified immediate TRWWTP improvements that were necessary, near-term TRWWTP improvements that were recommended, and long-term TRWWTP improvements that were envisioned. Please see the attached Executive Summary.

The TRWWTP Professional Wastewater Advisor

The Town of Telluride issued a Request for Proposals for a Professional Wastewater Advisor at the end of 2020 and selected the team of H_2O Innovations and Carollo Engineering as our PWA in early 2021. This team will provide guidance, planning, and engineering for the anticipated rebuild of the TRWWTP. Please see the attached H_2O Innovations/Carollo Engineering Proposal. In particular, please thoroughly review the Project Understanding & Approach Section, pages 12 – 26 of the Proposal.

H_2O Innovations and Carollo Engineering have completed the first two of six Technical Memorandums, which are TM 1: Basis of Design and TM 2: Hydraulic Modeling Evaluation. Please see the attached Telluride Kick Off Meeting Slideshow and the two technical memorandums.

Prepared by: Paul Ruud
Public Works Director
Town of Telluride

Executive Summary

The Telluride Regional Wastewater Treatment Plant (TRWWTP) serves the Towns of Telluride and Mountain Village, as well as the communities of Aldasoro, Hillside, and Lawson. Growth in the service areas and seasonally high loading conditions are pushing the TRWWTP to its design capacity. Growth of the base population has been steady at 1% to 1.5% annually. Visitors have a significant impact seasonally, nearly tripling the population during peak events. Commercial businesses also have an impact as business success leads to plans for expansion. Wastewater flow and loading to the TRWWTP were projected by estimating the contribution from the various service areas and sources, including residents, visitors, and commercial entities. Wastewater flows are projected to be within the current permit limits for most of the 30-year planning period. On the other hand, high wastewater loading as characterized by biochemical oxygen demand, or BOD_5, will be the primary driver for required near- and long-term improvements.

This Master Plan addresses the ability of the TRWWTP to meet the new metals discharge limits, and the planning for near-term (5-year plan) improvements, and the long-term (30-year plan) expansion for wastewater treatment and biosolids disposal.

<u>Metals Compliance</u>
The Colorado Water Quality Control Division (WQCD) issued new discharge limits for several metals parameters that went into effect on January 1, 2017. Metals test data were obtained from water supply and wastewater sources including drinking water supplies, influent wastewater and treated effluent from the TRWWTP. The data was categorized, mapped and analyzed to determine if any defined sources of metals could be eliminated or treated before entering the TRWWTP.

Three metals were identified as a potential concern: arsenic, copper, and selenium. The numeric standard that was originally listed for arsenic was retracted by permit modification pending further study by the USEPA and subsequent development of an arsenic standard by the WQCD (potentially 10 years out). The WQCD would issue a compliance schedule as part of the renewal of the TRWWTP discharge permit. The arsenic standard is unknown at this time and the requirements to meet a future arsenic limit remain vague.

Selenium data show that concentrations are normally below the permitted limit. However, a few data points indicate unexplained spikes in selenium concentrations entering the TRWWTP. Ongoing monitoring will determine if these high levels are real, requiring the TRWWTP to incorporate a treatment process to remove low levels of selenium, which would challenge the current limits of technology.

Copper concentrations show high seasonal levels, occasionally above the permit limit. Further investigation was conducted identifying corrosion of copper service lines and household plumbing in the Telluride drinking water distribution system as a concern. Our analysis showed that low buffering capacity of the drinking water and variable pH could be corrosive to household plumbing and service lines. Other possible sources of copper in wastewater include discharges of septage, brewery and distillery waste, and boiler water maintenance flushing. The TRWWTP obtained a modification to their permit allowing an additional year (January 1, 2018) to address corrosion control of the drinking water and monitor impacts on copper levels in the TRWWTP effluent. Monitoring indicates that Telluride's corrosion control program for drinking water is not sufficient on its own. Additional measures include an ordinance to limit boiler water discharges and discharge limits on specific commercial waste dischargers. Interim measures are being implemented for chemical treatment to remove copper at the TRWWTP.

Near-Term Improvements Plan

Wastewater influent to the TRWWTP has a relatively high concentration of BOD_5, which will bring the plant within 95% of its permitted design capacity within 3 years (refer to Figure ES-1). The Town will work on pre-treatment agreements with commercial wastewater dischargers. Currently, the TRWWTP does not restrict septage receiving. Seasonal restrictions on septage hauling to the TRWWTP will seek to decrease loadings during peak season. A septage receiving station is also being considered for storage of septage, which gives operators control of releases into the TRWWTP.

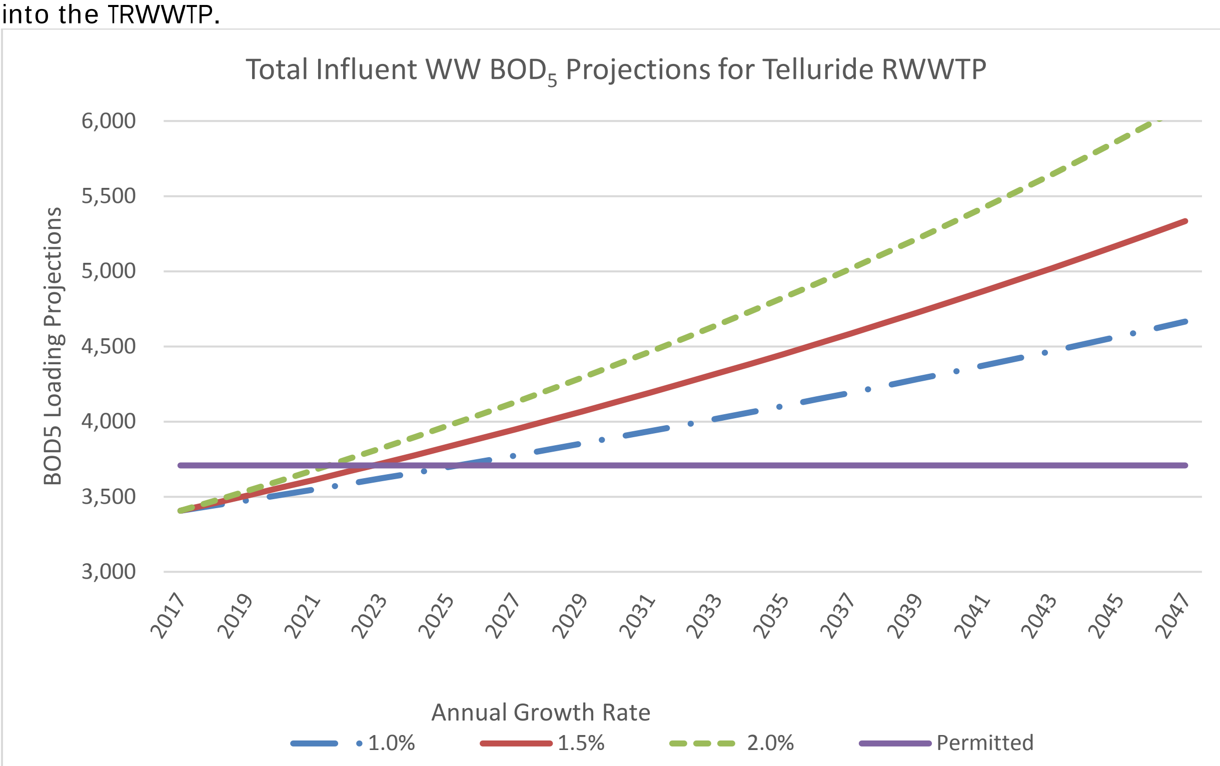


Figure ES-1 Loading Projections at Varied Population Growth Rates

At the TRWWTP, several limitations impact operations and maintenance. Condition assessments of observable structures and electrical system components were conducted. Oxidation ditch no. 1 shows signs of corrosion of structural supports. Several areas in the TRWWTP are classified according to the National Fire Protection Association Standard 820, which provides requirements for protection against fire and explosion hazards specific to wastewater treatment facilities. As related improvements are conducted at the TRWWTP, corrective measures will need to be incorporated into the plans.

The most immediate needs are for improvements to the existing oxidation ditches. Settled solids have accumulated and operators require a dewatering process for solids being removed during maintenance of these basins. Three alternatives were evaluated involving permanent and mobile systems. The two permanent options consist of concrete structures either using sand drying beds or geosynthetic tubes in a containment area. The mobile system is a containerized filter unit mounted on a trailer. The trailer unit can be used to transport the dewatered solids removed during maintenance activities to the landfill.

Supplemental oxygen will soon be needed for the oxidation ditches. The existing mechanical aeration system cannot supply enough oxygen to meet peak demand conditions resulting in periods of low dissolved oxygen concentrations in the oxidation ditches. As growth in the service area increases the pollutant load to the TRWWTP will exceed the permitted capacity. The first alternative for supplemental oxygen replaces the existing aeration system with larger units. Other alternatives would supplement the existing system using jet aeration or a pure oxygen saturator. The deck-mounted jet aeration system is the least efficient but could be added without shutting down the existing units. The pure oxygen saturator requires a source of liquid oxygen to be delivered and stored on site.

Long-Term Expansion Plan

If the near-term improvements are implemented, it is projected that the improved TRWWTP could serve the needs of the community until scheduled nutrient regulations for total inorganic nitrogen and total phosphorus are applied. Colorado Regulation No. 85 nutrient limits are anticipated to take effect in 2027. The TRWWTP will require major improvements just to meet these new limits. As such, a 30-year planning period (to year 2047) was established for the expansion project. Wastewater flow entering the plant in 2047 is estimated at 2.3 million gallons per day (mgd), and BOD_5 loading criteria is currently projected at 6,005 pounds per day (ppd).

Preliminary treatment would likely be the first construction to occur in support of a plant expansion. Pre-treatment consists of screening, grit removal and flow measurement within the "Headworks". A headworks building can be constructed on site as the first phase of construction.

The second phase of construction would target the secondary treatment processes. Figure ES-2 shows a diagram of a conventional activated sludge process for general reference.

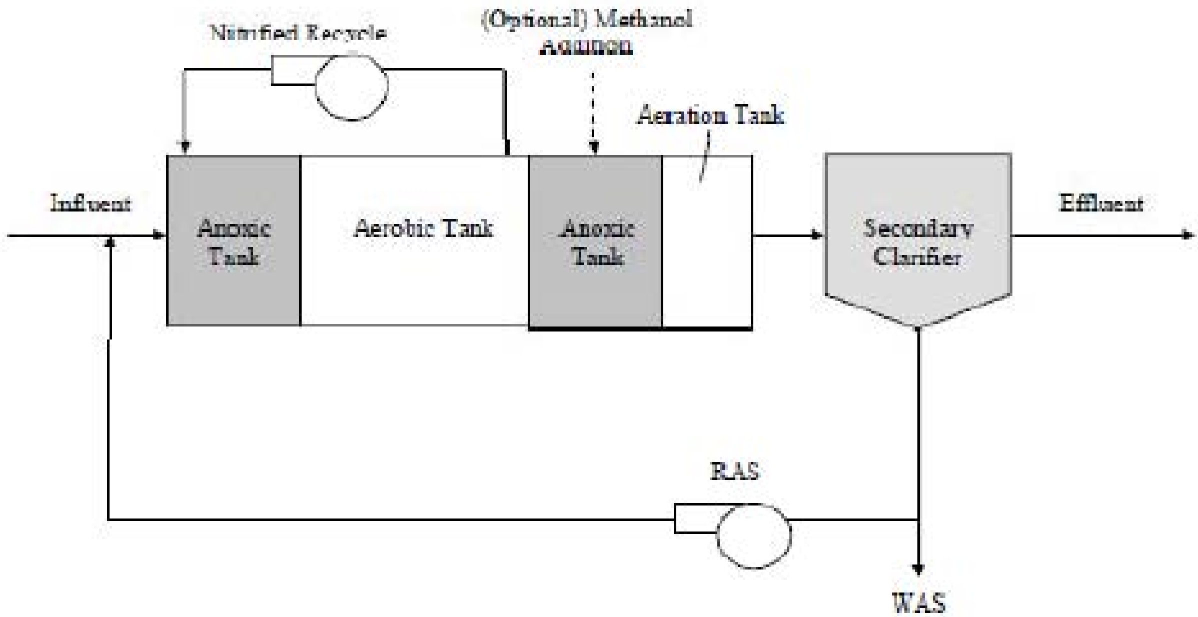


Figure ES-2 Conventional Activated Sludge Process Diagram

Image Source: USEPA Nitrogen Control Design Manual, 2010.

The existing TRWWTP site is constrained within a small area with little space to stage construction. Two technologies were identified as feasible ***if no additional land is added to the site***:

a) Membrane Bio-Reactor (MBR) coupled with an activated sludge system but replaces the secondary clarifiers with membranes

b) BioMag®, which is a proprietary enhancement to the existing process.

MBR provides superior filtration technology configured with an activated sludge process to process organic pollutants. The BioMag® system upgrades the existing activated sludge process using a magnetic ballast material that increases the settleability of floc particles within the secondary clarifier.

MBR improvements can be done within one of the three oxidation ditch/clarifier units, which allows the remaining two units to maintain operation. However, the limited space adds significant cost for demolition and construction activities for the MBR upgrades. While the BioMag® process uses the existing oxidation ditches and clarifiers, they require completely new aeration equipment and mixing systems, and a space for the magnetite feed and recovery equipment.

The MBR technology is preferred for expansion within the existing site but it is very costly for capital construction and for operation and maintenance. The BioMag® system is new proprietary technology that has a very small number of installations, but it is the least costly.

If land adjacent to the site could be purchased, construction access and staging is no longer a major constraint. New construction could occur without impacting the operation of the TRWWTP. Two technologies were considered:

a) MBR configured with activated sludge

b) Conventional Activated Sludge (CAS).

The CAS is a flexible process that has been used for over 100 years. CAS would require a larger footprint that the MBR system and the capital cost is roughly the same. The major disadvantage to the MBR technology is that the membranes must be replaced every 10 years at a significant cost. However, the MBR technology is the system of choice to meet new regulations and stringent discharge limits.

Expansion Project Cost Summary

A present value comparison of capital and operation and maintenance costs in FY 2017 dollars, is shown below:

Headworks: Capital Cost = $2.5 MM

On-site Expansion Options

- MBR: Capital Cost = $29.8 MM O&M Cost (PV2017) = $5.6 MM
- BioMag®: Capital Cost = $19.1 MM O&M Cost (PV2017) = $4.5 MM

Adjacent Site Expansion Options:

- MBR (new): Capital Cost = $28.3 MM O&M Cost (PV2017) = $5.6 MM
- CAS (new): Capital Cost = $26.9 MM O&M Cost (PV2017) = $3.4 MM

The existing disinfection system would be used as part of the various options. However, the cost to meet future limits associated with Colorado Regulation No. 31 are not included here. The CAS process would likely require a tertiary filtration process for ultra-low phosphorus limits. Very low nitrogen limits may require improvements to all process alternatives depending on the numeric standard given for the San Miguel River.

Biosolids Management Plan

Biosolids handling and treatment is a complex need for the TRWWTP. Biosolids treatment currently uses aerobic digestion to meet Class B biosolids requirements. There are four digester basins that are aerated using coarse-bubble diffusers. After the required time under aeration, the biosolids are thickened and stored for a contract hauler to beneficially reuse at their permitted land application sites.

The contract hauler operates throughout the region serving several other municipalities. As such, the hauler limits their services to the TRWWTP, and if the hauler is delayed it places severe constraints on the ability of operators to treat, thicken and store biosolids within available capacity.

The TRWWTP wants to develop their own biosolids program, with the goal of meeting the requirements for Exceptional Quality (EQ), Class A biosolids, according to Colorado Regulation No.64. The classification of biosolids is determined by pathogen and vector attraction reduction requirements. Class A biosolids have more requirements to meet than Class B. However, all types and classes of biosolids must meet the ceiling concentration for pollutants. The primary benefit of meeting Class A requirements is there are no site restrictions for beneficial reuse.

Disposal of EQ Class A biosolids normally involves beneficial reuse as a soil amendment. Biosolids can be sold in bags, hauled off by individuals in trucks and other containers, or distributed in bulk. End uses may include municipal restoration projects, such as parks and roadsides, mine reclamation, cover material for interim operations and final closure of landfills, agricultural land application and range land application.

The following is a summary of options for biosolids treatment and for handling/disposal. Treatment options are described separately for Class B and Class A criteria.

I. Biosolids Treatment

A. Class B biosolids treatment options:

1. Upgrade the existing digesters using mesophilic aerobic digestion in a process patented as MesoAer™.

a) Advantages: Approved process by CDPHE

b) Disadvantages:

(1) Requires a new building on site

(2) Requires WAS pre-thickening, which typically generates odors within the building

c) Costs:

(1) O&M, energy = $60,000 annually

(2) Capital = $3,500,000

2. CleanB™ using chlorine dioxide generated on-site. (Preferred option)

a) Advantages:

(1) Small footprint

(2) Significantly reduced odors

(3) Short stabilization time

(4) 1-3 digesters can be repurposed

(5) Easy to operate, supplier to provide all maintenance and chemical supply

b) Disadvantages:

(1) Requires a new building on site

(2) Requires storage and handling of 15% Sodium Chlorite solution, and 50% Sulfuric Acid solution

(3) May generate disinfection by-products, which will be regulated in the future (manufacturer indicated DBPs are not formed)

(4) Sole source supplier

(5) Not yet approved for use in Colorado

c) Costs:

(1) O&M, energy = $36,000 - $46,000 annually

(2) Capital = $2,000,000

Note: Leasing a mobile CleanB™ system allows pilot-testing on site and data gathering for design, operation and permitting. The cost quote from the manufacturer for 24 weeks including shipping, setup, training, chemicals and removal from the TRWWTP is $100,000.

B. Class A biosolids treatment options:

1. Composting offsite using the biosolids product from the CleanB™ system

a) Advantages:

(1) Allows composting operations to be moved to remote site where odors are not a major detractor

(2) Biosolids can be stored longer on larger site

(3) Farmers/Ranchers are more likely to come to site and handle biosolids for land application

b) Disadvantages:

(1) TRWWTP has no composting experience

(2) Bulking materials needed to mix with biosolids

2. Autothermal Thermophilic Aerobic Digestion (ATAD) installation on the existing site would prevent expansion of the TRWWTP within its current boundaries.

a) Advantages:

(1) Relatively stable end-product

(2) Would use existing digester basins

(3) Includes an odor control system

(4) Highly automated.

b) Disadvantages:

(1) Batched processing requires coordination of pre-treatment and post treatment systems

(2) Existing facility not set up for pre-thickening and post dewatering

(3) Potential for odors if system is upset and odor control system fails

(4) Reliance on multiple levels of instrumentation for stable operation

(5) New pumps, blowers, and controls systems needed in a new building

(6) Sequencing of construction may not be possible with current plant loading

3. Off-site Composting by 3rd Party in Olathe

a) Advantages:

(1) Could be part of a near-term strategy to extend timeline for improvements

b) Disadvantages:

(1) Site not currently permitted to take domestic biosolids

(2) No guarantees of permits or long-term viability of arrangement

(3) Town would be responsible for hauling

4. Closed alkaline stabilization process by Schwing Bioset, Inc.

a) Advantages:

(1) Compact

(2) Energy efficient

(3) Achieves a drier biosolids product.

b) Disadvantages:

(1) High alkaline biosolids difficult to distribute in SW Colorado having alkaline soil conditions.

II. Biosolids Hauling and Disposal

A. Hauling options

1. Extend contract for hauling and disposal

2. Take over hauling and disposal operations in-house

a) Costs:

(1) O&M = 1 full time FTE

(2) Capital = $200,000

3. Transition from contract hauling to in-house operations over the next year to allow purchase of equipment, development of additional permitted land application sites, and hiring of staff to take over in-house hauling and disposal operations

B. Disposal options

1. Expand sites for Class B biosolids disposal for long-term plan

2. Establish a Class A biosolids storage and distribution operation on existing permitted site in Nucla, CO and develop relationships with local farmers/ranchers, County landfill and others as part of end-use plan.

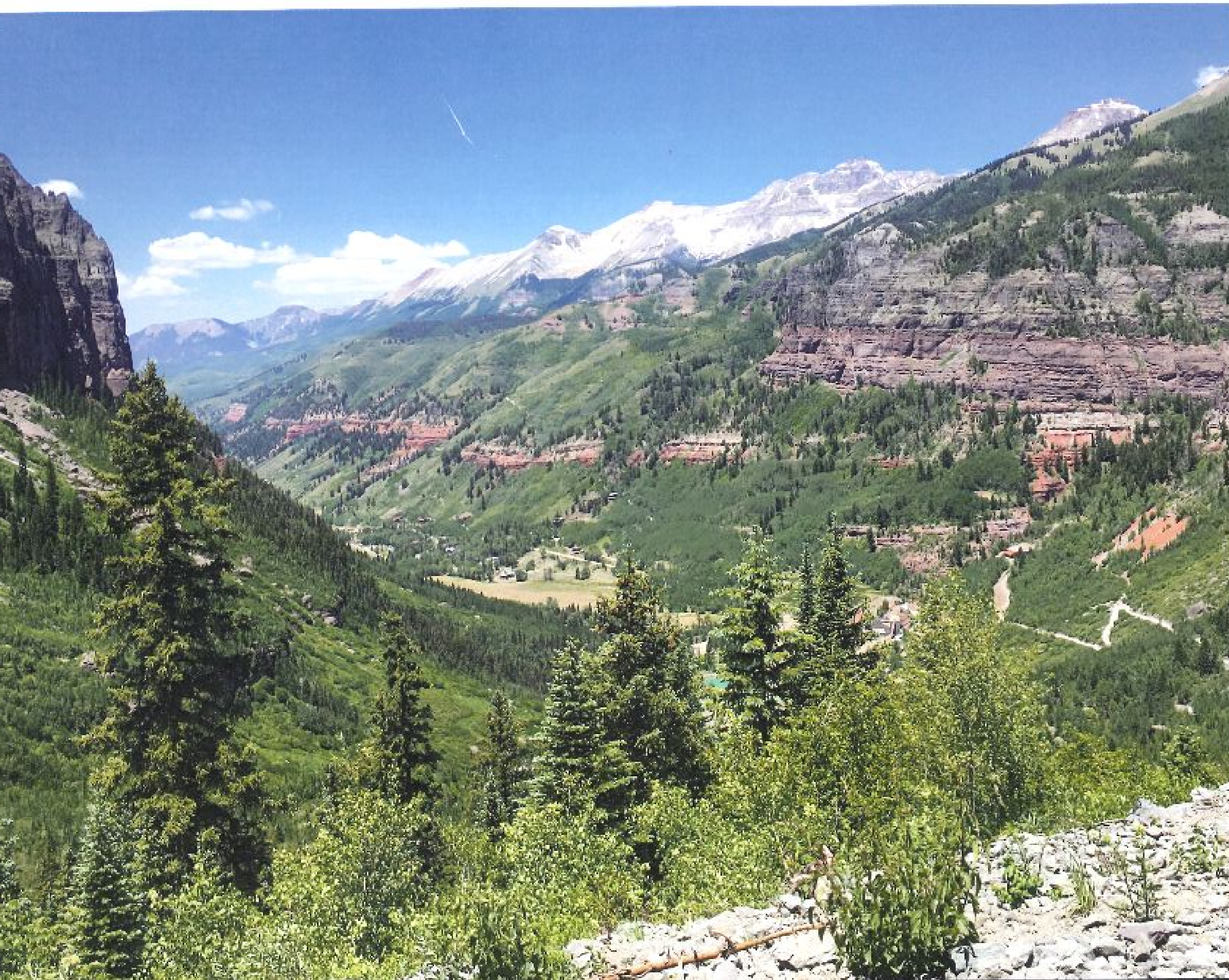
3. Develop a near-term plan to expand permitted sites for Class B and/or agreement with private compost facility owner until plant expansion allows construction within existing site for Class A treatment. Note that Disposal Option 3. still requires an end use plan to be developed for Class A biosolids but provides more time for transition.

Proposal for the **TOWN OF TELLURIDE**

Professional Wastewater Advisor to Assist the Town of Telluride with

Implementation of the Telluride Regional WASTEWATER TREATMENT PLANT MASTER PLAN

FEBRUARY 2021



h2O innovation® in association with carollo Engineers...Working Wonders With Water®

February 19, 2021

Paul Ruud
Public Works Director
Town of Telluride
1370 Black Bear Road
Telluride, Colorado 81435

Subject: Proposal for the Professional Wastewater Advisor – Implementation of the Telluride Regional Wastewater Treatment Plant Master Plan

Dear Mr. Ruud and the Selection Committee:

On behalf of H_2O Innovation and Carollo Engineers (Carollo), I would like to thank the Town of Telluride for the opportunity to provide this proposal in response to the Request for Proposals for a Professional Wastewater Advisor. As a leader in the implementation of membrane-based treatment technologies, H_2O Innovation's vision of an membrane bioreactor (MBR) retrofit for the existing Telluride Regional Wastewater Treatment Plant (TRWWTP) holds the potential to save the Town and other stakeholders millions of dollars while accelerating the schedule and taking advantage of existing infrastructure.

Our company has a highly qualified technical staff focused on innovative system engineering and manufacturing. To provide the Town of Telluride the very best Professional Wastewater Advisory role, we have partnered with Carollo, a first-class company who we highly respect as leaders in consulting engineering and design-build projects. Carollo has the in-house engineering expertise, vast experience with design-build projects in Colorado, and familiarity with CDPHE regulations to provide the ideal complement to H_2O Innovation's strengths to form a Professional Wastewater Advisory Team. H_2O Innovation has enjoyed partnering with Carollo in previous projects, most notably the implementation of our Fiberflex Ultrafiltration membrane system installed for the Clifton Water District, which is highlighted within this document.

H_2O Innovation and Carollo have appreciated the preliminary interactions we have had with the Town of Telluride representatives and have gained a deep understanding of the existing plant processes and equipment, as well as the importance of environmental stewardship, safety, and a practical approach to design for this project. We look forward to an opportunity to work with the Town to establish a collaborative vision in response to the upcoming regulatory framework that leverages the existing infrastructure at the Telluride Wastewater Treatment Plant. The outcome of the project scope detailed in this proposal will support the rapid execution of a wastewater treatment upgrade that incorporates sound engineering practices and the best available technology to secure the long-term compliance of the Town's wastewater program.

Sincerely,

Fraser Kent, PhD, PE

H_2O Innovation
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CAROLLO ENGINEERS, INC.

At Carollo, their mission is simple: Provide creative, responsive, and quality solutions to those they serve. They achieve this by focusing on only water-related engineering services. Since the firm's founding in 1933, Carollo has been a leading expert in the planning, design, and construction management of water and wastewater projects for public agencies and municipalities. With more than 1,200 employees in 49 offices, Carollo is the largest water-focused engineering firm in the country. Their commitment to the water industry has been a company hallmark for 88 years. They strive to sustainably optimize the use and benefits of this precious resource with a single-minded focus that allows them to deliver innovative solutions, the best talent in the business, and exceptional, responsive client service. They have become a leader in the development of comprehensive master planning projects, asset management, reliability assessment, and financial plans for clients nationwide. Carollo's history covers work on more than 25,000 projects, from small studies to large, complex design-builds.

Unparalleled Colorado Experience

Carollo's Colorado offices have more than 150 professionals dedicated to solving water and wastewater challenges for clients. They have provided engineering services for dozens of wastewater planning and design efforts throughout Colorado, including for Eagle River Water and Sanitation District, Clifton Water District; and the Cities of Grand Junction, Montrose, Crested Butte, Aspen, Fort Collins, Greeley, Loveland, Longmont, Boulder, and Aurora.

The H_2O/Carollo team complement each other perfectly to provide the expertise Telluride deserves for a successful project.

Project Team

TEAM ORGANIZATION

We have assembled a focused team to support and advise the Town on this important project. Our team is built around a simple, yet powerful concept—put the best individuals into roles where they can add the highest value to the Town and this project.

TOWN OF TELLURIDE

Project Lead
Fraser Kent, PhD, PE

Carollo Project Manager
Leanne Miller, PE*

QA/QC Leads/Advisors
Engineering Manager
Darren O'Neil, PE
Process Technical Advisor
Andrew Gilmore, PE*
Construction Implementation
Jason Garside, PE*

H_2O Innovation Project Manager
Chris Whiting

Project Engineer
Bryan Coday, PhD, PE*

Procurement
Fraser Kent, PhD, PE
Leanne Miller, PE*

Implementation Plan and Preliminary Design

Hydraulic Modeling
Bryan Coday, PhD, PE*

Flows and Loads/ Regulatory Planning
Bryan Coday, PhD, PE*

Liquids Stream and Preliminary Evaluation
Katherine Scott, PE
Adam Moore, PE
Andrew Gilmore, PE*

Solids and Biosolids Management Strategy
Becky Luna, PE*

Implementation Plan
Jeff Berlin, PE*

Equipment Procurement
Leanne Miller, PE*

Execution
Fraser Kent, PhD, PE

Supporting Team Members
IT and Controls - Paul Bartlett
Electrical - Etienne Roy, PE
Cost Estimating - Jason Rozgony, PE*
Structural - Mark Keller, PE, SE*
HVAC - Chad Green, PE*
Financial Analyst - Cody Berg*
Project Coordination - Shayan Yaghoubi

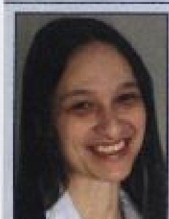
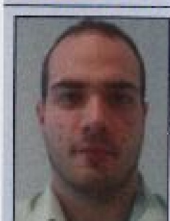
** Carollo Engineers, Inc.*

THE RIGHT TEAM FOR TELLURIDE

We have built our team around your needs for a professional wastewater advisor. Many of our core team members are already familiar with Telluride because of their experience working with you, and their industry contributions to challenges that you share with other utilities, such as fast-tracked schedule, aging infrastructure, complex construction challenges, and meeting stringent future effluent limits. We have a proven track record supporting wastewater utilities in treatment plant expansion planning and implementation and delivering cost-effective solutions that maximize existing reuse of equipment. More importantly to you, each team member has demonstrated experience that comes only from years of excellence in their respective disciplines. Our team's organization corresponds to our project approach, and the following pages detail our team member's qualifications.

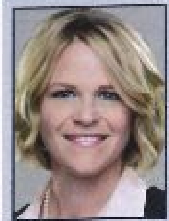
TEAM QUALIFICATIONS

H2O INNOVATION KEY TEAM MEMBERS

Team Member	Biography
 WORKED ON OVER **40** MBR PROJECTS **Fraser Kent, PhD, PE** *Project Lead*	Fraser is a Professional Engineer with over 20 years of process design experience in water and wastewater treatment with a focus on membrane filtration. He has a Ph.D. in Environmental Engineering, and his doctoral thesis focused on membrane bioreactors and reverse osmosis technologies for water reclamation. He has extensive experience with membrane technologies gained from over a decade working at Zenon Environmental and GE Water & Process Technologies before joining H_2O Innovation in 2012. He will serve as the project lead, Town contact, provide technical design expertise, and quality assurance/quality control for various aspects of the project. His relevant project experience includes: ▪ Conventional Activated Sludge Plant MBR Retrofit in Princeton, NJ ▪ SBR to flexMBR™ Retrofit Solution for City of Decatur, AR ▪ Virginia Water Hub MBR-RO for Sustainable Water, VA
 WORKED ON OVER **125 MGD** OF MBR DESIGNS **Darren O'Neil, PE** *QA/QC*	Darren is a Professional Engineer with over 20 years of water and wastewater treatment and engineering experience including project management, mechanical and process engineering design for various multi-million-dollar projects in both municipal and industrial fields. He has worked on large wastewater treatment projects such as the 4 MGD Marco Island MBR in Florida, the Tri-City WPCP in Clackamas County, Oregon- a 10 MGD MBR facility, and a 400-kW anaerobic digester for the Michigan State University power generation facility. Darren is H_2O Innovation's Engineering Manager and will provide quality assurance and quality control support for the preliminary design of the proposed retrofit as part of this project. Project experience includes: ▪ SBR to flexMBR™ Retrofit Solution for City of Decatur, AR ▪ Virginia Water Hub MBR-RO for Sustainable Water, VA ▪ Charles A. Strain WTP Micofiltration/Ultrafiltration Progressive Design-Build
 DELIVERED MORE THAN **30** MEMBRANE PROJECTS **Katherine Scott, PE** *Process Lead*	Katherine is a Professional Engineer with over 10 years of experience in membrane applications for drinking water and industrial water and wastewater systems. Her experience centers on cost development, wastewater process evaluation and design, and commissioning and managing membrane pilots systems. As part of this project, Katherine will serve as a wastewater process design and provide valuable insight as part of the liquid stream evaluation and preliminary design phases of the Implementation Plan. Project experience includes: ▪ SBR to flexMBR™ Retrofit Solution for City of Decatur, AR ▪ Virginia Water Hub MBR-RO for Sustainable Water, VA ▪ Ceramic MBR Retrofit for Charles County, MD
 COMPLETED OVER **50** MBR PROCESS DESIGNS **Adam Moore, PE** *Process Specialist*	Adam is a Professional Engineer whose education and experience has focused on wastewater treatment using membranes. His research work was focused on the application of membrane bioreactors for treating high strength food industry wastewater for potential reuse. His past experience includes conducting surface water field programs involving stream flow characterization, water quality and watershed surveillance. Adam's various experience benefits the team by providing "big picture" context to the liquid stream process design. For this project, he will provide modeling support and mechanical design feasibility considerations as part of the liquid stream evaluation and preliminary design. ▪ SBR to flexMBR™ Retrofit Solution for City of Decatur, AR ▪ flexMBR™ Industrial Retrofit in Jamestown, NY ▪ Biological Nutrient Removal MBR for Craig, MT

CAROLLO KEY TEAM MEMBERS

Team Member	Biography



LED **5** RECENT WASTEWATER IMPLEMENTATION PLANS FOR MOUNTAIN COMMUNITIES

Leanne Miller, PE
Carollo Project Manager

Leanne brings over 11 years of water and wastewater planning, design, construction, and optimization experience for treatment plants and infrastructure. She has authored multiple water and wastewater planning studies for communities throughout Colorado, such as Grand Junction, Montrose, Ouray, Orchard City, and Crested Butte. For this project, she will support hydraulic model development, solids processing and biosolids management strategy, cost estimating for developed solutions, evaluation of equipment acquisition, and development of the phased implementation plan. Leanne is known for her client centered, collaborative approach and is located in Glenwood Springs, allowing her to provide cost-effective onsite support if needed throughout the project. Her experience includes:

- Persigo Wastewater Treatment Plant Master Plan Development for City of Grand Junction, CO
- Wastewater Treatment Plant Nutrient Removal Optimization for City of Montrose, CO
- WWTP Master Plan for City of Ouray, CO

OVER **20** SUCCESSFUL MBR PROJECTS

Andew Gilmore, PE
QA/QC and Technical Advisor

Andrew has 23 years of professional experience in project management, wastewater treatment process and design, construction administration, water system process and design, civil site design, and cost estimating. He serves as Carollo's wastewater technical practice's Membrane Bioreactor Chief Technologist and is a national expert with both conventional and membrane wastewater treatment technologies. Project experience includes:

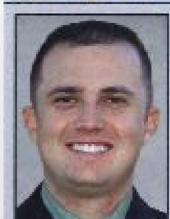
- Bee Ridge Water Reclamation Facility Expansion and Upgrade to Advanced Wastewater Treatment for Sarasota County, FL
- Robert W. Hite Northern Treatment Plant Owner's Advisor – PAR 1088 for Metro Wastewater Reclamation District, CO
- Wastewater Reclamation Owner's Advisor for Hi-Desert Water District, CA

WORKED WITH **10** LOCAL UTILITIES ON RECENT NUTRIENT REMOVAL PROJECTS

Becky Luna, PE
Solids and Biosolids Management

Becky is respected throughout the industry for her expertise in solids handling and biogas processes, and for her unwavering commitment to delivering projects that are tailored to clients' specific needs. She brings 18 years of experience focused on wastewater planning, design and construction. Becky is known for her hands-on, collaborative approach with nutrient removal projects. Project experience includes:

- Wastewater Planning, Regulatory Assistance, and Other Services for Eagle River Water and Sanitation District, CO
- Persigo Wastewater Treatment Plant Master Plan Development for City of Grand Junction, CO
- Wastewater Treatment Plant Nutrient Removal Optimization for City of Montrose, CO



PROVIDED HYDRAULC MODELING FOR **6** FACILITIES IN COLORADO

Bryan Coday, PhD, PE
Project Engineer and Hydraulic Modeling

Bryan is a lead technologist with Carollo specializing in wastewater process performance optimization, process hydraulic modeling, and the planning and design of wastewater treatment facilities. He has developed advanced and dynamic BioWin models to assess nutrient removal improvements several Colorado utilities and is trusted for his expertise in process and hydraulic modeling, data evaluations, condition assessments, design drawings, and report writing. His experience includes:

- Wastewater Planning, Regulatory Assistance, and Other Services for Eagle River Water and Sanitation District, CO
- Persigo Wastewater Treatment Plant Master Plan Development for City of Grand Junction, CO
- Wastewater Treatment Plant Nutrient Removal Optimization for City of Montrose, CO

KEY ROLE IN **5** COLORADO ALTERNATIVE DELIVERY PROJECTS

Jeff Berlin, PE
Implementation Plan

Jeff brings 20 years of experience in wastewater treatment planning, design, operations, construction administration, and cost estimating. He has helped cities across Colorado comply with Regulation 85 and meet their nutrient removal needs and has been serving Colorado clients, for more than 16 years. His Colorado wastewater design experience includes projects for the Eagle River Water and Sanitation District, Cities of Boulder, Longmont, Greeley, and Loveland, as well as for Metro Wastewater Reclamation District. Project experience includes:

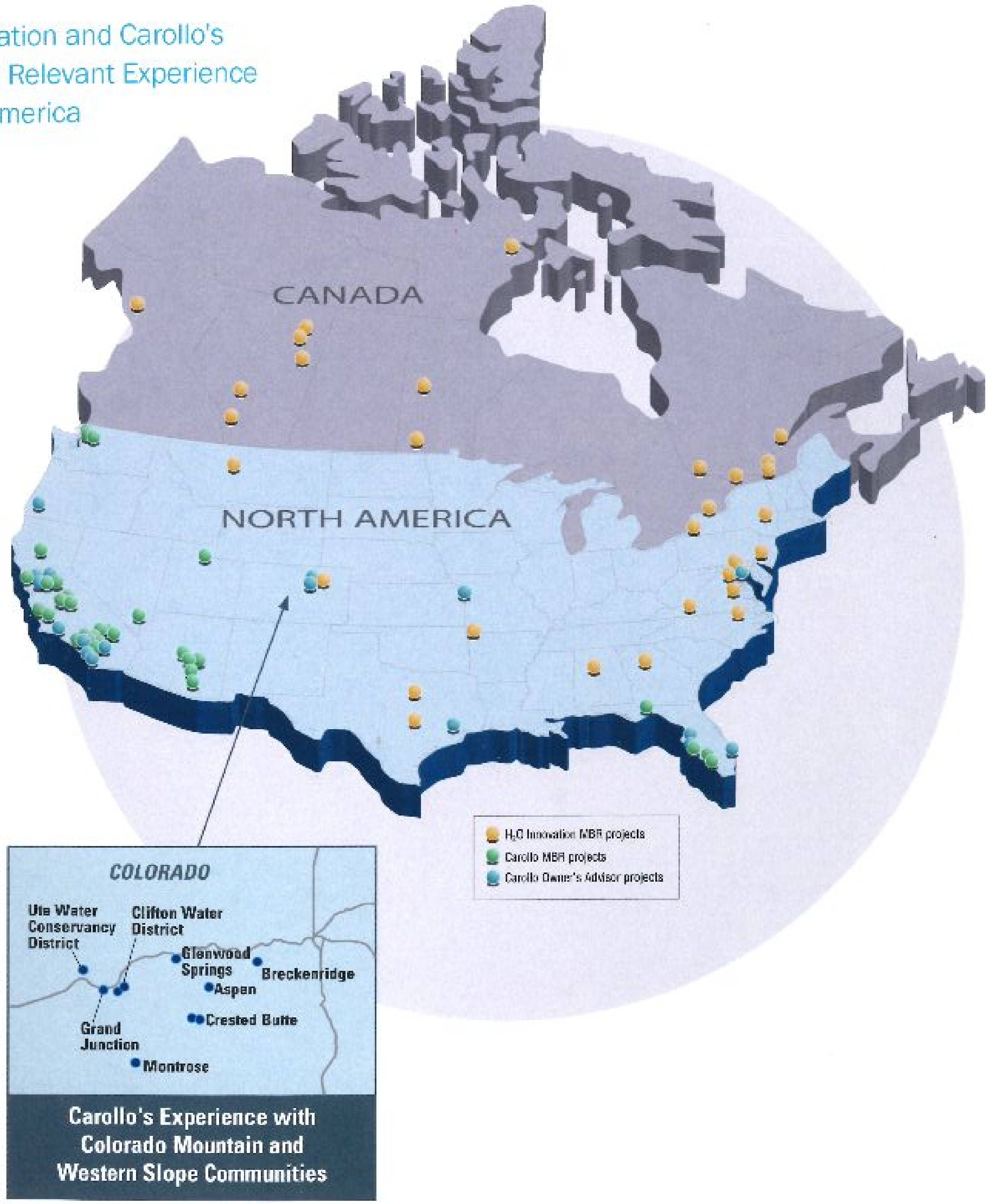
- Wastewater Planning, Regulatory Assistance, and Other Services for Eagle River Water and Sanitation District, CO
- WPCF Treatment and Nutrient Master Plan and Design for City of Greeley, CO
- WWTP Nutrient Removal Planning Study for City of Longmont, CO

Relevant Project Experience

AN INTEGRATED TEAM WITH SHARED EXPERIENCE

H_2O Innovation and Carollo team members have become trusted advisors on innovative wastewater treatment plant expansion retrofits for utilities throughout North America. Our varied experience brings the right resources to help you make informed decisions, giving you the confidence in the path ahead of the TRWWTP Expansion.

H_2O Innovation and Carollo's Combined Relevant Experience in North America



CHARLES A. STRAIN WTP MICROFILTRATION/ULTRAFILTRATION PROGRESSIVE DESIGN-BUILD

CLIFTON WATER DISTRICT, COLORADO

As the design engineer, Carollo completed the design and construction of this 12 mgd membrane filtration water treatment plant. This progressive design-build project utilized 3D design and frequent meetings with the District early in the design phase to make important decisions that kept the project on track. Maintaining operation of the existing water treatment facility during construction demanded a high-level of collaboration between the District, Carollo, and the design-builder to maintain water quality and ensure the success of the project. This project helped meet the District's goal of applying leading edge water treatment technologies to provide superior drinking water to their customers. The use of an open platform for the membrane system allowed the District to take advantage of lower project capital costs, the potential for system customization, and lower life-cycle costs without compromising long-term membrane module performance and warranties. H_2O Innovation served as the equipment supplier on this project. We designed the flexible, open platform membrane technology to meet the project design criteria. H_2O also provided the project integration and controls for the facility. The project was the first surface-water open-platform application in North America.

REFERENCE

Dale Tooker | Manager
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dtooker@cliftonwaterdistrict.org

PERSONNEL INVOLVED

Fraser Kent, Darren O'Neil, Mark Keller, Chad Green

STATUS

Completed 2016

SBR TO flexMBR™ RETROFIT SOLUTION

CITY OF DECATUR, ARKANSAS

The City of Decatur wastewater treatment plant operated as a Sequencing Batch Reactor (SBR) for over 10 years. The facility reached its maximum capacity of 2.2 MGD and was struggling to achieve the required effluent criteria. A design-build team determined that retrofit of SBR into a MBR. H_2O Innovation was chosen as the MBR supplier to expand the capacity to 4.6 MGD based on their competitiveness and unique design approach. Virtually all the existing infrastructure was leveraged for the MBR retrofit. The membrane system employs H_2O Innovation's flexMBR™ design and highlighted energy savings and SCADA integration. The flexMBR™ system includes a universal platform support system designed to fit most MBR modules covering an acceptable membrane surface area range.

The unique variable influent trends for the City of Decatur facility allowed an energy saving controls strategy to be implemented. Additionally, the design included blower VFDs and dissolved oxygen control loops leading to an extremely energy efficient process.

The SCADA developed by H_2O Innovation included a new state-of-the-art 55-inch touchscreen SCADA control panel. It also allowed integration of the existing headworks, dewatering system, influent pumps, and UV system in addition to the new MBR controls system. Extensive process monitoring functionality and the addition of automated report generation was provided using the Ignition software platform.

REFERENCE

James Boston | Public Works Manager
479-212-0726
jboston.cod@gmail.com

PERSONNEL INVOLVED

Fraser Kent, Darren O'Neil, Katherine Scott, Adam Moore, Paul Bartlett

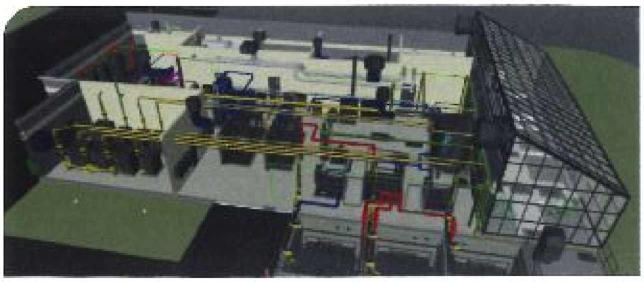
STATUS

Completed 2019

VIRGINIA WATER HUB MBR-RO

SUSTAINABLE WATER, VIRIGINA

Sustainable Water, an industrial manufacturer located in Virginia, was interested in novel ways of managing their water use and environmental impact. Historically they had discharged their wastewater to sewer and paid the city for potable water in their cooling tower makeup. H_2O Innovation worked to develop a cost-effective solution to construct a 0.71 mgd onsite system to treat wastewater to an industrial reuse level for cooling tower application. An MBR was selected as the initial treatment process, with an RO downstream. Due to the variable nature and flow of the industrial waste, the facility has integrated flexibility in the MBR design—a sewer interceptor pulls wastewater from the existing sewer up to a maximum flow and sends this flow to an equalization tank via fine screens. The wastewater is treated by anoxic and aerobic biological treatment followed by a swing post-anoxic tank that can be converted to additional aerobic volume as influent water quality demands. From this single bioreactor, the mixed liquor is pumped to three membrane trains, each of which is fitted with a flexMBR™ system. The flexMBR™ system includes a universal platform support system designed to fit most MBR modules covering an acceptable membrane surface area range. The robust plant controls accommodate a pre-determined range of membrane manufacturer operating parameters, including air scour rates, permeation cycles, cleaning frequency, and other process control parameters, such as sludge wasting to control MLSS.



REFERENCE

Eric Lohan | Director of Technology
434-242-1693
eric.lohan@sustainablewater.com

PERSONNEL INVOLVED

Fraser Kent, Darren O'Neil, Katherine Scott, Paul Bartlett

STATUS

Completed 2019

flexMBR™ INDUSTRIAL RETROFIT

PRIVATE INDUSTRIAL CLIENT, NEW YORK

A Diesel Engine Manufacturer, was experiencing problems with their aging wastewater treatment plant. The facility's influent included domestic and industrial waste. The average daily flowrate of 50,000 GPD was treated with a conventional activated sludge system but was unable to meet effluent discharge limits due to the challenging wastewater characteristics. H_2O Innovation was selected to provide a flexMBR™ demonstration pilot where both a ceramic membrane and PTFE membrane were evaluated for a full-scale facility over the course of eight months.

Based on the results of the pilot study, the ceramic membrane was selected as the technology of choice, and a full-scale facility was constructed. In order to expedite the execution of the project and take advantage of offsite manufacturing, a pre-fabricated approach was used, including five stainless steel tanks and a pre-engineered shippable building that houses the ancillary equipment. The pre-fabrication allowed the site construction to commence and the tanks and building to be constructed in parallel, saving approximately 8-12 months in the overall schedule.

H_2O Innovation's design involves fine screening followed by flow equalization and three trains of Anoxic -› Aerobic Membrane -› Filtration process flows.

REFERENCE

Christian Brinegar | Facilities Engineer
716-397-6615
christian.brinegar@cummins.com

PERSONNEL INVOLVED

Fraser Kent, Darren O'Neil, Adam Moore, Paul Bartlett

STATUS

Completed 2019

WASTEWATER PLANNING, REGULATORY ASSISTANCE, AND OTHER SERVICES

EAGLE RIVER WATER AND SANITATION DISTRICT, COLORADO

Carollo developed a master plan for three interconnected wastewater treatment plants (total combined capacity of 10 mgd) that considered flow and nutrient trading to develop the best-value and lowest life-cycle cost approach for achieving Regulation 85 and 31 compliance. Carollo developed and calibrated BioWin models for all three plants and identified optimization opportunities at each facility with plant staff. The project team conducted field testing with operations for alternative process control strategies to provide recommendations that were effective and acceptable to treatment staff. A major element of the project was performing a condition assessment to evaluate remaining useful life of the process/mechanical, structural, electrical/instrumentation and control, and HVAC systems at the three plants. With the results from the condition assessment, Carollo identified a prioritized list of asset replacement projects and an overall sequence of facility improvements.

Based on recommendations from the master plan, Carollo was selected to design the $50M Avon Wastewater Treatment Facility Biological Nutrient Removal Upgrades project, including conversion from an MLE to an A2O process, with flexibility to operate in the 5-Stage Bardenpho configuration. Construction includes expansion of existing aeration basin volume; construction of a third secondary clarifier; and replacement of major equipment for screening, grit removal, primary clarification, equalization, and electrical infrastructure. This construction project is in progress and is being delivered using the Construction Manager at-Risk (CMAR) alternative project delivery method.

REFERENCE

Siri Roman | Director of Operations
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sroman@erwsd.org

PERSONNEL INVOLVED

Becky Luna, Bryan Coday, Jeff Berlin, Jason Rozgony, Mark Keller, Chad Green

STATUS

Ongoing construction

PERSIGO WASTEWATER TREATMENT PLANT MASTER PLAN

CITY OF GRAND JUNCTION, COLORADO

For this project, Carollo is currently developing a comprehensive review of the existing treatment processes and recommending improvements using a holistic approach. This facility master plan is intended to develop a roadmap for achieving operational resiliency and reliability to meet the wastewater needs of users within the 201 Service Area. The master plan will identify the wastewater infrastructure needed to serve the anticipated growth projections for future land uses identified in the City's 2020 Comprehensive Plan. Additionally, the master plan will ensure the facility meets the current and future regulatory and statutory requirements while reinvesting in asset revitalization and replacement.

REFERENCE

Kurt Carson | Wastewater Services Manager
970-256-4171
kurtc@gjcity.org

PERSONNEL INVOLVED

Leanne Miller, Bryan Coday, Becky Luna, Jason Rozgony

STATUS

Ongoing

WASTEWATER TREATMENT PLANT NUTRIENT REMOVAL OPTIMIZATION

CITY OF MONTROSE, COLORADO

Carollo completed an evaluation of the ability of the existing wastewater treatment plant to improve biological nutrient removal and identify opportunities for implementing phosphorus removal. Working together with plant staff, the Carollo team developed an understanding of the existing processes to create a roadmap for the facility to achieve future effluent nitrogen and phosphorus limits, focusing specifically on Regulation 85 and the Incentive Program. The plant staff's extensive historical understanding of the process in conjunction with a calibrated BioWin process model and historical process data were used to highlight process optimization opportunities that could be full-scale tested as part of Phase 2 of this study.

As part of Phase 2, Carollo is conducting a full-scale test in coordination with plant staff to optimize DO concentrations in the oxidation ditches by automating and adjusting brush aerator speed to facilitate conditions for simultaneous nitrification and nitrification. The full-scale testing is a 16-week test, which also includes pilot testing ammonia and nitrate instrumentation. Results of this study will be used to develop a final approach to achieve future effluent nitrogen and phosphorus discharge limits.

REFERENCE

David Bries, CET, CPM | Utilities Manager
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dbries@ci.montrose.co.us

PERSONNEL INVOLVED

Leanne Miller, Bryan Coday, Becky Luna, Jason Rozgony

STATUS

Ongoing

BEE RIDGE WATER RECLAMATION FACILITY EXPANSION AND UPGRADE TO ADVANCED WASTEWATER TREATMENT

SARASOTA COUNTY, FLORIDA

The County selected Carollo to evaluate design upgrades and requirements to expand the facility from 12 mgd monthly average daily flow to 18 mgd maximum monthly average daily flow (MMADF) and convert its process to meet Florida's advanced wastewater treatment (AWT) requirements.

Carollo evaluated seven treatment alternatives to determine the best option to meet the County's requirements for AWT. The evaluations included BNR process in conventional activated sludge (CAS) arrangements and alternative technologies, such as MBR, IFAS, AGS, and BAS. A suite of decision criteria was used during a comparative analysis of each alternative. The County's priorities for each criterion were applied at a workshop and MBR, CAS, and IFAS alternatives were short-listed for further evaluations. Short listed evaluations assessed hydraulics, site layouts, additional project-specific design criteria, and various economic and non-economic criteria, such as capital and O&M costs, site constraints, and flexibility for future upgrades. Ultimately, a Modified Bardenpho treatment process with MBR was selected, as it required a much smaller footprint, allowing flexibility for future expansion. The MBR also provides future opportunities to implement high-level treatment options, such as indirect non-potable reuse.

After completion of the preliminary design phase, Carollo assisted the County in selecting a CMAR, including development of Request for Proposal documents, responses to proposer questions, and preparation of addenda. The County and Carollo are currently negotiating a scope of services for CMAR preconstruction activities.

REFERENCE

Greg Rouse, PE | Engineering Manager
941-861-0548
grouse@scgov.net

PERSONNEL INVOLVED

Andrew Gilmore

STATUS

Ongoing

Project Understanding & Approach

A successful project begins with a thoughtful and actionable plan which leverages experience in alternative project delivery, mountain construction complexity, and wastewater process design. Our team's combined experience provides this breath of expertise coupled with a focus on customer service and collaboration.

The Town of Telluride is looking for a professional wastewater advisor to serve as a partner through the implementation of a phased expansion project for the TRWWTP over the next 5-years. Our team lead, Fraser Kent, has spent the past two years reviewing the wastewater challenges facing the Town. Through multiple meetings with your staff and key stakeholders, he has become intimately familiar with these challenges and has developed a cost-effective retrofit option to expand the existing facility.

We listened, and what we heard from your staff and key stakeholders shaped our approach to providing the professional wastewater advisor services on the following four key goals.

- Develop a cost-effective pathway to achieve capacity and regulatory requirements.
- Re-using the existing infrastructure "where practical" while improving process efficiency, operability, and facility redundancy/reliability.
- Minimize risk to the Town through selection of the appropriate alternative project delivery method, equipment procurement strategies, and development of appropriate contract documents.
- Understanding construction complexity common to mountain communities like Telluride and developing a plan to achieve fast tracked schedule goals within these constraints.

To accomplish these goals, the five tasks included on the request for proposal fall into three project phases: procurement, implementation plan and preliminary design, and execution.

PROCUREMENT

Task 1

- Selection of Alternative Project Delivery Method
- Support Engineer/Construction Contractor RFP and contract document
- Review Engineer/Construction Contractor proposals and provide evaulation and recommended selection

IMPLEMENTATION PLAN AND PRELIMINARY DESIGN

Tasks 2–4

- Confirm the basis of design
- Optimize the facility hydraulic grade line
- Provide liquid and solids process solutions
- Develop the preliminary process design
- Create a thoughtful, cost-effective, and flexible biosolids management strategy
- Deliver a 5-year implementation plan
- Provide an equipment acquisition strategy consistent with the Town's goals

EXECUTION

Task 5

- Support the City throughout the alternative delivery process to ensure the vision is realized

Our team's collaborative approach and scope of work is organized to prioritize your input and guidance using seven interim deliverables and four workshops as shown in the project schedule on page 28. This approach provides multiple decision points to achieve consensus for future objectives and obtain buy-in at every step of the process. The following pages further outline our understanding, approach, and scope of services to deliver an actionable implementation plan for a successful, cost-effective expansion project within the budgetary and schedule goals.

PROCUREMENT

Our project delivery experts will listen carefully to your needs, then apply proven assessment methods to efficiently identify the best alternative delivery method to meet your project goals.

The TRWWTP expansion project will be a multi-year program which requires thoughtful planning and preparation for successful execution. Developing a well thought out program for procuring the Engineer/Construction Contractor team will be a critical step to delivering the implementation plan program cost effectively, on schedule, and while minimizing risk. As your wastewater advisor, our team will guide you through the process of selecting the delivery method that best meets the needs of your wastewater treatment plant improvement program. Step one in this process starts by identifying and understanding the key criteria which are driving the goals and objectives you have for your project. Step two is focused on evaluating these criteria with respect to the five delivery methods that municipal owners, engineers, and contractors have experience with on water/wastewater projects in Colorado and across the United States. Each of these delivery methods have varying capacities for meeting the Town's goals. We have provided the table below, which shows a high level comparison of how several typical project criteria are met by each delivery method. We will work with the Town to prioritize your identified project selection criteria, and then match these criteria to the delivery model that best meets them. Once the project delivery method has been selected, your criteria will also be used to determine the best procurement approach. Whether the procurement approach is a one-step or two-step procurement process, we will prepare documentation that will be efficient for the Town, as well as maximize interest in potential respondents.

Delivery Model Characteristic Comparison

	Design-Bid-Build	Competitive Sealed Proposals	Design/CMAR	Lump Sum Design-Build	Progressive Design-Build
Selection Criteria	Price based	Qualifications based with price considerations	Qualifications based with price considerations	Primarily priced based	Qualifications based with price considerations
Owner Involvement and Flexibility	Good through detailed design. Minimal after construction contract is awarded	Good through detailed design. Provides for modifications after selection	Good throughout entire design and construction phases	Good through preliminary design. Minimal after DB contract is awarded	Good throughout entire design and construction phases
Schedule	Slow	Slowest	Faster	Fastest	Faster
Number of Contracts to manage (with OA)	3	3	3	3	2
Potential to Deliver 'Least Cost'	Very good (in favorable market conditions with good design)	Very good to great (in favorable market conditions with good design)	Good to very good	Good	Very good to great
Cost Control	Reduced control once construction contract is awarded	Some flexibility in cost control after selection	Later cost identification. More control throughout entire project	Early cost identification. Least control after preliminary design is advanced	Later cost identification. Most control throughout entire project
Potential for Change Orders and Claims	Higher	Lower	Lower	Higher	Lowest

The delivery method that is most suitable for the Town will depend on the Town's priorities, such as schedule, cost control, owner involvement, and flexibility.

We recommend keeping the procurement approach streamlined and concise. Overly complex and extended procurement cycles will discourage prospective respondents due to the time and expense required in getting to contract award. In our experience as an Owner's Advisor, we know the most efficient way to select and get an Engineer/Construction Contractor hired is with a one-step RFQ. There is little material needed for a design criteria package (which compresses the procurement cycle) and the basis of selection is focused on firm qualifications, past experience with similar wastewater projects, and the experience of their key team members.

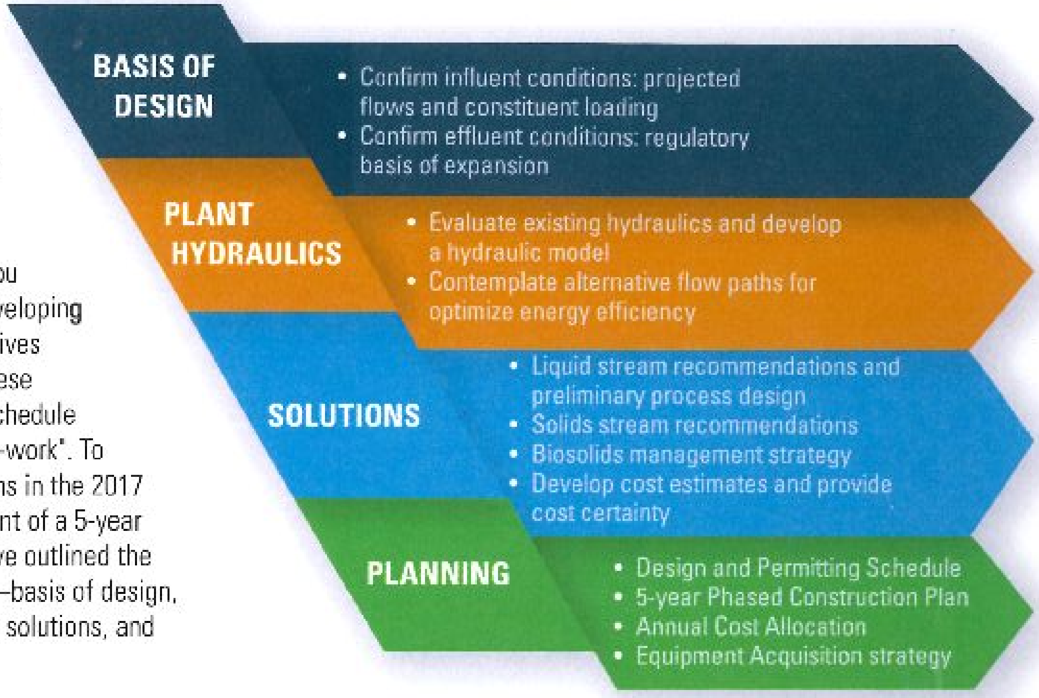
Procurement Task Workshops and Deliverables

- Workshop 1: Kickoff, Vision, and Site Visit.
- Draft RFP Comments.
- Draft Engineer/Construction Contractor team contract comments.
- Evaluation summary and recommendation for the selection of the Engineer/Construction Contractor team.

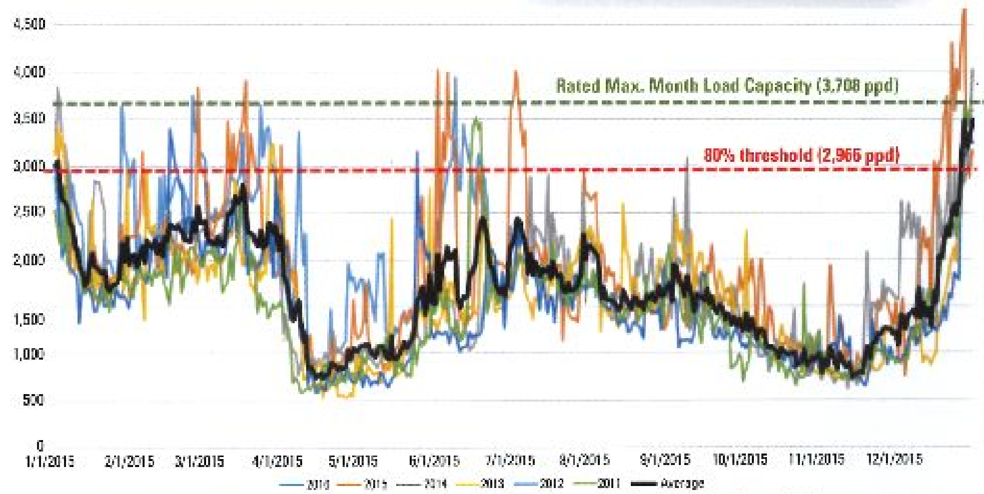
IMPLEMENTATION PLAN AND PRELIMINARY DESIGN

We will deliver a phased implementation plan to meet capacity expansion requirements, discharge permit compliance goals as well as satisfy mountain construction boundaries while respecting budget constraints.

The goal of the implementation plan is to provide a detailed set of next steps—a prioritization of recommended steps for the project describing an implementation pathway. You have already invested in developing a plan to meet future objectives and we want to leverage these efforts to reduce cost and schedule impacts associated with "re-work". To confirm the recommendations in the 2017 Master Plan and development of a 5-year implementation plan we have outlined the four steps of our approach—basis of design, plant hydraulics, developing solutions, and implementation planning.



Basis of Design



Prior loading data show seasonal trends and regular exceedances of expansion thresholds, suggesting a near-term expansion project.

Dramatic growth in flows and especially organic loads to the TRWWTP were discussed in the 2017 Master Plan and serve as a call to action. While not yet an emergency, initiating this facility expansion is pressing and a well-structured plan is crucial to getting the necessary capacity improvements in place. You are already operating your facility beyond CDPHE's wastewater planning trigger (80 percent of rated capacity) and were quickly approaching the State's capacity expansion trigger (95 percent of rated capacity) as of the 2017 Master Plan. Construction capacity improvements will need to be operational before the facility reaches 100 percent capacity —likely by 2023/2024 based prior projections.

We have analyzed the previous flow and organic (BOD) load projections from the 2017 Master Plan. This evaluation is now over five years old and lacks a comprehensive evaluation of influent nutrient loading that will impact how the Town plans and designs for Regulation 85 and Regulation 31 effluent nutrient limits. We suggest revisiting flow projections and capacity needs with you to define the exact near-term capacity rating that matches growth projections, and a logical modular facility expansion considering economies of scale. While the definition of the average daily maximum month flow (ADMMF) and load conditions is important for demonstrating rated design capacity with CDPHE, the definition of the future peak hour flows and loads from peak tourist seasons are also critical for design. We have experience in quantifying infiltration and inflow (I/I) contributions and separating these from peak hydraulic flow projections. We also are adept at characterizing the touristic nature of mountain communities to ensure you have adequate capacity and flexibility to confidently respond to seasonally variable conditions.

The effluent design conditions are equally as critical as the influent design conditions. Targeting future anticipated effluent limits as part of this effort, reduces the need for another significant capital project within the 20-year planning horizon. Additionally, reducing nutrients in the near-term allows the Town to take advantage of the voluntary incentive program offer by CDPHE to possibly defer Regulation 31 limits.

Your discharge permit issued December 2020 includes a number of new limits, such as the 2026 potential dissolved Copper limit. Other near term regulatory concerns to consider in the planning effort associated with this project are summarized below. Due to the costs associated with construction in remote mountain communities and the small footprint of the existing site you need reliable, efficient technology to achieve future regulatory requirements. Our team recommends prioritizing anticipated future effluent limits as a component of this expansion project to recognize cost savings and capitalize on effluent limit incentives from the voluntary incentive program.

CDPHE has a current back log of several months. The site application will need to be published and reviewed for commenting by a number of reviewing agencies before CDPHE will start its review. To keep the project on schedule, we need to hit the ground running with an updated flow and load evaluation and gain clear consensus with your stakeholders. A redefinition of the project later on can significantly delay your schedule.

Regulation 85 - The nutrient reductions required by Regulation 85, "Nutrients Management Control Regulation," are implemented through effluent TIN and TP limits as a running annual median of 15 mg/L and 1 mg/L, respectively. Regulation 85 implementation is delayed until December 31, 2027 for dischargers who discharge to a low priority watershed, like the TRWWTP. Planning for Regulation 85 limits at a minimum are recommended. Your permit also includes a daily maximum TIN limit of 17 mg/L that is effective starting in 2025. We anticipate the Town will receive nutrient limits as part of the next permit renewal cycle with limits effective starting between the years 2027 and 2029.

Regulation 31 - During the Regulation 85 and Regulation 31 Rulemaking Hearings in 2017, the State delayed adoption of TN and TP standards for rivers until 2027. Anticipated future nutrient limits under Regulation 31 therefore remain uncertain. We will work with the Town to define anticipated future effluent nutrient discharge limits required to meet the Regulation 31 instream standards, assuming the current dilution credit and the available instream background pollutant concentrations. TN and TP limits associated with Regulation 31 would likely become effective as annual median limits sometime between 2032 and 2034 based on the permitting cycle, assuming no earned credit under the Incentive Program.

Metals - Your CDPS permit lists monitoring requirements and limits for several metals. While you currently meet the limits for most the listed metals, your seasonally variable effluent copper concentrations (typically 15 to 20 µg/L) exceed the future limits starting in 2026 (12 µg/L 30-day average and 0.95 µg/L 2-year average). Your last Master Plan provided a first glimpse at some possible solutions, but did not yet conduct a systematic process analysis, predict the cost-effectiveness of proposed alternatives, or develop a practical plan for how to implement solutions at the TRWWTP. The good news is that you are already proactively working with LRE on your current and future effluent permit compliance. We will coordinate and verify effluent copper compliance assumptions with you, LRE, and CDPHE, while conducting an evaluation in-parallel on what technologies can meet your effluent permit requirements should additional treatment be needed.

Temperature - In compliance with the new permit requirements, your facility is currently conducting temperature monitoring in the final effluent and likely in the San Miguel River. As a result, the Town may receive temperature limits as part of a future permit renewal, should the decision be made that there is reasonable potential for the facility to cause or contribute to an exceedance of the water quality standard for temperature. Our team is familiar with efficient wastewater cooling technologies currently on the market and has worked with other Colorado facilities to identify and evaluate opportunities to meet future effluent temperature limits. We will bring this experience to bear on this project and provide solutions to replace the aging temperature recovery system currently installed at the TRWWTP.

Basis of Design Task Workshops and Deliverables

- Workshop 1: Kickoff, Vision, and Site Visit.
- Technical Memorandum: Basis of Design.

Developing an optimized hydraulic grade line of the existing facility allows us to understand hydraulic bottlenecks and evaluate alternative flow pathways to reduce energy consumption and minimize future O&M costs.

Carollo's internal hydraulic model is an Excel based program specifically designed for evaluation of wastewater treatment plant hydraulics.

The existing facility was constructed in three phases between 1987 and 2001. Our evaluation of the existing hydraulic grade line and future hydraulic grade line will evaluate site layout opportunities and options to reduce multiple points of pumping through the TRWWTP. To characterize the existing facility hydraulics, bottlenecks, and site limitations, as well as opportunities for hydraulic optimization, this task includes the following components:

- **Site survey:** We will partner with local surveyor, Bulson Surveying to develop a site survey which will be used during optimization of the site layout, confirmation of critical structure top of wall elevations, and water surface elevations (WSEs) during current flow conditions for model calibration. The developed site survey can also be used by the Engineer/ Construction Contractor team during design and will expedite the next steps for the design team.
- **Raw sewage lift station and headworks review:** Our team will review available equipment information and facility assessments to understand redundancy, equipment, and operational shortcomings and work with the Town in developing a path forward for an efficient and reliable influent pumping and headworks configuration.

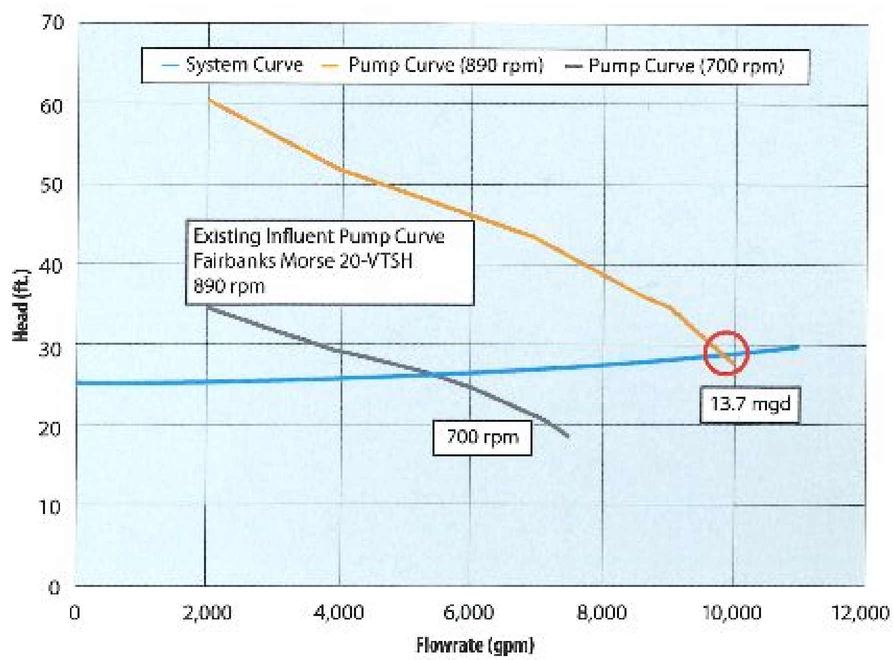
The following objectives will be achieved through this evaluation to provide a final product that facilitates ease of operation and process reliability and efficiency.

1. Determine potential hydraulic limitations and flow restrictions of the liquid stream processes.
2. Identify potential corrective measures and impacts from new process elements as part of the alternative analysis.
3. Summarize limitations and required upgrades to provide sufficient hydraulic capacity of the liquid stream to meet current and future flows.
4. Evaluate alternative flow configurations to reduce energy use and maximize hydraulic efficiencies.

To model the hydraulic and energy grade lines through the facility we will use our Hydraulix® modeling software. The program estimates the WSEs at a given point in the process stream by creating a hydraulic profile of the entire treatment facility. This process is a fundamental step to understanding the opportunities to reuse existing infrastructure while minimizing risk and complications during construction.

Plant Hydraulics Task Workshops and Deliverables

- Workshop 1: Kickoff, Vision, and Site Visit.
- Workshop 2: Liquid Stream Recommendations and Hydraulic Grade Line.
- Technical Memorandum #2 – Existing and Future Hydraulic Model.



In addition to flow paths, detailed hydraulic analysis will assess pumping requirements, capacity, and flow ranges.

Our head start will allow us to rapidly assess existing assets for replacement or optimization, as well as streamline the overall design direction for your facility to meet your short and long term goals.

Our team has visited the facility and has worked with your staff to explore preliminary design concepts for the proposed expansion retrofit. Key aspects of the proposed improvements are shown on the figure below. The concepts below will be discussed in a workshop with Town staff in a collaborative fashion, with the goal to obtain ideas from Town staff and work towards a future vision that meets the near and long term goals.

Key Retrofit Features to Make this Project a Success

Dewatering

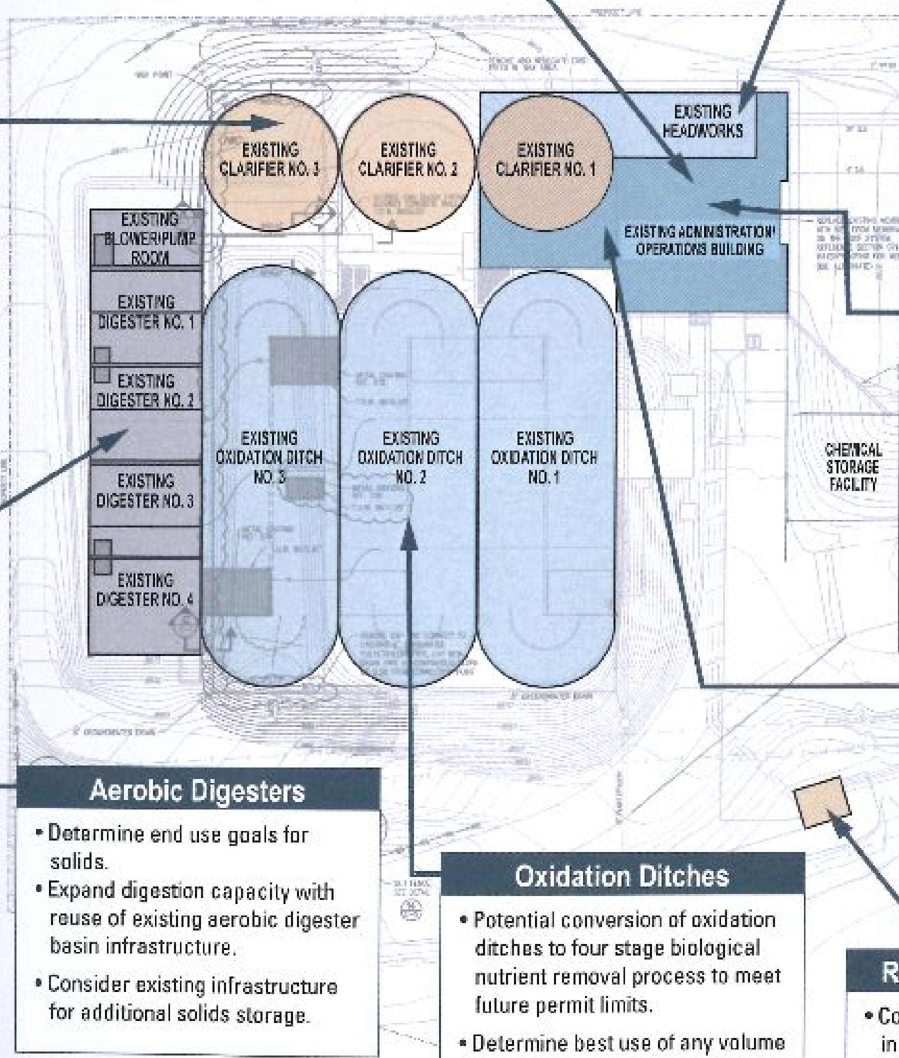
- Review Parkson Rotary Drum thickeners.
- Evaluate volute dewatering process.
- Confirm adequate capacity, redundancy, and storage for design period.

Secondary Clarifiers

- Re-purpose existing clarifier 1 for membrane train installation.
- Consider existing clarifier volume for equalization or potential solids thickening process.

Headworks/Preliminary Treatment

- Add fine screens to protect the membranes.
- Further evaluate the need for grit removal or possible variance request from CDPHE.
- Evaluate location for new headworks and eliminate double pumping, for long-term energy savings.
- Improve operator health and safety with improved containment, conveyance, and treatment of odors along with improved air quality into the operators spaces.



Administrative Building/ Lab/SCADA:

- Evaluate space previously used by animal control for administrative services.
- Identify optimal approach to controls integration of existing and new equipment.
- Improve SCADA to include laboratory data integrated with analogue parameter trending.

UV Disinfection

- Increase UV capacity for WWTP expansion and provide redundancy for critical disinfection process.
- Pontential UV optimization after membrane treatment for lower lifecycle costs.

Aerobic Digesters

- Determine end use goals for solids.
- Expand digestion capacity with reuse of existing aerobic digester basin infrastructure.
- Consider existing infrastructure for additional solids storage.

Oxidation Ditches

- Potential conversion of oxidation ditches to four stage biological nutrient removal process to meet future permit limits.
- Determine best use of any volume not needed in this project.

Raw Sewage Lift Station

- Consider hydraulic improvements in conjunction with headworks planning to eliminate pumping influent twice and improve system redundancy, operability, and staff health and safety.

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MBR technology will maximize the reuse of existing infrastructure, provide exceptional effluent water quality, and defer capital expenditures.

The Town of Telluride is at a crossroads with the selection of the future technology to meet nutrient limits at the forefront of that decision. There are several options which have been presented in prior reports and certainly meetings with parties interested in participating in this expansion project. Some of the options available to the Town are:

- Granular Sludge (such as Nereda).
- Moving Bed Bioreactor Reactor.
- Membrane Bioreactor.

Each of these options hold the potential to upgrade the existing oxidation ditch to meet the stringent nutrient requirements. Our analysis suggests that an MBR is the most suitable pathway forward for several key reasons:

1. Proven operation in cold climates.
2. Proven ability to meet stringent nutrient requirements.
3. Proven intensification approach that is not bleeding edge and reduces risks to the Town.
4. Ability to get best value pricing by using open platform membrane equipment approach.
5. Ability to modify the existing facility with the lowest cost and least interruptions to the existing plant.

Oxidation Ditch Modifications into an MBR meets Telluride's Future Permit Requirements

Modifying the oxidation ditch into an MBR will provide a robust, flexible, and reliable system for the Town. The process configation shown will provide for enhanced biological nutrient removal (nitorgen and phosphorus).

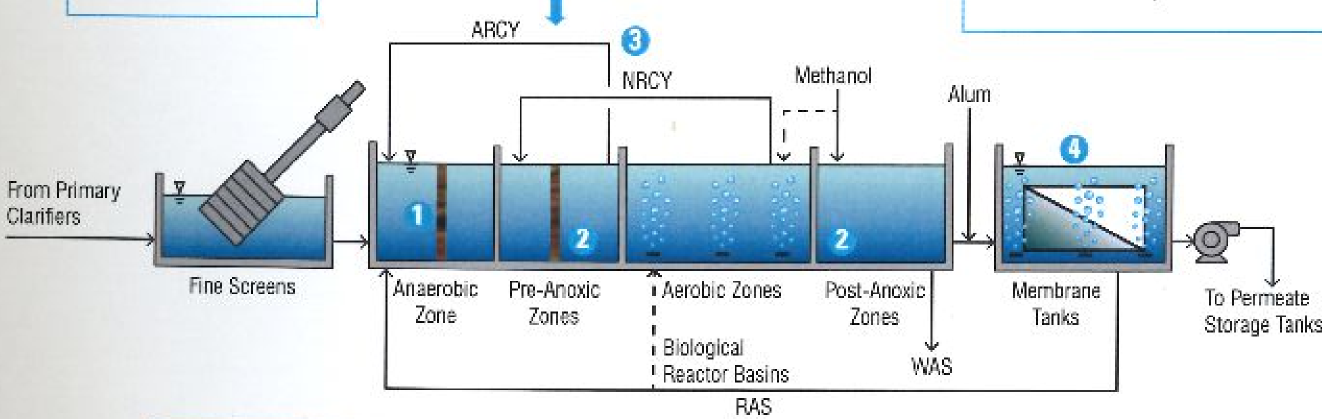
1 New Fine Screens
will be required to protect the membranes but will also benefit operation by reducing the amount of debris that gets into the plant.

2 Swing Zones
Allows testing the benefits of adjusting Pre-Anoxic and Post-Anoxic zone sizing for seasonal conditions.

5

Modify to using stainless steel baffles allows for added flexibilty if in the future you need to reduce or expand the sizes of zones. You are not locked into the configuration.

3 RAS and IMLR Rates and Return Locations
Allows testing of alternate RAS & IMLR approaches to prevent oxygen poisoning and optimize conditions in anaerobic/anoxic zones. For example, high-rate RAS return to aerobic zones and two-step lower IMLR return from aerobic to anoxic, and anoxic to anaerobic zones, as shown here.

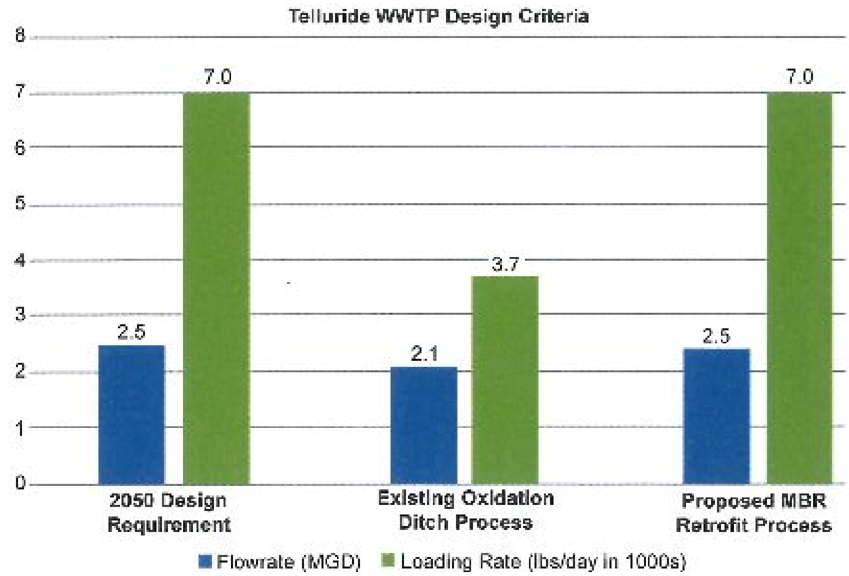


4 Universal MBR Rack
Each membrane manufacturer provides a special rack configuration to accommodate their system's design. However, with a bit of additional design thinking, a universal rack system can be designed to accommodate multiple manufacturers. This open platform approach will let the Town select a membrane supplier that is the best value and provide flexibility if in the future to adopt different manufacturers that may advance this process. A key benefit is that the Town is not locked into one supplier's configuration and platform.

After the review of the alternatives our team recommends proceeding with the recommended membrane bioreactor (MBR) strategy for a secondary treatment approach due to the exceptional water quality, which will achieve anticipated Regulation 31 effluent limits, small footprint, and ability to retrofit into existing infrastructure. The initial proposal for these improvements involves the installation of three (3) MBR trains, allowing an increase in treatment capacity and improved effluent water quality within the confines of the existing structures.

Solutions Task Workshops and Deliverables

- Workshop 2: Liquid Stream Recommendations and Hydraulic Grade Line.
- Technical Memorandum: Liquid Stream Process Recommendations.



The hydraulic and organic loading capacity of the existing oxidation ditch and MBR retrofit as compared to the 2050 design condition demonstrate the opportunities to reuse existing infrastructure.

BENEFITS OF PROPOSED MBR RETROFIT

1 Optimized Operation and Maintenance Costs

An biological nutrient removal MBR provides state-of-the-art biological process design minimizing chemical consumption. The process incorporates pre- and post-anoxic biological zones that minimize alkalinity consumption by returning half of the consumed alkalinity during the denitrification process. Also, the inclusion of an upfront anaerobic biological zone allows the proliferation of polyphosphate accumulating organisms that facilitate biological phosphorus removal to minimize the amount of coagulant needed to reach the effluent criteria. Finally, control and monitoring systems can provide real-time feedback loops and customized metrics to ensure consistent visibility on chemical and power usage to identify areas of potential savings.

2 Minimal New Construction

The biggest cost in any plant upgrade is new construction. Our approach considers the site-specific restrictions and building layout to maximize reuse of the existing infrastructure. Care has been taken to ensure that the system can be upgraded without requiring significant additional land development, significantly reducing the overall project costs.

3 Existing Plant Integration

The retrofit plan ensures that the plant will continue to operate at the required capacity throughout the MBR upgrade. Membranes can be installed in Clarifier 1 to avoid impacting the existing plant. Oxidation ditches can be retrofitted and commissioned on a train-by-train basis to eliminate downtime during the retrofit and avoid interrupting the existing process.

4 Exceptional Water Quality

MBRs have been recognized as a superior wastewater treatment technology with effluent TSS values near zero and the ability to virtually eliminate BOD, phosphorus and total nitrogen. This provides peace of mind that effluent criteria will be consistently met, now and in the future.

Advancing the process design as part of this scope of work will bring focus to the Engineer/ Construction Contractor RFP, zero-in on your goals and needs, and expedite project delivery.

The proposed upgrade approach requires updating the TRWWTP drawing set. At the end of the project a full set of as-built drawings will be provided to the Town that are finalized by the successful Engineer/Construction Contractor Team. However, there are distinct advantages to creating process focused engineering drawings in parallel with the development of the Engineer/Construction Contractor RFP to define the process design. The advantages include:

- **Improved schedule** – Moving forward with preliminary design saves the time it would take to develop these documents after the Engineer/Construction Contractor team is brought on board.
- **Facilitation of Hydraulic Grade Line Optimization** – The development of P&IDs and preliminary process selection for the various unit operations is necessary to complete Task #2 since the hydraulic profile is tied to the unit operations selected.
- **More Representative Evaluations of RFP Responses** – Advancing the preliminary process design prior to the RFP will bring focus to the RFP responses, improving the ability to make representative evaluations of the responses.
- **Improved Efficiency for Engineer/Construction Contractor** – A preliminary process design will allow the successful Engineer/Construction Contractor to commence immediately on other aspects of design such as structural, electrical, mechanical and architectural aspects and avoid the delays and distractions associated with a lack of direction in regard to the process design.

Process Flow Diagrams (PFD)

The basis of design inputs established by our team become inputs in the PFD where the general processes used to achieve the effluent water quality parameters established within the basis of design can be proposed. A PFD acts as a high level vision of how the wastewater treatment process functions.

Piping and Instrumentation Diagrams (P&ID)

The piping and instrumentation diagrams are more detailed than the PFDs and identify equipment, valves, instrumentation and pipe sizes. There is a significant advantage to creating preliminary P&ID drawings early in the process because there are so many ramifications of design elements that cannot be identified without P&ID development. For example, the size of a particular pipe required to transport liquid from a bioreactor to a membrane tank is tied to the optimization of the Hydraulic Grade Line and vice versa. Ultimately, a reasonable set of P&ID drawings brings more focus to the RFP for the Engineers/ Construction Contractors and stakeholders looking to move the project forward.

Layout Drawings for Priority Unit Operations

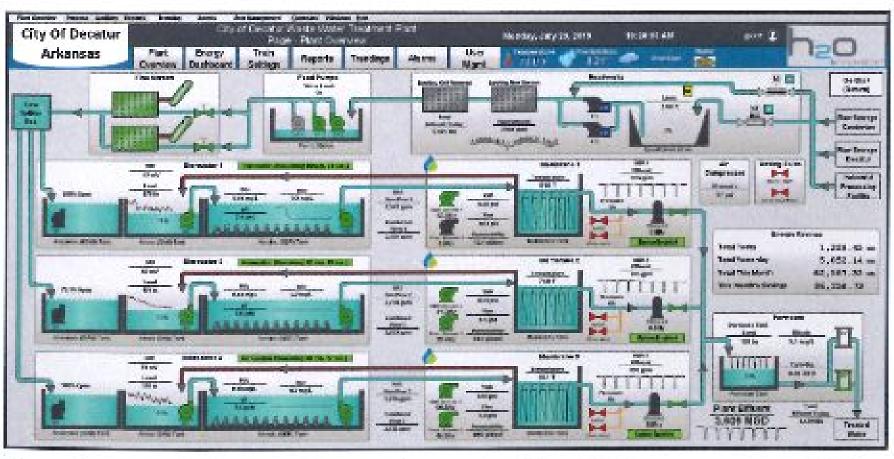
To optimize the reuse of existing infrastructure at the TRWWTP, we will conduct an evaluation of the available spaces and their ability to adequately house new equipment. We will model the proposed equipment in the existing spaces after field verification of dimensions to provide an assessment of process options at a "go/no-go" level. This step eliminates iterations by the successful Engineer/Construction Contractor team. It also feeds the constructability perspective regarding installation restrictions such as limiting doorway or hallway sizes. Furthermore, and perhaps most importantly, the development of these visual proposed upgrades will provide the opportunity for TRWWTP staff to visualize the proposed upgrades and provide comments early in the design process. Staff input is invaluable as the vision of the future treatment process takes shape.

Process Controls and Integration

A process control narrative (also known as a functional description) is an explanation, in words, of how the equipment, valves and instruments interact to function as a unified treatment process. It identifies process boundaries and system reactions to various conditions. It is essentially a summary of how the treatment system "should" work. This document will be developed to compliment the PFD, P&ID and layout models to clarify the manner in which the various unit operations will interact. This is particularly important for the TRWWTP staff to start to explore treatment processes they may be unfamiliar with and provide comments and feedback.

Preliminary Design Task Deliverables

- Liquid Treatment Process Preliminary Design.



Integrating new and existing equipment and processes within a SCADA system ensures unified system monitoring as well as the opportunity to take advantage of the latest SCADA platforms.

We will consider a range of solids treatment and biosolids end-use options, so the Town has a robust and flexible plan moving forward.

Secondary solids are sent to four aerobic digesters for stabilization and are thickened by a rotary drum thickener prior to conveyance to a recently installed volute dewatering press prior to be hauled offsite. Class B biosolids are hauled by a private contractor and are currently landfilled, although the Town has entered a contract with 3xM Grinding and Compost LLC for use at a compost facility in Olathe, Colorado. TRWWTP's solids handling system has several limitations, including thickening limitations with the RDT and within the aerobic digesters, digester performance, odor generation, redundancy, layout of solids processing equipment (dewatering and thickening is on the opposite site of the site from the digesters), and managing hauler's requirements.

Solids Handling Evaluation

Our team will evaluate your existing aerobic digestion process alongside alternative stabilization scenarios to determine the best fit for your facility in conjunction with your end use goals of achieving a Class A or Class B product. Your latest master plan provided an overview of digestion options, but ultimately recommended a technology that was not successful during pilot testing. While aerobic digestion may well be the best fit for your facility given your existing infrastructure and lack of primary clarifiers, our team will consider solids stabilization opportunities that compliment your existing infrastructure, planned secondary treatment retrofit, and long-term solids handling goals.

We recommend consideration of the following alternative solids stabilization approaches.

1. Aerobic digestion.
2. Autothermophilic aerobic digestion (ATAD).

Aerobic Digestion

Your current aerobic digestion process results in a biologically stable Class B end product. Aerobic digestion provides you with a simple-to-operate stabilization approach that has been proven at similar facilities across the country. While maintaining this process would result in the lowest capital cost requirements, it is critical that your existing limitations be addressed. Our team proposes considering several optimization measures, including an improved aeration and mixing system to improve oxygen transfer, and recuperative thickening.

Our team's history and experience with optimizing aerobic digestion will give the Town the confidence that, if this alternative is selected, plant staff will have a fully optimized digestion facility that reduces operating costs.

Our team's approach to optimizing aerobic digestion at other facilities reduces both capital and operating costs. The following optimization measures have been included in our recent designs.

- Staged configuration to help decrease the digester volume required to meet Class B from 60 days down to 42 days at 15 degrees Celsius.
- Thickening to up to 3 percent solids to further decrease the volume requirement.
- Cyclic aeration to reduce energy consumption and help prevent digester failure associated with pH depletion.
- Energy efficient mixers to keep solids in suspension during unaerated cycles.
- Recuperative thickening to prevent overheating of the digesters due to exothermic reactions.
- Foam abatement spray bars to provide relief during digester foaming episodes.

Autothermophilic Aerobic Digestion (ATAD)

An advantage of the ATAD system, which is a variation of both conventional and high-purity oxygen aerobic digestion, is that it has a small footprint and can generate Class A biosolids if operated in batch mode. The high temperature process increases the biological activity and results in a relatively short detention time (6 to 12 days). Adoption of this process opens up the potential for creating a marketable biosolids product for the Town. First generation ATAD systems installed in the 1990's experienced recurring issues with undersized and ineffective aeration equipment, and inadequate odor control systems. The second generation ATAD process technology has significantly improved mixing and aeration equipment, and better odor control.

ATAD has been successfully implemented in Colorado at the City of Fruita and the Eagle River Water and Sanitation District (Edwards Facility). The Edwards treatment facility opted to expand their ATAD process in 2016, forgoing an evaluation of other solids stabilization processes given their satisfaction with the technology (i.e., easier compliance, less monitoring and recordkeeping, and less odor in the final product). This high-temperature process is expected to result in a higher volatile solids reduction, in a range of 35 to 45 percent, which would reduce hauling costs.

ERWSD expanded their ATAD process in 2016.

Dewatering

The recent dewatering improvements at the TRWWTP to incorporate a volute dewatering press has improved the biosolids product and reduced implications on cost and end use options due to liquid hauling. This modification is anticipated to have significantly reduced hauling costs and reduced the bottleneck associated with your existing holding tanks. As part of the implementation plan, the capacity of the existing equipment and any opportunities to increase process efficiencies and redundancy will be reviewed relative to the proposed secondary treatment improvements and solids production projections. Additionally, consideration will be given to how the production of a dewatered cake (and associated return flows) might impact the liquid stream process. Our team is experienced, not just in the design of dewatering facilities, but working with utilities throughout Colorado, from Montrose to Fort Collins, to optimize their secondary treatment processes for nutrient removal. We will combine our experience in both solids handling and nutrients to maintain a whole plant perspective through this project.

Biosolids Disposal/Use

An evaluation of digestion alternatives for the Town must include capital and operating costs, ease of operation, flexibility for maintenance, and your long-term solids hauling and end use goals. For example, while continuing aerobic digestion may have the lowest capital costs, this process has higher solids generation, requiring additional land for land application and/or higher landfill tipping fees. On the other hand, conversion to ATAD or composting to produce a Class A product would increase marketability for beneficial use of your biosolids and could open up markets closer to the TRWWTP.

Throughout the country, we advise our clients that they maintain alternative management practices to ensure that their continued operation is not impacted by changes to the land application site, weather, or other external factors. Nowhere is this more important than in our mountain communities. As part of this project, we recommend that an evaluation be performed regarding the management practices for Class A and B biosolids to identify any cost savings opportunities.

Diversification of disposal options will provide redundancy under adverse weather and other unforeseen conditions. This strategy could involve Class B land application in conjunction with the 3XM composting facility. A third standby option may be to provide an onsite location for extended storage of biosolids to mitigate unanticipated events.

Solids and Biosolids Management Strategy Workshops and Deliverables

- Workshop 3: Solids Process Alternatives and Biosolids Management.
- Technical Memorandum: Solids Process and Biosolids Management Recommendations.

Our team's dedicated cost estimating personnel improve cost certainty and confidence in implementation costs starting at conceptual planning and design, avoiding cost surprises.

The proposed 5-year plan is anticipated to be a significant investment for the Town. As such, developing cost certainty you can have confidence in is essential.

Our team's approach to cost estimating is specifically designed to replicate the pricing methods used by general contractors such as those expected to submit pricing for this project. This includes the establishment of a dedicated team of full-time estimators who have all gained most of their work experience working for general contractors or specialty subcontractors that focus on the water/wastewater market space. This body of experience allows our team to not only anticipate the proper level of effort based on the complexity of the work, but anticipates a contractor's procurement strategy, both of which are critical to predicting project costs. Our team also understands the importance of early cost certainty and works to not only price what is shown in the preliminary engineering documents, but also what experience tells us will be required to construct the intent of the design.

2.7%
Carollo Cost Estimates Compared to Bid Over the Past 2 Years

$5.3B
Total Value of Cost Estimates Over the Past 2 Years.

Our experienced cost estimators will bring cost certainty to your budgeting process.

This team has implemented the use of industry-standard estimating software and other quantity surveying tools that add quality and consistency to the pricing process. These tools allow us to confidently identify project cost drivers and prioritize budgetary pricing requests from the market. Experience has shown that this approach is superior to relying on published pricing manuals created for the general construction industry.

Preliminary Estimate	Intermediate Estimate	Final Estimate
• Highly Collaborative • Coordinated Assumptions • Capture All Intended Scope Including "Reasonably Anticipated Work • Challenge Design Concepts	• Confirm/Revise Quantities • Updated Pricing for Cost Drivers • Incorporate Site and Schedule Constraints	• Finalize Quantities and Prices • Incorporate Prime Contract Terms • Adjust Contingency based on Bid Risk • Predict Fee Based on Anticipated Bid Participation

Establishing early cost certainty begins on day one and remains priority throughout the process.

Our phased implementation plan will define the path to capacity expansion and discharge permit compliance, while reflecting mountain construction realities and adhering to budget constraints.

Our plan will develop a phased approach that respects funding availability constraints but prioritizes needs and provides the justification to allocate funds through the budgeting process. This project is unique due to the remote location relative to material suppliers and labor availability. The complexity of mountain construction will play an integral role in implementation planning as we consider sequencing, cost, variable influent conditions, and site access for exterior construction throughout the year.

The implementation plan incorporates the following components:

- **Develop a permitting plan** to understand the required timelines for CDPHE permitting and identifying the critical path submittals.
- **Refine preliminary cost estimates and annual expenditures** based on the outcomes and recommendations from the cost estimating process to provide annual budgeting for improvements.
- **Conduct a constructability/project delivery analysis** for the project phases or targeted process construction to determine how best to achieve cost certainty while meeting an accelerated schedule when necessary.
- **Develop a phased implementation plan** that allocates available funding to the most urgent needs first and while maintaining plant operation.

Implementation Plan Workshops and Deliverables

- Workshop 4: Implementation Plan and Cost Estimates.
- Technical Memorandum: Implementation Plan.

Our hands-on equipment procurement experience provides real-world perspective on equipment procurement options, tailored to meet the Town's scheduling and budgetary needs detailed in the Implementation Plan.

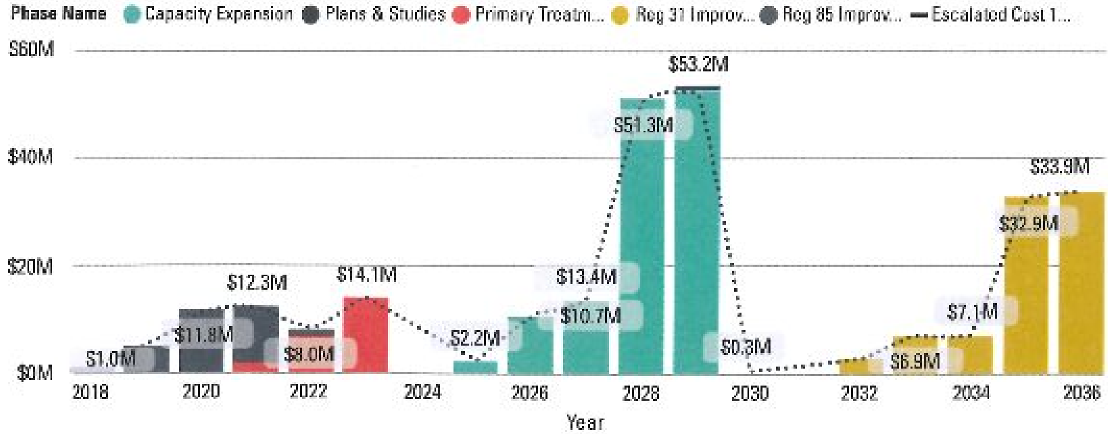
Identification of the appropriate method of equipment acquisition will be dependent on the selection of the project delivery method and the developed implementation strategy and schedule. The Implementation Plan will be used to understand critical path equipment and identify opportunities to reduce project schedule, cost, risk, and improve process performance assurances. Chapter 4, article 6 of your municipal code allows equipment procurement without competition if prescribed by a professional advisor (Sec. 4-6.250.h). This strategy may be recommended depending on the developed schedule. Pre-selection of equipment based on a best value selection process can also be used to streamline design, permitting, and construction while maintaining procurement responsibilities with the project contractor.

As part of a recent project for Glenwood Springs we developed an equipment procurement approach that combined pre-selection and pre-purchase options based on equipment lead times to meet an aggressive delivery schedule in response to the 2020 wildfire impacts to the City's watershed.

Equipment Acquisition Strategy Deliverables

- Technical Memorandum: Equipment Procurement Evaluation and Strategy Recommendation

Costs by Year (set Inflation to 0% to see unescalated costs)

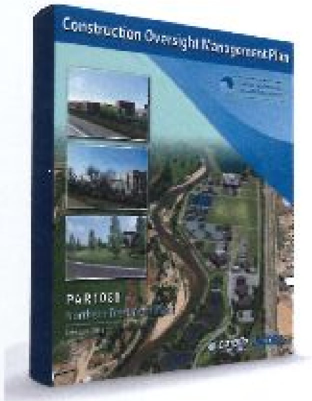


Carollo created a dynamic CIP dashboard using standard Microsoft Power BI for the City of Greeley's four-phase WWTP CIP. The dashboard and associated attributes were customized to the City's capital requirements.

EXECUTION

Developing a vision and a thoughtful implementation plan lays the foundation and "guard rails" to guide a successful TRWWTP expansion project. Maintaining our advisor role through design and construction provides continuity and reduces rework.

Our team is committed to maintaining key decisions made during planning through design, construction, and commissioning. Upfront, clear collaboration, has proven to be a winning formula for delivering fast-tracked projects cost-effectively and on budget.



As part of our Alternative project delivery (APD) services, Carollo has developed construction phase APD oversight procedures that delineate construction and quality auditing roles for the Owner, and Professional Advisor – the procedures have been discussed at DBIA as best practices and lessons learned in APD management.

Key areas where our team has supported Owners during the execution phase include:

- Project management.
  - document management (reporting).
  - workflow and contract management.
- Risk mitigation/project controls.
- Interim design and GMP review.
- GMP contract negotiations.
- Construction management.
- Commissioning.
- Project completion/warranty.

CAROLLO'S TWO-STEP APPROACH TO AN EFFECTIVE PROJECT CONTROLS STRATEGY

1. Identify the project risks.
2. Develop tailored collaboration and management tools to effectively monitor and manage the project.

Carollo's project controls strategy is based on the process of monitoring, controlling, and reporting on scope, budget, schedule, and quality. Effective management in all of these areas is critical to managing overall project risk.

We recommend evaluating the scope of services during design and construction for the professional advisor after selection of the project delivery method and development of the implementation plan to understand the services needed to best meet the project objectives. For completeness of this proposal response, we have included costs for attendance at one monthly design or construction meeting through 2026.

As your Professional Advisor, our focus during the execution phase is to help you efficiently and effectively meet your goals—it's not about taking control of your project, it's about being your trusted advisor and working as an extension of your team. We will ensure we have the committed resources doing the right things at the right time. This means working for you in a collaborative environment and never losing focus until your project is a success.

Project Management and Coordination

Our team's project management approach centers on a collaborative process. Our project lead, Fraser Kent, will provide the hands-on management experience required for a successful professional services advisor. Fraser is a technical expert who will be intimately involved with your staff and will facilitate the daily technical direction of the project to move this effort forward.

Planning the Work

The workflow diagram and schedule presented in this proposal illustrate the phases of work anticipated in 2021. The project schedule on page 28 shows the timeframes for key project elements, workshops, and deliverables anticipated during the first year of professional advisor services.

QA/QC

Our team's core value is delivering quality products to our clients within the budget and schedule required. Our QA/QC program is straightforward. We use industry experts not fully engaged in the project who employ time- tested quality review procedures and checklists for each deliverable throughout the project to ensure we meet our company wide standards and your expectations. We have assigned number individuals as the QC, each with different expertise. These individuals will review deliverables prior to being submitted.

Our QM tools include standard basis of planning checklists, independent process reviews, and cost reviews, which are integrated with our standard checking process from project start to finish.

PROJECT MANAGEMENT PRACTICES

- Systematic up-front planning to convey expectations and provide the framework for executing tasks.
- Conduct monthly progress meetings with select, key team member to solicit staff input, maintain project schedule, and review progress on project tasks.
- Maintain and issue decision and action logs to keep track of changes, resolution of issues, and document the progression of work relative to the contractual scope. Designate responsible personnel with due dates on a timely basis after all meetings, conference calls, and workshops.
- Conduct "solution-focused" workshops as defined in our project schedule - that concentrate the involvement of staff along with all relevant disciplines on key decisions and make efficient use of all of our time.
- Issue monthly progress reports documenting progress relative to schedule, budget, major decisions, and other key information.

Draft Contract Review

Below is a summary of the requested modifications to the Town of Telluride draft contract.

- **Section 7.4:** It is not possible to name additional insureds on Professional Liability insurance policies. To make that clear, we request the following changes:
  - » In the 1st line, insert "or Professional Liability" after "Workers' Compensation."
  - » In the 6th line, delete "[and/or Professional Liability."
- **Section 8:** This indemnification obligation should be in accordance with CRS 13-50.2-102 (Section 8(a). To make this indemnification obligation insurable under a professional liability insurance policy and to bring it into conformance with the noted statute, we request the following:
  - » In the 3rd line, replace: "if" with "to the extent,"
  - » In the 4th line, insert "negligent" before "act, omission,"
  - » In the 5th line, replace "other fault" with "error."
  - » New Section 8.2: Unless attributable to gross negligence, willful misconduct, or bodily harm, Consultant's liability shall not exceed the insurance limits required under this Agreement and neither party shall be liable for consequential, indirect, or special damages.
- **New Sections:** As shown below for inclusion.

22. STANDARD OF CARE

Consultant shall complete the services required hereunder in accordance with the prevailing standard of care by exercising the skill and ability ordinarily required of consultants performing the same or similar services, under the same or similar circumstances, in the State of Colorado.

23. TOWN-PROVIDED INFORMATION AND SERVICES

Town shall furnish Consultant available studies, reports and other data pertinent to Consultant's services; obtain or authorize Consultant to obtain or provide additional reports and data as required; furnish to Consultant services of others required for the performance of Consultant's services hereunder, and Consultant shall be entitled to use and reasonably rely upon all such information and services provided by Town or others in performing Consultant's services hereunder, in accordance with the prevailing standard of care.

24. ESTIMATES AND PROJECTIONS

Consultant has no control over the cost of labor, materials, equipment or services furnished by others, over the incoming wastewater quality and/or quantity, or over the way Town's plant(s) and/or associated processes are operated and/or maintained. Data projections and estimates are based on Consultant's opinion based on experience and judgment. Consultant cannot and does not guarantee that actual costs and/or quantities realized will not vary from the data projections and estimates prepared by Consultant and Consultant will not be liable to and/or indemnify Town and/or any third party related to any inconsistencies between Consultant's data projections and estimates and actual costs and/or quantities realized by Town and/or any third party in the future, except to the extent such inconsistencies are caused by Consultant's negligent performance hereunder.

25. DELAYS

Consultant is not responsible for damage or delay in performance caused by events beyond the reasonable control of Consultant. In the event Consultant's services are suspended, delayed or interrupted for the convenience of Town or delays occur beyond the reasonable control of Consultant, an equitable adjustment in Consultant's time of performance and cost of Consultant's personnel and subcontractors may be made.

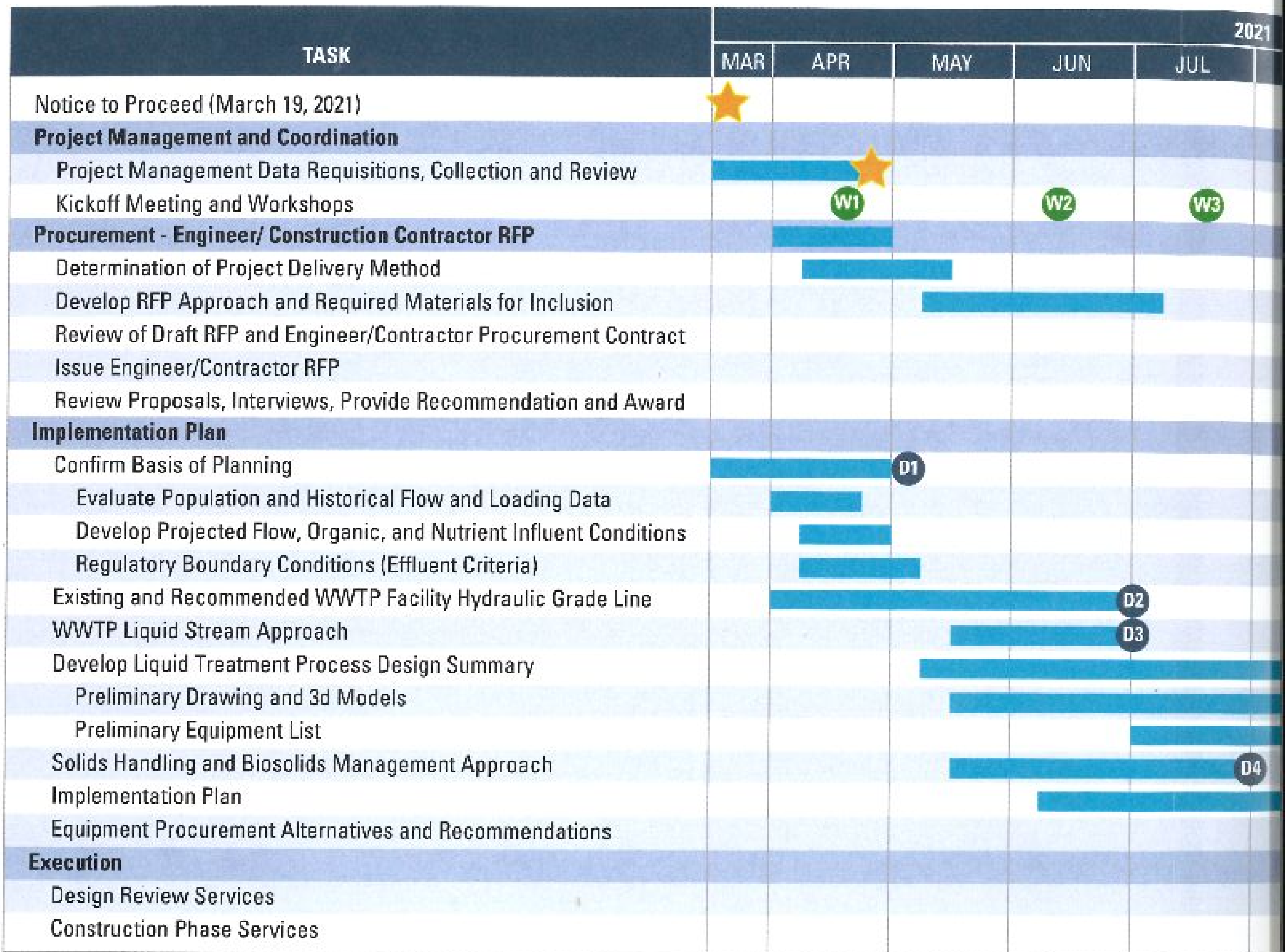
26. WARRANTIES, GUARANTEES, AND DAMAGES

Consultant shall not be responsible for warranties, guarantees, fitness for a particular purpose, breach of fiduciary duty, loss of anticipated profits or for economic, incidental, liquidated, or consequential damages to Town or any third party arising out of breach of contract, delay, termination, or for professional negligence. Additionally, Consultant shall not be responsible for acts and decisions of third parties, including governmental agencies, other than Consultant's subconsultants, that impact project completion and/or success.

27. THIRD PARTIES

The services to be performed by Consultant are intended solely for the benefit of Town. No person or entity not a signatory to the Agreement shall be entitled to rely on Consultant's performance of its services hereunder, and no right to assert a claim against Consultant by assignment of indemnity rights or otherwise shall accrue to a third party as a result of the Agreement or the performance of Consultant's services hereunder.

Schedule



PROPOSED PROJECT SCHEDULE

With a commitment to providing a timely and responsive schedule, we assume a start date of March 19, 2021.

The schedule provided above shows our proposed work for 2021, with an approximate schedule through the 2026 implementation time frame. Our team will work with the Town during project initiation to finalize the schedule, including key deliverables, site visits, and workshops. Work completed in 2021 for the Implementation Plan will further dictate the remainder for the project schedule.

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Vision
Measu
W2 - L
and Hy
W3 - S
Manag
W4 - I

Fee for Project

TOWN OF TELLURIDE
PROFESSIONAL WASTEWATER
LABOR HOURS AND ENGINEERI

	EXPENSES			
	Project Communication and Equipment Expense	Travel, Mileage, Shipping, Misc.	Total Expenses	TOTAL BASE COST
	$13			
Project Management and Coordination	**$2,500**	**$5,600**	**$9,200**	**$47,500**
Project Management, Data Requisitions, Collection	$624		$624	$9,744
Project Coordination and Progress Reporting (9 Mo	$234		$234	$3,654
Monthly Coordination Calls (9 Months)	$416		$416	$6,496
Workshop 1 Kickoff, Project Delivery Approach	$1,274	$6,519	$7,693	$27,633
Plan Engineer/Construction Contractor RFP (Task 1	**$2,000**	**$0**	**$2,000**	**$31,800**
Determination of project delivery method	$338		$338	$5,550
Develop RFP approach and required materials for	$598		$598	$9,314
Review of draft RFP and Engineer/Contractor Proc	$572		$572	$8,760
Review proposals, interviews, provide recommend	$520		$520	$8,120
Implementation Plan (Task 2 - 4)	**$18,700**	**$0**	**$18,700**	**$271,800**
Evaluate Population and Historical Flow and Loadi	$572		$572	$8,044
Develop Projected Flow, Organic, and Nutrient Infl	$234		$234	$3,926
Regulatory Boundary Conditions (Effluent Criteria)	$390		$390	$6,362
D1 (Draft) Basis of Planning	$520		$520	$7,724
D1 (Final) Basis of Planning	$364		$364	$5,068
Develop existing WWTP Hydraulic Model	$1,248		$1,248	$19,592
Evaluate alternative flow configurations (assume 3	$1,144		$1,144	$17,872
D2 (Draft) Hydraulic Modeling Evaluation	$286		$286	$3,926
D2 (Final) Hydraulic Modeling Evaluation	$104		$104	$1,304
WWTP Liquid Stream Approach	$1,144		$1,144	$15,352
D3 (Draft) Liquid Stream Process Recommend	$832		$832	$11,168
D3 (Final) Liquid Stream Process Recommend	$520		$520	$7,184
Workshop 2 - Liquid Stream and Hydraulic Gra	$676		$676	$10,556
Preliminary Process Design	$3,848		$3,848	$50,136
Solids Handling and Biosolids Management Appro	$1,170		$1,170	$17,186
D4 (Draft)) Solids Process and Biosolids Mana	$546		$546	$8,186
D4 (Final) Solids Process and Biosolids Manag	$221		$221	$3,181
Workshop 3 - Solids Process and Biosolids Ma	$780		$780	$12,380
Implementation Plan	$962		$962	$15,534
D5 (Draft)) Implementation Plan	$910		$910	$13,026
D5 (Final) Implementation Plan	$468		$468	$6,396
Workshop 4 - Implementation Plan (virtual)	$1,014		$1,014	$16,078
Equipment Procurement Evaluation and Strategy I	$390		$390	$6,262
D6 (Draft) Equipment Procurement Evaluation	$208		$208	$3,348
D6 (Final) Equipment Procurement Evaluation	$130		$130	$2,030
Execution (Task 5)	**$3,100**	**$0**	**$3,100**	**$48,700**
Monthly Design Progress Meetings (assumed 24 t	$1,248		$1,248	$19,488
Monthly Construction Progress Meetings (anticipa	$1,872	$6,619	$1,872	$29,232
PROJECT TOTALS	**$26,300**	**$9,600**	**$33,000**	**$399,800**

Deliverable	Contracted Date	Revised Date	Reasons for Delay	Comments
TM 1 - Basis of Design	7/29/2021	8/26/2021	* Received final influent flow data required for calculating peak hour and peak instantaneous factors on August 11 from BHEC (originally requested June 30) * Received direction from Town regarding design flow and load on August 5	TM is unlikely to capture the permit modifications that are anticipated from the CDPHE in the regulatory update.
Apply for PELs	8/6/2021	8/19/2021	* Received decision on design flow and loading on August 6	Package will be ready for Town to submit to CDPHE after Town review and input
TM 2 - Hydraulic Modeling Evaluation and Recommendations	8/27/2021	9/2/2021 9/16/2021	* Received final equipment headloss information on 8/6/21 * Providing a week between submitting TM1 and TM2 for Town review for initial draft * Second draft will be submitted with the liquid stream recommendation to incorporate the hydraulic evaluation for the proposed alternative.	This draft will only cover existing hydraulics at the facility for 2.1 mgd and the proposed design capacity of 2.3 mgd. The hydraulic evaluation for the recommendations will be developed with H_2O Innovations during the Liquid Stream Approach TM and submitted to the Town for review.
TM 3 - Liquid Stream Process Recommendations (H_2O Innovations)				
Workshop 2 - Liquid Stream and Hydraulic Modeling	9/22/2021	On Schedule		
TM 4 - Solids Process and Biosolids Management Recommendation	10/5/2021	On Schedule		Pending delivery of solids projections from liquid stream recommendations are provided by September 1.
TM 5 - 5 Year Implementation Plan and CIP	11/19/2021	On Schedule		Pending scheduled delivery and Town review of TM 3 and TM 4 as information developed for these deliverables are inputs for the implementation plan, cost, and sequencing. Understanding of Town's bond spending requirements in 2022 is also required to complete this task. Originally requested on June 18, 2021
Workshop 4 - Implementation Plan Review	12/1/2021	On Schedule		
TM 6 - Equipment Procurement Evaluation and Strategy Recommendation	12/21/2021	On Schedule		Pending scheduled delivery and Town review of TM 3, 4, and 5 as information developed for these deliverables are inputs for the strategy to procure equipment. Understanding of Town's bond spending requirements in 2022 is also required to complete this task. Originally requested on June 18, 2021

1

// Kick-off workshop(s): agenda(s)

PART 1 – JULY 8

1. Welcome and Introductions [10 min.]
   - Introductions
   - Agenda Overview
   - Meeting Objectives
2. Project Information / Background / Expectations [20 min.]
   - Team contacts
   - Communications
   - Scope, Workflow, Schedule

BREAK

3. Regulatory Overview [40 min.]
   - Overview
   - Liquid Stream
   - Solids Stream discussion
4. Flow and Load Projections [50 min]
   - Population projections
   - Influent flow and load Conditions
5. Wrap up and coordination for next week

PART 2 – JULY 13

1. Surveyor Site Meeting [60 min.]
2. Project status, workflow, schedule [10 min.]
3. Basis of Design [20 min.]
   - Information request
   - Influent projections
   - Regulatory overview
4. Project Goals and Objectives [90 min.]
   - Background
   - Group Exercise

LUNCH

5. Facility Walk Through [2 hrs.]

PART 3 – JULY 14

1. Alternative Project Delivery Method Selection [2 hrs.]
   - Summary of Project Goals/Objectives
   - CMAR and Progressive DB
   - Schedule Implications

LUNCH

2. Hydraulic Profile Model Development [60 min.]
   - Review flow path
   - Clarifications
   - Required field verification
3. Field Verification [2 hrs.]
4. Workshop wrap up [60 mins.]
   1. Goals
   2. Selected ADP Method
   3. Schedule
   4. Next Steps and Action Items

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2

2

// Today's meeting objectives

- Kick-off project and review scope, fee, and preliminary schedule
- Review projections and influent conditions
- Discuss regulatory scenarios
- Review of data and data gaps
- Confirm agenda for next week's site visit

3

3

Project Information

4

// Primary project team contact list

Contact Name	Project Role	Phone Number	Email Address
Paul Ruud	Public Works Director	(970) 728-3077	pruud@telluride-co.gov
Karen Guglielmone	Env. and Engineering Manager	(970) 728-0190	kguglielmone@telluride-co.gov
Katie Doody	Water/ Wastewater Manager	(970) 708-4862	kdoody@telluride-co.gov
Joyce Huang	Town Engineer	(970) 728-2169	jhuang@telluride-co.gov
Fraser Kent	H_2O Innovation Project Manager	(289) 813-5533, ext 103	fraser.kent@h2oinnovation.com
Leanne Miller	Carollo Project Manager	(720) 878-8465	lmiller@carollo.com
Andrew Gilmore	Technical Advisor	(602) 474-4214	agilmore@carollo.com

5

// Project communication

- Funneling communications
  - Decisions – through PMs
  - Correspondence – carbon copy PMs
- Data storage and sharing: Project OneDrive
  - Wastewater Data
  - Equipment Shop Drawings
  - Facility Record Drawings
  - Planning Documents
- Weekly coordination calls – Thursdays 1:00pm
- Meeting minutes, action items, decision log

6

6

// Project Objectives and Goals – PSA Implementation Plan

- Select and solicit project delivery method and equipment procurement method(s)
  - Minimize Town risk by selecting appropriate project delivery method, equipment procurement strategies, and development of appropriate contract documents
- Create a hydraulic model for the facility
  - Understand expansion project optimization opportunities
- Develop an Implementation Plan for the TRWWTP Expansion
  - Provide pathway for liquid stream and solids stream improvements
  - Cost effective solutions to achieve capacity and regulatory requirements
  - Re-use existing infrastructure where practical while improving process efficiency, operability, and facility redundancy/ reliability
  - Understand complex mountain construction constraints to create a plan that achieves expansion goals, timeline, and cost within these constraints

// Project workflow

Alternative Project Delivery Procurement

Project scope, workflow, and anticipated schedule is HIGHLY dependent on selected project delivery method and schedule for design team onboarding

› TM 1 › Kick-off Meeting	› TM 2 › Workshop 2	› TM 3 and 4 › Workshop 2 and 3	› TM 5 and TM 6 › Workshop 4

// Interim deliverables and workshops opportunity to provide input and direction

- Define the interim deliverables
- How to review and provide input
- Addressing your comments
- Final versions

DELIVERABLES AND WORKSHOPS

1. Six (6) Tech Memos
2. Four (4) Workshops
3. 2-Day Site Visit

TMs, workshops, and other deliverables are used to create your vision.

9

9

// Interim deliverables and workshops opportunity to provide input and direction

DELIVERABLES

- TM 1: Basis of Design (July)
- TM 2: Hydraulic Modeling Evaluation (Aug.)
- TM 3: Liquid Stream Process Recommendations (Sept.)
- TM 4: Solids Process and Biosolids Management Recommendation (Oct.)
- TM 5: Implementation Plan (Nov.)
- TM 6: Equipment Procurement Evaluation and Recommendation (Dec.)

WORKSHOPS

- WS 1a: Basis of Design (virtual)
- WS 1b: Site Visit and Kickoff Workshop
- WS 2: Liquid Stream and Hydraulic Model (Virtual)
- WS 3: Solids Process and Biosolids Management (Virtual)
- WS 4: Implementation Plan (Virtual)

10

10

// Schedule and Key Milestones

	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN 22	FEB 22
ADP PROCUREMENT DOCUMENTS AND RFP								★	
BASIS OF DESIGN		★							
HYDRAULIC MODELING			★						
RECOMMENDATIONS				★	★				
IMPLEMENTATION PLAN / PRIORITIZE						★	★		

// Project schedule – 3 month look ahead

JULY	AUGUST	SEPTEMBER
› TM 1 Draft : July 29 › WS 1: July 8, 13 - 15	› Apply for PELs: Aug 1* › TM 1 Comments Due: Aug 6 › TM 2 Draft: Aug 27 › TM 2 Comments Due: Sept 3	› TM 3 Draft: Sept 15 › TM 3 Comments Due: Sept 30 › Workshop 2: Sept. 22 (virtual)

Regulatory Drivers and Scenarios

13

// Current effluent permit limitations

Parameter	30-day Average	7-day Average	Daily Maximum	2-Year Average
TSS (mg/L)	30	45		
BOD_5 (mg/L)	30	45		
E. *Coli (#/100 mL geometric mean)*	224	448		
TRC (mg/L)	0.02		0.032	
Total Ammonia (mg/L)	1.8 to 10		20 to 37	2.4 (Sept.)
Total Inorganic Nitrogen (mg/L)			34 17 (eff. 2025)	

** Metals limits that are currently included in the Town's discharge permit will be contested through the permit modification, alternatives analysis, and discharge specific variance processes. These limits will be summarized next week and incorporated into the final basis of design technical memorandum.*

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14

14

// Regulation 85 technology based effluent limits

- Effective implementation date
  - Sept. 30, 2012
- Delayed implementation date
  - Dec. 21, 2027
- Qualifications for delayed implementation
  - Design flow greater than 1 mgd but less than 2 mgd
  - Existing watershed control regulations
  - Discharging into a low-priority 8-unit HUC watershed

Regulation 85 Discharge Limits

Parameter	Annual Median	95th Percentile
TIN (mg/L)	15	20
TP (mg/L)	1.0	2.5

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HUC = Hydrologic unit code

15

15

// Voluntary Incentive Program for Early Nutrient Reductions

CDPHE's Voluntary Incentive Program allows facilities to reduce nitrogen and phosphorus in the effluent below Regulation 85 limits in exchange for an extended Regulation 31 compliance schedule. Incentive credits will be calculated for each calendar year based on the annual median of each pollutant. Incentive credits can be earned for up to a maximum of 10 years if decreasing both nutrients.

Voluntary Incentive Program Effluent Targets

Parameter	Upper End	Lower End
TIN (mg/L)	14.99	7.0
TP (mg/L)	0.99	0.7

ENTER DATA HERE

CREDITS EARNED

	Annual median concentrations		Incentive credits earned		
	TIN	TP	TIN	TP	TIN+TP
	mg/L	mg/L	Month	Month	Month
2018	21.3		0	0	
2019	16.8		0	0	
2020			0	0	
2021			0	0	
2022			0	0	
2023			0	0	
2024			0	0	
2025			0	0	
2026			0	0	
2027			0	0	

Total months	0	0	0
Eligible Months	0	0	0
Eligible Years	0	0	0

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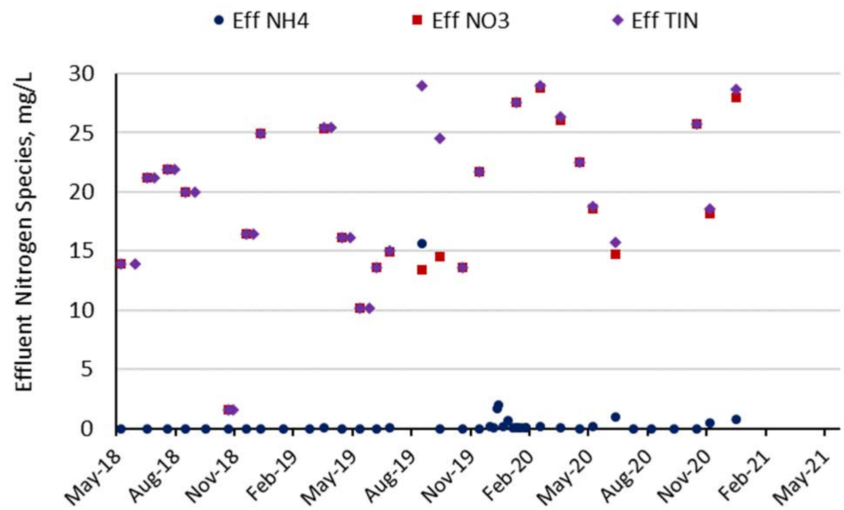
16

16

// Historical effluent TIN concentrations



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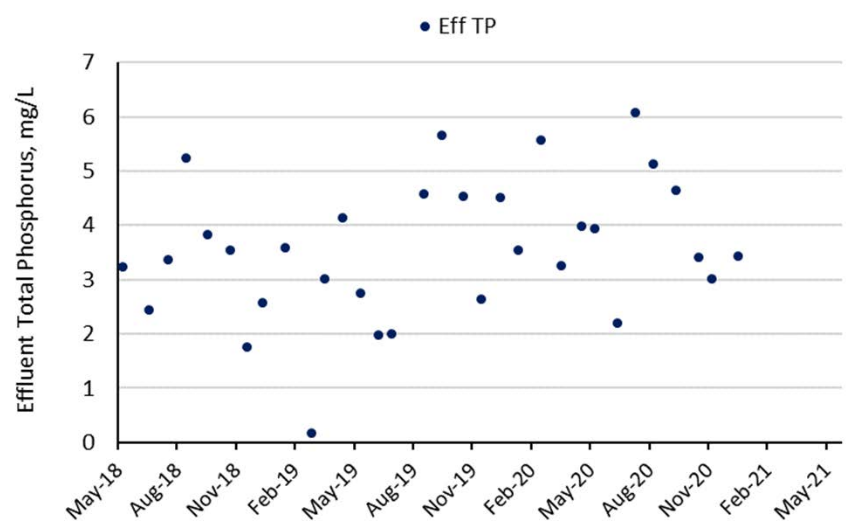
// Historical effluent TP concentrations



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56

// Regulation 31 Water Quality Based Effluent Limits (WQBELs) implemented after 2027

Condition	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
In-stream Requirement (Cold Designation)	1.25	0.11

$$M_2 = \frac{M_3Q_3 - M_1Q_1}{Q_2}$$

- Q1 = Upstream flow
- Q2 = WRRF Design flow
- Q3 = Downstream flow
- M1 = In-stream background concentration
- M2 = Calculated WQBEL
- M3 = Water Quality Standard

- Assumptions
  - 30E3 flow data used in lieu of 1E5 data (conservative)
    - Evaluated with and without bifurcation
  - 85th percentile of in-stream TN and TP data adopted

The limits shown above were the limits included in the 2017 Master Plan

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// Regulation 31 Water Quality Based Effluent Limits (WQBELs) implemented after 2027

Condition	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
In-stream Requirement (Cold Designation)	1.25	0.11

$$M_2 = \frac{M_3Q_3 - M_1Q_1}{Q_2}$$

- Q1 = 2.5 cfs / 9.7 cfs
- Q2 = 3.2 cfs
- Q3 = 5.7 cfs / 12.9 cfs
- M1 = 0.35 mg/L (TN) / 0.00 mg/L (TP)
- M2 = Calculated WQBEL
- M3 = 1.25 mg/L (TN) / 0.11 mg/L (TP)

- Assumptions
  - 30E3 flow data used in lieu of 1E5 data (conservative)
    - Evaluated with and without bifurcation
  - 85th percentile of in-stream TN and TP data adopted

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20

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// Regulation 31 Water Quality Based Effluent Limits (WQBELs) implemented after 2027

Condition (Current Design Capacity 2.1 mgd)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
In-stream Requirement (Cold Designation)	1.25	0.11
Estimated Discharge Limit (with bifurcation)	>1.94	>0.19
Estimated Discharge Limit (without bifurcation)	>3.93	>0.44

- Q1 = 2.5 cfs / 9.7 cfs
- Q2 = 3.2 cfs
- Q3 = 5.7 cfs / 12.9 cfs
- M1 = 0.35 mg/L (TN) / 0.00 mg/L (TP)
- M2 = Calculated WQBEL
- M3 = 1.25 mg/L (TN) / 0.11 mg/L (TP)

- Assumptions
  - 30E3 flow data used in lieu of 1E5 data (conservative)
    - Evaluated with and without bifurcation
  - 85th percentile of in-stream TN and TP data adopted

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21

// Regulation 31 Water Quality Based Effluent Limits (WQBELs) implemented after 2027

Condition	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
In-stream Requirement (2017 MP design condition)	1.25	0.11
Estimated Discharge Limit (without bifurcation, 2.1 mgd)	> 3.93	> 0.44
Estimated Discharge Limit (without bifurcation, 2.5 mgd)	> 3.50	> 0.39

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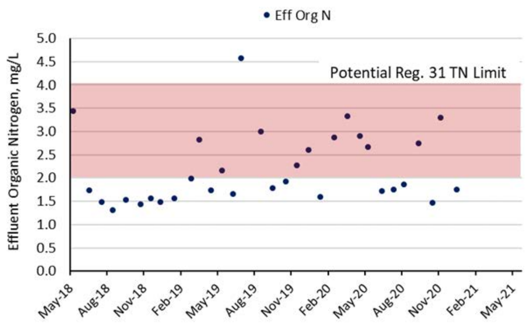
22

22

// Regulation 31 Water Quality Based Effluent Limits (WQBELs) implemented after 2027

Condition at current rated capacity	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
In-stream Requirement (Cold Designation)	1.25	0.11
Estimated Discharge Limit (with bifurcation)	>1.94	>0.19
Estimated Discharge Limit (without bifurcation)	>3.93	>0.44



- Assumptions
  - 30E3 flow data used in lieu of 1E5 data (conservative)
    - Evaluated with and without bifurcation
  - 85th percentile of in-stream TN and TP data adopted

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23

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// Summary of potential future effluent nutrient regulations

Parameter	30-Day Average	Daily Maximum	Regulation 85 (~2030)	Regulation 31 (~2035+)
Ammonia (mg/L)	1.8 - 10	20 to 37		
TIN (mg/L)		34 17 (eff. 2025)	15 / 20	
TN (mg/L)				~ 3.5
TP (mg/L)			1 / 2.5	~ 0.39

CDPHE WQCD could immediately jump to Regulation 31 implementation in 2027 (plus time for negotiated compliance schedule)

2020 > 2021 > 2022 > 2023 > 2024 > 2025 > 2026 > 2027 > 2028 > 2029 > 2030 > 2031 > 2032 > 2033 > 2034 > 2035

- 2020: Current Permit
- 2025: - New Permit - Reg 85 Comp. Schedule
- 2030: - New Permit - Reg 85 Limits - Reg 31 Comp. Schedule
- 2035: New Permit Reg 31 Limits

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24

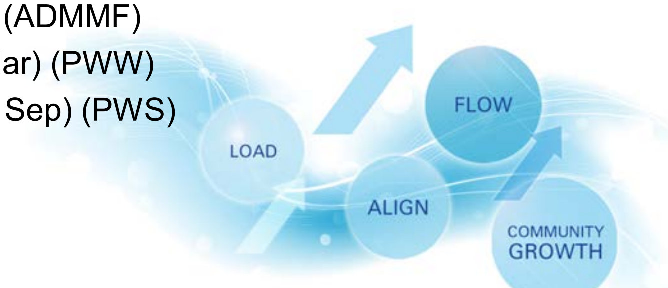
24

Flow and Load Projections

25

// Flow and load projections – introduction

- Per capita flow and loading developed to project future influent WWTP conditions
- Population projections adopted from 2017 Master Plan
- Projections developed for
  - Average day annual (ADAF)
  - Average day maximum month (ADMMF)
  - Peak Week Winter (Oct thru Mar) (PWW)
  - Peak Week Summer (Apr thru Sep) (PWS)
  - Peak Day (PDF)
  - Peak Hour (PHF)



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26

26

// Flow and load projections – definitions

Condition	Projected Parameters	Purpose
ADAF	Flow and loads	Demonstrating treatment capacity with units out of service now and in the future.
ADMMF	Flow and loads	CDPHE permitting and design treatment capacity.
PWW	Flow and loads	Demonstrating peak seasonal treatment capacity now and in the future.
PWS	Flow and loads	
PDF	Flow	Demonstrating hydraulic treatment and equalization capacity now and in the future.
PHF	Flow	CDPHE for permitted hydraulic treatment capacity purposes – selected processes.

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27

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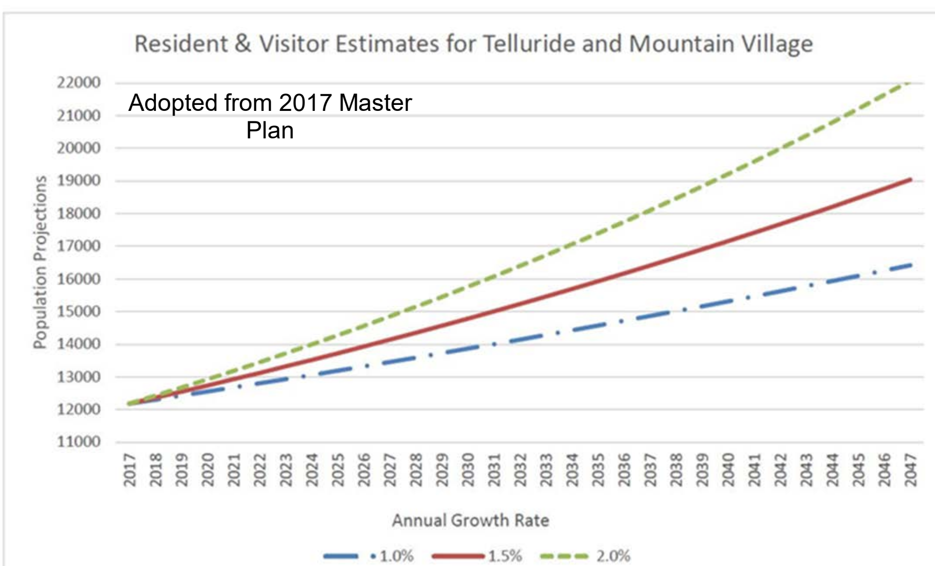
// Population projection for service area



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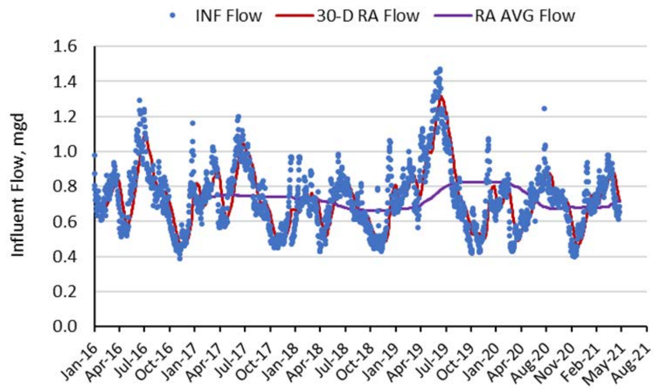
// Historical influent flow data



Flow Condition	2017 Value (mgd)	2021 Value (mgd)	Peaking Factor
ADAF	0.70	0.83	-
ADMMF	1.04	1.32	1.59
PW – Winter	NA	1.01	1.22
PW – Summer	NA	1.41	1.71
Peak Day	1.39	1.47	1.78
Peak Hour	2.8*	2.00	2.41

Current permitted hydraulic capacity = 2.1 mgd

** 2017 Peak Hour was an estimated value based on 2x peak day*

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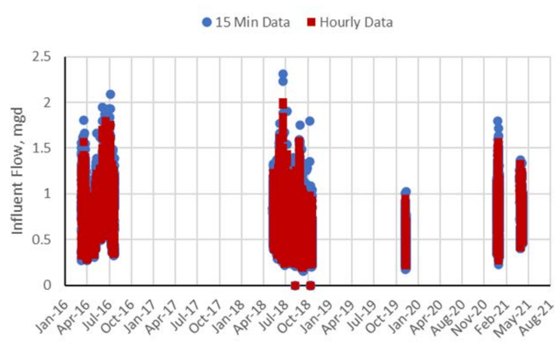
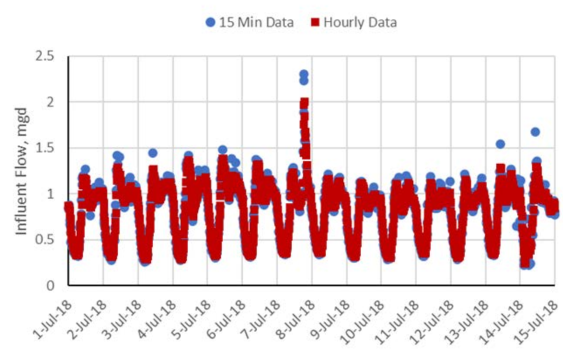
// Historical influent flow data – Peak hour





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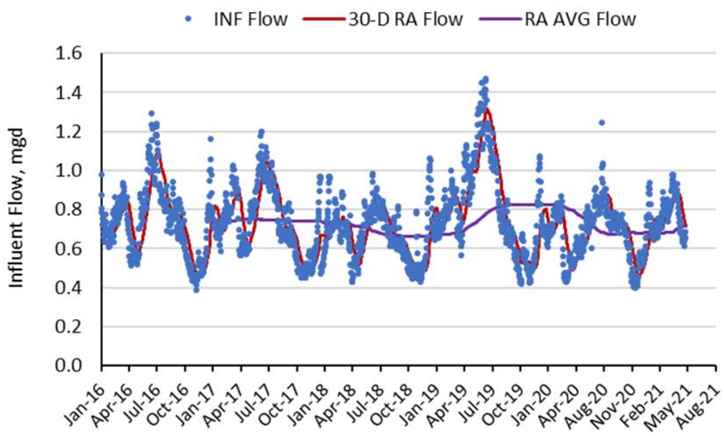
30

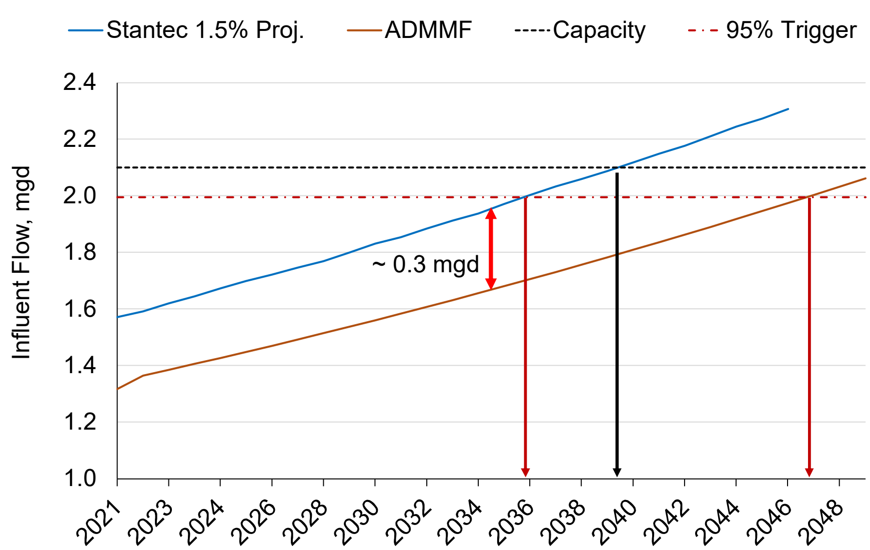
// Historical influent flow data



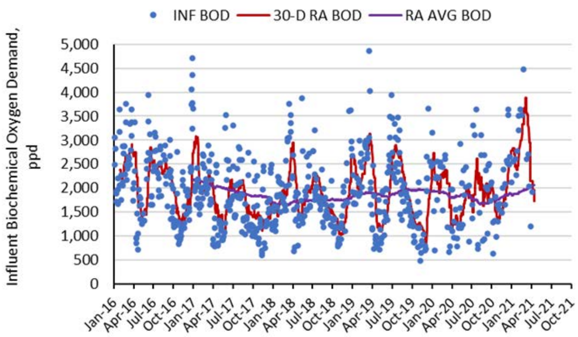
Flow Condition	Value (mgd)	Per Capita (gpd/cap)
ADAF	0.83	66
ADMMF	1.32	104
PW – Winter	1.01	80
PW – Summer	1.41	112
Peak Day	1.47	116
Peak Hour	--	--

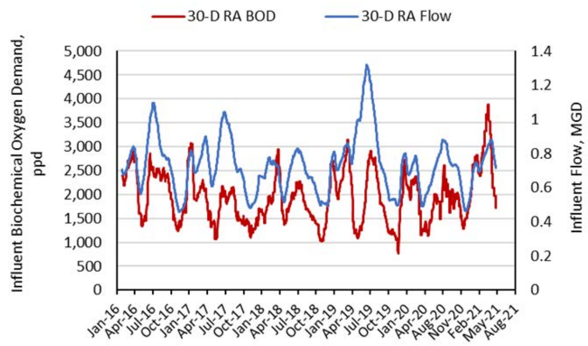
*Assumes 2021 population of 12,693

// Influent flow projections



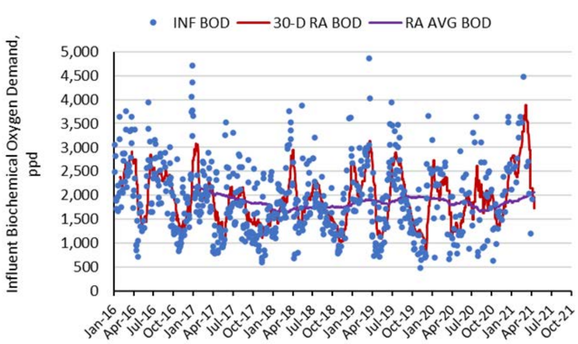
// Historical influent BOD_5 data

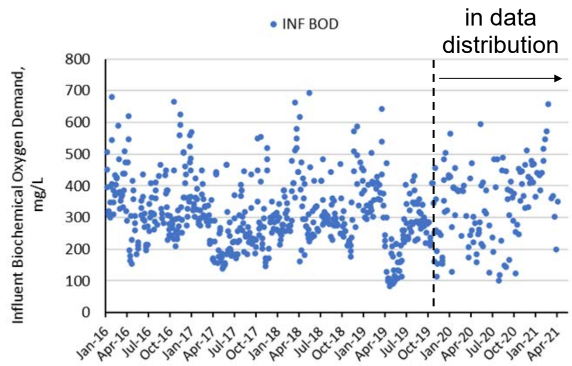




*Not uncommon for Town events to coincide with and even mask I/I events

// Historical influent BOD_5 data





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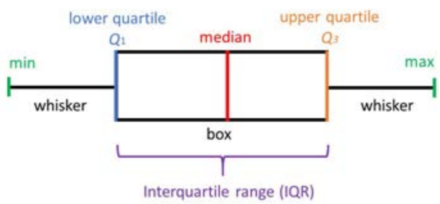
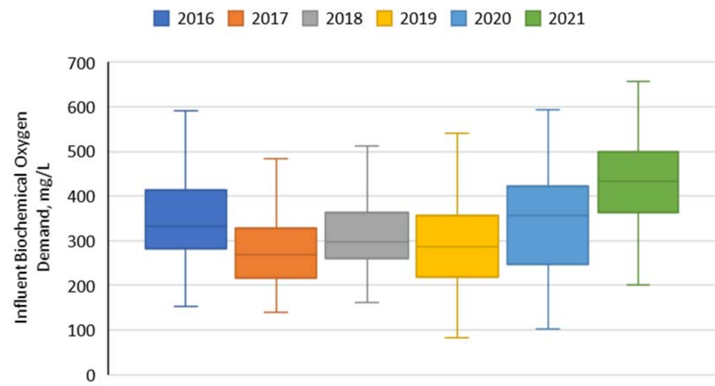


Reading a Box Plot



- Greater data variability since Nov. 2019
  - Median value has increased
  - IQR has increased
  - Min-Max range has increased

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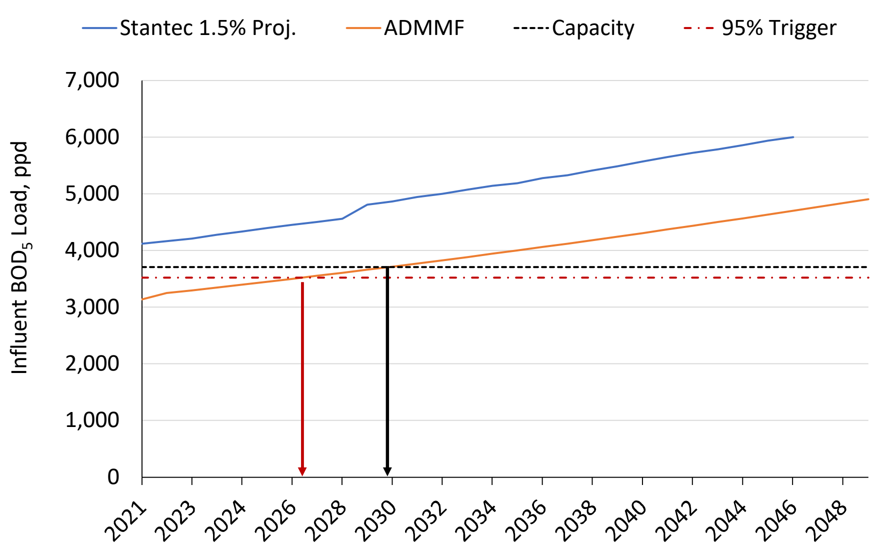
// Influent BOD_5 projections (excluding 2021 data)



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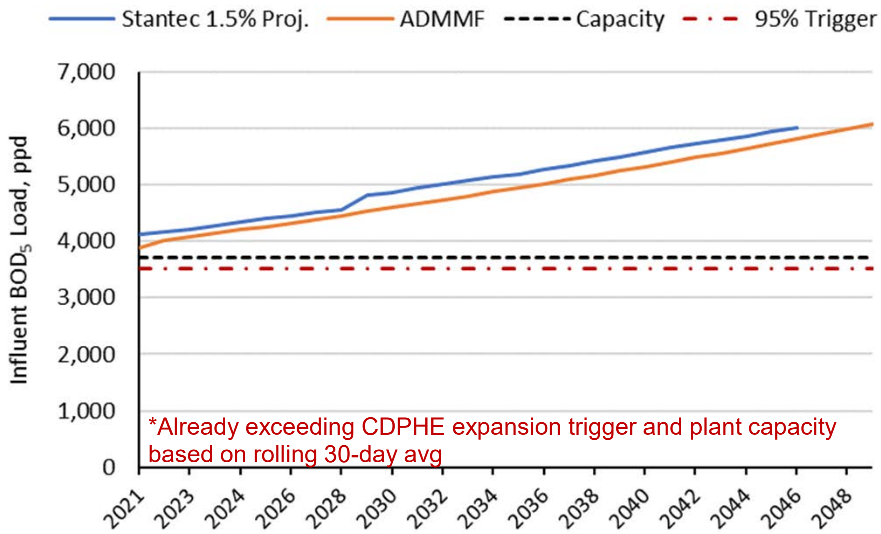
// Influent BOD_5 projections (including 2021 data)



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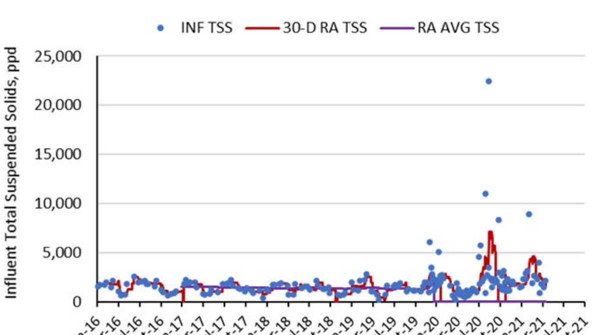
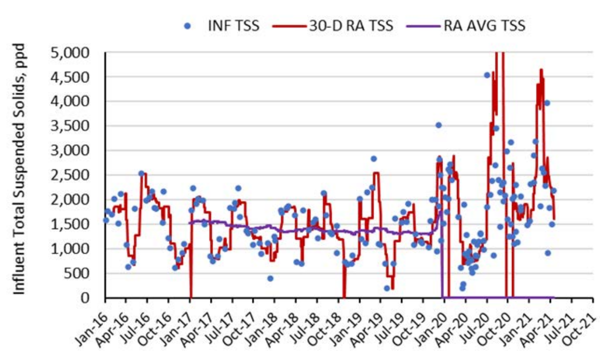
37

// Historical influent TSS data





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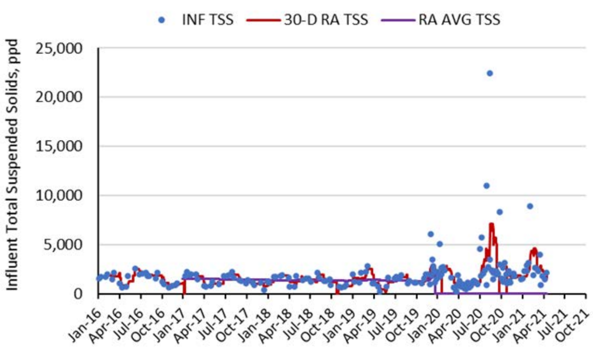
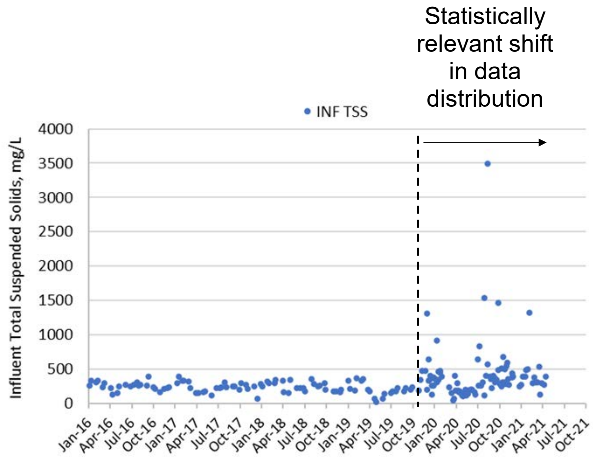
66

// Historical influent TSS data





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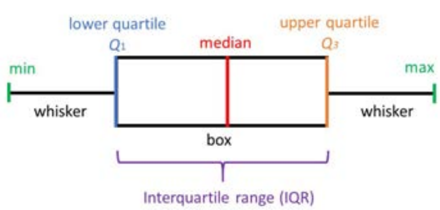
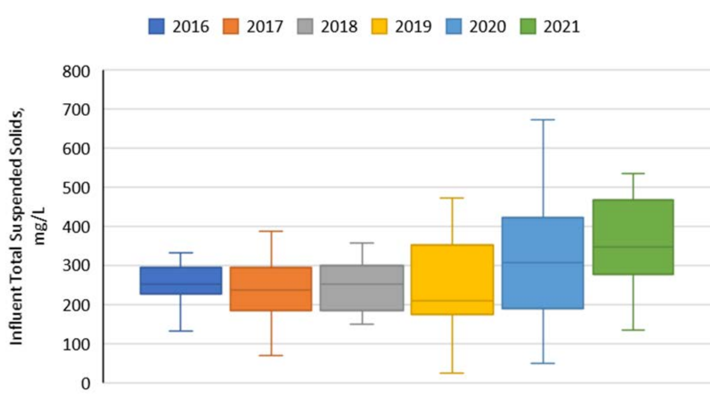
// Historical influent TSS data



Reading a Box Plot



- Greater data variability since Nov. 2019
  - Median value has increased
  - IQR has increased
  - Min-Max range has increased

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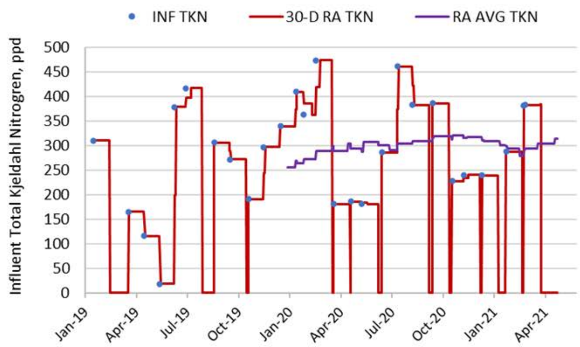
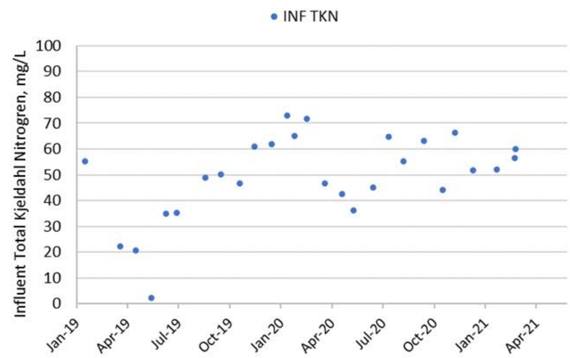
// Historical influent TKN data





**Influent nutrient data sampled only 1x per month

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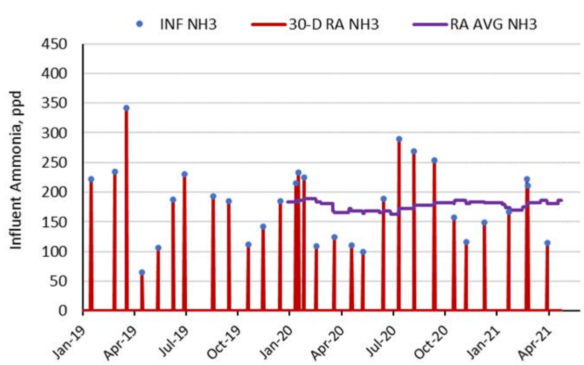
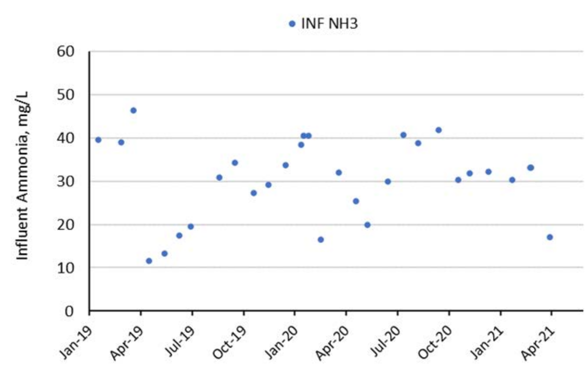
41

// Historical influent NH_4 data





**Influent nutrient data sampled only 1x per month

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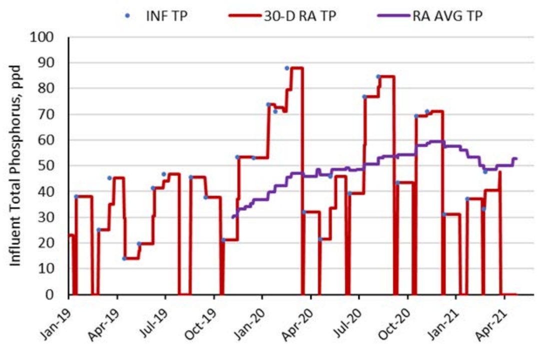
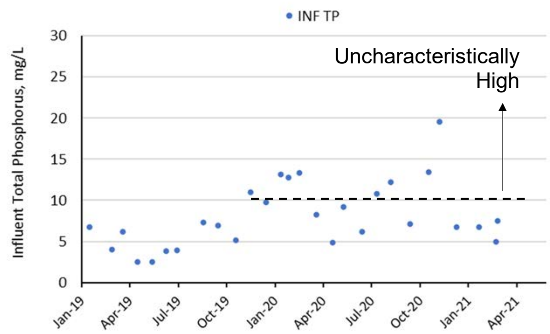
42

42

// Historical influent TP data





**Influent nutrient data sampled only 1x per month

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// Discussion – Data for inclusion in the flow and load projections

Exclude 2021 as incomplete year…

Use data as is…

Exclude years with Covid…

Use data pre-2019…

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Next Steps

45

// Recap Today's Meeting Objectives

- ✓ Confirm agenda for next week's site visit
- ✓ Kick-off project and review scope, fee, and preliminary schedule
- ✓ Discuss regulatory scenarios
- ✓ Review projections and influent conditions
- ✓ Review of data and data gaps

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// Next steps / 30 day look ahead

- Town to complete information request
- Finalize site visit agenda and confirm meeting locations
- Select project delivery method
  - Revise project schedule
- Basis of design and PEL application
- Hydraulic modeling
- Site Survey
- Draft TM 1 to Town July 29

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Town of Telluride

Telluride Regional Wastewater Treatment Plant Expansion

TM 1 – BASIS OF DESIGN

DRAFT | August 2021

h2o innovation in association with carollo

Telluride Regional Wastewater Treatment Plant Expansion

Technical Memorandum 1
BASIS OF DESIGN

DRAFT | August 2021

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Abbreviations

2017 Master Plan	Telluride Regional Wastewater Treatment Plant Master Plan
ADAF	average daily annual flow
ADMM	average daily maximum month
ADMMF	average daily maximum month flow
BOD_5	5-day biochemical oxygen demand
°C	degrees Celsius
Carollo	Carollo Engineers
CDPHE	Colorado Department of Public Health and Environment
cfs	cubic feet per second
CFU/gram	colony forming units per gram
EPA	Environmental Protection Agency
F	Fahrenheit
FOG	fats, oil, and grease
gpd	gallons per day
HA	health advisory
I/I	inflow and infiltration
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mgd	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^2	milligrams per square meter
mL	milliliter
MPN/g	most probable number per gram
ng/L	nanograms per liter
NH_4	ammonia
nm	nanometer
NORM	Naturally Occurring Radioactive Materials
PDF	peak day flow
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanyl sulfonate
PEL	preliminary effluent limits
ppb	parts per billion
ppd	pounds per day

ppt	parts per trillion
PSRP	Processes to Significantly Reduce Pathogens
Regulation 64	Biosolids Regulation No. 64 (5 CCR 1002 64)
SSE	site specific equation
SU	Standard Unit
TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
TIN	total inorganic nitrogen
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily loads
TN	total nitrogen
TOrC	trace organic contaminant
Town	Town of Telluride
TP	total phosphorus
TRWWTP	Telluride Regional Wastewater Treatment Plant
TSS	total suspended solids
TVS	total volatile solids
VAR	vector attraction reduction
WQBEL	water quality based effluent limits
WQCD	Water Quality Control Division
WWTP	wastewater treatment plant

Technical Memorandum 1

BASIS OF DESIGN

1.1 Introduction

The Town of Telluride (Town) manages, operates, and maintains the Telluride Regional Wastewater Treatment Plant (TRWWTP) for the benefit of the current and future users of sewer service, which includes the Town, Mountain Village, and Aldasoro, Lawson Hill, and unincorporated San Miguel County. Mountain Village participates jointly with the Town to provide financial support for operation and maintenance of the facility. The current TRWWTP was commissioned in 1988 and has complied with its statutory and regulatory requirements along with meeting obligations as outlined in the agreement between the Town and Mountain Village.

Figure 1.1 Vicinity Map and Aerial of TRWWTP

The Town is committed to safeguarding the community's most vital resource, clean water. A team of dedicated water professionals manage, operate, and maintain the wastewater treatment systems in a fiscally responsible manner that ensures the protection of public health and the environment. The TRWWTP provides reliable and efficient wastewater collection, conveyance, and treatment service to approximately 12,000 people in surrounding service area.

The TRWWTP:

1. Provides treatment services for the surrounding service area and receives septic waste from users not connected to the collection system in the surrounding area.
2. Treats wastewater flows at the 2.1-million-gallon-per-day (mgd) facility, which is located at 12000 Colorado 145 (location shown in Figure 1.1). Effluent from the TRWWTP is discharged to the San Miguel River.

1.2 Project Objectives and Goals

As part of the Town's 2017 Master Planning effort, expansion projects for the TRWWTP were recommended to address increasing organic and hydraulic loading to the existing TRWWTP. The purpose this memorandum and the additional memoranda supporting this document is to develop a strategic implementation roadmap for achieving operational resiliency and reliability to meet the wastewater needs of users within the service area through the 2050 planning horizon in a strategic and financially responsible manner.

The primary goal of this effort is to develop influent and effluent design criteria based on existing facility data. As part of this project, the Town identified seven objectives to guide the development of the implementation pathway and the ultimate TRWWTP expansion project. The main objective of the implementation plan is to recommend sequential improvements using a holistic approach that:

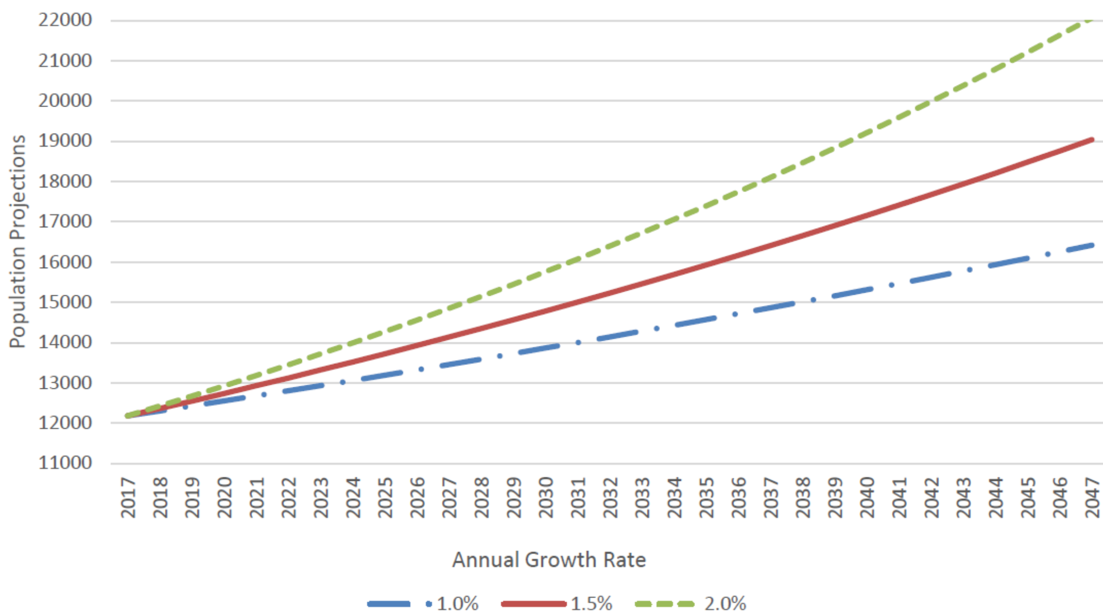
- Revitalizes **aging infrastructure** to support long term operation of the new facility.
- Protects the health and safety of the community and Town employees.
- Generates solutions that are forward thinking to provide options to address **future regulatory** challenges.
- Streamline unit **process efficiency** to reduce variability and minimize staff attention by leveraging operational and energy efficiencies
- Enhances facility **automation and control** by increasing connectivity and functionality for process control, data management, and decision making by implementing the latest technology standards.
- Develop **project communication** guidelines between the Town, engineer, and contractor team to enhance project success and efficient delivery of the final TRWWTP expansion project.
- Solutions are protective of and provides benefit to all environmental media (water, air, land) by considering opportunities for enhanced **sustainability** practices through resource recovery opportunities, renewable energy, and energy efficient processes.

1.3 Population Estimates

Population projections for this basis of design were adopted from the *Telluride Regional Wastewater Treatment Plant Master Plan* (2017 Master Plan) (Stantec, 2017). The projections were developed from 2017 through a 30-year planning horizon of 2047 and assumed a constant annual growth rate from both residents and short-term visitors to the Town. Key findings and assumptions from those population projections included:

- The year-round resident population of the service area is relatively small and has grown at a rate of between 1 and 2 percent, annually.
- The available accommodations are likely to be developed at a rate that is consistent with residential population growth.
- Projections for both the Town and Mountain Village assumed a 1.5 percent annual growth rate for residents and visitors for the next 30 years.

Figure 1.2 shows the totalized resident and visitor populations during the peak seasons at three annual growth rates over 30 years; 1 percent, 1.5 percent, and 2 percent. For continuity of planning and at the direction of Town staff, this basis of design adopted these projections assuming a 1.5 percent annual growth to estimate future flows and loads. Town staff approved the use of the 1.5 percent growth data, as it is consistent with observed growth in the service area since the 2017 Master Plan was published.



Adapted from the 2017 Master Plan

Figure 1.2 Resident and Visitor Population Projections for TRWWTP Service Area

1.3.1 Future Impacts of Commercial and Industrial Dischargers

The 2017 Master Plan identified three additional sources of wastewater that impact flows and loads into the TRWWTP, which will remain primary contributors into the future.

1.3.1.1 Septage

Septage will continue to be collected at the TRWWTP into the future. At this time, septage haulers discharge flows into a manhole outside of the facility headworks; no storage is provided to attenuate flows. The 2017 Master Plan recommended installation of a dedicated receiving station consisting of an equalization tank and odor control treatment system, giving operations staff the ability to control how and when septage is discharged into the plant headworks.

Based on several assumptions regarding the number of county septic systems, the gallons pumped from each system, and the pumping frequency, the 2017 Master Plan used an annual growth rate of 3 percent for septage flows into the TRWWTP. In 2047, the estimated septage flows were 1,700 gallons per day (gpd) (average daily flow), 5,600 gpd (maximum month flow), 11,200 gpd (maximum week flow), and 56,000 gpd (peak day flow [PDF]). The projected maximum month flow represents approximately 0.3 percent of the current rated hydraulic capacity of the facility. The estimated 5-day biochemical oxygen demand (BOD_5) loads in the 2047 were 99 pounds per day (ppd) (average daily), 330 ppd (maximum month), 660 ppd (maximum week), and 817 ppd (peak day). The projected maximum month BOD_5 load represents approximately 8.9 percent of the current rated organic capacity of the facility.

Given the comparatively low flow and load contribution to the TRWWTP on a maximum month basis (as a percentage of the total flow and load), and the fact that the 2017 Master Plan septage projections were based largely on textbook values and not actual sampling data, this basis of design assumed that septage flows will increase at a rate proportional to the resident and visitor population into the future. Septage flows and loads were not allocated separately as compared to other contributing sources and were instead assumed to be represented in the combined historical influent wastewater data provided by the Town.

During the design phase for the TRWWTP expansion project, septage flow data collected since the completion of the 2017 Master Plan should be used to design and appropriately size the recommended septage receiving station. For purposes of the implementation plan and conceptual cost estimates in subsequent phases, the projections from the 2017 Master Plan will be used for sizing purposes.

1.3.1.2 Commercial Businesses

The following subsections discuss the significant commercial dischargers identified as contributing flows to the TRWWTP in the 2017 Master Plan. Town staff have indicated that there has been no change to the commercial dischargers since the 2017 Master Plan was published.

Restaurants and Bars

The 2017 Master Plan assumed that the estimates of resident and visitor population account for the flow and loading from this source; this assumption will remain consistent for this basis of design. An exception is the discharge of fats, oil, and grease (FOG) from restaurants. By Town ordinance, restaurants are required to install and maintain grease traps on their service lines. Currently, haulers of FOG transport this material as far as Grand Junction for disposal. Long-term, the Town is interested in considering opportunities to receive this waste at the TRWWTP.

Hotels and Laundromats

The 2017 Master Plan assumed that waste associated with hotels and laundromats are also captured in the per capita flow and loading associated with the resident and visitor population estimates. For continuity of planning, this basis of design has adopted the same assumption.

Boiler Systems

Another source of high strength waste that is commonly discharged to the collection system comes from boilers used to heat buildings and infrastructure. The 2017 Master Plan noted that the spent glycol-based boiler water is either discharged into the collection system or transported by septage haulers to the TRWWTP during maintenance activities. Because the discharges are associated with maintenance activities that are unpredictable in nature, no flow or load projections were established in the 2017 Master Plan for this waste stream. It was instead recommended that the Town develop a utility ordinance and public education program to control the discharge of boiler waste streams in the collection system.

Given the comparatively low flow and load contribution to the TRWWTP, and the lack of available data, this basis of design assumed that boiler discharge flows will increase at a rate proportional to the resident and visitor population.

Brewery and Distillery

The Town is home to one brewery and one distillery. Currently, the waste streams from both businesses discharge to the TRWWTP under an industrial discharge permit with required monitoring, sampling, and reporting. Based on discussions with the business owners regarding speculative future growth, the 2017 Master Plan developed projections through the 30-year planning horizon for consideration against the current rated capacity of the treatment facility. In

2047, the estimated brewery/distillery waste flows were 12,700 gpd (average daily flow), 19,100 gpd (maximum month flow), 22,230 gpd (maximum week flow), and 25,500 gpd (PDF). The projected maximum month flow represents approximately 0.9 percent of the current rated hydraulic capacity of the facility. The estimated BOD_5 loads in 2047 were 573 ppd (average daily), 846 ppd (maximum month), 1,025 ppd (maximum week), and 1,170 ppd (peak day). The projected maximum month BOD_5 load represents approximately 23 percent of the current rated organic capacity of the facility. Note that these projections from the 2017 Master Plan assumed that a 400 percent brewery expansion would occur at a new location in 2020, and that a second brewery would open in 2030. Town staff confirmed that the brewery expansion has not occurred as intended and that the planned expansion location is no longer an option for the brewery.

This space to be updated with information from the Town regarding the future expansion plans from the brewery.

1.3.1.3 Institutions

Schools are currently the only large institutions in the TRWWTP collection system. The 2017 Master Plan assumed that the resident and visitor population estimates cover the flow and loading from these sources. For continuity of planning, this basis of design has adopted the same assumption.

1.3.1.4 Society Turn Development – Medical Facility

Although not included in the 2017 Master Plan, future development adjacent to the TRWWTP is anticipated to occur within the expansion project planning horizon. Documentation provided by the development engineer in a memorandum dated May 31, 2019, indicated that all water use for the development is anticipated to be conveyed to the TRWWTP as irrigation will be provided through a separate raw water irrigation source. Uses anticipated as part of this development include retail, food and beverage, office space, industrial, medical center, employee housing (multi-family), and a proposed hotel. Projected wastewater flow from the final development is anticipate to equal 376 gpd (average daily flow).

Although this analysis developed anticipated hydraulic loading from the proposed development, organic loading and other constituents of concern anticipated to be conveyed to the TRWTTP (metals in particular) were not identified. During the design phase for the expansion project, special consideration of the medical center waste and possible recommendations for industrial pre-treatment should be further considered to protect the TRWWTP. For the purposes of the basis of design, an assumption was made that projected flow and loading from resident and visitor populations will cover the addition loading associated with this development.

1.4 Influent Flow Projections

In support of the TRWWTP expansion project, the Town provided 5 years (2016 to 2021) of historical average day flow data. These data were used to quantify the recent base and peak flow events, which were then projected through 2050 based on the available population projections as discussed in Section 1.2. For the basis of design, future projections were developed for the scenarios shown in Table 1.1.

Table 1.1 Summary of Projected Flow and Load Conditions

Condition	Projected Condition	Master Planning Purpose
Average Daily Annual Flow (ADAF)	Flow and Loads	Relevant for demonstrating treatment capacity with units out of service now and in the future.
Average Daily Maximum Month Flow (ADMMF)	Flow and Loads	Relevant for Colorado Department of Public Health and Environment (CDPHE) permitting and design treatment capacity purposes.
Peak Week – Winter	Flow and Loads	Relevant for demonstrating peak seasonal treatment capacity now and in the future
Peak Week – Summer	Flow and Loads	
PDF	Flow	Relevant for demonstrating hydraulic treatment and equalization capacity now and in the future.
Peak Hour Flow (PHF)	Flow	Relevant for CDPHE for permitted hydraulic treatment capacity purposes.
Peak 15-Minute Flow	Flow	Relevant for demonstrating hydraulic treatment and equalization capacity now and in the future

The TRWWTP influent wastewater is a combination of flows from the Telluride interceptor, Lawson interceptor, Mountain Village interceptor, and the Aldasoro interceptor. Nonresidential sources of wastewater entering the plant were discussed in Section 1.2.2 and include commercial businesses (e.g., restaurants/bars, breweries, distilleries, hotels), septage (hauled from residential septic tanks, recreational vehicles, and from portable toilets set up during festivals), boiler water drain waste, and institutions (e.g., schools). The Town continues to develop its Industrial Pretreatment Program with monitoring requirements for nutrients, BOD_5, and various metals. Flow and organic loading from the industrial dischargers are routinely monitored by the Town but are not restricted.

A reasonable expectation, based on discussions with operations and Town staff, is that commercial and industrial customers in the service area will continue to grow at a rate proportional to the anticipated residential growth. Therefore, flow and load projections that were calculated in this basis of design on a per capita basis comprise all existing flow sources including domestic, short-term visitors, commercial, institutional, and septage wastewater. By multiplying the expected future population by combined per capita flows and loads, future commercial and industrial flows and loads are inherently reflected in flow and load projections for the treatment plant.

Results derived from the flow and load analyses, along with supporting documentation from previous studies and population projections, are summarized below.

1.4.1 Current Flow

Historical influent flows the TRWWTP are plotted from 2016 through April of 2021 in Figure 1.3. Each of the influent flow scenarios defined in Table 1.2, excluding PDF, PHF, and peak 15-minute flow were determined from this data set. Note that the 7-day running average influent flows are not shown and can instead be viewed in Figure 1A.1 of Appendix 1A. All critical flow values used to calculate hydraulic peaking factors in this basis of design and for use in the flow projections occurred in 2019. This was a particularly wet and busy year for the Town and many other mountain communities, with above average snowfall, runoff, and a significant increase in regional tourism.

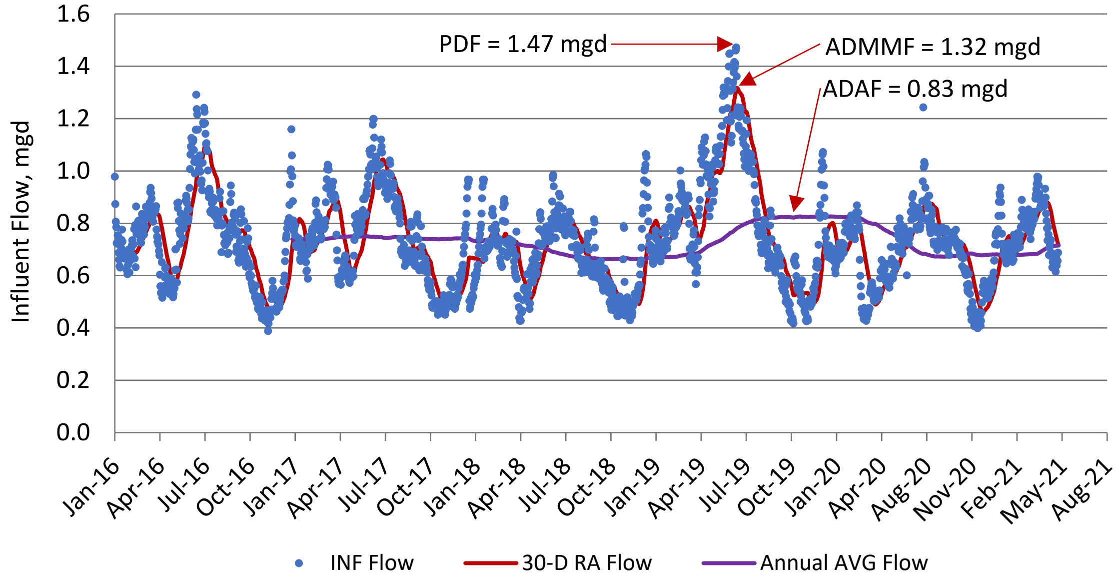


Figure 1.3 Average Day and 30-day Running Average Flows Since 2016

A water balance approach for estimating future ADMMF and PDF was attempted during this analysis. The water balance approach is based on the premise that the ADMMF and PDF events are comprised of a "dry weather" and a "wet weather" flow component. The wet weather flow contribution is calculated as the difference between the peak 30-day running average or PDF (typically inflow and infiltration [I/I] influenced) and the base dry weather flow. The project team can then choose to hold the wet weather flow contribution constant through the planning horizon and add the flow component to the projected increase in dry weather flow due to population growth. Or the project team can assume that the wet weather flow contribution will increase proportionally to the base dry weather flow through the planning horizon, which is a more conservative approach.

Given the increase in year-round tourism of the area and the large number of tourism events and festivals that occur in the Town during peak I/I season (typically June for mountain communities similar to Telluride), it was not possible to distinguish (with an acceptable level of certainty) between peak runoff and I/I flows and the increase in influent to the TRWWTP due to heavy tourism volume associated with events in late May and June. Therefore, the project team adopted the more conservative approach to project the future hydraulic flow conditions and assumed that wet weather flows will increase proportionally with population.

The historical PHF and peak 15-minute events were determined using the combined 15-minute flow data from the Telluride interceptor and Mountain Village Interceptor (upstream of influent pumping) (Figure 1.4). The combined flow from these two interceptors represents most all of the influent flow to the TRWWTP, as shown in Figure 1.4, when overlayed with the daily average pumped influent data. Generally, it is preferred to evaluate at least 5 years of diurnal influent flow data for estimating peak flows to ensure that the high variance exhibited by hydrologic factors that drive peak flow are captured. However, only 15-minute data from January 2019 through August 2021 was provided to the project team for this analysis.

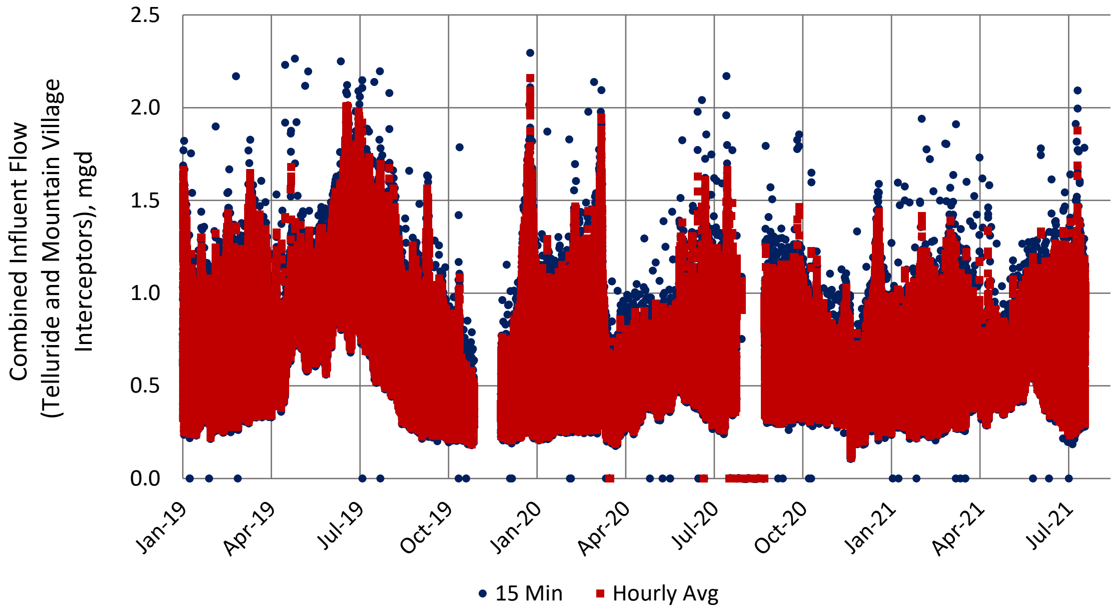


Figure 1.4 Combined Influent Flow Data from Telluride and Mountain Village Interceptors

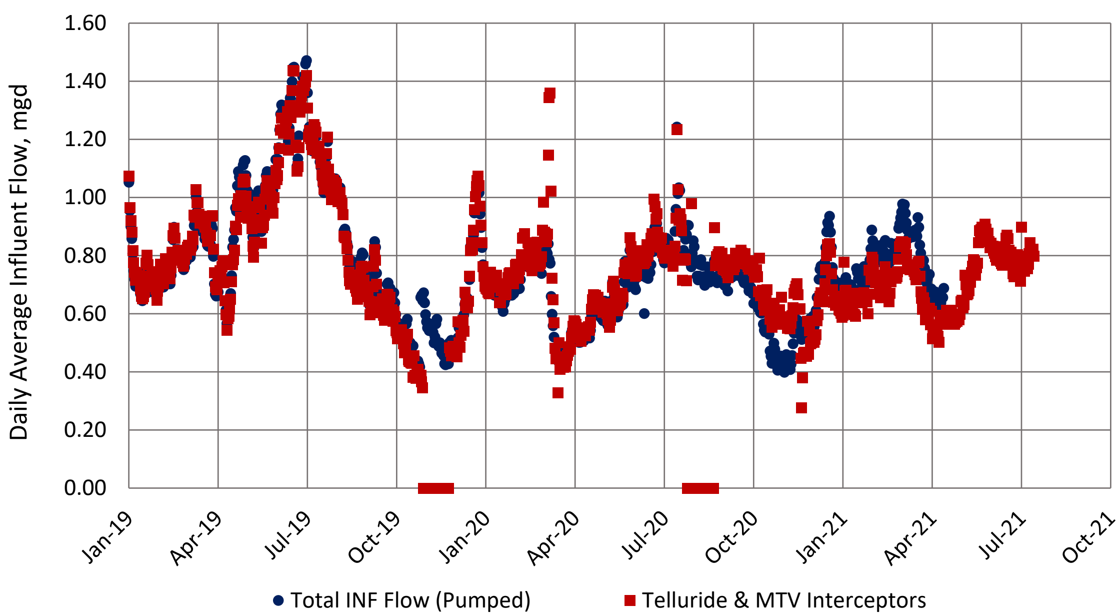


Figure 1.5 Comparison of Daily Average Influent Flow Data – Combined Interceptor and Pumped

A summary of the current flows and peaking factors calculated from the available historical data are presented in Table 1.2. These values are used for the flow projection analysis described in later sections.

Table 1.2 Summary of Historical Flow Conditions and Peaking Factors

Condition	Current (mgd)[(1)]	Peaking Factor[(2)]
ADAF[(3)(9)]	0.83	1.0
ADMMF[(4)(9)]	1.32	1.59
Peak Week – Winter[(5)(9)]	1.01	1.21
Peak Week – Summer[(6)(9)]	1.41	1.70
PDF[(7)(9)]	1.47	1.77
PHF[(8)(10)]	2.16	2.60
Peak 15-Minute Flow[(10)]	2.30	2.77

Notes:
(1) Assumes that wet weather flow contribution (i.e., I/I) grows proportionally with population through the planning horizon.
(2) Peaking factors for each flow condition are calculated against the reported ADAF of 0.83 mgd.
(3) Maximum value from a running 365-day average calculated over the span of available data.
(4) Maximum monthly average value obtained by a 30-day running average of flows over the span of available data.
(5) Maximum 7-day running average obtained for months October through March over the span of available data.
(6) Maximum 7-day running average obtained for months April through September over the span of available data.
(7) Maximum 1-day average flow observed in the available data.
(8) Maximum flow rate sustained for a 1-hour period over the span of available data.
(9) Based on daily influent flow data from 2016 through April 2021.
(10) Based on 15-minute influent flow data from the Telluride and Mountain Village interceptors from January 1, 2019, to August 1, 2021.

1.4.2 Inflow and Infiltration Analysis

A specific I/I assessment of the collection system was not conducted as part of the basis of design. While the Town intends to maintain and rehabilitate segments of the collection system to reduce I/I in future years, the project team did not take credit for possible I/I reductions in the peak flow projections. This approach is conservative and assumes the wet weather flows will increase proportionally with population in the future as discussed in the previous section.

1.4.3 Unit Flow Rate Per Capita

Per capital flow rates, calculated using the current population (shown in Section 1.3) and the historical influent flows shown in Table 1.2, are presented in Table 1.3. These values are used to project future influent flows through 2050. Per capita flow values are not shown for PDF or PHF, as these are flow conditions that are typically influenced by I/I; these conditions were projected by applying the peaking factors from Table 1.2 to the projected ADAF.

Table 1.3 Summary of Historical Flow Conditions and Peaking Factors

Condition	Current (mgd)[(1)]	Per Capita Flow (gpd/capita)[(2)]
ADAF	0.83	65.2
ADMMF	1.32	103.8
Peak Week – Winter	1.01	79.7
Peak Week – Summer	1.41	111.3

Notes:
(1) Assumes that wet weather flow contribution (i.e., I/I) grows proportionally with population through the planning horizon.
(2) Per capita flows are calculated for each condition assuming a population of 12,693, adopted for 2021 as presented in the 2017 Master Plan.

1.4.4 2040 Projected Flow Conditions

Figure 1.6 presents the projected influent flows to the TRWWTP through 2050. For clarity, the projected flow rates for each condition in 2050 are as follows:

- ADAF = 1.29 mgd.
- ADMMF = 2.05 mgd.
- Peak Week – Winter = 1.56 mgd.
- Peak Week – Summer = 2.19 mgd.
- PDF = 2.28 mgd.
- PHF = 3.35 mgd (not shown).
- Peak 15-Minute = 3.57 mgd (not shown).

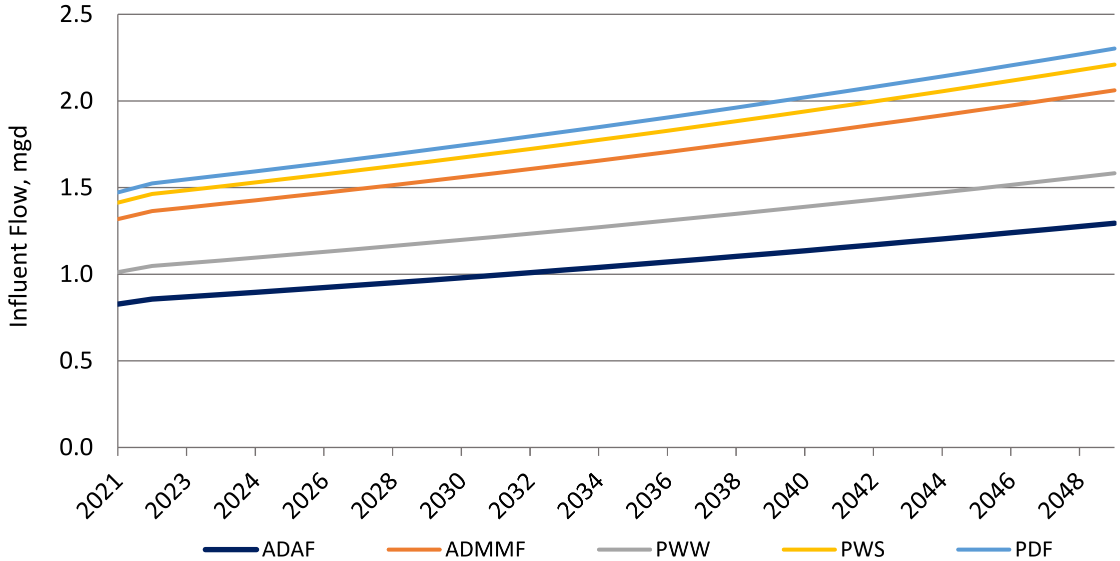


Figure 1.6 Projected Flow Conditions through 2050

Per CDPHE, domestic wastewater treatment works are required to 1) initiate engineering and financial planning for expansion whenever the ADMMF throughput and treatment reaches 80 percent of design capacity, and 2) commence construction of such expansion whenever ADMMF throughput reaches 95 percent of the design capacity. The estimated ADMMF in 2050 (2.06 mgd) is less than the current permitted capacity of the WWTP (2.10 mgd ADMMF) but is projected to exceed the 95 percent construction trigger around 2047.

Therefore, the near-term drivers for design and construction of capital improvements at the TRWWTP are not driven by the hydraulic capacity of the existing facility, which is consistent with the general finding in the 2017 Master Plan.

1.5 Influent Load Projections

Influent loads and design concentrations for BOD_5, total suspended solids (TSS), total Kjeldahl nitrogen (TKN), ammonia (NH_4) and total phosphorus (TP) are summarized in the sections below. Detailed analysis of historical influent concentrations and loads to the TRWWTP underlie the load projections for this basis of design.

1.5.1 Current Influent Loads

In support of the influent load analysis, the Town provided historical influent wastewater concentrations from the following date ranges:

- Influent BOD_5 and TSS from January 1, 2016, to April 30, 2021. Samples were generally collected by operations staff between 1-2 times per week.
- Influent TKN, NH_4, and TP from January 1, 2019, to April 30, 2021. Samples were collected by operations staff once per month.

Graphs presenting the influent concentrations and calculated influent loads for each constituent are available in Appendix 1A.

During analysis of the available data, the project team identified a shift in the reported influent concentrations that occurred in early November 2019 and continues through present day. The shift was most notable for influent BOD_5 and TSS, where the mean and interquartile range (or the statistical spread) of the data increased as compared to previous years. This is confirmed by visually inspecting the concentration data (see Figures 1A.2 and 1A.5 in Appendix 1A) and by developing box plots for both data sets (see Figures 1A.3 and 1A.6 in Appendix 1A).

The project team cannot conclude with certainty that a similar shift in concentrations occurred for the influent nutrients given the limited span and number of available data points. During project meetings with the Town on three separate occasions regarding the influent data (June 24, July 8, and July 13, 2021), operations and lab staff provided the following additional information pertaining to influent sampling.

- Prior to November 2019, influent samples were hand composited using grab samples collected four times per day (8:00 AM, 10:00 AM, 12:00 PM, and 2:00 PM). Since then, the facility has transitioned to an autosampler, which collects a 24-hour flow based composite sample. Following the meeting on June 24, operations and lab staff initiated a side-by-side comparison of the autosampler and hand composited data from the influent to determine if there was a significant, repeatable difference in the data between the two approaches. *Results from that effort were pending at the time of this draft report and will be updated for the final report.*
- Operations staff noted on June 24 that there have been periods when the influent sampler tube has been found touching the bottom of the influent channel. During these periods, the samples may have collected a higher load of solids that were either moving across or deposited on the bottom of the influent channel. Operations staff have since raised the sample tube in the influent channel and are currently monitoring it to ensure that the tube remains submerged under diurnal low-flow conditions.
- Operations staff noted on both July 8 and July 13, the uncharacteristically high influent TSS concentrations (concentrations much greater than 1,000 milligrams per liter [mg/L]) are most likely due to recent (and more frequent) mechanical issues with the influent screening equipment. The influent screen was offline for a period of 4 weeks during the second quarter of 2021. When the screens are down, there is a significant increase in the solids conveyed through the influent channel. These events also likely impacted the influent BOD_5 measurements, albeit not to the same degree.

After presenting a summary of the influent concentration and load data to Town and operations staff on July 8, the Town directed the project team to proceed using the influent loading data prior to November 2019 for load projections while the operations team continues to investigate the observed sampling discrepancy, such as the side-by-side sampling campaign noted above. Ultimately, a sampling error could not be confirmed by the TRWWTP through ongoing review of the influent data and the side-by-side comparison, and therefore the data from beyond the November 2019 was incorporated in the projected loading values. For comparison and documentation, the loading projections which excluded the influent data after November 2019 are included in Appendix 1B.

The current influent wastewater loads and calculated design concentrations assuming the entire data set are summarized in Table 1.4. Note that the following five influent TSS samples (all above 1,000 mg/L) were excluded from the analysis, as these concentrations are atypical for municipal wastewater and don't align with other influent parameters collected on and around the same dates:

- 1,310 mg/L on December 12, 2019.
- 1,533 mg/L on August 11, 2020.
- 3,493 mg/L on August 26, 2020.
- 1,460 mg/L on October 7, 2020.
- 1,322 mg/L on February 17, 2021.

Even with the exclusion of the above data points, the peak week influent TSS loads may be biased by uncharacteristically high influent concentrations. Typically, the BOD_5 to TSS ratio in municipal wastewater influent is around 1.0, while ratio calculated for the influent at the is significantly lower, as low as 0.52 for peak week calculations.

Table 1.4 Current Influent Flows, Loads, and Design Concentrations Using All Available Data from January 2016 through April 2021

Parameter	ADAF	ADMMF	Peak Week – Winter	Peak Week – Summer
Influent Flow, mgd	0.83	1.32	1.01	1.41
Influent Loads				
BOD_5, ppd	2,180	3,880	4,480	3,980
TSS, ppd	2,010	3,560	8,360	5,740
TKN, ppd	325	475	475	465
NH_4, ppd	190	345	345	290
TP, ppd	60	90	90	85
Design Concentrations				
BOD_5, mg/L	316	353	530	338
TSS, mg/L	291	324	990	487
TKN, mg/L	47	43	56	39
NH_4, mg/L	27	31	40	25
TP, mg/L	8.7	8.0	10.4	7.2

Given the limited availability of influent nutrient data, the project team recommends that a sensitivity analysis be conducted as part of the liquid stream and solid stream approach technical memorandum using a range of influent concentrations. This approach will inform the Town and the final design engineer (to be contracted in late 2021) of any capacity (both liquids and solids stream) and nutrient removal bottlenecks/deficiencies that should be addressed if the influent concentrations are indeed higher in coming years. The sensitivity analysis is especially prudent given the likelihood that the facility will be designed for Regulation 31 limits.

The project team also recommends that the TRWWTP increase the frequency of influent nutrient sampling to at least once per week moving forward. Ideally, laboratory staff would collect one composite sample representative of weekend conditions, and at least one composite sample representative of weekday conditions each week. This increased sampling becomes even more critical during peak tourism events in the service area which may necessitate collecting samples on additional days during peak week scenarios (Telluride Bluegrass Festival, Fourth of July, Christmas, Spring Break, etc.).

1.5.2 Per Capita Loading Rate

Per capital loading rates, calculated using the current population (shown in Section 1.3) and the historical influent loads shown in Table 1.2, are presented in Table 1.5. These values are used to project future influent loads through 2050.

Table 1.5 Current Per Capita Loading Rates

Per Capita Loading Rates	ADAF	ADMMF	Peak Week – Winter	Peak Week – Summer
BOD_5, ppd per capita	0.17	0.31	0.35	0.31
TSS, ppd per capita	0.16	0.28	0.66	0.45
TKN, ppd per capita	0.026	0.037	0.037	0.036
NH_4, ppd per capita	0.015	0.027	0.027	0.023
TP, ppd per capita	0.0047	0.0069	0.0069	0.0067

1.5.3 Influent Load Projections

Influent load projections, based on the historical influent data prior to November 2019 and summarized in Table 1.4, are presented in 2050 in Table 1.6. For brevity of this section, load projection graphs for each influent parameter are provided in Appendix 1A.

Table 1.6 Load Projections in 2050

	ADAF	ADMMF	Peak Week – Winter	Peak Week – Summer
Influent Flow, mgd	1.29	2.06	1.58	2.21
Influent Loads				
BOD_5, ppd	3,410	4,910	6,290	6,230
TSS, ppd	2,480	3,990	4,440	3,960
TKN, ppd	380	655	485	655
NH_4, ppd	295	535	535	360
TP, ppd	55	75	75	75

As noted previously, CDPHE requires domestic wastewater treatment works to 1) initiate engineering and financial planning for expansion whenever the average daily maximum month (ADMM) organic loading to the plant reaches 80 percent of design capacity, and 2) commence construction of such expansion whenever ADMM organic loading reaches 95 percent of the design capacity. The estimated ADMM BOD_5 in 2050 (4,910 ppd) exceeds the current permitted capacity of the TRWWTP (3,708 ppd as BOD_5) and is anticipated to exceed the CDPHE 95 percent construction trigger around 2027.

Note that for transparency in this basis of design, the estimated ADMM BOD_5 load in 2050 is 6,070 ppd assuming the use of all historical influent data (not shown in Table 1.6). Under this assumption, the facility would have already exceeded the 95 percent construction trigger when using a 30-day rolling average calculation (in lieu of a 30-day calendar average) of the influent data.

Regardless of the chosen data set, initiation of design and construction of capital improvements at the TRWWTP is driven more immediately by organic loading capacity and anticipated regulatory requirements as opposed to hydraulic capacity.

1.6 Comparison to Previous Studies

The 2017 Master Plan was reviewed in support of the flow and loading analysis to provide a comparison between historical and current flows and load and population projections.

Table 1.7 shows a comparison of the design flow and loading concentrations and peaking factors that were summarized for conceptual design. Generally, the values presented in the 2017 Master Plan are slightly more conservative as compared to the values calculated as part of this basis of design (assuming all years of available data). It is important to note the following with respect to the 2017 Master Plan values:

- Influent design concentrations were only provided for the average daily annual condition. No recommended design concentrations were provided for the other planning scenarios including average daily maximum month or peak seasonal conditions.
- The concentrations shown were based on ratios calculated from 24-hour composite influent monitoring that was conducted on December 26, 2016, which represented the maximum week wastewater loading conditions at the time. These values were adopted as a conservative basis of planning but are not based on long-term influent monitoring data.

Table 1.7 Historical Master Planning Effort – Flow and Load Projection Factor Comparison

Parameter	Units	2017 Master Plan	2020 Basis of Design – All Historical Data Since 2016
ADAF Per Capita Flow	gpd/capita	80	65.2
ADMMF Per Capita Flow	gpd/capita	120	103.8
ADMMF/ADAF	--	1.50	1.59
Peak Week – Winter/ADAF	--	1.75	1.22
Peak Week – Summer/ADAF	--		1.71
PDF/ADAF	--	2.01	1.78
PHF/ADAF	--	3.89	2.58
Peak 15-Minute/ADAF	--	--	2.74
BOD_5	mg/L	350 / NA	316 / 353
TSS	mg/L	250 / NA	291 / 324
TKN	mg/L	49 / NA	47 / 43
NH4	mg/L	35 / NA	27 / 31
TP	mg/L	7.0 / NA	8.7 / 8.0

Notes:
(1) Projected loads for ammonia were not included as part of the 2017 Master Plan.

1.6.1 Influent Flow

Figure 1.7 shows the influent flow projections from the 2017 Master Plan assuming 1.5 percent population growth and the actual ADMMF observed each year since 2016. This graph shows that influent flows to the TRWWTP are trending lower as compared to the projections in the 2017 Master Plan.

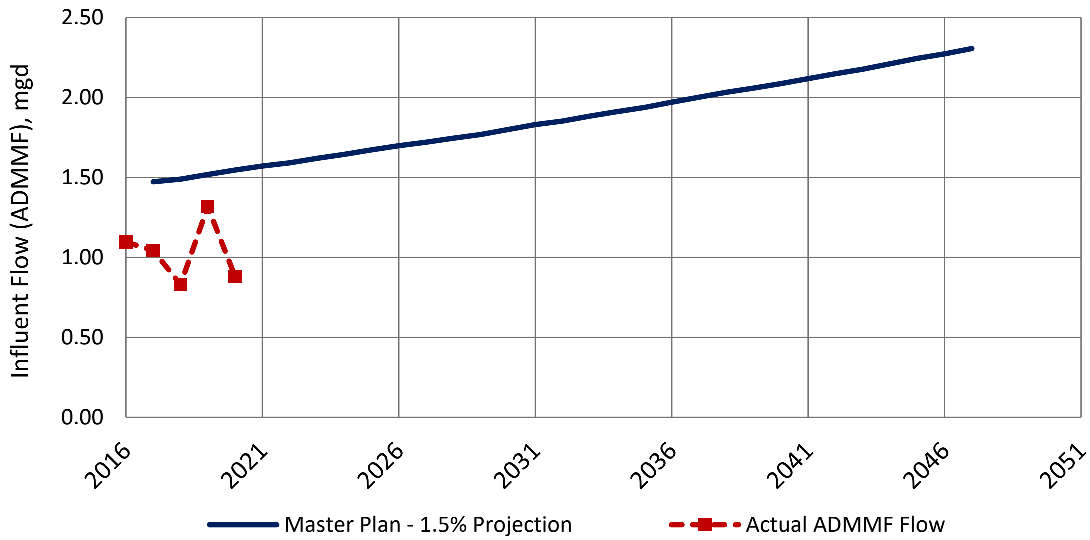


Figure 1.7 Comparison of 2017 Master Plan Flow Projections and Historic Influent ADMMF Data (2016-2021)

Projecting the 2019 ADMMF of 1.32 mgd forward through 2050, the TRWWTP is not expected exceed its current rated hydraulic capacity or the projections presented in the 2017 Master Plan (Figure 1.8). The 95 percent construction trigger associated with the hydraulic capacity is projected to be exceeded between 2046 and 2047. The current rated capacity of the plant would be exceeded between 2051 and 2052.

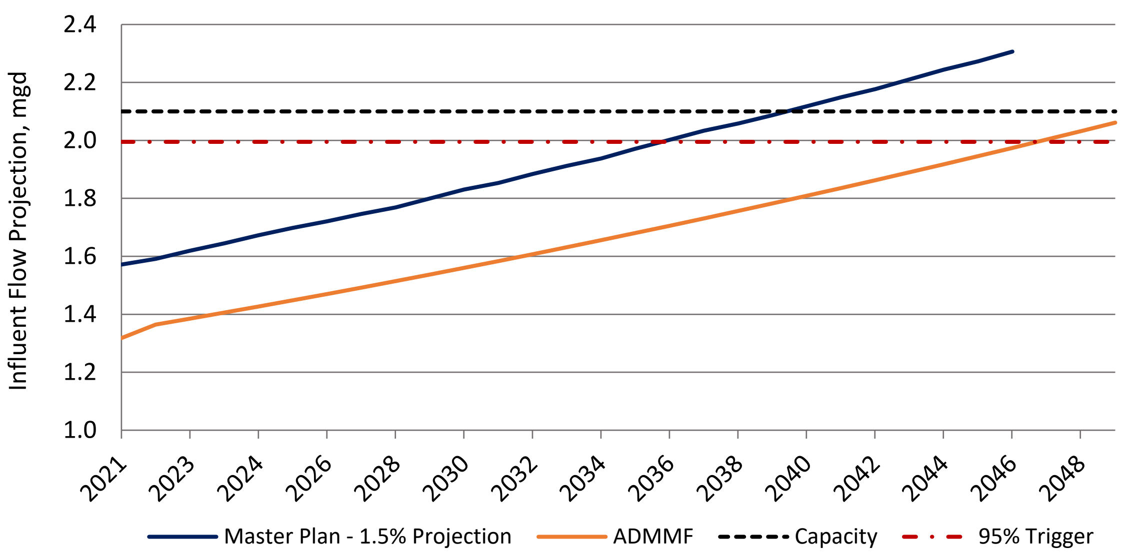


Figure 1.8 Comparison of 2017 Master Plan Flow Projections and Basis of Design Flow Projections

1.6.2 Influent Organic Loading

Figure 1.9 shows the influent BOD_5 load projections from the 2017 Master Plan using the 1.5 percent annual population growth and the actual ADMM BOD_5 loads since 2016. The plot includes two scenarios from the 2017 Master Plan:

1. The first scenario assumes a 400 percent expansion of the Telluride Brewery in 2020, followed by the opening of a smaller brewery in 2030.
2. The second scenario assumes no Telluride Brewery expansion.

At the July 13, 2021, meeting staff confirmed that the Telluride Brewery expansion was not anticipated within the planning horizon. *Town staff intend to confirm the brewery's long-term plan, no update has been provided at the time of this draft report. Information will be updated in the final report if available.*

The graph shows that influent loads to the TRWWTP were trending about 10 percent lower as compared to the BOD_5 projections in the 2017 Master Plan until this year, when BOD_5 fell between the two projection scenarios noted above.

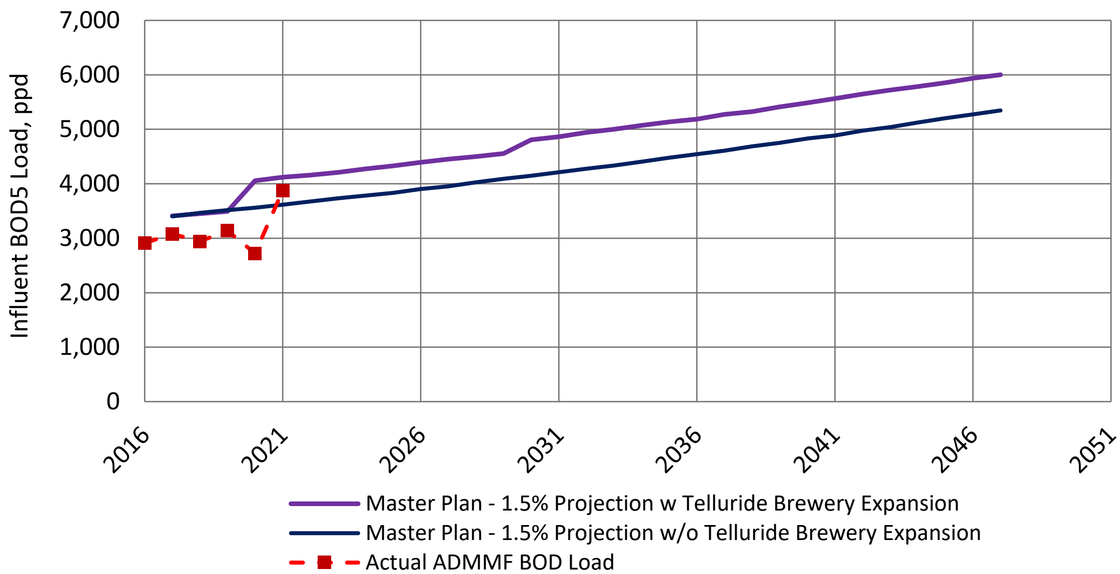


Figure 1.9 Comparison of 2017 Master Plan BOD_5 Load Projections and Recent Influent BOD_5 Load Data (2016-2021)

Projecting the current ADMM BOD_5 load of 3,880 ppd forward through 2050, the TRWWTP has already exceeded its 95 percent construction trigger, is at risk for triggering a construction schedule compliance plan in the event the increased loading conditions occur within a 30-day calendar period and may exceed the current rated organic loading capacity within the next 2 years (Figure 1.10). The organic loading projections fall between the two influent loading scenarios presented in the 2017 Master Plan with and without and expansion of the Telluride Brewery.

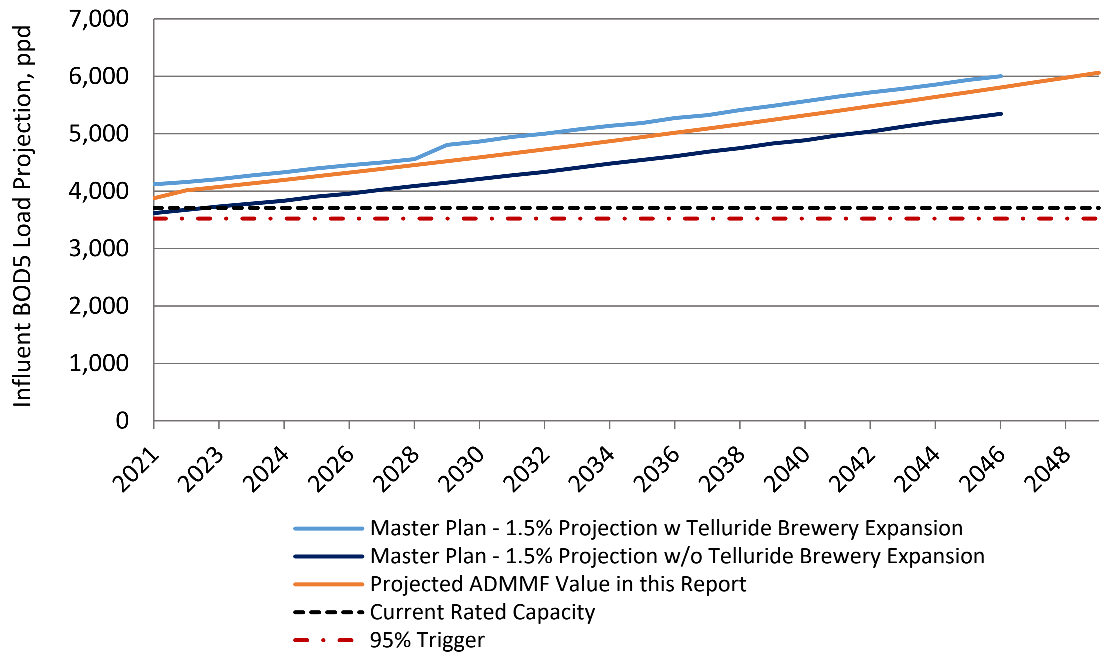


Figure 1.10 Comparison of 2017 Master Plan BOD_5 Load Projections and Basis of Design BOD_5 Load Projections

1.7 Summary of Hydraulic and Loading Projections for Preliminary Design

Based on the information presented above, Table 1.8 summarizes the 2050 influent conditions based on the available historical process data from January 2016 to April 2021.

Table 1.8 Summary of Projected 2050 Influent Design Criteria (based on historical data)

	ADAF	ADMMF	Peak Week – Winter	Peak Week – Summer	PDF	PHF	Peak 15-Minute
Influent Flow, mgd	1.29	2.06	1.56	2.19	2.28	3.35	3.57
Influent Loads							
BOD_5, ppd	3,410	6,070	7,000	6,230			
TSS, ppd	3,140	5,570	13,100	8,980		Not Analyzed	
TKN, ppd	510	745	745	725			
NH_4-N, ppd	300	535	535	455			
TP, ppd	95	140	140	135			

Based on discussions with the Town for developing design criteria for the proposed expansion project, the above hydraulic and organic loading considerations are close to the recommendations included in the 2017 Master, and therefore the ADMMF and organic loading recommended in the 2017 Master Plan will be used for design implementation. The final influent design criteria are provided in Table 1.9 and the primary difference is the influent flow criteria.

Table 1.9 Summary of 2050 Influent Design Criteria

	ADAF	ADMMF	Peak Week – Winter	Peak Week – Summer	PDF	PHF	Peak 15-Minute
Influent Flow, mgd	**1.44**	**2.3**	**1.74**	**2.45**	**2.54**	**3.73**	**4.0**
Influent Loads					Not Analyzed		
BOD_5, ppd	3,410	**6,005**	7,000	6,230			
TSS, ppd	3,140	5,570	13,100	8,980			
TKN, ppd	510	745	745	725			
NH_4-N, ppd	300	535	535	455			
TP, ppd	95	140	140	135			

1.8 Regulatory Framework

The regulatory requirements for the TRWWTP are continuously changing through revisions of current regulations, new water quality standards, or the addition of new facilities that can alter existing assimilative capacity allocations in the San Miguel River. The following sections present current, future, and other potential water quality regulatory drivers that are expected to impact near- and long-term treatment planning activities for the TRWWTP.

1.8.1 Current Discharge Permit

The TRWWTP is owned and operated by the Town and is permitted under Discharge Permit No. C00041840 that went into effect on December 1, 2020. The permit is valid for 5 years and will expire on November 30, 2025. The TRWWTP is located in the SW 1/4 of the NW 1/4 of S33; T24N; 12000 Hwy 145, Telluride CO; at 37.94866° N and 107.87366° W. There is one permitted outfall location to the San Miguel River.

The TRWWTP is permitted for a hydraulic capacity of 2.1 mgd ADMMF and an organic loading of 3,708 ppd measured as BOD_5. Table 1.10 summarizes the current discharge limits as published in the permit (December 1, 2020). The current discharge permit does not set effluent limits for TP and a variety of metals, but the Town is required to monitor and report effluent concentrations for these constituents at this time. On March 31, 2021, the Town submitted a permit modification request to CDPHE to incorporate instream modifications that removed the bifurcation condition and adjust the low flow criteria based on provided monitoring data collected and submitted by the Town. At the time of this draft report, the permit modifications have not been finalized by the CDPHE Permitting Division.

Table 1.10 TRWWTP Discharge Permit Limitations for San Miguel River (excluding metals)(1)(2)

Effluent Parameters	Units	San Miguel River Effluent Limitations	
Effluent Flow	mgd	2.1	
E. coli	#/100 mL	224 (30-day average) 448 (7-day average)	
Total Residual Chlorine	mg/L	0.02 (30-day average) 0.032 (daily maximum)	
BOD_5	mg/L	30 (30-day average) 45 (7-day average)	
TSS	mg/L	30 (30-day average) 45 (7-day average)	
pH	SU	6.5-9.0	
Total Inorganic Nitrogen (TIN)	mg/L	34 (daily maximum) 17 (daily maximum)(3)	
Oil and Grease	mg/L	10 (daily maximum)	
Total Ammonia as N		**30-day Average**	**Daily Maximum**
January	mg/L	2.8	28
February	mg/L	2.8	27
March	mg/L	2.8	29
April	mg/L	2.8	23
May	mg/L	2.8	20
June	mg/L	2.8	28
July	mg/L	2.8	36
August	mg/L	1.8	34
September	mg/L	10	37
October	mg/L	1.8	28
November	mg/L	2.8	31
December	mg/L	2.8	28

Notes:
(1) As of August 26, 2021.
(2) The TRWWTP also has monitoring and reporting requirements for the following parameters: effluent temperature, total dissolved solids, aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese ,mercury, molybdenum, nickel, selenium, silver, zinc, chloride, sulfate, and nonlyphenol.
(3) Effective December 1, 2025.
mL milliliter
SU Standard Unit

The TRWWTP is authorized to only use the following chemicals on-site based on the current discharge permit documents: sulfuric acid for pH control during biosolids digestion and sodium chlorite for chlorine and chloride control in biosolids digestion.

1.8.2 Water Quality of Receiving Water

This section provides a brief overview of water quality considerations in the San Miguel River discharge Segment COGUSM03b (water quality based effluent limits [WQBEL] summarized in Table 1.11). Segment COGUSM03b in the San Miguel River is designated as reviewable under the classification for Aquatic Life Cold 1, Recreation Class E, Agriculture and water supply and requires an antidegradation review as a "reviewable" segment. The dilution ratio of the chronic low flow (30E3 – 30-day average low flow recurring in a 3-year interval) to the design flow of the TRWWTP (2.1 mgd) for discharge into the San Miguel River is 0.78:1 based on the information provided in the most recent discharge permit.

The stream segment is on the 303(d) list of water quality impacted streams for cadmium, zinc, and sediment. The CDPHE's Restoration and Protection Unit has completed the determination of total maximum daily loads (TMDL) and therefore, the requirements of the TMDLs would normally apply for these constituents. However, the TMDLs completed in 2008 determined that the Town is not considered a major contributor of metals and therefore, the fact sheet and discharge permit does not include waste allocation loads (or limits) for the TRWWTP.

According to the Rationale for Classifications, Standards and Designations of the San Miguel River, Segment COGUSM03b is designated a water supply. For this reason, the nitrate standard of a daily maximum instream concentration of 10 mg/L, which is applied at the point of intake to a water supply, was evaluated as part of the last Water Quality Assessment in 2020. The daily maximum effluent limitation of 21 mg/L for TIN effective September 1, 2024, are therefore based on that standard.

Table 1.11 CDPHE Chronic and Acute WQBELs Developed for San Miguel River

Effluent Limit	Units	San Miguel River	
		Acute	Chronic
E. coli	#100/mL	126	
Total Ammonia		TVS	TVS
Chlorine	mg/L	0.019	0.011
Sulfide			0.002
Boron			0.75
Nitrite as N	mg/L	0.5	
Nitrate as N	mg/L	10	
Chloride			250
As, dissolved	µg/L	340	
As, total recoverable[(1)]	µg/L		0.02
Cd, dissolved		SSE	SSE
Cd, recoverable	µg/L	5.0	
Cr +3, total recoverable	µg/L	50	
Cr+3, dissolved	µg/L	TVS	
Cr+6, dissolved	µg/L	TVS	TVS
Cu, dissolved	µg/L		TVS
Cyanide, free	mg/l	0.005	
Fe, total recoverable	µg/L		1,000
Pb, dissolved	µg/L	TVS	

Effluent Limit	Units	San Miguel River	
		Acute	Chronic
Pb, total recoverable	µg/L	50	
Mn, dissolved	µg/L	TVS	TVS
Mo, total recoverable	µg/L		150
Hg, total	µg/L		0.01
Ni, dissolved	µg/L	TVS	TVS
Ni, total recoverable	µg/L		100
Se, dissolved	µg/L	TVS	TVS
Ag, dissolved	µg/L	TVS	
Zn, dissolved	µg/L		190

Notes:
(1) Expiration date of 12/31/2024
µg/L micrograms per liter
SSE site specific equation
TVS total volatile solids

1.8.3 Water Quality Parameters Potentially Relevant in Future Permit Renewal

1.8.3.1 Temperature

In compliance with the permit requirements, the TRWWTP is currently conducting temperature monitoring in the final effluent and in the San Miguel River. As a result, the facility may receive temperature limits as part of a future permit renewal, should the decision be made that there is reasonable potential for the facility to cause or contribute to an exceedance of the water quality standard for temperature. Table 1.12 summarizes the in-stream standards.

Table 1.12 Temperature

Date	Daily Maximum Temperature (°C)	Maximum Weekly Average Temperature (°C)
October 1-October 31	13.9	9
November 1-March 31	13	9
April 1-May 31	14	9
June 1-September 30	21.7	17

Notes:
°C degrees Celsius

1.8.3.2 Nutrients

Total Inorganic Nitrogen and Total Phosphorus – Regulation 85

The nutrient reductions required by Regulation 85, "Nutrients Management Control Regulation," are implemented through the TIN and TP limit as a running annual median of 15 mg/L and 1 mg/L, respectively. Regulation 85 also requires meeting a running annual 95th percentile limit of 20 mg/L TIN and 2.5 mg/L TP. Although Regulation 85 became effective on September 30, 2012, delayed implementation (until December 21, 2027) is specified in the regulation to occur for domestic WWTPs that fall into one of three categories: discharge more than 1 mgd and less than or equal to 2.0 mgd; have an existing watershed control regulation; or where the discharge is to waters in a low-priority 8-digit hydrologic unit code.

Based on the Fact Sheet to Permit No. C00041840, the TRWWTP discharges to a low-priority watershed and therefore, implementation of technology based effluent TIN and TP limits under Regulation 85 are delayed. As such, the Town is anticipated to receive (at the minimum) a compliance schedule as part of the next permit renewal cycle with limits effectively starting in 2030 (assuming CDPHE does not proceed immediately to Regulation 31 limits – summarized below).

Total Nitrogen and Total Phosphorus – Regulation 31

In March 2012, interim numeric nutrient criteria were adopted for total nitrogen (TN) and TP, but not directly applied to streams and lakes except in limited cases in which TP standards were adopted above discharge locations and in direct use water supply reservoirs. The Environmental Protection Agency (EPA) subsequently approved the interim values for TN and TP in lakes (with additional recommendations) and chlorophyll-*a* in lakes and streams but took no action on stream TN and TP interim values. During the Regulation 85 and Regulation 31 Rulemaking Hearings in October 2017, the Water Quality Control Commission identified an anticipated schedule for nutrients standards adoption as follows:

- 2022 – Statewide adoption of chlorophyll-*a* standards for lakes and streams, and adoption of TN and TP standards for lakes and reservoirs with either Direct Use Water Supply classification or a public swim beach. The chlorophyll-*a* interim numeric values for warm water streams is 150 milligrams per square meter (mg/m^2) and for warm water lakes is 20 µg/L.
- 2027 – Statewide adoption of TN and TP standards for rivers and remaining lakes.

Anticipated future nutrient limits under Regulation 31, "The Basic Standards and Methodologies for Surface Water" (5 CCR 1002-31 Section 31.17), therefore remain uncertain at this time. The interim nutrient values (effective December 31, 2027, if approved by the EPA) for TN and TP limits in cold water streams are 1.25 mg/L and 0.11 mg/L, respectively. A conservative assumption is that these interim values would apply at the end-of-pipe for the TRWWTP, particularly if the ambient water quality in the San Miguel River exceeds the instream standard (TN and TP data were not included in the recent Water Quality Analysis). However, the ratio of the low flow in the San Miguel River to the TRWWTP design flow is currently 0.78:1 and 100 percent of the available assimilative capacity of the river can assumed when calculating WQBELs. Therefore, the estimated effluent nutrient discharge limits required to meet the Regulation 31 instream standards, assuming the dilution credit at the proposed hydraulic rating of the plant (2.3 mgd), are summarized in Table 1.13.

Table 1.13 Estimated Effluent Nutrient Discharge Limits under Regulation 31

Condition	TN (mg/L)	TP (mg/L)
Instream Requirement(1)	1.25	0.11
Estimated Effluent Discharge Limit without Bifurcation, at 2.3 mgd proposed design capacity(2)	Approx. 3.69	Approx. 0.41

Notes:
(1) Regulation 31 cold water stream standard prior to dilution credit.
(2) Calculated using the mass-balance equation presented in the Fact Sheet to Permit No. CO0041840. Upstream flow (9.7 cubic feet per second [cfs]), average daily effluent flow (3.6 cfs), and downstream flow (13.3 cfs) were adopted from flow numbers developed for the permit modification dated March 31, 2021. Instream 85th percentile TN concentration of 0.35 mg/L was adopted for the calculation of effluent TN based on data collected monthly by the TRWWTP from May 2018 to December 2020. Instream 85th percentile TP concentration of 0 mg/L was adopted for the calculation of effluent TP from the same data set.

Note that the estimated upper discharge limits were calculated assuming the 30-day average low flow from the San Miguel River as submitted in the 2021 permit modification, as the annual median low flow of the river was not provided. The analysis also assumed that the bifurcation removal is approved by CDPHE as part of the permit modification request. The instream background pollutant concentrations upstream of the plant were taken as the 85th percentile of monthly sample data collected by the TRWWTP from May 2018 through December 2020. Instream data that was reported as non-detect by the Town was converted to 0 mg/L for the analysis.

Given the TRWWTP's permitting cycle, one of two regulatory scenarios may occur:

1. The Regulation 31 limits would become effective as annual median limits (as observed in preliminary effluent limits from other Colorado facilities) sometime around 2035, assuming no earned credit under the Incentive Program. This scenario assumes that the Town would first receive a Regulation 85 compliance schedule as part of the next permit renewal cycle in 2025 (compliance required by 2030), followed by a Regulation 31 compliance schedule as part of the following permit renewal cycle in 2030 (compliance required by 2035).
2. The Regulation 31 limits would become effective as early as 2030. This scenario assumes that since the Regulation 85 limits for low-priority water sheds become effective the same year as Regulation 31 (year 2027), CDPHE would immediately jump to Regulation 31 limits. It is unknown whether or not the typical 5-year compliance schedule would apply, or if additional years would be granted when bypassing the Regulation 85 values.

Carollo Engineers (Carollo) attempted to contact the CDPHE Permitting Division for guidance regarding the above scenarios and did not receive feedback at the time of this draft report. Based on discussions with operations staff, the Town's legal counsel has also not received any confirmation from the CDPHE Permitting Division regarding how the regulations will be applied to the TRWWTP in the future. As such, the project team recommends that the Regulation 31 effluent limits be used as the basis of design for this project, pending receipt of preliminary effluent limits (PEL) from CDPHE.

1.8.3.3 Ammonia

Since the EPA published updated ammonia standards in 1999, the ammonia aquatic life criteria have been reevaluated on basis of recent evidence that freshwater mussel species may be more susceptible to ammonia than the aquatic organisms used for developing the 1999 criteria. The EPA published the revised ammonia criteria in 2013. CDPHE is currently assessing the presence of sensitive mussel species in Colorado streams and rivers. Alternate ammonia criteria may be developed for Colorado streams and rivers pending these results. CDPHE is scheduled to propose revised ammonia criteria in 2027. These criteria could tighten TRWWTP's effluent ammonia limits within the 2050 planning horizon.

1.8.3.4 Metals

The following subsections capture the metals identified as constituents of concern as related to the limits stated in the current discharge permit. Additional metals limits are also captured in the Town's discharge permit; however, a review of the historical data indicates that the effluent concentrations are below the proposed discharge limits for these constituents. Metals with an effluent concentration below the discharge permit limit were not included in the subsections below. The Town's permit modification request submitted on March 31, 2021, is anticipated to further adjust the metals limits described in the sections below due to the modification to the low flow condition. The Town intends to pursue additional permit modification efforts associated with these limits in lieu of treatment due to technological limitations to achieve these limits and the associated costs.

Copper

The current 30-day average limit is 45 µg/L and the TRWWTP is in compliance with this limit. The future 30-day average limit is 12-µg/L and a 2-year average limit will also be added of 16 µg/L in 2024. The future 2-year average will be 0.95 µg/L in 2026. Based on previous monitoring, the TRWWTP may not be able to consistently meet the new limitations and a compliance schedule was added to the permit to give the facility time to meet the limitations.

Arsenic

The current 30-day average limit is 4.7 µg/L and the TRWWTP is historically in compliance. The upcoming limit will be 0.036 µg/L. Based on the current effluent data, the TRWWTP may not be able to meet the future limitation consistently. A compliance schedule was added to the permit to give the facility time to meet the limitation. The in-stream standards also include a temporary modification for total recoverable arsenic with an expiration date of December 31, 2024.

Nonylphenol

The current 30-day average limit is 23 µg/L and the daily maximum limit is 37 µg/L until 2023. The future 30-day limit is 12 µg/L, daily maximum is 47 µg/L and 2-year average is 1.8 µg/L. Based on the current effluent data, the facility may not be able to meet the future limitation consistently; however, the current data set is limited and ongoing monitoring of this parameter is recommended.

1.8.4 Future Effluent Regulatory Considerations

1.8.4.1 Per- and Polyfluoroalkyl Substances in Effluent Discharges

Per- and polyfluoroalkyl substances (PFAS) are a large group of synthetic fluorinated organic chemicals that are soluble, mobile, and recalcitrant to chemical and biological processes. The two most dominant groups of PFAS consist of perfluorooctanyl sulfonate (PFOS) and perfluorooctanoic acid (PFOA).

PFAS are manmade chemicals that are heat, water, and lipid resistant. Because of these qualities, they deter water, grease, and oil, and are therefore used in many industrial applications, ranging from flame-retardants to stain-resistant carpets to Teflon® pans. Due to decades of ubiquitous use of these chemicals, PFAS are now detected throughout the environment in soil, air, water, household dust, and humans.

Elevated exposure to PFAS compounds (primarily by way of ingestion of drinking water) have been associated with developmental effects during pregnancy such as low infant birth weights and skeletal variations, effects on the immune system such as changes in antibody production and immunity, liver effects including tissue damage, cancer, and thyroid hormone disruption. Even though PFAS compounds are not used in the wastewater treatment process, because they are so widely used in commercial and residential applications, they end up in wastewater. The largest source of PFAS compounds at WWTPs is from industrial dischargers. Thus, source control of industrial facilities using significant volumes of PFAS compounds is important because WWTP solids treatment processes do not destroy PFAS compounds. Under certain circumstances, PFAS can be created from precursors during the treatment process.

Most PFAS will partition to solids and end up in the biosolids stream. However, some treated effluents can contain concentrations that could be deemed problematic. What concentrations are "problematic" for discharge into streams and rivers is currently being defined by regulatory state agencies including CDPHE. The EPA has not regulated PFAS other than in drinking water, but it is in the process of developing standards for PFAS in biosolids and surface waters. As such, the EPA is following regulatory developments that individual state agencies are currently leading. Examples include:

- States that have already developed or are in the process of developing surface water quality standards for PFAS include Colorado, Michigan, Minnesota, New Hampshire, Vermont, and Wisconsin, and have set a PFOS limit of 12 nanograms per liter (ng/L) and for PFOA 12,000 ng/L for non-drinkable sources.
- States that have developed or are in the process of developing biosolids and or compost standards for PFAS include California and Massachusetts. Maine has set enforceable biosolids screening levels at 0.0025 milligrams per kilogram (mg/kg) for PFOA, 0.0052 mg/kg for PFOS, and 1.9 mg/kg for perfluorobutanesulfonic acid (PFBS).
- First states that require monitoring and reporting of PFAS concentrations in biosolids include California, Maine, Massachusetts, New York, North Carolina, and Washington.
- First states that have implemented requirements to monitor and report PFAS concentrations in treated effluents include California and Washington.

In 2012, the European Union implemented a combined PFOS and PFOA limit of 100 micrograms per kilogram (µg/kg) that was adopted into composting and biosolids standards. This limit is generally not considered to be stringent enough by regulatory agencies in the United States.

CDPHE has initiated a public stakeholder group process in 2019 to accompany the development of water quality standards in Colorado for PFOS. As of August 2021, three permit renewals within the State of Colorado include monitoring for effluent PFAS as a new parameter on the discharge permit, although no limits have been implemented yet. Monitoring requirements are anticipated for the Town on the next permit renewal cycle.

CDPHE focuses on surface water standards first since the analytical methods for PFAS in wastewater matrices are further developed. CDPHE currently does not have a basis for developing PFAS limits for biosolids since occurrence data does not exist currently and analytical methods for PFAS in biosolids are still under development. Regardless, it is anticipated that PFAS effluent limits may be implemented within the next 5 years in Colorado followed shortly by PFAS limits for biosolids.

1.8.4.2 Emerging Unregulated Contaminants

A number of trace organic contaminants (TOrC) can be detected in treated domestic wastewater effluents that have been demonstrated to negative effects aquatic and/or human health depending on occurrence concentrations. These contaminants originate differently in domestic, industrial, or stormwater sources including personal care products, food additives, pharmaceuticals, industrial chemicals, or disinfectant by-products. Concentrations in treated effluent can range from micro to nanograms. While some of the chemicals can be toxic or carcinogenic for humans, concentrations are typically too low and of more immediate concern for discharge locations can be the possible toxic effects of TOrC on aquatic life, specifically endocrine disruption in fish.

Because of the large amount of TOrCs and incomplete data on cause-effect relationships, the EPA has not yet regulated the majority of these compounds. Instead, standards have been developed for individual compounds, such as nonylphenol and currently perfluorinated compounds (see section below). However, regulations regarding TOrCs discharge from wastewater treatment facilities have been anticipated in the coming one to two decades. Several years ago, other European countries already started to require and implement treatment requirements in form of the so-called fourth treatment step (post tertiary treatment for nutrient removal). The two most typical technologies that are implemented for TOrC removal are either activated carbon sorption or ozonation followed by biologically active filtration.

Two feasible regulatory pathways for TOrC in future years are:

1. Development of regulatory requirements for a small defined group of TOrCs that require treatment upgrades that will then also result in the effective removal of a broader group of TOrCs.
2. The EPA has also contemplated developing "group regulations" for TOrCs instead of proceeding with compound-by-compound regulations.

While timing and nature of these regulations are uncertain, utilities are advised to plan long-term in site layouts and finances for treatment upgrades that can accommodate TOrC removal.

1.8.4.3 Microplastics

Microplastics in wastewater and the environment have become a topic of research over the past years. Of general interest are particles less than 5 millimeters (mm) in size and particles are categorized into micro-, meso-, and nano plastics. Plastic particles are detected virtually ubiquitously and introduced in wastewater treatment plants through consumer products, stormwater, and other sources.

Microplastics cause possible concerns for aquatic life, but the science and cause-effect relationships are not yet well understood. Detection methods are still under development and not standardized. In the United States, research needs to be further developed before it is clear whether microplastics need to be regulated to mitigate exposure risks, and if that should be the case, for the EPA to develop the necessary data to develop standard methods and the necessary database to develop standards. For this reason, regulations in the United States from the EPA are not anticipated within the next 10 to 15 years.

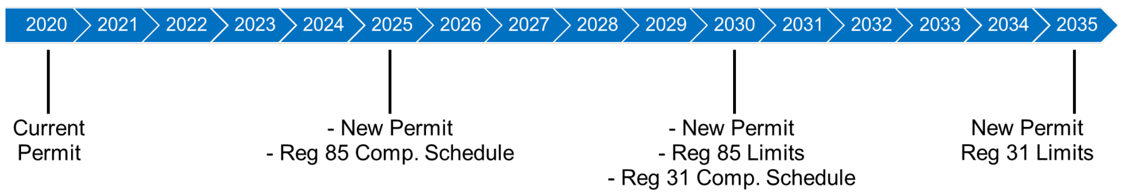
1.8.4.4 Nanoparticles

Nanoparticles are a broad group of organic or inorganic particles in the size range of about 1 to 100 nanometers (nm) or larger. These particles originate various sources in wastewater influent including consumer products, industrial chemicals, clothing, electronics, or food. In August 2017, the EPA issued a requirement for information collection and reporting for nanomaterials under the Toxic Substances Control Act. This is regarded as a first necessary step for the EPA to start collecting data on this group of chemicals to help with the assessment of whether regulations may be necessary.

Nanoparticles have a high surface area to volume ratio and are therefore often reactive. Few particles are known to be cancerogenous or toxic; for most particles, such information is not yet available. Toxicity endpoints are not well understood, occurrence data is difficult to analyze in environmental matrices, and toxicity data is insufficient. For this reason, regulations in the United States from the EPA are not anticipated within the next 10 to 15 years.

1.8.5 Anticipated Permitting Timeline

Based on the preliminary regulatory review, the anticipated regulatory timeline is presented in Figure 1.11. There is uncertainty surrounding the timing of the promulgation of Regulation 31 as compared to Regulation 85 for the TRWWTP. The timing for Regulation 31 limits shown in Figure 1.11 do not account for any credits earned through the Voluntary Incentive Program (the Town has earned nothing to date) and assume that the CDPHE Permitting Division will implement Regulation 85 and Regulation 31 sequentially. A more conservative approach assumes that CDPHE transitions directly to Regulation 31 for the TRWWTP in 2027. Efforts to confirm the strategy for dischargers similar to Telluride has not generated any feedback from the CDPHE Permitting Division regarding this approach. Therefore, the project team recommends that the Regulation 31 effluent limits be used as the basis of design for this project, pending receipt of PELs from CDPHE. These limits will be summarized in Section 1.9.



Timeline assumes CDPHE does not bypass Regulation 85.

Figure 1.11 Anticipated Regulatory Timeline

1.8.6 Current and Anticipated Regulatory Requirements for Biosolids

The Town's current practice for biosolids disposal is through hauling and disposal at the landfill, which is a cost effective and operationally simplistic solution for disposal of generated biosolids in the near-term. However, volatility in hauling costs and landfill tipping fees, risk to hauling (and on-site storage availability) operations during the winter, and future sustainability goal warrant consideration of other disposal options as part of the implementation pathway and long-term planning considerations.

1.8.6.1 Regulation 64 Background

The Water Quality Control Division (WQCD) adopted Biosolids Regulation No. 64 (5 CCR 1002-64) (Regulation 64) (CDPHE, 1993) in November 1993; the regulation was last amended June 2014. Regulation 64 "establishes requirements, prohibitions, standards, and concentration limitations on the use of biosolids as a fertilizer and/or organic soil amendment in a manner so as to protect the public health and prevent the discharge of pollutants into state waters."

Regulation 64 is based on EPA 40 CFR Part 503 Biosolids Rule, but it is a Colorado-specific rule that governs how biosolids are handled, treated, and applied to land or utilized for public use. The following discussion presents regulatory pathways for beneficial use of biosolids for land application (Class B).

Class A biosolids are a higher-quality product that must meet more stringent pathogen reduction requirements. As a result, these biosolids can be distributed for public use without further testing and monitoring. Class B biosolids must still meet certain pathogen reduction requirements, but the limits are lower than those for Class A biosolids. These biosolids cannot be distributed for public use, but they may be land-applied. However, sites that apply Class B biosolids are subject to certain access and food production restrictions.

1.8.6.2 Pathogen Reduction Requirements

Pathogens are disease-causing organisms present within the biosolids. Only biosolids that meet either Class A or Class B requirements for pathogen destruction can be land applied.

For Class B biosolids to be used or distributed for beneficial use, the biosolids pathogen destruction must be evaluated or treated by one of two alternatives, as shown in Table 1.14.

Table 1.14 Pathogen Reduction Alternatives (Class B)

Alternative	Description
1	Geometric mean of seven samples
2	Process to significantly reduce pathogens

Alternative 1 requires that the geometric mean of seven samples shows the density of fecal coliforms to be less than 2,000,000 most probable number per gram (MPN/g) of total solids on a dry weight basis or less than 2,000,000 colony forming units per gram (CFU/g) of total solids on a dry weight basis. No further treatment is required if the biosolids meet this criterion.

Alternative 2 requires processing the biosolids using one of six treatment processes known as "Processes to Significantly Reduce Pathogens" (PSRP). The possible PSRPs are shown in Table 1.15.

Table 1.15 Processes to Significantly Reduce Pathogens

Alternative	Process	Description
2a	Aerobic Digestion	Biosolids are agitated with air or oxygen to maintain aerobic conditions for a mean cell residence time at a temperature or temperatures within a time-temperature function having as end points 40 days at 20°C and no less than 60 days at 15°C.
2b	Air Drying	Biosolids are dried on beds or on paved or unpaved basins. The biosolids dries for a minimum of 3 months. During 2 of the 3 months, the ambient average daily temperature is above 0°C.
2c	Anaerobic Digestion	Biosolids are treated in the absence of air for a mean cell residence time at a temperature or temperatures within a time-temperature function having as end points 15 days at 35 to 55°C and no less than 60 days at 20°C.
2d	Composting	Using either the within-vessel, static aerated pile, or windrow composting methods, the temperature of the biosolids is raised to 40°C or higher and remains at 40°C or higher for 5 days. For 4 hours during the 5 days, the temperature in the compost pile exceeds 55°C.
2e	Lime Stabilization	Sufficient lime is added to the biosolids to raise the pH of the sewage sludge to 12 after 2 hours of contact.
3	Alternative EPA Approved	Any other method of biosolids treatment which is certified as a PSRP by the EPA, Region VIII, or, after assumption of delegation by the State, which is is certified as such by the WQCD.

1.8.6.3 Vector Attraction Requirements

In addition to pathogen destruction criteria, biosolids for use or distribution must also meet vector attraction reduction (VAR), also referred to as "biosolids stability." Vectors are disease-carrying organisms that are attracted to biosolids. VAR requirements must be met regardless of whether the biosolids are Class A or Class B. There are ten methods available to meet the VAR requirement; only one must be met for compliance with Regulation 64. The VAR alternatives are described in Table 1.16.

Table 1.16 Vector Attraction Reduction Alternatives (Class A and Class B)

Alternative	Process	Description
1	Volatile Solids Reduction	Reduce the mass of volatile solids by a minimum of 38%.
2	Bench-Scale Digestion (Anaerobic)	Demonstrate vector attraction reduction with additional anaerobic digestion in a bench-scale unit.
3	Bench-Scale Digestion (Aerobic)	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit.
4	Specific Oxygen Uptake Rate	Meet a specific oxygen uptake rate for aerobically treated biosolids.
5	Aerobic Processing Plus Raised Temperature	Use aerobic processes at greater than 40°C for 14 days or more.
6	Alkaline Addition	Add alkaline materials under specified conditions.
7	Percent Solids of Stabilized Biosolids	Reduce moisture content of biosolids.
8	Percent Solids of Unstabilized Biosolids	Reduce moisture content of unstabilized biosolids from primary treatment.
9 or 10	Application Method	Inject or incorporate biosolids under specified conditions.

The Town has indicated that the existing biosolids stabilization process does not meet current regulations for stabilization with regards to time or temperature conditions.

1.8.6.4 Metals Concentration Limits in Biosolids

Section 64.12 of Regulation 64 lists the limits on metals concentrations in biosolids. Both Class A and Class B biosolids must be tested for metals and meet the same concentration limits. Biosolids with metals exceeding the ceiling concentrations in Table 1.17 are not allowed to be applied to land.

Table 1.17 Metals Ceiling Concentration Limits (Table 1 Quality)

Pollutant	Ceiling Concentration Limit (mg/kg, dry weight)
Arsenic	75
Cadmium	85
Copper	4,300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
Selenium	100
Zinc	7,500

Biosolids which meet the ceiling concentration limits listed in Table 1.17 are considered "Table 1 quality" biosolids and are subject to maximum cumulative loading limits on land application sites. Regulation 64 also specifies pollutant concentration limits under which biosolids are no longer subject to those maximum loading limits. If the average of at least seven daily composite samples in a calendar month is below the concentration listed in Table 1.18, the biosolids are considered "Table 3 quality" and are not subject to cumulative pollutant loading rates for land application sites. This means it may be easier to find and manage land application sites for "Table 3 quality" biosolids versus "Table 1 quality" biosolids.

Table 1.18 Metals Pollutant Concentration Limits (Table 3 Quality)

Pollutant	Ceiling Concentration Limit (mg/kg, dry weight)
Arsenic	41
Cadmium	39
Copper	1,500
Lead	300
Mercury	17
Molybdenum	N/A
Nickel	420
Selenium	100
Zinc	2,800

1.8.6.5 Biosolids Land Application Requirements

Before pursuing land application of biosolids, a "Letter of Intent" must be submitted to CDPHE. It includes general information regarding both the application site, the biosolids generation facility, and the biosolids applier. The soil must be tested for soil fertility, physical characteristics, and metals concentrations, both before application and on a set sampling frequency after application. These results are used to determine both the quantity and quality of acceptable biosolids application. The site also must meet several location-specific criteria to qualify as an acceptable location. These include proximity to surface water as well as several other physical characteristics.

The biosolids from the TRWWTP would need to be routinely sampled to confirm quality. Biosolids require sampling on a frequency determined by the total quantity of solids production and the total quantity being reused for land application purposes. In addition to the pathogen, vector reduction, and metals sampling requirements discussed above, there are general biosolids monitoring requirements that include testing for nutrients such as phosphorus and nitrogen. The results of this testing are factored into a calculation on cumulative metals and nutrient loading to the site. When a site has reached their allowable metals and nutrient limits (which are based on agronomic uptake rates), the site can no longer accept biosolids.

All collected data is summarized and reported annually in accordance with Regulation 64 Biosolids Annual Report – Section 1 Biosolids Land Application Report. This report form is also referred to as the "self-monitoring report." There are also notification letters required of both the biosolids preparer (WWTP) and applier (end user).

1.8.6.6 Anticipated Future Biosolids Requirements

It is anticipated that in the foreseeable future biosolids regulations in Colorado will be expanded to include provisions for PFAS limits and radionuclide requirements.

Per- and Polyfluoroalkyl Substances

PFAS water quality standards are currently under development by CDPHE. Given that several states in the United States are already currently developing PFAS limits for biosolids and that this is a current priority focus by EPA as well, it is to be anticipated that CDPHE will also develop or adopt PFAS limits for biosolids in the near future. As a first step, monitoring and reporting of PFAS in biosolids may be required.

The concern with PFAS in biosolids is two-fold. In particular, in shallow groundwater areas, the land application of biosolids containing PFAS contamination has resulted in PFAS leaking into ground water resulting in drinking water source contamination. Second, PFAS may be taken up into plants and crops and thereby entering the human food chain.

On a national level, the EPA has set a health advisory (HA) for PFOA and PFOS in drinking water at 70 parts per trillion (ppt) and is currently evaluating the need for maximum contaminant levels. An HA limit provides information on contaminants that can cause human health effects and are set to offer a margin of protection for all humans (including the most vulnerable populations) throughout their life. The HA limits are non-regulatory and non-enforceable, regardless public attention and concern surrounding PFAS have required utilities and local regulators in many parts of the country to take immediate action.

To date, most biosolids land application sites where groundwater monitoring is conducted have not found levels of PFOA and PFOS above 70 ppt; however, there have been a few cases (e.g., in Alabama, Maine, and Michigan) where biosolids land application resulted in PFAS levels above the EPA drinking water HA in the groundwater tested. These cases were the result of high levels of PFAS discharged to WWTPs by a PFAS-using industry. In March 2019, in reaction to public outcry of a farm that received paper mill sludge and biosolids, Maine initiated a testing requirement for all land-applied biosolids. While this farm did receive biosolids, after further investigation, the source of the PFOS contamination (biosolids or other residuals) was inconclusive. As a precautionary measure, Maine established a limit for PFOA and PFOS in beneficially used biosolids. These limits are 2.5 parts per billion (ppb) and 5.2 ppb, respectively. Notably, these levels are lower than the concentration levels detected in most biosolids products tested to date.

Radionuclides

Geologic sources of radionuclides in groundwater in the Colorado River basin may enter the collection system via I/I. Therefore, the Town should anticipate that monitoring and reporting might be included in the upcoming permit renewal.

Regulation 64 does not include requirements for Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) in biosolids at this time. A recent law was passed (Senate Bill-245) in Colorado that requires CDPHE to develop new Naturally Occurring Radioactive Materials (NORM) and TENORM regulations even without the EPA having adopted such rules first, following a stakeholder process. A stakeholder process was initiated and began in July 2018, finalized rules regarding TENORM have not been promulgated at this time.

1.9 Summary of Regulatory Design Criteria for Preliminary Design

Based on the information presented in the previous sections, Table 1.19 summarizes the 2050 influent conditions (excluding future metals limits) to be used in the preliminary design of the TRWWTP expansion project.

Table 1.19 Summary of Key Effluent Design Criteria

Parameter	Discharge Limit (mg/L)	Design Condition(1) (mg/)
BOD_5	30	15
TSS	30	15
NH_3-N (most restrictive value)	1.8	0.9
TN(2)	3.69	2.76
TP(2)	0.41	0.30

Notes:
(1) Design condition assumes a 25% safety factor for TN and TP, 50% safety factor for ammonia, and 66% safety factor for BOD_5 and TSS. These criteria are to be reviewed as part of this draft report and finalized with input from the Town.
(2) TN and TP conditions are based on projected Regulation 31 limits using low flow criteria submitted to the CDPHE on March 31, 2021. These criteria have not been approved by CDPHE at the time of this draft report.

With regards to regulatory considerations for the solids process to be incorporated into TM 4 – Solids Processing Recommendations, the implementation pathway will provide solutions to achieve Class B biosolids quality as an operational option for the TRWWTP expansion project (near-term planning horizon). Recommendations will also be provided to achieve Class A biosolids as a part of the long-term planning horizon 10- to 20-year time frame.

Appendix 1A

HISTORICAL FLOWS, LOAD, AND CONCENTRATIONS

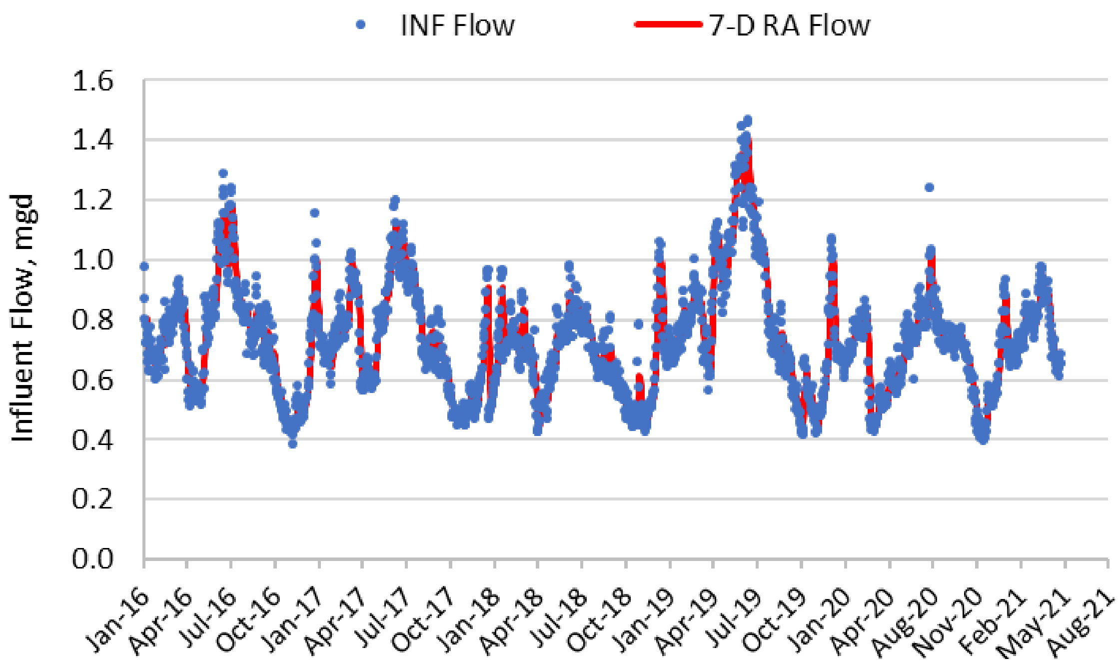


Figure 1A.1 Historical Influent Flow Since 2016

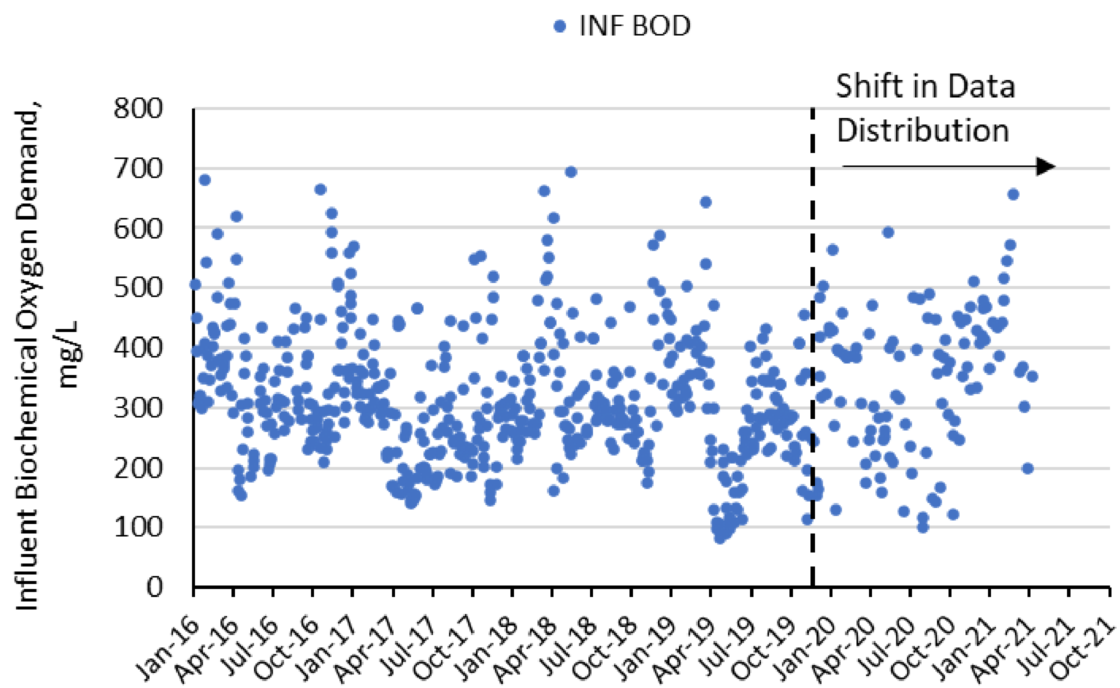


Figure 1A.2 Historical Influent BOD_5 Concentration Since 2016

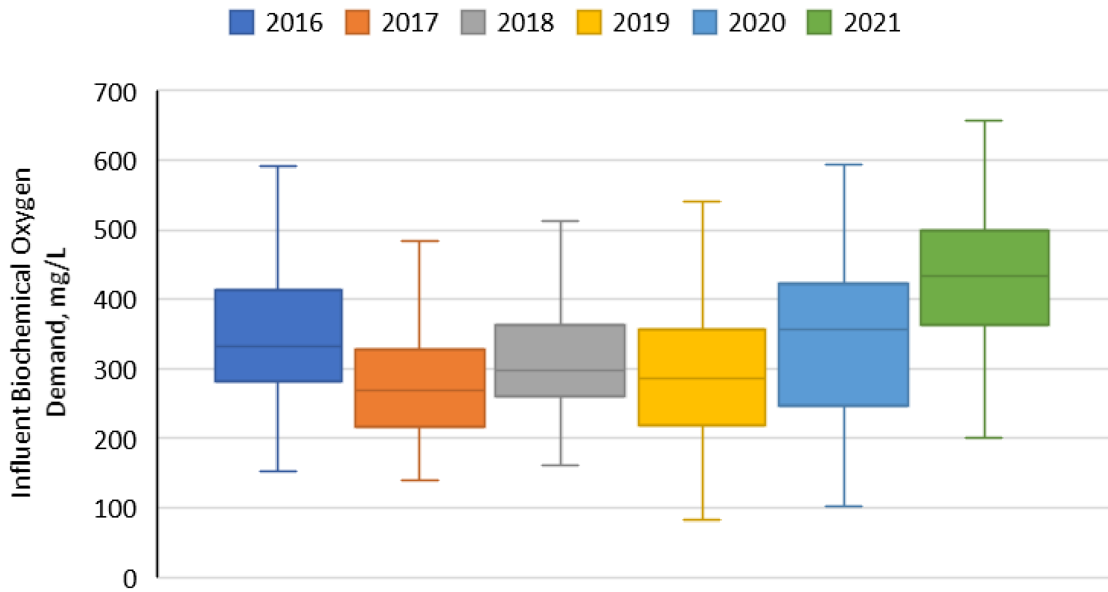


Figure 1A.3 Statistical Box Plot of Historical Influent BOD_5 Concentration Since 2016

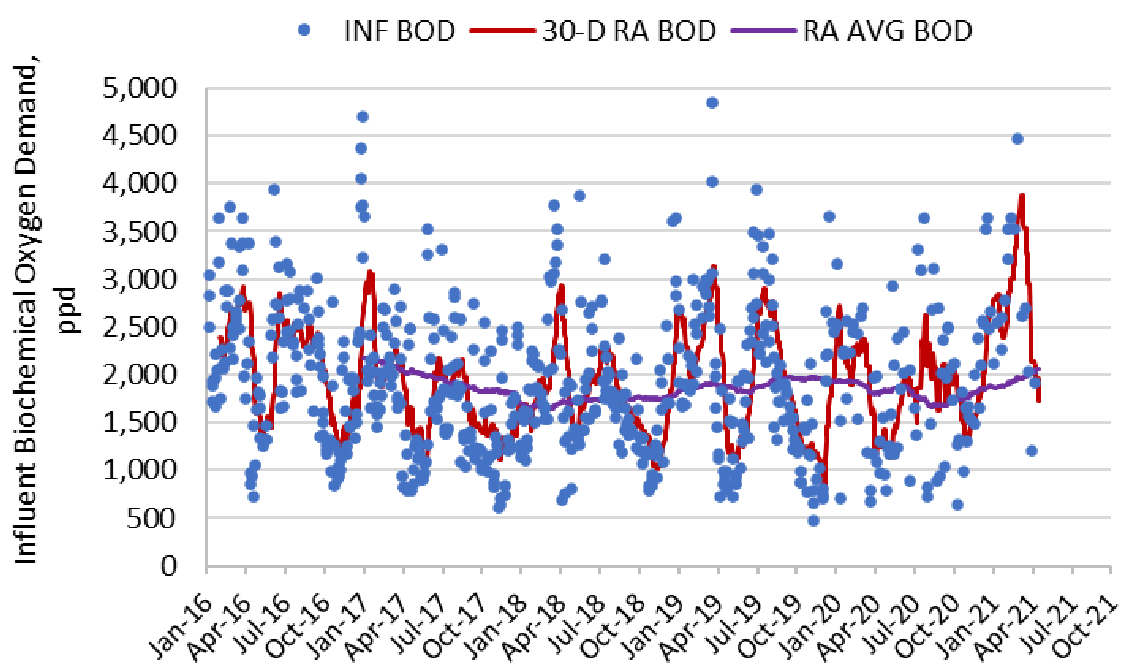


Figure 1A.4 Historical Influent BOD_5 Load Since 2016

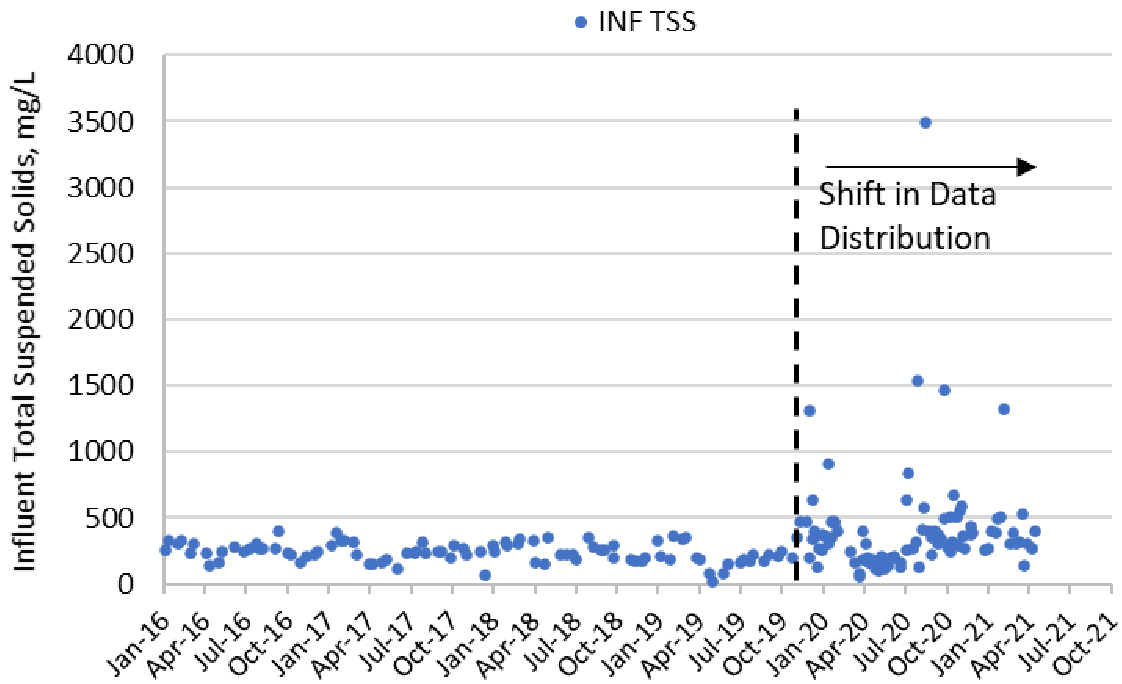


Figure 1A.5 Historical Influent TSS Concentration Since 2016

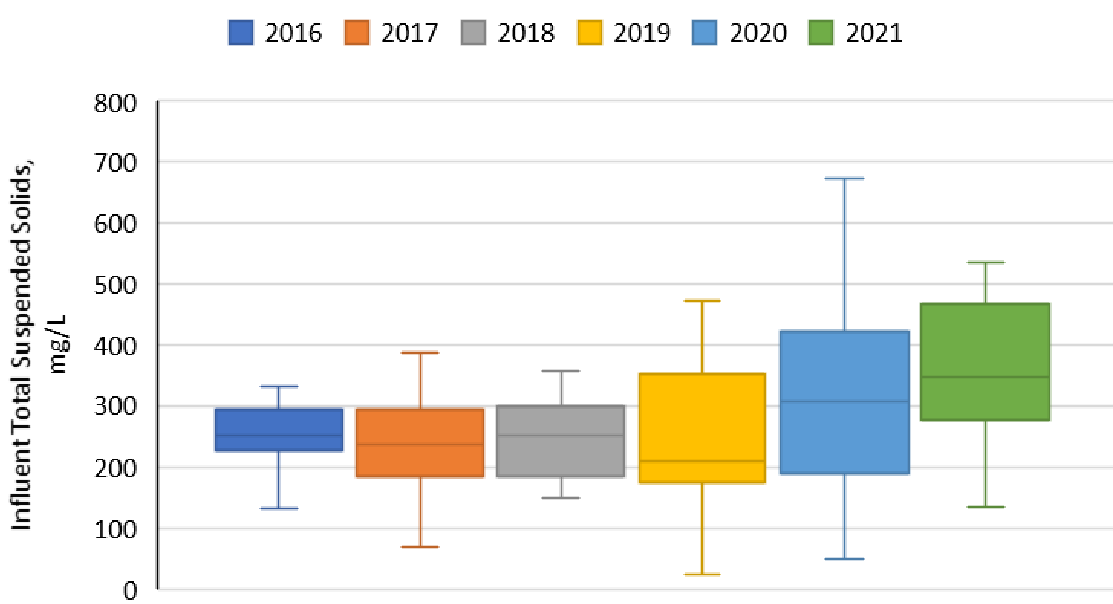


Figure 1A.6 Statistical Box Plot of Historical Influent TSS Concentration Since 2016

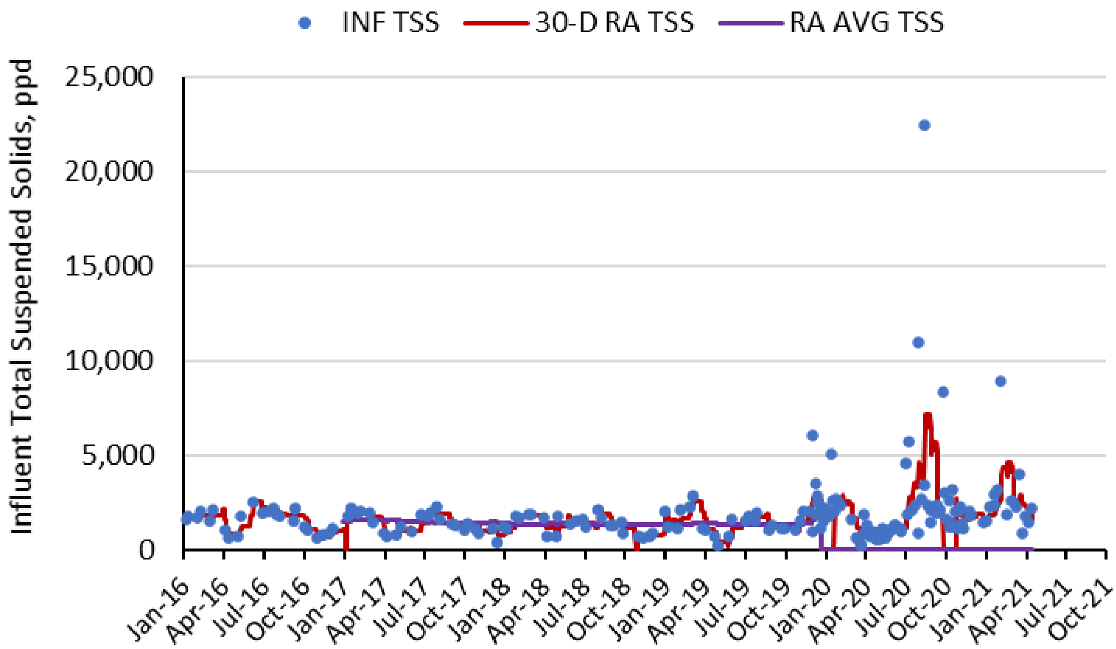


Figure 1A.7 Historical Influent TSS Load Since 2016

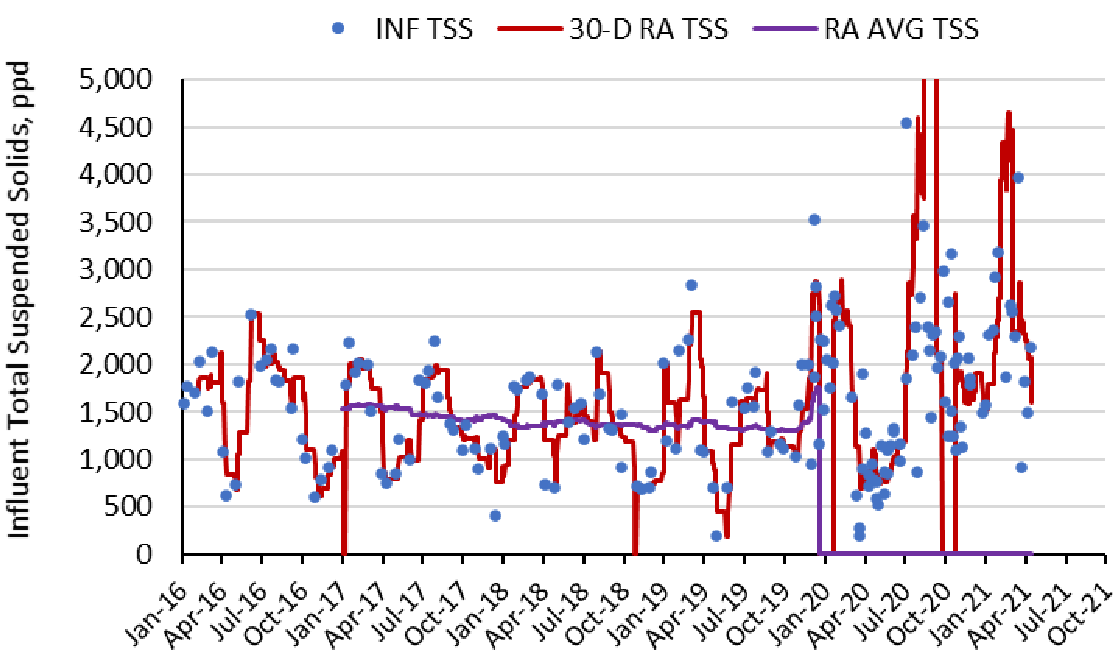


Figure 1A.8 Historical Influent TSS Load Since 2016 (Zoomed in Y-Axis for Clarity)

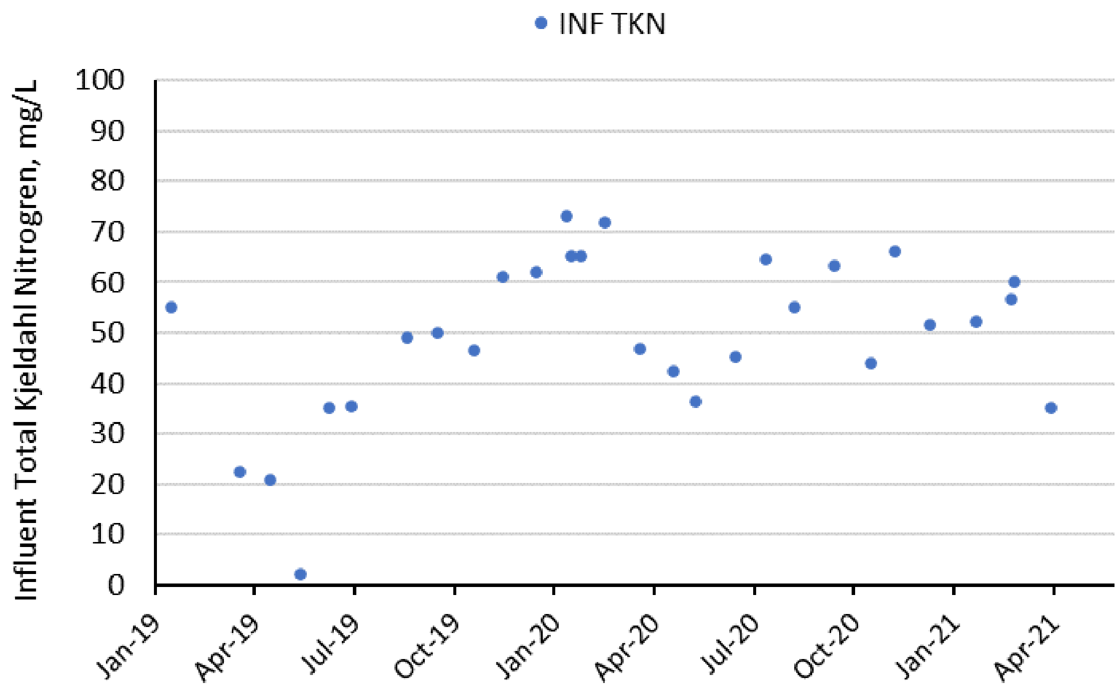


Figure 1A.9 Historical Influent TKN Concentration Since 2019

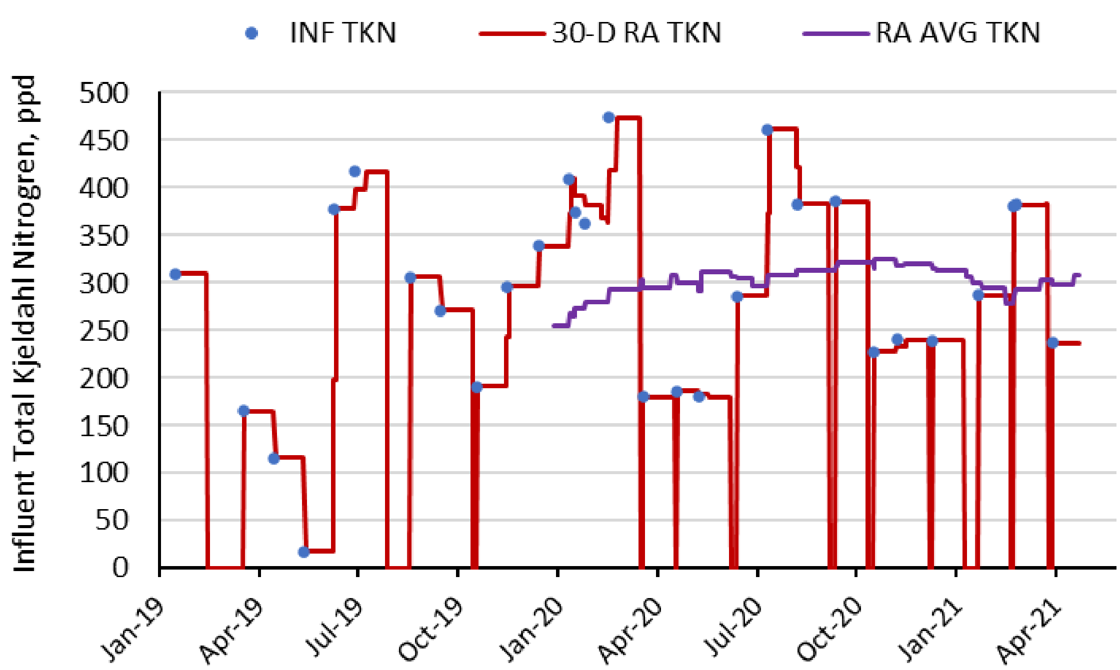


Figure 1A.10 Historical Influent TKN Load Since 2019

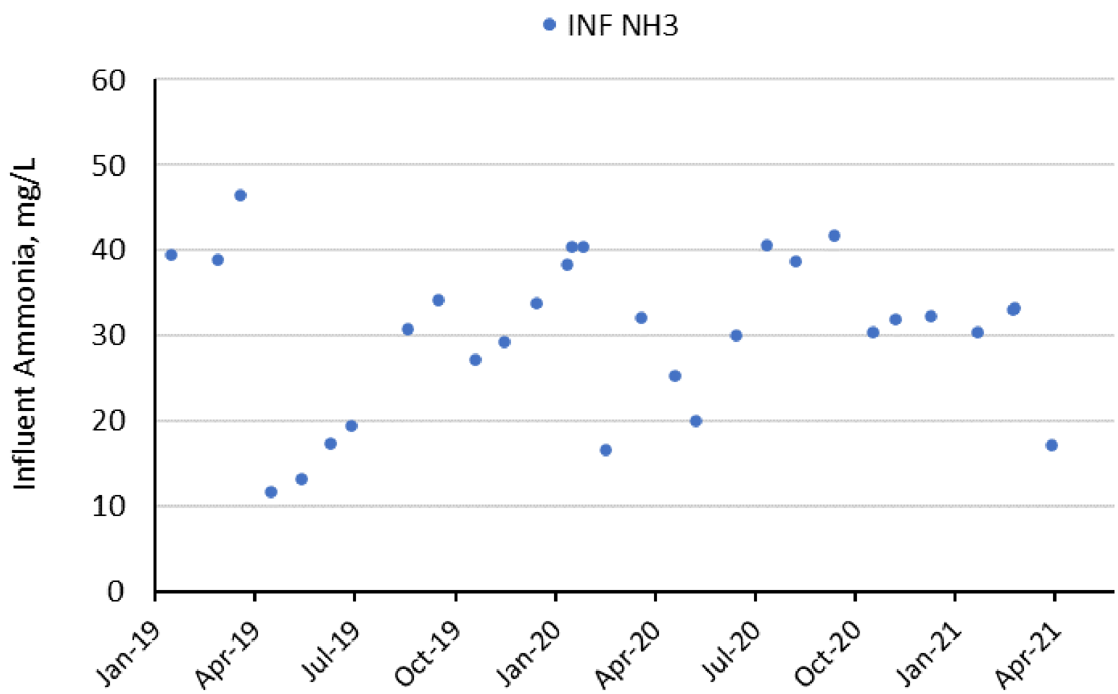


Figure 1A.11 Historical Influent Ammonia Concentration Since 2019

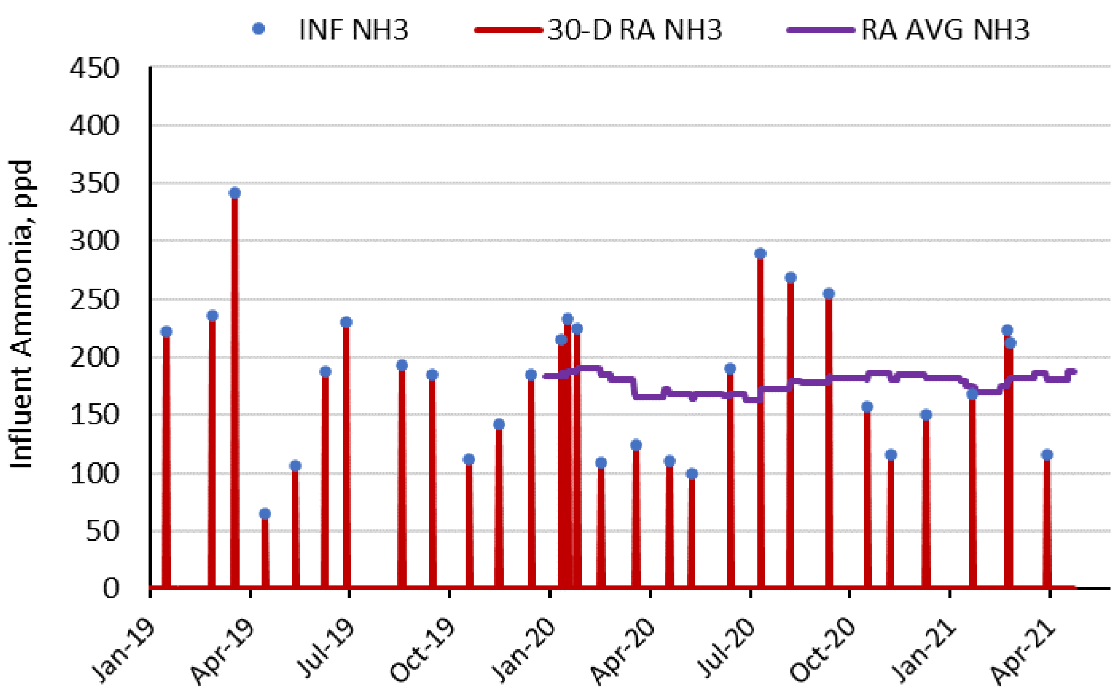


Figure 1A.12 Historical Influent Ammonia Load Since 2019

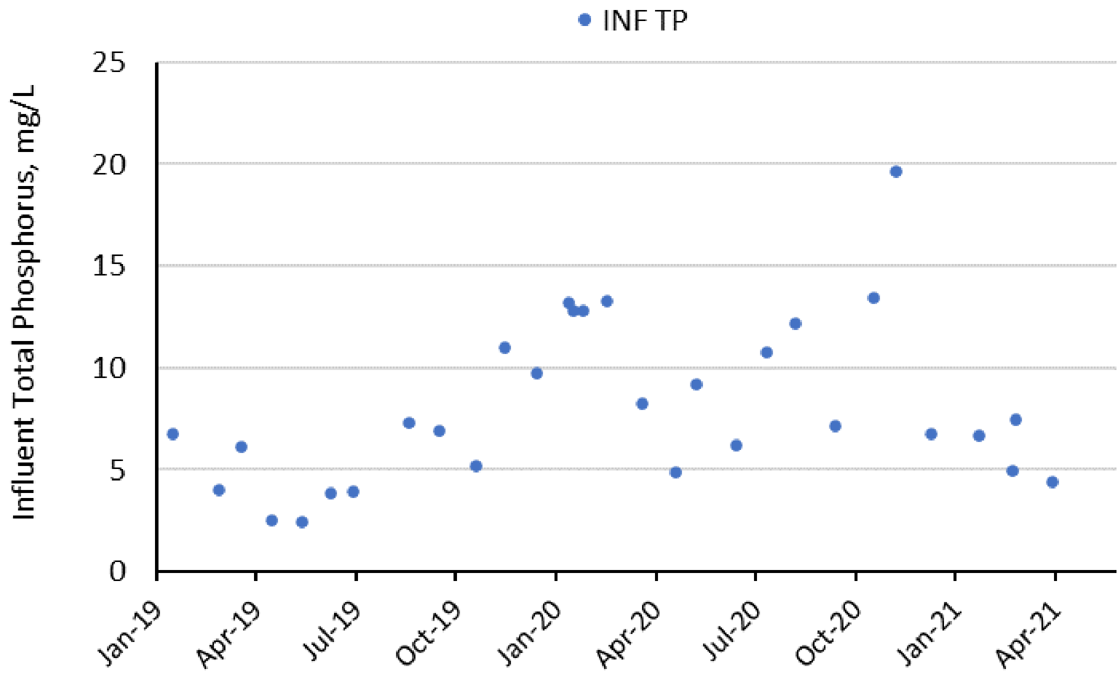


Figure 1A.13 Historical Influent Total Phosphorus Concentration Since 2019

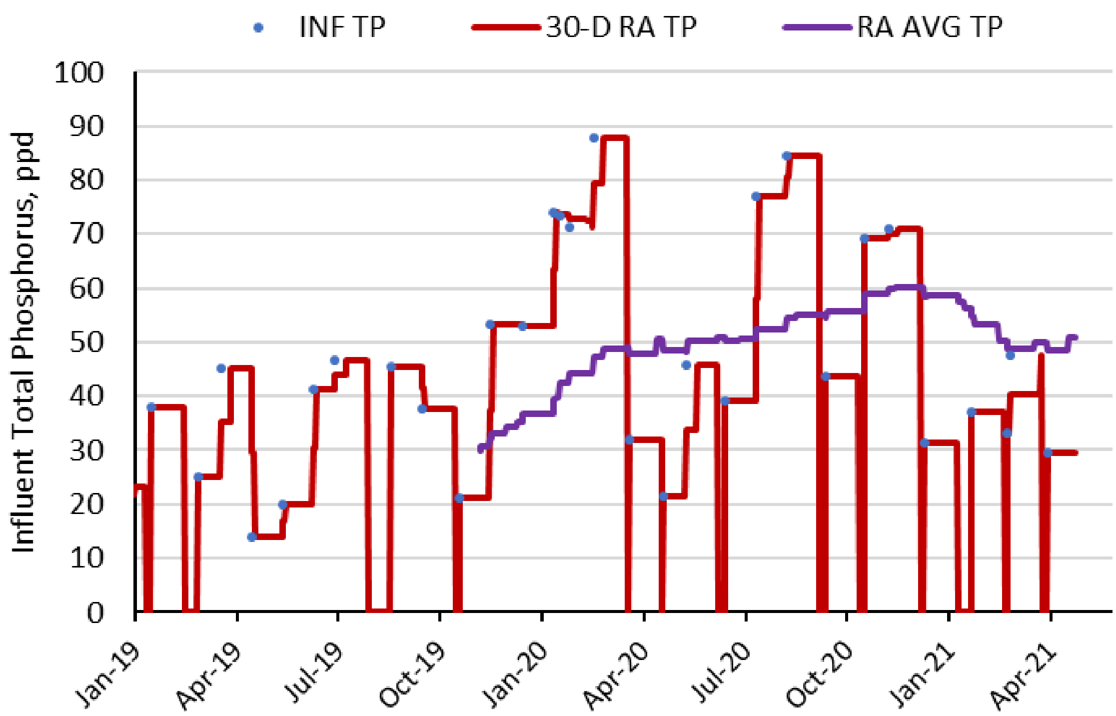


Figure 1A.14 Historical Influent Total Phosphorus Load Since 2019

Appendix 1B

INFLUENT LOADING ANALYSIS EXCLUDING DATA AFTER NOV 2019

Introduction and Background

As noted in TM 1 – Basis of Design, the project team identified a shift in the reported influent concentrations during the influent loading analysis that occurred in early November 2019 and continues through present day. The shift was most notable for influent BOD_5 and TSS, where the mean and interquartile range (or the statistical spread) of the data increased as compared to previous years. This is confirmed by visually inspecting the concentration data and by developing box plots for both data sets (see Appendix 1A).

After presenting a summary of the influent concentration and load data to the Town and operations staff on July 8, 2021, the Town directed the project team to proceed using the influent loading data prior to November 2019 for load projections while the operations team continues to investigate the observed sampling discrepancy, such as the side-by-side sampling campaign noted above. Ultimately, a sampling error could not be confirmed by the TRWWTP through ongoing review of the influent data and the side-by-side comparison, and therefore the data from beyond November 2019 was incorporated in the projected loading values. For comparison and documentation, the loading projections, which excluded the influent data after November 2019, are presented herein.

Current Influent Load Analysis Excluding Data After November 2019

The current influent wastewater loads and calculated design concentrations for the available data prior to November 2019 are summarized in Table 1B.1. It is important to note that a full 12 months of data are not available for calculating the average daily annual (ADA) load for influent nutrients under this scenario, as the TRWWTP started collecting influent nutrient data in January 2019. Therefore, the average load over the available 10 months of data is shown.

Table 1B.1 Current Influent Flows, Loads, and Design Concentrations Using Data Prior to November 2019

Parameter	ADA	ADMM	Peak Week – Winter	Peak Week – Summer
Influent Flow, mgd	0.83	1.32	1.01	1.41
Influent Loads				
BOD_5, ppd(1)	2,180	3,140	4,020	3,980
TSS, ppd(1)	1,590	2,550	2,840	2,530
TKN, ppd(2)	245	420	310	420
NH_4, ppd(2)	190	345	345	230
TP, ppd(2)	35	50	45	50
Design Concentrations				
BOD_5, mg/L	316	285	476	338
TSS, mg/L	230	232	336	215
TKN, mg/L	35(1)	38	37	35
NH_4, mg/L	27(1)	31	40	20
TP, mg/L	4.8(1)	4.2	5.4	4.0

Notes:
(1) Calculated from data collected between January 2016 to November 2019.
(2) Average of 10 months of available data, from January to November 2019.

The calculated increase in influent load (as ppd and percent increase) and design concentrations between the influent loading presented in TM 1 (including data beyond November 2019) and the data presented in Table 1B.1 are shown in Table 1B.2. Influent loads and concentrations generally increase for all parameters and nearly all planning scenarios if the entire set of available data is used in the analysis (as seen in TM 1). This is especially true for influent TSS, TKN, and TP.

Table 1B.2 Approximate Increase in Influent Loads and Design Concentrations Between Analysis Approaches

Parameter	ADA	ADMM	Peak Week – Winter	Peak Week – Summer
Increase in Influent Loads(1)				
BOD_5, ppd (% increase)	0 (0)	740 (24)	460 (11)	0 (0)
TSS, ppd (% increase)	420 (26)	1,010 (40)	5,520 (194)	3,210 (127)
TKN, ppd (% increase)	80 (33)	55 (13)	165 (53)	45 (11)
NH_4, ppd (% increase)	0 (0)	0 (0)	0 (0)	60 (26)
TP, ppd (% increase)	25 (71)	40 (80)	45 (100)	35 (70)

Notes:
(1) Percent difference is based on the two separate influent load analyses where the first assumed only the available data prior to November 2019 (as presented above). The second load analysis assumed all available data including data after November 2019 (as presented in TM 1).

Influent Load Analysis Excluding Data After November 2019

Influent load projections, based on the historical influent data prior to November 2019 and summarized in Table 1B.1, are presented in 2050 in Table 1B.3. For brevity of this section, load projection graphs for each influent parameter are provided in Appendix 1A.

Table B.3 Load Projections in 2050

(1)	ADAF	ADMMF	Peak Week Winter	Peak Week Summer
Influent Flow, mgd	1.29	2.06	1.58	2.21
Influent Loads				
BOD_5, ppd	3,410	4,910	6,290	6,230
TSS, ppd	2,480	3,990	4,440	3,960
TKN, ppd	380	655	485	655
NH_4, ppd	295	535	535	360
TP, ppd	55	75	75	75

As noted previously, CDPHE requires domestic wastewater treatment works to: 1) initiate engineering and financial planning for expansion whenever the ADMM organic loading to the plant reaches 80 percent of design capacity; and 2) commence construction of such expansion whenever ADMM organic loading reaches 95 percent of the design capacity. Under the above assumptions related to available historical data, the estimated ADMM BOD_5 in 2050 (4,910 ppd) exceeds the current permitted capacity of the WWTP (3,708 ppd as BOD_5) and is anticipated to exceed the CDPHE 95 percent construction trigger around 2027.

Town of Telluride

Telluride Regional Wastewater Treatment Plant Expansion

TM 2 – HYDRAULIC MODELING EVALUATION AND RECOMMENDATIONS

DRAFT | September 2021

h2O innovation in association with carollo

Telluride Regional Wastewater Treatment Plant Expansion

Technical Memorandum 2
HYDRAULIC MODELING
EVALUATION AND RECOMMENDATIONS

DRAFT | September 2021

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Abbreviations

ADMMF	average daily maximum month flow
Carollo	Carollo Engineers
CDPHE	Colorado Department of Public Health and Environment
mgd	million gallons per day
RAS	return activated sludge
TM	Technical Memorandum
Town	Town of Telluride
TRWWTP	Telluride Regional Wastewater Treatment Plant
UV	ultraviolet
WAS	waste activated sludge
WSE	water surface elevation

Technical Memorandum 2

HYDRAULIC MODELING EVALUATION AND RECOMMENDATIONS

2.1 Overview

The Town of Telluride (Town) Regional Wastewater Treatment Plant (TRWWTP) has a design capacity of 2.1 million gallons per day (mgd) at average daily maximum month flow (ADMMF) conditions. The TRWWTP was constructed in three major phases with some additional upgrades and improvements since completion of the final project phase in 2001. An updated and complete liquid stream hydraulic profile of the facility does not currently exist. Carollo Engineers (Carollo) was tasked to develop a hydraulic model to identify existing hydraulic limitations. As part of a follow up to this draft Technical Memorandum (TM) 2, opportunities to improve the existing hydraulic grade line in conjunction with the TRWWTP Expansion Project will be discussed. In particular, the Town is interested in options to improve the hydraulic efficiency through a new flow path and eliminating multiple influent points of pumping.

The primary objectives for this initial phase of the hydraulic modeling effort are to:

- Develop a complete liquid stream hydraulic profile of the existing facility.
- Document hydraulic limitations of the existing facility based on the permitted design capacity.
- Document hydraulic limitations of the existing infrastructure based on the future ADMMF/hydraulic design capacity of 2.3 mgd. (It is understood that peak day and peak hour flow conditions will be equalized through an equalization process either before or after the headworks facility and therefore, the existing secondary treatment infrastructure was not evaluated at flows higher than the future ADMMF capacity.)

As part of the final TM 2, the following objectives will be achieved:

- Assessment of the pumped flow system associated with the existing raw sewage pump station and influent/primary wet well pump station.
- Complete influent to effluent hydraulic grade line for the recommended TRWWP Expansion Project including pump sizing for new influent pumping system to support the future flow conditions.

The appendices supporting this TM include Appendix 2A – Compiled Drawing Set and Appendix 2B – Hydraulix® Model Output.

2.1.1 Summary of Flows

Influent and internal recycle design flow conditions are summarized in Table 2.1. The influent flow condition is based on the permitted facility capacity. The future design flow of 2.3 mgd was also evaluated as part of the existing facility model (30-year projected influent flow from the

Telluride Regional Wastewater Treatment Plant Master Plan [Stantec, 2017]). Internal recycle and waste flows were assumed based on process information and previous reports and studies.

Table 2.1 Influent and Internal Recycle Flows

Flow Description	ADMMF (mgd)	Future ADMMF (mgd)
Influent	2.1	2.3
Return Activated Sludge (RAS)(1)	1.58	1.73
Waste Activated Sludge (WAS)(2)	0.03	0.03
Recycle Flows(3)	0.17	0.17

Notes:
(1) RAS flow assumed to be 75 percent of influent flow
(2) WAS flow assumed average annual solids loading to the aerobic digesters per the *Dewatering Improvements: Engineering Report for the Telluride Regional Wastewater Treatment Plant* (Jacobs Engineering, 2019).
(3) Recycle flows include pressate recycle, decant and filtrate recycle. Pressate recycle assumed 0.158 mgd per the *Dewatering Improvements: Engineering Report for the Telluride Regional Wastewater Treatment Plant* (Jacobs Engineering, 2019), decant flow assumed to be 0.008 mgd, and filtrate recycle assumed 0.004 mgd. Recycle flows assumptions to be updated in continued modeling efforts.

2.2 Hydraulic Flow Path and Unit Process Notes

2.2.1 Hydraulix® Model

Hydraulic modeling of the TRWWTP was performed using Carollo's Hydraulix® software. Hydraulix® is an in-house, spreadsheet-based, steady-state hydraulic model used to calculate the hydraulic and energy grade lines through the treatment plant. The model tracks the estimated water surface elevation (WSE) from downstream to upstream in the plant, accounting for headloss through the critical path of flow conveyance.

2.2.2 Model Development

The following units were identified as the critical path for this hydraulic model as part of discussions with the project team during Workshop 1:

- Screening channel.
- Grit vortex unit.
- Oxidation Ditch No. 3.
- Secondary Clarifier No. 3.
- UV disinfection.

The critical path is the path of most hydraulic resistance through the plant. Wherever applicable, the pipe route with the longest pipe segments and most fittings was modeled, even if that flow path is a fictional route (e.g., flow into Secondary Clarifier No. 2 and out of Secondary Clarifier No. 3) to develop the most conservative hydraulic scenario. The Town provided drawings for previous projects at the TRWWTP and these drawings were compiled into a comprehensive drawing set with existing structures and components of the hydraulic critical path highlighted. Drawing elevations are reported in a local datum and are consistent across all drawing sets. The hydraulic profile drawing set developed to create the model is included as Appendix 2A – Compiled Drawing Set.

2.2.3 Hydraulic Assumptions

Hydraulic assumptions used in the development of the hydraulic model are included in this section. The following assumptions were used for hydraulic coefficients:

- A Manning's "n" friction coefficient of 0.013 for channel hydraulic calculations.
- An absolute roughness coefficient of 0.004 for pipe hydraulic calculations.

2.2.4 Unit Process Assumptions

The following specific notes apply to individual process areas.

2.2.4.1 Plant Influent

The hydraulic model extends to the influent channel of the headworks where flow is pumped from the raw sewage pumping station in a 14-inch force main. As assessment of the raw sewage pump station pumping capacity will be included as an appendix to the final TM.

2.2.4.2 Screening Channel

The screening channel in the headworks consists of a Duperon FlexRake bar screen installed in 2018. Headloss through the bar screen process was provided by Duperon for flow rates of 1 mgd and 5 mgd. Headloss assumptions are presented in Table 2.2. For the hydraulic modeling, the headloss of 3.34 inches was assumed for both flow conditions. Headloss across the screen assumed a 25 percent blinding factor. There is a bypass channel connected to the screening channel, but the Town has indicated it is only used as an emergency bypass and therefore was not modeled.

Table 2.2 Bar Screen Headloss Conditions from Vulcan Industries

Flow (mgd)	Blinding Factor	Headloss through One Screen (inches)
1	25%	3.09
5	25%	3.34

2.2.4.3 Grit Removal

The grit removal system consists of a Smith and Loveless vortex grit unit installed as part of the Phase 3 WWTP Improvements Project in 2001. Headloss through the system was assumed to be 0.25 inches, as information on the exact headloss was not provided by the manufacturer at the time of this draft. There is a bypass channel around the grit system, but the Town indicated it is only used as an emergency bypass and therefore was not included in the model.

2.2.4.4 Influent Wet Well Pump Station

Flow is pumped from the influent wet well pump station to the oxidation ditch diversion structure. The WSE in this area is the downstream hydraulic set point for the grit removal unit, screening channel, and plant influent segments of the model. A high water alarm WSE of 8,661 feet was used as a conservative value, and may be updated once the pumps are modeled.

2.2.4.5 Oxidation Ditches

All three oxidation ditches were modeled in service, as would be the typical operation under the permitted design capacity condition. Flow is pumped to the oxidation level control structure. The flow split between the three oxidation ditches is controlled by three straight edged weirs. Each weir is set at the same elevation to split flow evenly between the ditches. The WSE of each oxidation ditch is controlled by a 2-foot wide effluent adjustable weir. Each oxidation ditch flows over its effluent weir and into a diversion structure which routes flow to the secondary clarifiers.

2.2.4.6 Secondary Clarifiers

There are three 50-foot diameter secondary clarifiers downstream of the oxidation ditches. All three clarifiers are connected with a bypass line, but the Town indicated that the existing configuration does not allow flow to reach Clarifier No. 1. For this reason, Clarifier No. 1 is not in service and was not included in the model. In the developed model, the flow from the oxidation ditches is split between Clarifier No. 2 and Clarifier No. 3.

2.2.4.7 Ultraviolet Disinfection

Headloss through the ultraviolet (UV) disinfection lamps was taken from the 2013 TRWWTP UV Disinfection System Improvements project. Downstream of the UV lamps is a finger weir before discharge to the plant effluent line. No drawings are available for the details of this weir, so the hydraulic model includes a straight edge weir from the original construction.

2.3 Hydraulic Profile

WSEs for the two flow scenarios with respect to top of concrete elevations are plotted in Figure 2.1. Available freeboard was calculated for each hydraulic node and is presented in Table 2.3. The hydraulic model output is included as Appendix 2B – Hydraulix® Model Output.

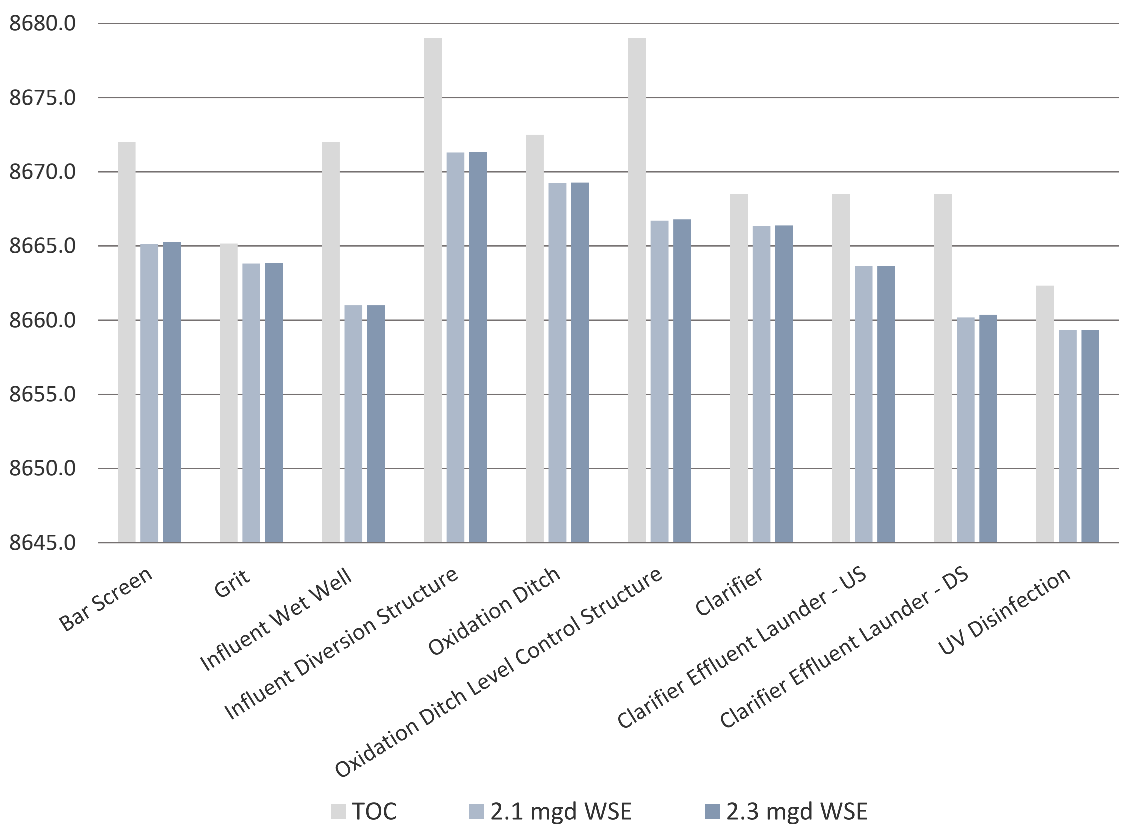

Figure 2.1 Water Surface Elevations with Respect to Top of Concrete

Table 2.3 Existing Facility Available Freeboard

Location	Freeboard Available at 2.1 mgd (feet)	Freeboard Available at 2.3 mgd (feet)
Bar Screen	6.9	6.7
Parshall Flume	1.4	1.3
Grit	1.4	1.3
Influent Wet Well	11.0	11.0
Influent Diversion Structure	7.7	7.7
Oxidation Ditch	3.3	3.2
Oxidation Ditch Level Control Structure	12.3	12.2
Clarifier	2.1	2.1
Clarifier Effluent Launder – US	4.8	4.8
Clarifier Effluent Launder – DS	8.3	8.1
UV Disinfection	3.0	3.0

2.4 Existing Hydraulic Limitations

The Colorado Department of Public Health and Environment's (CDPHE) *Colorado Design Criteria for Domestic Wastewater Treatment Works, WPC-DR-1* (2012) defines numerous hydraulic design criteria. These include total and firm (with largest unit out of service) capacity requirements for conveyance and pumping facilities, freeboard requirements (18 inches [1.5 feet] for most areas, 12 inches [1 foot] for primary and secondary clarifiers), and floodplain considerations. In addition, certain unit processes have required operating levels above which treatment performance is affected. These include UV disinfection and hydraulic control points such as weirs that are intended to be free flowing (i.e., unsubmerged).

The initial hydraulic modeling shows that there are no immediate hydraulic concerns for the UV system, clarifiers, oxidation ditches, or grit removal system. Adequate freeboard is maintained in each process area, and all flow control weirs are free-discharging at both flow conditions.

The 9-inch Parshall flume between the grit unit and the bar screen is 100 percent submerged at 2.1 mgd and 111 percent submerged at 2.3 mgd. Submergence of greater than 100 percent can result in less accurate flow measurement. In addition, directly upstream of the Parshall flume, the top of concrete is at a lower elevation than the screening channel, and there is only 15.6 inches of freeboard available, which is slightly below the requirement of 18 inches per CDPHE. Modifications to this system will be required to accommodate the future design flow if the existing headworks facility is reused. The required modifications will be more significant at the future peak hour condition if flow equalization is not provided upstream of the future headworks process.

The Town indicated that there is an uneven flow split between the three clarifiers such that Clarifier No. 1 does not receive flow. Although Clarifier No. 1 was not included in the hydraulic model, visual observation of the piping layout provided on the facility drawings clearly indicates concerns associated with this flow split. Additional modeling and recommendations to correct this deficiency was not deemed appropriate as the proposed retrofit associated with the TRWWTP Expansion project will no longer require a flow split between the three clarifiers since the membrane modules are planned for installation only in one existing clarifier.

2.5 Additional Considerations

Based on the elevation of the plant outfall to the San Miguel river and the invert elevation of the UV system, there is almost 20 feet of excess and available head. This could be an opportunity to explore utilizing hydro-electric power between the UV system and the plant outfall.

2.6 Recommended Flow Path, Site Layout, and Hydraulic Profile

All following sections will be updated for the final deliverable in conjunction with TM 3 – Liquid Stream Recommendations.

2.6.1 Flow Path, Process Flow Diagram, and Site Layout

Pending.

2.6.2 Hydraulic Profile

Pending.

2.6.2.1 Influent Pumping

Pending.

2.6.3 Existing Limitations and Proposed Solutions

Pending.